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REVIEW ARTICLE

ASSESSMENT OF SUITABILITY OF GROUNDWATER OF AKASAR VILLAGE (RAJASTHAN) FOR DRINKING AND IRRIGATION PURPOSES

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ABSTRACT

The present study investigates groundwater quality of Akasar village of Bikaner (Rajasthan), India to check its drinking and agricultural irrigation aptness. Total 30 sampling sites of Akasar village were selected to collect groundwater samples in the period of July to August 2024. The physical and chemical parameters of groundwaters were analysed like pH, electrical conductivity, chloride, carbonate, bicarbonate, calcium, magnesium, sodium, sodium absorption ratio and residual sodium carbonate. Parameters such as pH, Ca+Mg, and carbonate were within the standard permissible limits of BIS. 37% groundwater samples displayed drinking unsuitability because of high contents of EC, Na, Cl and HCO^3. The groundwater of Akasar village for irrigation purpose had slightly saline features. Saline groundwater was observed in 5 sampling sites. 17% groundwater samples were found unsuitable for irrigation purpose. Hence, groundwater quality of Akasar village is comprehensively suitable for drinking and irrigation uses. Examination of groundwater with wide hydro-chemical metrices would deliver the precise representation of Akasar village's groundwater quality.

KEYWORDS

Groundwater, Drinking water, Irrigation water, Sodium absorption ratio, Residual sodium carbonate, Rajasthan.

1. INTRODUCTION

Water is the foundation of all form of life. Groundwater, stored beneath the Earth's surface within porous layers of soil and rock, is typically accessed through wells or boreholes. In rural regions, groundwater serves as a major source of drinking water. Human activities play a significant role in altering the natural characteristics of groundwater. Various sources, including waste disposal sites, agricultural pesticides and fertilizers, industrial chemical leaks, animal waste, and underground storage tank seepage, can introduce contaminants into groundwater supplies. This contamination often renders groundwater unfit for diverse uses, with restoration being a complex, lengthy, and costly process. As a result, monitoring and managing activities that impact both its quality and availability are crucial.

However, it is still vulnerable to pollution from a variety of pollutants, and it is challenging to restore it to its original, pristine state (Helena et al., 2020). Numerous chemicals, such as synthetic organic compounds, hydrocarbons, inorganic cations, inorganic anions, radionuclides, and pathogens, have been identified as groundwater pollutants. Geological, climatic, and human-made variables all have a substantial impact on the composition and concentration of these compounds in groundwater. The chemical makeup of groundwater is the product of extensive interactions with its environment (Gautam and Rai, 2023). Recent research indicates that nearly 20% of the global groundwater supply is allocated for irrigation, while around 80% of wastewater worldwide is released into the environment without undergoing adequate treatment (Li et al., 2021; Dimple et al., 2022). Groundwater resources are diminishing at an alarming rate of 800 Km^3 annually across the globe primarily through agricultural irrigation. India being the largest consumer of groundwater, utilizes more than 60% of groundwater for irrigation. Consequently, groundwater levels have fallen by more than 4 m in the country (Balacco et al., 2023). As per the Central Ground Water Board, irrigation-related groundwater consumption in India is estimated to be roughly 245 billion cubic meters (CGWB, 2010).

The suitability of groundwater for agricultural use is influenced by its bacteriological, chemical and physical characteristics. Globally, over 1.5 billion people depend on groundwater, either directly or indirectly, for their drinking needs. Using contaminated groundwater for drinking purposes can pose both carcinogenic and non-carcinogenic health risks to humans. It is the need of the hour to sustainably manage groundwater resources. Several studies have been done worldwide to evaluate groundwater quality (Qureshi et al., 2021; Wang et al., 2021; Raphael et al., 2023; Nadjai et al., 2024). Groundwater assessment studies have been done in India too. Few such studies are represented in Table 1.

Table 1: Analysis of few groundwater studies done in India.

