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An Investigation of Physicochemical Quality of Ground water Source of Bikaner Block: a Case Study

Research Article

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Abstract

The provision of safe supply of drinking water is a high priority issue to a government for safe guarding the health of human beings. The production and supply of adequate and safe drinking water is the most important factor contributing to a decrease in morbidity and mortality in developing country like India. As we know water is a very good solvent, hence some toxic and hazardous substance dissolves in it and produce water pollution problem posing many parameters of interest for water quality assessment. In Rajasthan 71% of the irrigation and 90% of the drinking water supply sources are under ground water (Rathore 2005).Water quality index is one of the most effective tools to communicate information on the quality of water to the concerned citizen and policy makers. It thus, becomes an important parameter for the assessment and management of ground water. In absence of surface water resources, people of the area primarily depend upon underground water to meet out their drinking and agricultural requirements. The underground water in the study area is characterized by medium to high salinity. More than 57% water is of sodium chloride type and distributed throughout the district. The district is notorious for having high fluoride and nitrate concentration in underground water [1], which makes it unsuitable for drinking purpose. The dry climate condition with high evaporation and insignificant recharge might have accelerated the strengthening of fluoride and nitrate concentration in the underground water of this area.

Keywords: Physicochemical quality; Ground water source; Sampling method

About the Study Area

Bikaner block is located in the North-western part of Rajasthan and encompassed between North Latitudes 27°11' to 29°03' and East Longitudes 71°52' to 74°15' covering geographical area of 30247.90 km. The block experiences arid type of climate. The Mean annual rainfall (1971- 2005) of the district is 297.7 mm. whereas normal rainfall(1901-1971) is lower than average rainfall and placed at 257.8 mm. Almost 90% of the total annual rainfall is received during the Southwest monsoon, which enters the block in the first week of July and withdraws in the mid of September. As the block lies in the desert area, extreme of heat in summer and cold in winter is the characteristic of the desert. The temperature varies from 48 degree in summer to 1 degree in winter. Atmosphere is generally dry except during the monsoon period. The humidity is highest in august with mean daily relative humidity is 71% in the morning and 52% in the evening. The soils of Bikaner block area predominantly light textured, weak- structured but well-drained.

Materials & Methods

In present study of discourse total 17 ground water sample were collected from tube-wells, open wells and Hand pumps of different locations were analyzed for estimation of physical and chemical properties like PH, total Hardness, Ca^{+2}, TDS, chloride, EC, Nitrate and fluoride, sample were collected clean bottles of 1 litre [2].

The physicochemical characteristics of the ground water sample determined by Standard method in 2002. The PH, TDS was measured

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Ground water sampling taken from study area.

by using portable meters and manual method. The concentrations of magnesium, calcium, hardness were estimated by volumetric method and total hardness of water was estimated by complex metric titration with EDTA, chlorides content here determined volumetrically by A_gNo_3 titrimetric method. Other parameters like F^- and No_3^- were estimated by Spectrophotometric method. The results are comparable with WHO and BIS water standards [3,4].

The 17 Sample collected from different villages/sites of different regions of Bikaner block in district Bikaner are namely.1 Ridmalsar (S_1)2. Norangdesar (S_2)3. Napasar (S_3)4. Raisar (S_4)5. Sagar (S_5)6. Himtasar (S_6)7. Gadhwala (S_7)8. Udasar (S_8)9. Kotegate (Choutina Kua) (S_9)10. Bichwal (Lalgarh) (S_{10})11. Tilak nagar (S_{11})12. Patel nagar (S_{12})13. Shiv bari (S_{13})14. Pawanpuri (S_{14})15. Jassusargate (SongiriKua) (S_{15})16. Johdbid (S_{16})17 [5]. Jawahar Nagar (S_{17}) following parameters were studied as per prescribed method pertaining to the discourses in study area like pH is most important in determining the corrosive nature of water. Lower the pH value higher is the corrosive nature of water. pH was positively correlated with electrical conductance and total alkalinity the reduced rate of photosynthetic activity the assimilation of carbon dioxide and bicarbonates which are ultimately responsible for increase in pH, the low oxygen values coincide with high temperature during the summer month. Various factors bring

