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Physicochemical Analysis of Groundwater Quality of Some Selected Villages of Tosham Region

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Abstract: *To evaluate the groundwater quality of the Tosham area of the Bhiwani district in the Indian state of Haryana, a comprehensive study has been conducted. Eleven physicochemical parameters, including pH, electrical conductivity, total alkalinity, total hardness, total dissolved solids, calcium, magnesium, fluoride, chloride, nitrate, and sulphate, were analysed on 600 groundwater samples that were collected over the course of different seasons from ten selected villages. Various physicochemical parameters, including pH, total alkalinity, total hardness, total dissolved solids, calcium, magnesium, fluoride, chloride, nitrate, and sulphate, are found to be higher than the desirable limits suggested by the ICMR, according to analytical data of some groundwater samples from the study areas. Groundwater quality parameters show that some sampling stations groundwater samples are highly unfit for human consumption due to high levels of total alkalinity, total hardness, total dissolved solids, calcium, magnesium, fluoride, and chloride. As a result, appropriate recommendations for improving the groundwater quality have been made.*

Keywords: Physicochemical parameters, groundwater quality

I. INTRODUCTION

The most priceless gift that nature has given to humanity is water. Without water, all life and related activities come to an end. Apart from drinking and personal cleanliness, water is required for other purposes such as agricultural output, industrial manufacture, waste assimilation, recreation, wildlife, and hydroelectric power generation. The physical, chemical, and biological characteristics of water determine its quality, which can vary depending on its intended use. Both natural and man-made factors, such as the local climate, geology, and irrigation techniques, can affect the quality of water. The key to eternal existence is water. All living things, including microbes, the simplest plants, and the human body, which is the most complex living system, require it. The systems in our bodies depend on water. Because water is essential to human life, its quality is a critical matter. Ash ponds, home garbage, hospital waste, and industrial waste are the main sources of groundwater contamination. Subterranean water quality can be assessed using both physical and chemical parameters. pH, electrical conductivity, total alkalinity, total hardness, total dissolved solids, chloride ions, magnesium ions, calcium ions, and other variables are among the various physicochemical parameters. Since 3/4 of the earth's surface is covered in water, it is crucial to monitor subterranean water quality in all respects in order to guarantee the precise quality of water for this purpose. There are two types of water bodies on Earth: salt water bodies and fresh water bodies. Both contain earth surface water. Water that has fewer than 0.5 parts per thousand of dissolved salts is considered fresh water. Water quality can be described by its physical and chemical characteristics. The parameters of water quality encompass chemical, physical, and biological characteristics. Depending on the intended water quality characteristics of interest, it can be tested or observed. Temperature, dissolved oxygen, pH, electrical conductivity, total hardness, total alkalinity, total dissolved solids, and other parameters are widely examined or monitored for water quality. The physicochemical properties of water undergo a range of changes due to the introduction of different types of pollutants and nutrients via industrial effluents, sewage, agricultural runoff, etc. These changes have been the focus of several studies. These days, freshwater resource pollution is a major concern for the entire world. Pollution makes water harder and foamier and intensifies unpleasant tastes, colours, smells, and

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turbidities. Additionally, it makes water more corrosive to some metals and alloys. The optimal range for various physicochemical properties is necessary in India, as a significant portion of the population relies on groundwater for household, agricultural, and drinking water needs. The primary supply of drinking water in both urban and rural regions is groundwater. It is thought that groundwater is cleaner and less contaminated than surface water. When rainwater hits the earth, it percolates through the soil and turns into subterranean water. Subterranean water is typically colourless and pure, but as it seeps into the earth, inorganic salts are dissolved. The least amount of dissolved organic materials is often found in groundwater. The development of low-cost methods for decontaminating groundwater is necessary to ensure that people have access to safe drinking water.