Study area	Parameters studied	Organization for standard	Findings	Reference
Aurangabad district (Maharashtra)	TDS, TH, EC, chloride and Mg	BIS and WHO	Higher concentration of all parameters made water unsuitable for drinking.	Deshpande and Aher, 2017

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Table 1 (Cont) : Analysis of few groundwater studies done in India.				
Study area	**Parameters studied**	**Organization for standard**	**Findings**	**Reference**
Mahoba district (U.P.)	pH, EC, TDS, alkalinity, TH, Ca, Mg, Na, K, HCO_3, SO_4, Cl, F, Cu, Mn, Ag, Zn, Fe and Ni	BIS and WHO	Ground water was safe for drinking in most samples.	Ram et al., 2021
Suryapet district, Telangana	pH, electrical conductivity, total dissolved solids, total hardness, major cations, and major anions	WHO	Geogenic and human activities were responsible for 74% of groundwater contamination. They suggested proper treatment of contaminated groundwater before consumption.	Saikrishna et al., 2023
Kurukshetra district (Haryana)	pH, BOD, COD, EC, Ca, Mg, Na, K, TDS, TSS, TH, Ca, CO_3, Cl, SO_4, nitrate and ammonia	BIS and WHO	All parameters except hardness, alkalinity, and magnesium (limited locations) were within the range of permissible limits. Groundwaters fell into two categories i.e., good or poor water according to water quality index for drinking. Groundwater samples were suitable for irrigation.	Bhatnagar and Thakral, 2024

Rajasthan, the driest state in India, is well-known for its arid western region, characterized by deserts and recurring droughts. The Thar Desert faces a severe water shortage due to minimal rainfall, high evaporation rates, decreasing groundwater levels, and its poor water quality (PHED, 2021). Addressing both water availability and quality presents a significant challenge in Rajasthan, as a large portion of the state's groundwater is either saline or contains harmful levels of nitrates and fluoride. Groundwater is the primary source of drinking water, fulfilling over 94% of the population's need for potable water. The objective of the present study was to investigate the quality of groundwater in Akasar village of Bikaner district (Rajasthan) for drinking and irrigation purposes.

2. Materials And Methods

2.1 Study area

Akasar village, situated in the Kolayat tehsil of Bikaner district in Rajasthan, India, lies in the southwestern part of Bikaner. It spans the latitudes of 27° 22' to 28° 24' N and longitudes of 71° 53' to 73° 11' E. According to the 2011 Census, Akasar is a sizable village with a population of 4243, comprising 2186 males and 2057 females, across 526 households. The village covers a total area of 4706 hectares. As of 2009, 3,686 hectares were used for agriculture, with approximately 2456.76 hectares being rainfed and 1229.24 hectares irrigated, primarily through wells and tube wells. Around 176 hectares were utilized for non-agricultural purposes. The main kharif crops grown under rainfed conditions include pearl millet, moth bean, cluster bean, and sesame, while groundnut and cotton are cultivated on irrigated land. During the rabi season, the primary crops are chickpea, mustard, and wheat (Gupta et al., 2021).

The district experiences a climate marked by extreme heat, irregular rainfall, and dryness. Winter begins in November and lasts until February, followed by a hot summer that extends through June. The monsoon season occurs from July to mid-September. There is a significant difference between the highest and lowest temperatures in the region, with the average maximum temperature reaching up to 50°C and the minimum dropping to around 5°C. The annual average rainfall is approximately 455 mm, as per the Hydrogeological Atlas of Rajasthan's Bikaner district. Akasar village falls under agroclimatic zone IC, classified as a hyperarid and partially irrigated zone.

The soil in Akasar village is categorized into four distinct types: (i) light and medium soil irrigated by canals; (ii) desert soils and sand dunes with aeolian origins, featuring a coarse, loamy texture and calcareous composition; (iii) fine sandy to loamy sandy soil found in rainfed areas with sand dunes; and (iv) sandy, alkaline soil influenced by salinity (Gupta et al., 2021). The positions of sampling sites is tabulated in Table 2 and the map of the study area is depicted in Figure 1.

