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ION ANALYSIS OF GROUNDWATER OF SOME RURAL POCKETS OF BARMER[RAJASTHAN], INDIA

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Abstract
A systematic study of Groundwater quality was carried out in some rural areas of Barmer district Rajasthan by collecting forty groundwater samples from probable sensitive places. In this study, Cl^-, Na^+ and K^+ ions were analyzed in particular to assess suitability for potable nature of water as well as for irrigation purposes. These ions play a significant role for health component of human beings as high/low intake becomes a cause for many diseases.

Introduction
Ground water is considered as more clean and pollution free in comparison to surface water but discharge of industrial effluents, domestic sewage and solid waste dump pollutes it and transforms it to be harmful entity for health. Sodium and chloride occur naturally in groundwater and are not harmful but due to some human activity like industrial wastes, sewage, fertilizers etc. considerably disturb sodium and potassium quantity in ground water. Higher concentration of these changes the taste of water, affects plants and converts water corrosive which affect household plumbing. Only 20% of sodium is consumed by human beings in drinking water intake but higher consumption of sodium becomes a health hazard for those on a salt restricted diet [1-11, 15]. In this paper, concentrations of sodium and potassium ions have been determined by using flame photometer technique.

Study area

Barmer district is situated in south west of Rajasthan between 28°48' and 26°32' north latitude and 70°05' and 72°52' east longitude. It has geographical area of about 28, 387 sq.km. The temperature variance is of extremes and is between 0°C and 50°C respectively with dry air throughout the year with meager rainfall.

The district being part of arid zone has mineralized ground water. The prevalence of high salinity in ground water is due to the hydro geological barriers like clay formation, which covers around 60 % of the region. These formations restrict the circulation of water through aquifers and extreme arid climatic conditions help in salinization of ground water. Except for the highly saline and alkaline waters the ground water has low contents of fluoride. The present study covers some pockets of rural areas of Barmer district.

Materials and methods
The human body needs sodium in order to maintain blood pressure, control fluid levels and for normal nerve and muscle function. Sodium in drinking water is not a health concern for most people but may be an issue for someone with severe hypertension, congestive heart failure or on a sodium-restricted diet. High amount of potassium causes chest tightness, nausea and vomiting, diarrhoea, hyperkalaemia, shortness of breath and heart failure. Chloride concentration more than 250 mg/l can give rise to detectable taste. There is no any health based issue is proposed for chloride. It can be assumed that human health is a serious cause of concern in Barmer district as a whole due to higher values of these parameters.

Sodium and Potassium ions were estimated by Digital flame photometer (Systronic 121):

In commonly used flame photometers, the specific filters are used for different elements as monochromators, which allow passing the wavelength specific to that particular element. The characteristic radiation for sodium is 589 nm, the intensity of which can be read on a scale by using a filter for this wavelength. The intensity of the emitted radiation is always proportional to the concentration of the element in the flame, thus a calibration curve can be prepared using various standards of that element. Potassium has a similar chemistry like Na and remains mostly in solution without undergoing any precipitation. It also enters into exchange equilibria of the adsorbed cations.

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Estimation of chloride was done by Mohr's method using Argentometric titration method employing silver nitrate as the titrant and potassium chromate as the indicator.

Statistical analysis of ground water data:

The statistical approach was made to establish correlation between different water quality parameters of study areas among these ions. For this purpose the correlation coefficient (r) values are summarized in Table 1.

TABLE 1. STATISTICAL ANALYSIS OF GROUND WATER DATA

IONS	Na	K	Cl
Na	1		
K	0.05	1	
Cl	0.08	0.17	1

Results and discussion

The main cations are sodium and potassium and main anion is chloride which are present in water. 92% samples are not suitable for drinking purpose because they have higher concentration of sodium than permissible limit which is 200 mg/l. [12] Likewise 65% water samples are unsuitable for drinking purpose on the basis of potassium concentration. As many as 95% water samples are unsuitable for drinking purpose due to chloride concentration.