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about changes the pH of water. The higher pH values observed suggests that carbon-dioxide; carbonate-bicarbonate equilibrium is affected more due to changes in physico-chemical condition. The parameter like conductivity (specific conductance) is the numerical expression of the water's ability to conduct an electric current. It is measured in micro Siemens per cm and depends on the total concentration, mobility, valence and the temperature of the solution of ions. Electrolytes in a solution disassociate into positive (cations) and negative (anions) ions and impart conductivity. Most dissolved inorganic substances are in the ionised form in water and contribute to conductance. The conductance of the samples gives rapid and practical estimate of the variation in dissolved mineral content of the water supply. Conductance is defined as the reciprocal of the resistance involved and expressed as mho or Siemen (s). The presence of chlorides in natural waters can mainly be attributed to dissolution of salt deposits in the form of ions (Cl^-) [8]. Otherwise, high concentrations may indicate pollution by sewage, industrial wastes, intrusion of seawater or other saline water. It is the major form of inorganic anions in water for aquatic life. High chloride content has a deleterious effect on metallic pipes and structures, as well as agricultural plants. They are calculated by Argento- metric method. Total Dissolved Solid is calculated by conductivity cell done with standard KCL solution. It is based on the principle of wheat-stone bridge. The unknown resistance can be calculated. Its reciprocal gives us the conductance [9,10].

Total Hardness estimated in accordance to select a sample volume that requires less than 15ml EDTA titrate and complete titration with in 5 min., measured from time of buffer addition. Take 50ml well mixed sample in a conical flask. Add 1-2ml buffer solution followed by 1ml inhibitor usually 1-2ml buffer solution is sufficient to give of pH of 10.Add a pinch of Erichrome black-T and titrate with standard EDTA (0.01) till wine red color change to blue.

The confinement of Fluoride estimatation as it has dual significance in water supplies. High concentration causes dental fluorosis and lower concentration (<0.8 mg/L) causes dental caries. A fluoride concentration of approximately 1mg/L in drinking water is recommended. They are frequently found in certain industrial processes resulting in fluoride rich wastewaters. Significant sources of fluoride are found in coke, glass and ceramic, electronics, pesticide and fertiliser manufacturing, steel and aluminium processing and electroplating industries. It is calculated by SPADNS method [11-15].

Results

The following observations have been made as per recommended methods of studied parameters in study area (Table 1 & Figures 1-6).

Discussion

The data revealed that pH ranged from shows that 6.3 to 8, the minimum pH was observed in Ridmalsar village (S_1) and maximum pH was detected in Jodbid (S_{16}) [16,17]. According to BIS standard, least and ideal pH value for human consumption is 7.0, but it may vary from 6.5 to 8.5 thus, the entire sample tested very slightly Alkaline. The pH of all samples was within limit the pH value above 7.0 shows the alkaline nature of water due to excess of carbonate

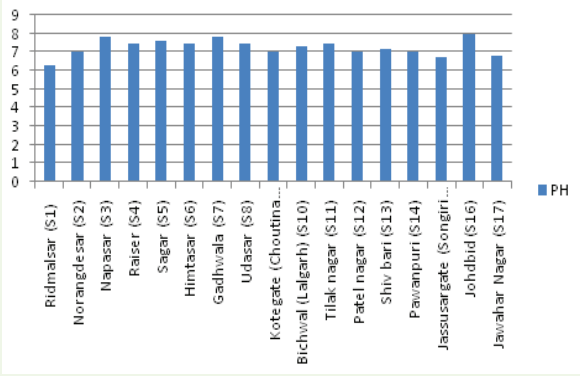

Figure 1: Distribution of pH in Bikaner block.

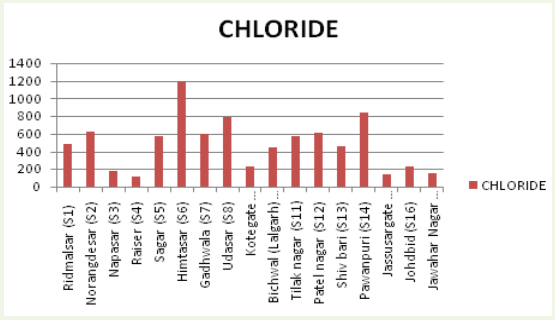

Figure 2: Distribution of Chloride in Bikaner block.

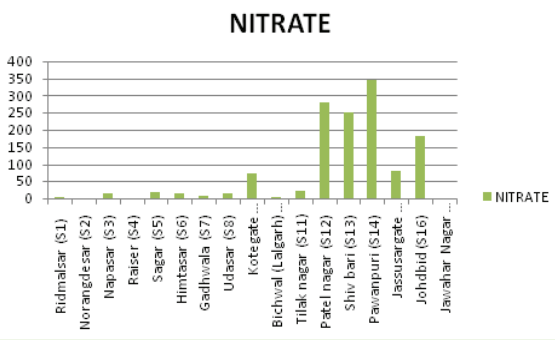

Figure 3: Distribution of Nitrate in Bikaner block.