Table 2: Locations of selected sampling sites of Akasar village.			
Sample No.	**Sampling location name**	**Latitude**	**Longitude**
S1	Gajner Road, Akasar	27.89322	73.099395
S2	Gajner Road, Akasar	27.893253	73.099411
S3	Akasar	27.910817	73.096455
S4	Gajner road, Akasar	27.893328	73.099459
S5	V4M5+GRH, Akasar	27.884219	73.110065
S6	W34R+5RQ, Akasar	27.904096	73.093382
S7	Akasar	27.911602	73.096017
S8	Akasar	27.91057	73.094832
S9	Akasar	27.911238	73.099788
S10	Gajner road, Akasar	27.907696	73.090182
S11	Akasar	27.908778	73.093698
S12	Akasar	27.911318	73.115186
S13	Akasar	27.91205	73.102291
S14	Akasar	27.922485	73.119053

Table 2 (Cont): Locations of selected sampling sites of Akasar village.

Sample No.	Sampling location name	Latitude	Longitude
S15	Akasar	27.919493	73.122197
S16	Akasar	27.911038	73.096445
S17	Akasar	27.886364	73.121499
S18	Akasar	27.918631	73.113892
S19	Akasar	27.909889	73.099892
S20	Akasar	27.911394	73.095879
S21	Akasar	27.918861	73.11046
S22	W34R+5RQ, Akasar	27.90572	73.091821
S23	Akasar	27.899198	73.079449
S24	Gajner road, Akasar	27.905791	73.096539
S25	Akasar	27.912282	73.098216
S26	Akasar	27.920939	73.116677
S27	Akasar	27.919499	73.122179
S28	Akasar	27.9093	73.095082
S29	Akasar	27.91695	73.111843
S30	Akasar	27.912503	73.117745

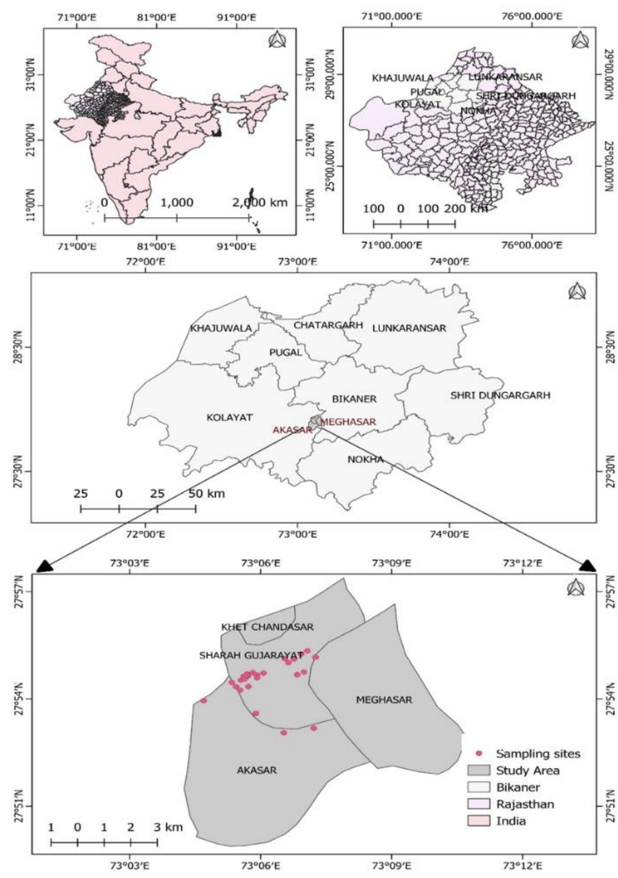

Figure 1: Study area map with sampling sites.

3. Methodology

The sampling was carried out during July to August 2024 at the selected sampling sites (Table 2). A total of thirty samples of groundwater were collected in the polyethylene bottles with capacity of 250 ml to 500 ml which are pre-cleaned with diluted hydrochloric acid and washed with distilled water. The bottles were tightly closed and labelled after each sample collection. The selected parameters like pH, electrical conductivity (EC), chloride (Cl), carbonate (CO^3), bicarbonate (HCO^3), magnesium (Mg), sodium (Na), sodium absorption ratio (SAR) and residual sodium carbonate (RSC) were analysed for all the samples. Parameters analytical

Table 3: Details of groundwater parameters analysis (Yadav et al., 2015).

