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EVALUATION OF THE QUALITY OF GROUND WATER AT KOLAYAT AND NOKHA, BIKANER: AN IN-DEPTH ANALYSIS OF PHYSICOCHEMICAL PARAMETERS

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Abstract
Water plays a crucial part in the world of life's nourishment. In addition to making water shortages worse, Rajasthan's dry geography, particularly in the Bikaner region, has a substantial negative impact on the condition of the state's valuable groundwater reservoirs. A thorough investigation was carried out in the Kolayt and Nokah tehsils of the Bikaner district in response to the urgent water problem. The study's objectives were to list a variety of problems relating to water and suggest practical solutions. Remarkable insights have been gained by careful study of water samples, which took into account factors including pH, total dissolved solids (TDS), total hardness, fluoride, chlorides, and nitrates. Notably, the most recent discoveries highlight the high levels of Fluoride found in the groundwater of these tehsils.

Key Word: Fluoride, Groundwater, Kolayat, Nokha, Physico-Chemical Parameters, TDS

Introduction
A crucial supply of water is groundwater, which is found underground in the pores of rocks and soil. Groundwater makes up roughly 96% of all accessible, non-frozen freshwater that is appropriate for human use (Paliwal, BS et al 2017). It has historically supported socioeconomic development in many countries. Groundwater, which is prized for both its availability and purity, is a valuable resource that is vital to the household, agricultural, and industrial sectors. 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, B 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

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groundwater. The chemical makeup of groundwater is the product of extensive interactions with its environment (Gautam, A et al 2023).

Potable water finds application in the culinary domain. The Earth's freshwater reserves, encompassing rivers, lakes, and groundwater, collectively constitute approximately 8 million km3 or about 0.6% of the total global water volume. However, potential hazards stemming from deforestation, climate shifts, population expansion, and intensive land utilization, particularly in agricultural and industrial realms, endanger the continuity and purity of this resource (Kouam, KGR et al 2006 and Nguimalet, CR et al 2005). Consequently, it is essential to ensure the preservation of its physical-chemical and microbiological attributes.

When it comes to both water supply and water quality, Rajasthan is faced with a double issue. Groundwater in a sizable area of the state is either salty or has high concentrations of nitrates and fluoride. Over 94% of the demand for potable water is evidently met by groundwater, making it the main source of drinking water. Fluoride levels that are too high in drinking water have negative impacts on people's health. Fluorosis is a problem that affects all of Rajasthan's districts, but to different degrees. The state mostly uses groundwater because there are no reliable surface water sources for drinking. However, because of excessive exploitation, the groundwater level is dropping yearly.

Study Area Geography and Rainfall

Geographically, Bikaner is located at 28°1' East Longitude and 73°19' North Latitude. Bikaner, which has noticeable temperature variations, has an average elevation of 797 feet. The geographic coordinates of Kolayat, a significant portion of Bikaner in Rajasthan, India, are 27° 50' 0" North and 72° 57' 0" East. This area has 37 Panchayats in total within the Kolayat Block. Similar to Bikaner, Nokha is located within Rajasthan, India, at 27° 36' 0" North and 73° 25' 0" East. The climate of Bikaner is categorised as subtropical desert (BWh). The district's average annual temperature of 30.27°C (86.49°F) is 4.3% higher than India's national average. 18.83 millimetres (0.74 inches) of precipitation, or 9.32% of the total annual precipitation, fall on Bikaner in an average year, with 34.0 wet days.