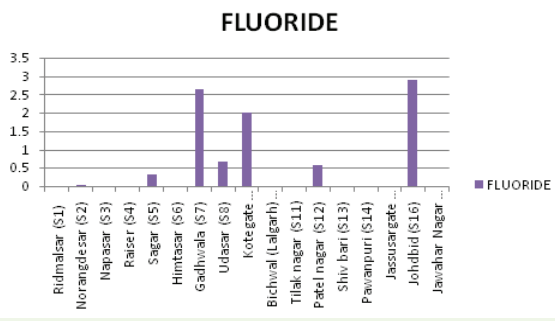

Figure 4: Distribution of Fluoride in Bikaner block.

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Table 1:

S.N	Location of Bikaner Block	pH	Hardness			TDS (mg/l)	Chloride (Cl^-) (mg/l)	Nitrate (No_3^-) (mg/l)	Fluoride (mg/l)	EC (S)
			Total	Mg^+ (mg/l)	Ca^+ (mg/l)					
1	Ridmalsar (S_1)	6.3	1128	27.9	22	440	478.6	2.13	0.0(trace)	960
2	Norangdesar (S_2)	7.00	3466	65.6	68	1430	620	1.54	0.04	3170
3	Napasar (S_3)	7.8	914	13.3	18	400	178.7	16.09	0.0(trace)	900
4	Raiser (S_4)	7.5	1216	15.8	24	200	114.8	0.1	0.0(trace)	430
5	Sagar (S_5)	7.6	1627	26.7	32	1480	574.5	20.07	0.32	3260
6	Himtasar (S_6)	7.5	7388	87.5	146	2520	1194	15.27	0.0(trace)	5560
7	Gadhwala (S_7)	7.8	2039	38.9	40	850	5957	5.85	2.64	1890
8	Udasar (S_8)	7.5	1639	38.9	32	1840	786	13.91	0.68	4100
9	Kotegate (Choutina Kua) (S_9)	7.0	2738	37.6	54	720	229.7	71.91	2	1590
10	Bichwal (Lalgarh) (S_{10})	7.3	2354	53.5	46	1200	441	2.97	0.0(trace)	2630
11	Tilak nagar (S_{11})	7.5	2558	57.15	50	1320	568.1	23	0.0(trace)	2880
12	Patel nagar (S_{12})	7.0	3485	85.12	68	1730	613	280	0.56	3780
13	Shiv bari (S_{13})	7.2	2060	60.8	40	1270	459.5	250	0.0(trace)	2780
14	Pawanpuri (S_{14})	7.0	4526	25.5	90	2090	837	347	0.0(trace)	4580
15	Jassusargate (SongiriKua) (S_{15})	6.7	1021	20.6	20	190	135	80	0.0(trace)	420
16	Johdbid (S_{16})	8.0	827	26.7	16	900	223.4	182	2.88	1940
17	Jawahar Nagar (S_{17})	6.8	1220	19.4	24	250	146.8	1.12	0.0(trace)	560

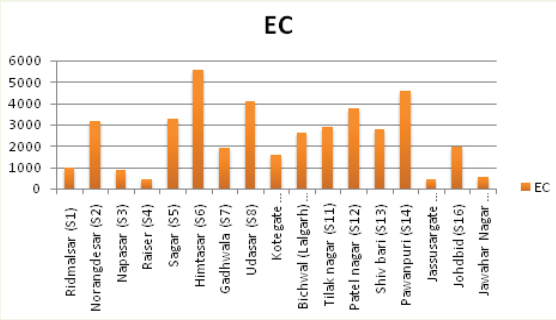

Figure 5: Distribution of EC in Bikaner block.

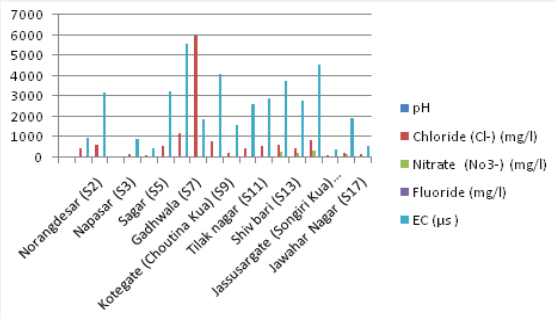

Figure 6: Distribution of the groundwater samples in Bikaner block.