The highest concentration of sodium ion was observed in Godoyal TW.1 [GWS1] and Baghera TW.1 [GWS28] area where the concentration of sodium ion is 560mg/l. while highest potassium concentration was found in Budhatala area [GWS2] where the concentration of potassium is 350 mg/l. Similarly, highest concentration of chloride [1597.5 mg/l.] was estimated in Godoyal area [TWS1] of the district. It is observed that higher concentration of sodium is due to the leaching of soap and use of fertilizers in nearby areas.

The source of potassium is likely to be due to silicate minerals, orthoclase, microcline, hornblende, muscovite and biotitic in igneous and metamorphic rocks and evaporation deposits gypsum and sulphate releases considerably increase amount of potassium in groundwater. However, main reason of increased potassium into groundwater appears to be due to agricultural activities.

Increasing chloride ion concentration in groundwater is likely to be due to salt pan deposits agricultural return flow into groundwater. The estimated values are summarized in Table 2

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TABLE 2. Sample analyses [Location wise]

Sample No.	Sample Name	Location	Sodium	Potassium	Chloride
1	GWS1	Godoyal TW.1	560	230	1597.5
2	GWS2	Budhatala TW.1	180	280	213
3	GWS3	Ratadi TW.1	170	290	461.5
4	GWS4	Ratadi TW.2	280	300	710
5	GWS5	Ratadi TW.3	680	310	461.5
6	GWS6	Ratadi TW.4	270	320	1278
7	GWS7	Ratadi TW.5	280	330	248.5
8	GWS8	Ratadi TW.6	320	340	1491
9	GWS9	Budhatala TW.2	180	350	426
10	GWS10	Nagadda TW.1	510	290	923
11	GWS11	BudhatalaTW.3	360	200	355
12	GWS12	Gehum Road TW.1	360	180	355
13	GWS13	Gehum Road TW.2	360	200	390.5
14	GWS14	Ratadi TW.7	430	300	603.5
15	GWS15	Gehum Road TW.3	340	170	390.5
16	GWS16	BudhatalaTW.4	330	150	319.5
17	GWS17	Kanasar TW.1	530	310	1029.5
18	GWS18	Nagadda TW.2	500	270	816.5
19	GWS19	Ratadi TW.8	330	220	248.5
20	GWS20	Kanasar TW.2	480	270	781
21	GWS21	BudhatalaTW.5	460	260	603.5
22	GWS22	Gehum Road TW.4	330	170	284
23	GWS23	SemusarTW.1	550	250	1242.5
24	GWS24	Gehum Road TW.5	340	170	355
25	GWS25	Gehum Road TW.6	360	190	355
26	GWS26	Gehum Road TW.7	350	180	426
27	GWS27	Undu TW.1	390	220	532.5
28	GWS28	Baghera TW.1	560	300	1100.5
29	GWS29	Baghera TW.2	530	250	994
30	GWS30	Baghera TW.3	520	240	1065
31	GWS31	Bhadka TW.1	380	180	497
32	GWS32	Bhadka TW.2	350	190	710
33	GWS33	Bhadka TW.3	500	280	887.5
34	GWS34	Bhadka TW.4	370	270	1313.5
35	GWS35	Sajinatda TW.1	370	190	710
36	GWS36	Sajinatda TW.2	360	330	426
37	GWS37	Sajinatda TW.3	370	190	319.5
38	GWS38	Sajinatda TW.4	370	210	355
39	GWS39	Sajinatda TW.5	390	190	426
40	GWS40	Sajinatda TW.6	410	230	390.5

In order to have a clear idea of areas of highest and lowest Sodium cations concentrations, Graph 1 was plotted and it can easily be concluded that values are much higher than permissible limits of Sodium ions.