II. MATERIAL AND METHOD

Area of study: Ten villages of Tosham region is selected as the study area of present investigation. Tosham is a census town in Bhiwani district of Haryana state, India. It is located 25 km from district headquarter, Bhiwani.

Groundwater samples : 600 groundwater samples from ten selected villages of Tosham region were collected in the different seasons. The samples were collected from handpumps, borewells and tubewells in new HDPE bottles pre-washed with dilute HCl and rinsed four to five times with the groundwater before filling it to capacity and then labelled accordingly. All the samples were immediately transported to the laboratory for analysis.

Table-1: Ten selected villages of Tosham region from where groundwater samples were collected

Sample No.	Collected sample address
S1	Sungarpur
S2	Katwar
S3	Devrala
S4	Kairu
S5	Bhera
S6	Dang Khurd
S7	Rodhan
S8	Bhariwas
S9	Dang Kalan
S10	Jhulli

Table-2: Standard values and unit employed in physicochemical parameters examinations of groundwater samples

Sr. No.	Parameters of Groundwater Samples	Methods Used	Standard Values as recommended by ICMR		Unit
			Desirable Concentration	Maximum Permissible Concentration	
1.	pH	pH metric method	7.0 – 8.5	6.5-9.2	----
2.	Electrical Conductivity	Conductometric method	----	----	µmhos /cm
3.	Total Alkalinity (as $CaCO_3$)	Titrimetric method	200	600	mg/l
4.	Total Hardness (as $CaCO_3$)	Titrimetric method	200	600	mg/l
5.	Total Dissolved Solids	Conductometric method	500	1500	mg/l
6.	Calcium ions	EDTA Complexometric method	75	200	mg/l

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7.	Magnesium ions	EDTA Complexometric method	30	100	mg/l
8.	Fluoride ions	Ion Selective Electrode method	1.0	1.5	mg/l
9.	Chloride ions	Argentometric method	200	1000	mg/l
10.	Nitrate ions	Colorimetric method	20	50	mg/l
11.	Sulphate ions	Turbidity method	200	400	mg/l

Table-3: Physicochemical analysis of groundwater samples of Tosham region

Sample No.	pH	EC (µmhos/cm)	TA (mg/l) (as $CaCO_3$)	TH (mg/l) (as $CaCO_3$)	TDS (mg/l)	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	F^- (mg/l)	Cl^- (mg/l)	NO_3^- (mg/l)	SO_4^{2-} (mg/l)
S1	8.1	832	364	125	508	96	33	1.1	228	23	77
S2	7.8	651	385	117	651	75	16	1.5	282	15	65
S3	7.6	725	367	148	465	58	24	0.7	386	41	46
S4	8.0	449	389	139	571	67	37	1.4	235	27	81
S5	7.5	981	321	109	989	89	22	1.0	325	37	70
S6	8.2	978	408	135	1029	65	79	1.9	256	25	61
S7	8.3	1025	428	102	565	55	35	1.6	287	18	53
S8	7.7	552	413	125	878	87	63	0.9	226	46	79
S9	8.4	789	353	137	987	115	45	1.3	337	29	59
S10	7.9	996	421	114	890	72	72	0.8	213	32	84

III. RESULTS AND DISCUSSION

600 groundwater samples from ten selected villages of Tosham region were collected and analysed for the following 11 physicochemical parameters such as pH, EC, TA, TH, TDS, Ca^{2+}, Mg^{2+}, F^-, Cl^-, NO_3^- and SO_4^{2-}. The parameters analysed in this assessment includes:

1. pH: All of the groundwater samples in the current investigation have pH values between 7.5 and 8.4 . The desirable limits for pH is 7.0 to 8.5 recommended by ICMR. 58 groundwater samples have higher values of pH than desirable limits. In many different kinds of geochemical equilibrium or solubility calculations, the pH of water is a crucial indicator of its quality.

2. Electrical conductivity: In the present study, the EC values in all the groundwater samples varies from 449 to 1025 µmhos/cm. There is no desirable limits for EC recommended by ICMR.