Parameter	Instrument used	Analytical method
pH	pH meter	Glass electrode method
Electrical conductivity	Electrical conductivity meter	Conductivity cell method
Sodium	Flame photometer	Flame photometry method
Calcium and Magnesium	Titration unit	Versenate method
Calcium and Magnesium	Titration unit	Versenate method
Chloride	Titration unit	Mohr's titration method
Carbonate and Bicarbonate	Titration unit	Titration method

The sodicity or alkalinity hazards of water is assessed by sodium absorption ratio (SAR) by the given formula:

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

Residual sodium carbonate (RSC) is determined in samples in milliequivalent per litre by the given formula: RSC (mEq/L)= (CO3+ HCO3) - (Ca+ Mg)

For irrigation purposes, water is considered optimal if the residual sodium carbonate value is below 1.25. If the RSC value falls between 1.25 and 2.5, the water is deemed moderately suitable. However, RSC values exceeding 2.5 pose significant risks and are categorized as unsafe for irrigation.

methods and instruments used for analysis are depicted in Table 3. Parameters analytical methods and instruments used for analysis are depicted in Table 3.

4. Results And Discussion

The quality of groundwater in Akasar village of Bikaner district was investigated. Total sampling sites were thirty for the study. The parameters selected were pH, electrical conductivity, sodium, calcium, magnesium, chloride, carbonate, bicarbonate, residual sodium carbonate (RSC), and sodium adsorption ratio (SAR) as shown in Table 4.

pH: According to BIS standards, the acceptable range for drinking water pH is between 6.5 and 8.5 (BIS, 2012). Groundwater samples analyzed showed pH values ranging from 7.50 to 7.85, with the lowest value observed at 7.50 (S8) and the highest at 7.85 (S21). This indicates that the groundwater in the area is predominantly neutral to slightly alkaline. While pH itself does not directly impact human health, it is closely associated with various water parameters.

Electrical Conductivity (EC): The electrical conductivity of water reflects its ability to conduct electricity, which depends on the number and types of ions present in the solution. It can help estimate the concentration of dissolved solids, which influences the taste and suitability of water for various purposes. Higher conductivity values suggest a greater presence of dissolved solids in the water. In the study, EC values ranged between 1110 µS/cm and 6450 µS/cm, with the lowest reading at 1110 µS/cm (S8) and the highest at 6450 µS/cm (S24). None of the examined stations met the BIS standard limit of 800 µS/cm.

Sodium (Na): The presence of Na in groundwater is very important for determining water quality. Its concentrations were found from 165-957 mg/l. The minimum valueof Na was observed 165 mg/l at S8 while maximum value was observed 957 mg/l at S24.

Calcium (Ca) and Magnesium (Mg): Calcium is commonly found in groundwater due to the presence of calcium-rich minerals in the earth's crust such as calcite and limestone. It is carried into groundwater by rainwater filtering through alkaline soil. Groundwater with calcium levels below 60 mg/l is categorized as soft, 60–120 mg/l as moderately hard, 120–180 mg/l as hard, and over 180 mg/l as extremely hard. On the other hand, magnesium, while less abundant in groundwater compared to calcium, is prevalent in seawater and is a contributor to water hardness alongside calcium. Magnesium makes up 2.08% of the earth's upper crust, and its concentration in typical groundwater is lower than calcium, usually ranging from 1 to 40 mg/l. The combined concentration of calcium and magnesium (Ca+Mg) in groundwater samples varied between 39.5 mg/l and 230 mg/l. The lowest concentration, 39.5 mg/l, was noted at S8, while the highest, 230 mg/l, was observed at S24.