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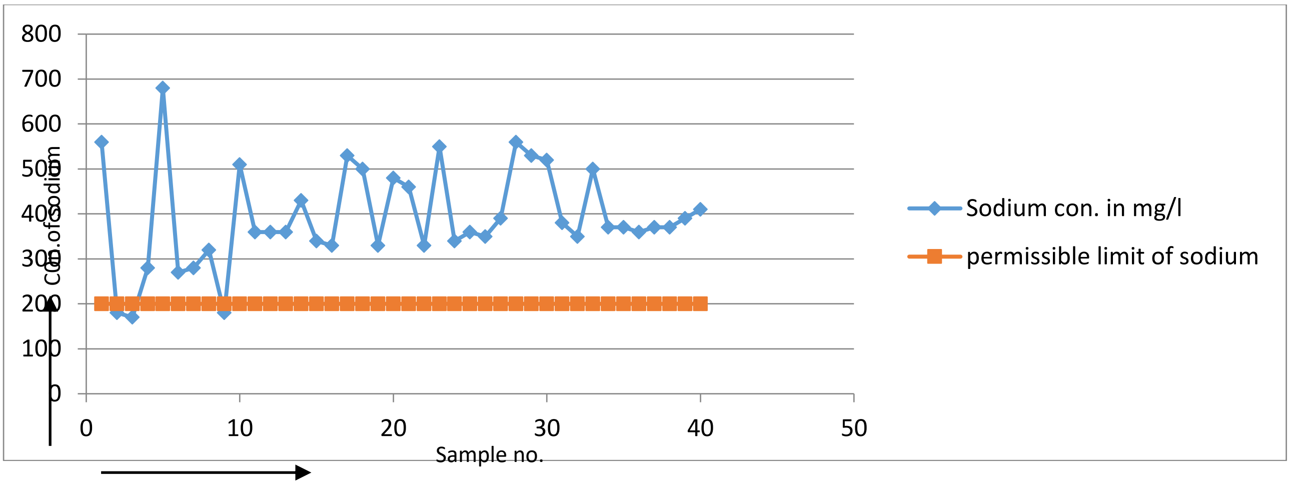
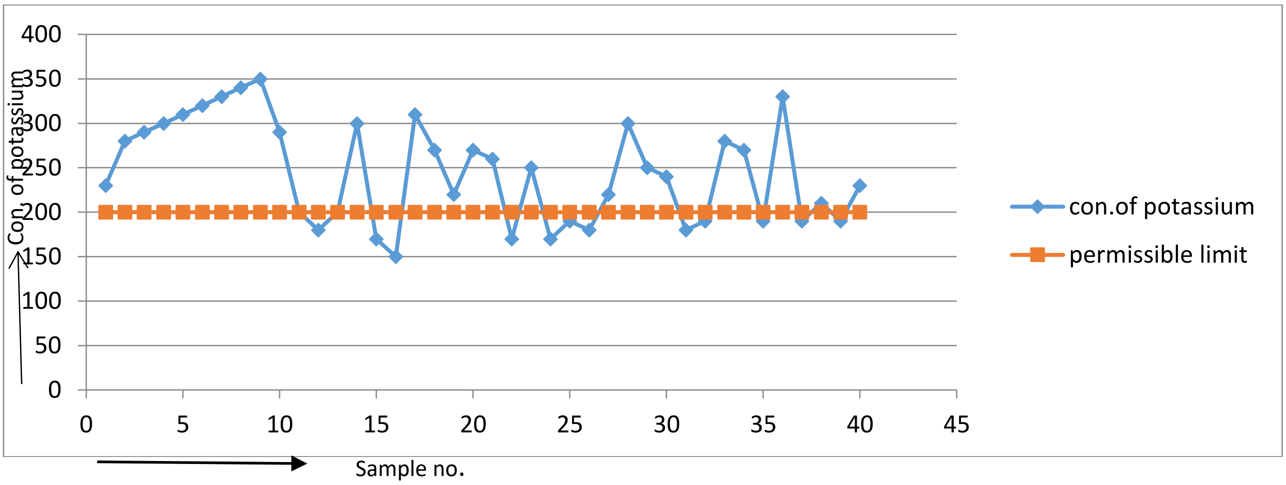


GRAPH 1. SODIUM CATION CONCENTRATIONS IN DIFFERENT WATER SAMPLES

We have plotted our results of Potassium cation and Chloride anion concentration in Graph 2 and Graph 3 against samples and have safely concluded that values in both cases are extremely on higher side and are indicative of putting human health to serious damage.