3. Total alkalinity: In the present study, the TA values in all the groundwater samples varies from 321 to 428 mg/l. The desirable limits for TA is 200 - 600 mg/l recommended by ICMR. 45 groundwater samples have higher values of TA than desirable limits. In groundwater, most of the alkalinity is caused due to carbonates and bicarbonates.

4. Total hardness: TH of water is due to the presence of alkaline earths inclusive of calcium and magnesium. It is a crucial factor for determining whether water is suitable for drinking, household uses and a variety of industrial applications. TH values in all of the groundwater samples in the current investigation ranges from 102 to 148 mg/l. The ICMR recommends a desirable limits of 200 - 600 mg/l for TH. 49 groundwater samples have higher values of TH than

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desirable limits.

5. Total dissolved solids: TDS is an important parameter for drinking water and water to be used for other purposes. TDS values in all of the ground samples in the current investigation ranges from 465 to 1029 mg/l. The desirable limits for TDS is 500 - 1500 mg/l recommended by ICMR. Beyond the prescribed limit, it imparts a peculiar taste to water. 42 groundwater samples have higher values of TDS than desirable limits.

6. Calcium: In the present study, the Ca^{2+} values in all of the groundwater samples ranges from 55 to 115 mg/l. The desirable limits for Ca^{2+} is 75 to 200 mg/l recommended by ICMR. 29 groundwater samples have higher values of Ca^{2+} than desirable limits.

7. Magnesium: In the present study, the Mg^{2+} values in all of the groundwater samples ranges from 16 to 79 mg/l. The desirable limits for Mg^{2+} is 30 to 100 mg/l recommended by ICMR. 25 groundwater samples have higher values of Mg^{2+} than desirable limits.

8. Fluoride: F^- in human nutrition is important for the normal development of bones. In the present study, the F^- values in all of the groundwater samples ranges from 0.7 to 1.9 mg/l. The desirable limits for F^- is 1.0 to 1.5 mg/l recommended by ICMR. 15 groundwater samples have higher values of F^- than desirable limits. Due to higher concentration of F^- in groundwater may develop molting of teeth, skeletal fluorosis, deformation in knee joints etc.

9. Chloride: In the present study, Cl^- values in all of the groundwater samples ranges from 213 to 386 mg/l. The desirable limits for Cl^- is 200 to 1000 mg/l recommended by ICMR. 18 groundwater samples have higher values of Cl^- than desirable limits.

10. Nitrate: In the current study, NO_3^- values in all of the groundwater samples ranges from 15 to 46 mg/l. The desirable limits for NO_3^- is 20 to 50 mg/l recommended by ICMR. 29 groundwater samples have higher values of NO_3^- than desirable limits.

11. Sulphate: SO_4^{2-} ions is one of the major anions occurring in natural water. In the present study, the SO_4^{2-} values in all of the groundwater samples ranges from 46 to 84 mg/l. The desirable limits for SO_4^{2-} is 200 to 400 mg/l recommended by ICMR. 41 groundwater samples have higher values of SO_4^{2-} than desirable limits. Higher value of sulphate may cause intestinal disorder.

IV. CONCLUSION

To assess the groundwater quality in the Tosham area of the Bhiwani district in the Indian state of Haryana, physicochemical analysis was performed. The physicochemical parameters of some groundwater samples in the study areas, as determined by analytical data, are found to exceed the desirable limits recommended by the ICMR. These parameters include pH, total alkalinity, total hardness, total dissolved solids, calcium, magnesium, fluoride, chloride, nitrate, and sulphate. Due to high levels of pH, total alkalinity, total hardness, total dissolved solids, calcium, magnesium, fluoride, and chloride, the groundwater quality parameters values show that some sampling stations groundwater samples are highly unfit for human consumption. As a result, appropriate recommendations were made to improve the groundwater quality.

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