Chloride (Cl): Chloride in groundwater originates from both natural processes and human activities. Anthropogenic sources include agricultural runoff, use of inorganic fertilizers, industrial discharge, septic tank effluents, and animal feed stocks. At low concentrations, chloride is not harmful to human health but can affect the water's taste when its concentration exceeds 250 mg/l. In the study, chloride levels ranged from 215 mg/l to 1249 mg/l, with the lowest concentration recorded at S8 (215 mg/l) and the highest at S24 (1249 mg/l). Notably, none of the observed stations fell within the permissible limit of 1000 mg/l set by BIS.

Bicarbonate (HCO3): The alkalinity of groundwater primarily stems from the formation of bicarbonates during chemical reactions within soil as water flows through it. In this study, bicarbonate concentrations ranged from 278 mg/l to 1613 mg/l, with the lowest value recorded at S8 and the highest at S24. None of the sampled stations fell within the permissible BIS range of 100–500 mg/l.

Carbonate (CO3): Carbonate levels varied between 12 mg/l and 75 mg/l, with the lowest reading noted at S8 and the highest at S24. The BIS standard for carbonate concentration is set between 50–200 mg/l.

Table 5 shows statistical analysis of groundwater parameters of the study area. The average values of pH, EC, Na, Ca+Mg, Cl, HCO^3, CO^3, SAR and RSC are 7.7, 2079 µS/cm, 309 mg/l, 74.0 mg/l, 402 mg/l, 538 mg/l, 25 mg/l, 49 and 489 respectively. The standard deviation of pH, EC, Na, Ca+Mg, Cl, HCO3, CO3, SAR and RSC are 0.1, 1310 µS/cm, 194 mg/l, 46.6 mg/l, 254 mg/l, 348 mg/l, 15 mg/l, 40 and 316 correspondingly. Whereas, coefficient of Variance (CV) of pH, EC, Na, Ca+Mg, Cl, HCO^3, CO^3, SAR and RSC are 0.0, 630 µS/cm, 1.0 mg/l, 0.6 mg/l, 1.0 mg/l, 1.0 mg/l, 1.0 mg/l, 1.0 and 1.0 correspondingly.

Table 4: Groundwater quality parameters of Akasar village.

Sample No.	pH	EC (µS/cm)	Na (mg/l)	Ca+Mg (mg/l)	Cl (mg/l)	HCO_3 (mg/l)	CO_3 (mg/l)	SAR	RSC
1	7.65	2350	349	84	455	588	27	54	531
2	7.6	1780	264	63	345	445	21	47	403
3	7.65	3560	528	127	689	891	42	66	806
4	7.5	1280	190	46	248	320	15	40	290
5	7.6	1220	181	43	236	305	15	39	277
6	7.58	1170	174	42	227	293	15	38	266
7	7.52	1160	172	41	224	290	15	38	264
8	7.5	1110	165	40	215	278	12	37	250
9	7.54	1190	177	42	223	298	15	38	270
10	7.7	2460	365	88	476	1164	30	55	1107
11	7.68	2540	377	90	492	635	30	56	575
12	7.5	1180	175	42	228	295	15	38	268
13	7.58	1240	184	44	240	310	15	39	281
14	7.78	2130	316	76	412	533	24	51	481
15	7.6	1220	181	43	236	305	15	39	277
16	7.6	1220	181	43	234	305	15	39	277
17	7.65	1340	199	48	259	335	15	41	302
18	7.62	1270	188	45	246	318	15	40	288
19	7.68	1130	168	40	219	282	12	37	254
20	7.8	1240	184	44	240	310	15	39	281
21	7.85	4570	678	163	884	1143	54	75	1034
22	7.8	4070	604	145	788	1018	48	71	921
23	7.84	4550	675	162	881	1138	54	75	1030
24	7.78	6450	957	230	1249	1613	75	89	1459
25	7.75	1160	172	41	224	290	15	38	264
26	7.6	1890	280	67	366	473	21	48	426
27	7.5	1860	276	66	360	465	21	48	420
28	7.68	1720	269	61	333	430	21	49	390
29	7.78	2140	317	76	414	535	24	51	483
30	7.8	2170	322	77	420	543	24	52	490

Table 5: Statistical analysis of groundwater parameters.