GRAPH 2. POTASSIUM CATION CONCENTRATIONS IN DIFFERENT WATER SAMPLES

The maximas in case of Potassium ions is as high as 350 mg/l while in case of Chloride touches a value of 1600 mg/l. In ground water chloride comes from many natural and anthropogenic activities. We can see in graph that except only two samples all areas are suffering from high concentration of chloride in drinking water. High chloride concentration is the indication of heavy pollution. It may be due to the use of inorganic fertilizers, landfill latchets, septic tank effluent and industrial and irrigation drainage. No health based issue has been discussed for chlorine but it gives undesirable taste to water.
According to the results the concentration of sodium ion is determined to be in range of 170ppm-560ppm and the mean concentration is 401ppm which is so much higher than maximum permissible limit. Result shows that concentration of potassium is in the range of 150-350 mg/l and the mean concentration is 238.5 mg/l which is within the permissible limit. According to the results the concentration of chloride in the range of 213-1597.5 mg/l and the mean concentration are 652.31 mg/l. [12-14]

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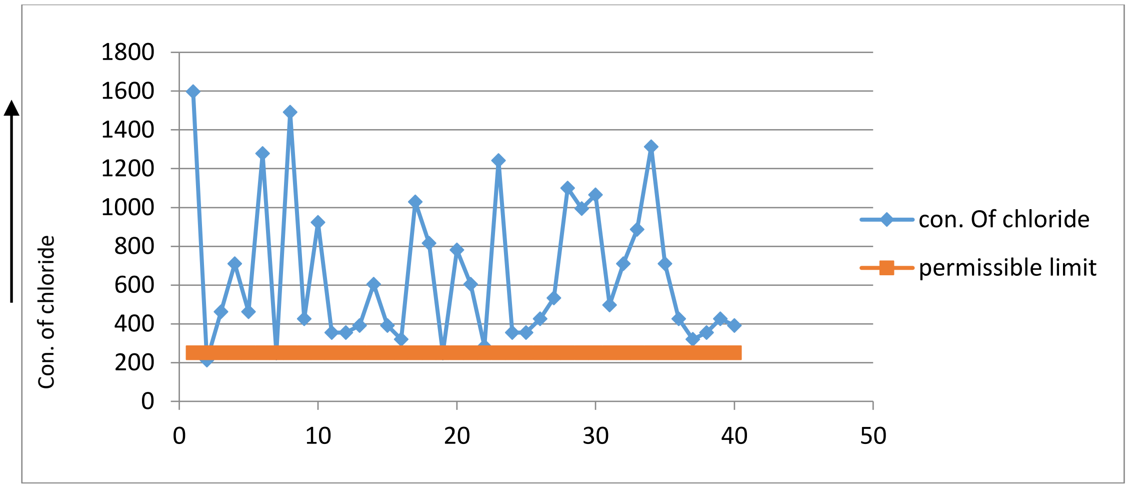

GRAPH 3. CHLORIDE ION CONCENTRATIONS IN DIFFERENT WATER SAMPLES

Conclusion

It can be concluded that water of Budhatala area is good for drinking purpose because here the concentration of chloride is within the limit (213 mg/L) and concentration of sodium is within limits(180 mg/l) but potassium concentration is slightly higher(280 mg/L) than permissible limit. Water of Godayal area cannot be used as potable water because salt concentration is very high in this area.

Sodium, Potassium and Chloride containing water can be treated by using reverse osmosis and distillation methods. But before choosing the treatment method one should consider the initial and operating costs. Operating cost includes the energy needed to operate the system, consumable filters, repairs and general maintenance. One should also keep in mind the supply of water because in reverse osmosis treatment of large quantity of water gets wasted. Bottled water is also an option for those areas. Regular testing and adopting practices to prevent contamination appears to be the need of hour.

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