and biocarbonates. It is the important parameter for the use of water. The water with a high TDS value Indicates that water is highly mineralized. The Desirable limit for TDS 500 Mg/l and maximum limit is 2000mg/l. Prescribed for drinking purpose according to BIS. The Concentration of TDS in the present. Study is observed in the range of 190mg/l to 2520mg/l. It is showed that sample S_6 and S_{14} are unsuitable for drinking and irrigation purpose as the TDS is more than 2000mg/l in these samples. - The concentration of chloride varied between 114.8 to 837 mg/l. The minimum value was observed in Raisar (S_4) and maximum concentration in Pawanpuri (S_{14}). However according to BIS the permissible limit for chloride is 250-1000 mg/l, Which indicate that the drinking water of location contained chloride, concentration within permissible limit except for Pawanpuri (S_{14}).Where in the chloride concentration ishigher than the permissible limit. High concentration of Cl^- produces hypertension, effect metabolism of the body and increase the electrical conductivity of water. Present study shows the concentration of Ca is between 16 to 146 mg/l. The minimum value was observed in Jorbir (S_{16}) and maximum concentration in the Himtasar (S_6) all sample is permissible limit. Magnesium value in the studied area varies between 13.3 to 87.5 mg/l. The maximum value was recorded in the Himtasar (S_6) & minimum value was observed in Napasar (S_3). According to BIS standards Magnesium permissible limit is 30-100 thus, the all sample were within limit.- The hardness of water produced by the ca^{+2} and Mg^{+2} salt. The bicarbonate sulphates and chlorides. Hardness value in the studied area varied between 827 to 7388 mg/l. Excess hardness cause stomach disorder and finally weakens the stomach permanently. The nitrate content in water source of present study area ranged from 0.1 to 347 mg/l. the minimum value was observed in Raisar (S_4) & maximum concentration in Pawanpuri (S_{14}). Sample S_9, S_{12}, S_{13}, S_{14}, S_{15}, S_{16}, shows higher level of nitrate in drinking water which is beyond permissible limit. According to BIS permissible limit of nitrate in water is 45 mg/1-100mg/l. So this water is not good for health. Nitrate in ground water is originated from fertilizers, septic system and manure spreading operations. Nitrate is one of the most frequent ground water pollutions in rural area it needs to be regulated in drinking water basically. The toxicity of No_3^- ion is due to its reduction in No_2^- ion in the human body. No_2^- oxidized normal hemoglobin to me hemoglobin. Which is unable to transport oxygen to the tissue? This condition is called methenoglobinema (blue baby disease) causes cyanosis and at higher concentration asphyxia. According to BIS standard the limit of fluoride is 1.0 to 1.5 mg/l.

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The fluoride content in water sources of present study area ranged from0.0 trace to 2.88 mg/l at S_1, S_2, S_3, S_4, S_6, S_{10}, S_{11}, S_{13}, S_{14}, S_{15}, S_{17} & maximum value (S_{16}) respectively. Three samples (S_7), (S_9), (S_{16}), have fluoride more than the permissible limit. So it is not suitable for drinking purpose and its leads to various health hazards line dental and skeletal fluorosis, the people of study area also complained of joint and abdominal pain. The fluoride concentration is between 0.9 to 1.2 mg/l. than dental fluorosis is started and fluoride exceeds the level of 3 mg/l. than skeletal fluorosis is started in living beings [18-21].

Conclusion

The Quality of ground water of Bikaner block and surrounding area is not according to norms of Rajasthan government and WHO standards higher concentration to there at this salt had deleterious effect on the human health [5]. Higher concentration of nitrates had been found to be associated with cancer in Slovakia [6]. Knobetoch (2000) reported blue baby syndrome associated with high nitrate concentration in water [7]. Neal et al. (2000) analyzed the water quality of Thames tributaries and found to be contaminated by anthropogenic activities Akhilesh et al. (2005) carried out study on the geochemical scenario of fluoride in the whole Rajasthan [1]. The pH results indicate that ground water of Bikaner block is highly brackish to saline in nature. The total hardness of ground water of this area falls in the hard category. Total hardness, chloride, nitrates and fluoride properties of drinking water in the study area indicate the sign of deterioration which calls for at least primary treatment of ground water before being used for drinking. During sample collection people of area also complained about diarrhea, gastric and other digestion related problems, which may be because of consuming ground water containing high amount of nitrate contents. Consumption of high concentration of fluoride was resulted in bone deformity and joint pains. Laanthe et al. (2002) has suggested some bioremediation methods of nitrate but these have yet to gain fruitful results [9]. The purpose to persuade present research work was to know ground water quality and to find out chemical and biochemical remediation of problematic ions. The Study suggests that regular evaluation of water quality needed in Bikaner block so that strategies can be developed to reduce excess chemical contaminations and the water can made suitable for drinking purposes.

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