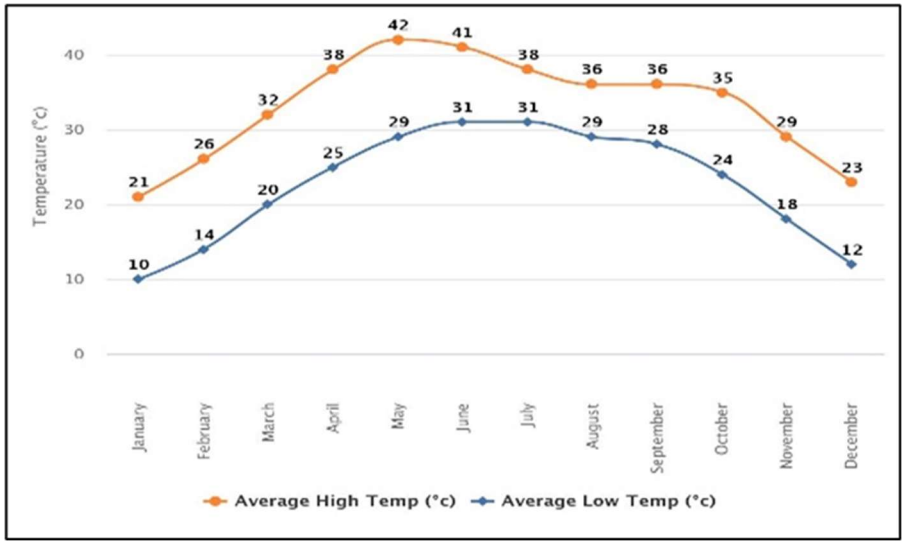

Figure- 1: Average Temperature (oC) Graph of Bikaner

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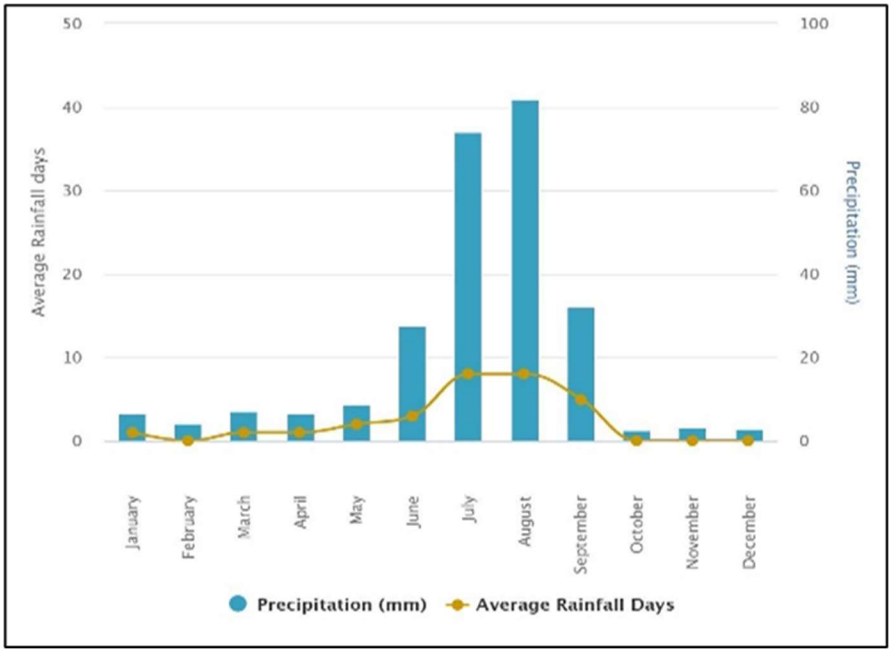

Figure- 2: Average Rain fall (mm) Graph of Bikaner

Material and Method

Various physicochemical properties, including pH, Total Dissolved Solids (TDS), Total Hardness, Chloride, Nitrate, Fluoride, and Sulphate, were assessed during the examination using standard techniques3. It takes a lot of time and effort to evaluate water samples in order to determine their quality. However, if linkages between the many water quality metrics can be found, the task of continuously monitoring water quality throughout time could be greatly streamlined. This possibility arises from the fact that, in situations where such relationships exist, identifying a small number of key parameters would be sufficient to give a general picture of the overall quality of the water, as the remaining parameters could be predicted through correlations derived from these relationships.

Sampling Methods: - A total of thirty water samples were gathered from diverse locations across Kolayat and Nokha from January to December 2022. These water samples served a wide range of purposes, including drinking and various household uses. The collection process involved utilizing high-quality one-liter plastic bottles that were thoroughly cleaned with Distilled water prior to use. The protocols and approaches employed encompassed all stages, namely collection, preservation, analysis, and subsequent interpretation of the data.