Statistical parameter	pH	EC (µS/cm)	Na (mg/l)	Ca+Mg (mg/l)	Cl (mg/l)	HCO_3 (mg/l)	CO_3 (mg/l)	SAR	RSC
Mean	7.7	2079	309	74.0	402	538	25	49	489
Maximum	7.9	6450	957	230	1249	1613	75	89	1459
Minimum	7.5	1110	165	39.5	215	278	12	37	250
Mode	7.6	1220	181	43.4	236	305	15	39	277
Median	7.7	1530	231	54.5	296	382	18	44	346
Standard Deviation	0.1	1310	194	46.6	254	348	15	40	316
Coefficient of Variance	0.0	630	1	0.6	1	1	1	1	1
Skewness	0.2	1896	2	1.9	2	2	2	2	2
Variance	0.0	1715	37697	2174	64366	120995	233	1143	119054
Kurtosis	-1.1	3445	3	3.4	3	2	3	3	2

Table 6 is the correlation among these physico-chemical parameters of groundwater. Carbonate and bicarbonate show high affinity with EC, Na, Ca+Mg, and sulfate. A strong positive correlation is observed between HCO^3 and EC (0.958), HCO^3 and Na (0.958), HCO^3 with Ca+Mg (0.958), and HCO^3 with Cl (0.958). Carbonate have positive correlation with EC (0.998), Na (0.998), Ca+Mg (0.998), Cl (0.998) and HCO^3 (0.960).

Table 6: Correlation among physico-chemical parameters of groundwater samples.

	pH	EC (µS/cm)	Na (mg/l)	Ca+Mg (mg/l)	Cl (mg/l)	HCO_3 (mg/l)	CO_3 (mg/l)
pH	1						
EC (µS/cm)	0.620	1.000					
Na (mg/l)	0.621	1.000	1.000				
Ca+Mg (mg/l)	0.620	1.000	1.000	1.000			
Cl (mg/l)	0.621	1.000	1.000	1.000	1.000		
HCO_3 (mg/l)	0.605	0.958	0.958	0.958	0.958	1.000	
CO_3 (mg/l)	0.615	0.998	0.998	0.998	0.998	0.960	1

Standard permissible limits for drinking water and irrigation water as per BIS (BIS 2012 and BIS 2019) are shown in Table 7. The pH range of all water samples was found to be suitable for drinking and irrigation purpose. All samples have pH values within the suitable range as per BIS standards. For EC, 11 samples are beyond the permissible limit of drinking water. These samples are S1, S3, S10, S11, S14, S21, S22, S23, S24, S29 and S30. While for irrigation sample S21, S22, S23 and S24 are above the standard limit. Na is found above the standard permissible limit of drinking water in 4 samples (S21, S22, S23 and S24). Ca+Mg are within the permissible standards of BIS. For Cl, only S24 sample is found to be not suitable for drinking water. Out of 30 samples, 11 samples are beyond the permissible limit of drinking water for bicarbonate. These samples are S1, S3, S10, S11, S14, S21, S22, S23, S24, S29 and S30. While for irrigation sample no. S10, S21, S22, S23 and S24 are above the standard limit. Carbonate is found within the permissible limit for both drinking and irrigation. The value of SAR and RSC are found outside the permissible limits for drinking and irrigation purposes.

Table 7: Standard permissible limits for drinking water and irrigation water as per BIS.

Parameter	Drinking standard (BIS 10500:2012)	Irrigation standard (BIS 11624:2019)
pH	6.5-8.5	6.5-8.5
EC	400-2000 µS/cm	500-4000 µS/cm
Total Alkalinity (HCO_3)	100-500 mg/l	100-1000 mg/l
Total Hardness (Ca+Mg)	100-500 mg/l	100-1000 mg/l
Na	200-600 mg/l	100-1500 mg/l
Cl	250-1000 mg/l	100-1500 mg/l
K	10-100 mg/l	10-200 mg/l
CO_3	50-200 mg/l	50-500 mg/l
SAR	-	6-12
RSC	-	1.25-2.5

Table 8 depicts groundwater quality index (GWQI) of Akasar Village, Bikaner. Out of 30 samples,18 samples fall under good category, 6 samples fall under poor category and 6 samples are of unsuitable category.

Table 8: Groundwater Quality Index (GWQI) of Akasar Village, Bikaner.

Sample	pH	EC	Na	Ca+Mg	HCO_3	CO_3	Cl	Mean WQI	Class
S1	56	5	29	19	135	1	2	35	Good
S2	55	5	28	19	133	1	2	35	Good
S3	55	5	27	18	128	1	2	34	Good
S4	55	5	29	19	137	1	2	36	Good
S5	57	11	60	40	535	2	5	102	Unsuitable
S6	56	5	29	19	135	1	2	35	Good
S7	55	5	28	19	133	1	2	35	Good
S8	55	5	27	18	128	1	2	34	Good
S9	55	5	29	19	137	1	2	36	Good
S10	57	11	60	40	535	2	5	102	Unsuitable
S11	56	12	62	42	292	2	5	67	Poor
S12	55	5	29	19	136	1	2	35	Good
S13	56	6	30	20	142	1	2	37	Good
S14	57	10	52	35	245	2	4	58	Poor
S15	56	6	30	20	140	1	2	36	Good
S16	56	6	30	20	140	1	2	36	Good
S17	56	6	33	22	154	1	3	39	Good
S18	56	6	31	21	146	1	3	38	Good
S19	56	5	28	18	130	1	2	34	Good
S20	57	6	30	20	142	1	2	37	Good
S21	58	21	112	75	526	4	9	115	Unsuitable
S22	57	19	100	67	468	4	8	103	Unsuitable
S23	58	21	112	74	523	4	9	114	Unsuitable
S24	57	30	158	106	742	6	13	159	Unsuitable
S25	57	5	28	19	133	1	2	35	Good
S26	56	9	46	31	217	2	4	52	Poor
S27	55	9	46	30	214	2	4	51	Poor
S28	56	8	45	28	198	2	3	49	Good
S29	57	10	53	35	246	2	4	58	Poor
S30	57	10	53	36	250	2	4	59	Poor

Table 9 represents three characteristics of groundwater of Akasar village. First category of groundwater is slightly saline and sampling sites S1, S4, S5 and S7 come under this category. Groundwater of slightly saline is not good for pulses. However, crops like wheat, bajra, maize, mustard and cotton can be grown. Second category of Akasar groundwater is also slightly saline such as S2, S6, and S8-S20. Third category of Akasar groundwater is saline and is not suitable for irrigation. These sampling sites are S3, S21, S22, S23 and S24.

Table 9: Groundwater quality and irrigation suitability.

S.N.	Characteristics of groundwater	Sample ID
1	Groundwater is slightly saline. Pulses cannot be grown in such water, rest crops can be grown such as wheat, maize, mustard, Bajra, and cotton.	S1, S4, S5, S7
2	Groundwater is slightly saline. Pulses cannot be grown in such water; rest crops can be grown.	S2, S6, S8 to S20, S25, S26, S27, S28, S29, S30
3	The water is saline and is not suitable for irrigation.	S3, S21, S22, S23, S24

5. Conclusion

Groundwater quality of Akasar village (Bikaner, Rajasthan) was assessed across 30 sampling sites. Groundwater quality parameters like pH, electrical conductivity, carbonate, chloride, bicarbonate, calcium, sodium, magnesium, residual sodium carbonate and sodium absorption ratio were examined. The study revealed that parameters like pH, calcium and magnesium (Ca+Mg), and carbonate fell within the permissible limits set by BIS standards. However, 36.6% of groundwater samples were deemed unsuitable for drinking due to elevated levels of electrical conductivity, sodium, bicarbonate, and chloride. Additionally, 16.6% of samples were found inappropriate for irrigation purposes. Despite these issues, the overall groundwater quality in Akasar village is considered acceptable for both drinking and irrigation uses. Further investigations into the presence of heavy metals in the groundwater are recommended to ensure sustainable management and utilization of this vital resource.

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