Analysis Techniques: Standard techniques were used to determine the physicochemical parameters of the ground water samples. Utilising portable metres, the pH and electrical conductivity were measured. Magnesium, calcium hardness, total hardness, and nitrate concentrations were determined using volumetric methods, and the results were compared to water standards.

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Table 1: Acceptable Upper Limits for Several Parameters

S.N.	Parameters	WHO	UNICEF	BIS
1.	pH	6.5-8.0	6.5-8.5	6.5-8.5
2.	TDS	500	500	500-2000
3.	Fluoride	1.5	1.5	0.5-1.5
4.	Chloride	200	200	250-1000
5.	Nitrate	50	45	45-100
6.	Calcium	100	100	75-200
7.	Magnesium	40	30	30-150

Result-

The Karl Pearson Coefficient (r) has been calculated in this continuing study to find correlations between various water quality measures. In Tables 4 and 5, the precise numerical values of the correlation coefficients (r) have been organised with great care. For the groundwater samples under investigation, the correlation coefficient (r), which measures the link between any two parameters, including water pH, total dissolved solids, fluoride, nitrate, sulphate, chloride, calcium, magnesium, and others, has been calculated.

In Kolayat Fluoride has negative correlation with turbidity, Calcium, Magnesium and dissolved oxygen. Due to low fluoride solubility hardness showed negative correlation with fluoride content. If calcium is present in higher concentration, it is most effective in reducing the fluoride concentration. A strong negative correlation between calcium and fluoride in the groundwater that contain calcium in excess of that required for the solubility of fluoride minerals. Nitrate has positive correlation with sulphate. It may be use of fertilizer for enhance crop production. In Nokha Fluoride has positive correlation with pH, total hardness, Nitrate, TDS and negative correlation with turbidity, Calcium and dissolved oxygen. Nitrate has positive correlation with sulphate. It may be use of fertilizer for enhance crop production. Total dissolved solids have positive correlation with all parameters.

Average physico chemical parameter of Kolayat is pH 8.035, turbidity 28.35, BOD 4.5, Nitrate 26.25, Sulphate 49.25, and Fluoride 1.6 and Nokha is pH 8.025, turbidity 25.1, BOD 4.5, Nitrate 22.05, Sulphate 196.75, and fluoride 1.63.

Table- 02 Physico- Chemical Parameter of Groundwater of Kolayat in 2022

Parameter	January	April	July	October
Water Temperature	16.8	27.2	27.8	21
pH	7.54	8.1	8.5	8
Turbidity %	18.8	25.2	39.2	32.2
Dissolve Oxygen (ppm)	8.1	8.7	9.9	9.3
BOD (ppm)	2.9	5.5	5.7	4
Total Hardness	87	91	98	110
Nitrate (ppm)	22	24	28	31
TDS	498	510	540	521
Sulphate	45	48	53	51
Magnesium (ppm)	5	12	13.5	12.5
Chloride (ppm)	23	50	42	30

Calcium (ppm)	16.4	24.52	26	20
Fluoride (ppm)	1.1	1.5	1.8	2.09

Table- 03 Physico- Chemical Parameter of Groundwater of Nokha in 2022

Parameter	January	April	July	October
Water Temperature	18.1	28	30	22.7
pH	7.4	8.2	8.4	8.1
Turbidity %	22.7	29.1	44.5	4.1
Dissolve Oxygen (ppm)	10.1	7.7	7.2	7.1
BOD (ppm)	2.1	4.9	5.1	5.9
Total Hardness	498	540	580	630
Nitrate (ppm)	22	22.5	21.7	22
TDS	3010	3300	3640	3840
Sulphate	191	184	197	215
Magnesium (ppm)	41	48	56	59
Chloride (ppm)	410	688	912	1165
Calcium (ppm)	52	72	89	120
Fluoride (ppm)	1.04	1.42	1.97	2.1

Table- 04 Correlation Matrix for Different Water Quality Parameter of Kolayat, 2022

Parameter	Water Temperat-ure	pH	Turbidity %	Dissolve Oxygen (ppm)	BOD (ppm)	Total Hardness	Nitrate (ppm)	TDS	Sulphate	Magnesium (ppm)	Chloride (ppm)	Calcium (ppm)	Fluoride (ppm)
Water Temperature	1												
pH	0.907055	1											
Turbidity %	0.647508	0.905234	1										
Dissolve Oxygen (ppm)	0.657939	0.909936	0.999768	1									
BOD (ppm)	0.999778	0.915376	0.663244	0.673531	1								
Total Hardness	0.100586	0.383043	0.661808	0.665792	0.118732	1							
Nitrate (ppm)	0.248448	0.546137	0.797638	0.800641	0.267284	0.98001	1						
TDS	0.677242	0.924022	0.992852	0.991427	0.691916	0.721931	0.721931	1					
Sulphate	0.644743	0.894624	0.994381	0.99591	0.660695	0.975627	0.975627	0.975627	1				
Magnesium (ppm)	0.825861	0.901979	0.853251	0.864269	0.835529	0.888935	0.888935	0.821498	0.888935	1			
Chloride (ppm)	0.945631	0.724595	0.381301	0.395886	0.93946	0.698887	0.698887	0.406894	0.392688	0.698887	1		
Calcium (ppm)	0.995684	0.939958	0.707555	0.716484	0.997054	0.911535	0.911535	0.739009	0.699883	0.840649	0.911535	1	
Fluoride (ppm)	0.395436	0.632285	-0.813432	-0.8200 03	0.412267	0.430394	0.430394	0.738455	0.867472	-0.842561	0.217712	-0.430394	1

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Table- 5 Correlation Matrix for Different Water Quality Parameter of Nokha, 2022

Parameter	Water Temperature	pH	Turbidity %	Dissolve Oxygen (ppm)	BOD (ppm)	Total Hardness	Nitrate (ppm)	TDS	Sulphate	Magnesium (ppm)	Chloride (ppm)	Calcium (ppm)	Fluoride (ppm)
Water Temperature	1												
pH	0.93322501	1											
Turbidity %	0.64517747	0.36202	1										
Dissolve Oxygen (ppm)	-0.7621129	-0.94302	-0.04048	1									
BOD (ppm)	0.65683689	0.878632	-0.12507	-0.98564	1								
Total Hardness	0.34051023	0.652766	-0.35833	-0.85444	0.895082	1							
Nitrate (ppm)	0.01122757	-0.05777	-0.22956	0.060673	0.012129	-0.29247	1						
TDS	0.44565473	0.729147	-0.21978	-0.89109	0.907315	-0.36002	-0.36002	1					
Sulphate	-0.183721	0.163084	-0.62393	-0.44358	0.521158	0.793917	0.793917	0.793917	1				
Magnesium (ppm)	0.5087837	0.773568	-0.14475	-0.9121	0.916021	0.751015	0.751015	0.996997	0.751015	1			
Chloride (ppm)	0.39909976	0.699522	-0.31014	-0.88551	0.919001	0.984462	0.984462	0.99381	0.808842	0.984462	1		
Calcium (ppm)	0.27182574	0.598275	-0.43626	-0.82166	0.876028	0.990236	0.990236	0.973367	0.867942	0.953405	0.990236	1	
Fluoride (ppm)	0.51164819	0.769371	-0.10911	-0.89887	0.895377	0.94032	0.94032	0.993124	0.750558	0.998205	0.974421	-0.94032	1

Conclusion

The primary objective of the current study is to examine the physico-chemical characteristics of the groundwater in Kolayat and Nokha, Bikaner. The majority of the general physico-chemical characteristics of the examined groundwater samples were below the upper limit of the WHO and Bureau of Indian Health recommended upper limit. Fluoride concentrations in groundwater range from 1.63 ppm in Nokha to 1.6 ppm in Kolayat on average. In the research area, the distribution of fluoride levels in groundwater is not uniform. After analysing the study's data, it was determined that Nokha's groundwater is contaminated and deteriorating due to fluoride pollution, which can cause dental fluorosis and skeleton fluorosis. Fluorosis can be avoided by eating a diet high in calcium and vitamin C because calcium is known to inhibit the intestinal absorption of fluoride.

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