



ASSESSMENT OF GROUNDWATER QUALITY FOR DRINKING PURPOSE IN RAI BLOCK, SONIPAT DISTRICT, HARYANA, INDIA

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Abstract

Water is important for survival of living beings on the planet Earth. Drinking water quality should be as per drinking water standards to avoid the health effects. Anthropogenic activities have deteriorated the groundwater quality. In urban areas groundwater quality is more or less not suitable for drinking purpose. Shallow water table areas are more prone to water pollution due to anthropogenic activities. Rai block is located in Sonipat district of Haryana. The block covers an area of 280.49 sq.km. In the present study 20 groundwater samples in Rai block were collected in the month of January, 2019. The samples were analyzed using Field Water Testing Kit prepared by Tamil Nadu water Supply and Drainage Board, Chennai for twelve chemical parameters-pH, alkalinity, hardness, chloride, total dissolved solids (TDS), fluoride, iron, nitrate, nitrite, ammonia, phosphate and residual chlorine. Chemical analysis of groundwater samples show that pH 6.5 to 9, alkalinity 100-2700 mg/l, hardness 130-920 mg/l, chloride 20 - 750 mg/l, TDS 828-3350 mg/l, fluoride 1-3 mg/l, iron nil to 5 mg/l, ammonia 0.5 - 1 mg/l, nitrite 0.2-1.0 mg/l, nitrate 45-100 mg/l, phosphate nil to 2 mg/l and residual chlorine nil to 0.2 mg/l. Groundwater is non-potable at Rasoi-2 (pH 9, alkalinity 860 mg/l, fluoride 2 mg/l, iron 5 mg/l, ammonia 1mg/l, nitrate 100mg/l), Rasoi-1 (alkalinity 2700 mg/l, TDS 3350 mg/l, fluoride 3 mg/l, nitrate 100 mg/l), Jakholi-3 (alkalinity 780 mg/l, nitrate 100 mg/l), Nathupur (alkalinity 850 mg/l, fluoride 3 mg/l, ammonia 1 mg/l), Bahalgarh (Hardness 920 mg/l, TDS 2388 mg/l, fluoride 2 mg/l, ammonia 1mg/l), Jatheri-1 (Hardness 700 mg/l), Liwaspur (Hardness 800 mg/l, TDS 2064 mg/l, ammonia 1 mg/l), Sabauli (fluoride 3 mg/l, nitrate 100 mg/l), Nangal Kalan (fluoride 3 mg/l, ammonia 1 mg/l, nitrate 75 mg/l), Patla-2 (iron 3mg/l, ammonia 1 mg/l), Jakholi-2 (iron 1 mg/l, nitrate 100 mg/l, phosphate 2 mg/l), Sewli-1(ammonia 1mg/l), Rai-1(ammonia 1 mg/l), Jat Joshi (ammonia 1 mg/l), Jat Joshi-2 (ammonia 1 mg/l). The study is highly useful for monitoring groundwater quality for drinking purpose in the study area.

Keywords

Groundwater, quality, drinking, Rai, Sonipat, Haryana.

INTRODUCTION

Water is important for survival of human beings and other living beings on the planet earth. In the present developmental activities water is polluted and not fit for drinking purposes. In industrial and high population density areas groundwater is polluted and not suitable for drinking purpose as per BIS drinking water standards. The need of the

hour is to protect this precious natural resource for future generations. On various aspects of groundwater quality many workers have done good work Agrawal (2009), Ana et al. (2018), Balakrishnan, et al (2011), Das and Nag (2015), Durgadevagi, et al. (2016), Hussain and Prasad (2013). Jeihouni, et al. (2014), Mahadevaswamy, et al. (2011), Okoye, et al. (2016), Pandian and Jeyachandran (2014),

Patel and Dhiman (2011), Rajesh, (2016), Sarkar, et al. (2012), Satyanarayana, et al. (2013), Saxena and Saxena (2015), Sengupta and Dalwani (2008), Shahida and Ummatul (2015), Sheikh and Kumari (2017), Sinha, et al. (2018), Subramani, et al. (2012), Thomas et al. (2015), Topper and Horn (2011), Vashisth (2017).

STUDY AREA

Rai block is located in Sonapat district of Haryana. The block covers 280.49 sq.km area. Geologically the block has soils of quarternary age. Rai is an industrial area with many types of industries working in the area. It is located on national highway adjacent to Delhi.

OBJECTIVE

The main objective was to assess groundwater quality for drinking purpose in the study area.

MATERIALS AND METHODS

Twenty groundwater samples were collected in plastic bottles from different parts of the Rai block in the month of January, 2019. Groundwater samples were analyzed using Field Water Testing Kit prepared by Tamil Nadu Water Supply and Drainage Board, Chennai for twelve chemical parameters- pH, alkalinity, hardness, chloride, total dissolved solids, fluoride, iron, ammonia, nitrate, nitrite, phosphate, residual chlorine. Chemical data entered in excel software and prepared the bar graphs of each parameter for all the sample location. Results were compared with BIS drinking water standards to know the pot-ability and non-potability of groundwater for drinking purpose.

RESULTS AND DISCUSSION

Results of twenty groundwater samples are given in Table 1 and BIS drinking water standards are given in Table 2. Parameter wise groundwater quality is given below:

Table 1: Results of chemical analysis of groundwater samples (in mg/l except pH).

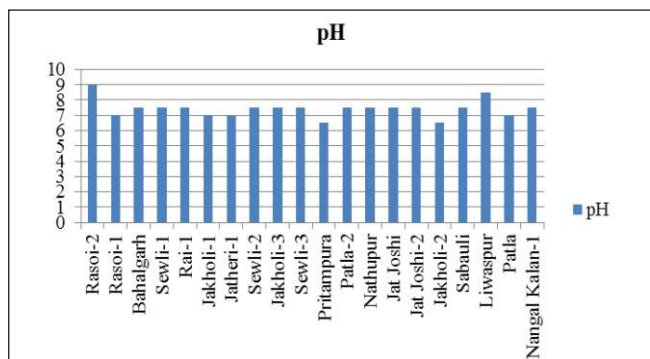
Sample Location	Latitude	Longitude	pH	Alkalinity	Hardness	Chloride	TDS	Fluoride	Iron	Ammonia	Nitrite	Nitrate	Phosphate	Residual Chlorine
Rasoi-2	28 54'25"	77 6'45"	9	860	570	20	1380	2	5	1	1	100	0	0.2
Rasoi-1	28 54'6"	77 6'44"	7	2700	300	350	3350	3	0	0.5	1	100	0	0
Bahargarh	28 57'29"	77 5'36"	7.5	400	920	670	2388	2	0	1	0.5	45	0	0
Sewli-1	28 55'47"	77 7'37"	7.5	600	600	50	1500	1	0	1	0.5	45	0	0
Rai-1	28 56'27"	77 5'53"	7.5	350	430	550	1596	1.5	0	1	0.5	45	0	0
Jakholi-1	28 55'45"	77 8'58"	7	450	600	250	1560	1.5	0	0.5	0.5	45	0	0
Jatheri-1	28 55'19"	77 4'24"	7	600	700	350	1980	1.5	0	0.5	0.5	45	0	0.2
Sewli-2	28 55'20"	77 7'33"	7.5	400	250	110	912	1	0	0.5	0.5	45	0	0
Jakholi-3	28 55'58"	77 8'29"	7.5	780	300	100	1416	1	0	0.5	1	100	0	0.2
Sewli-3	28 55'47"	77 7'35"	7.5	380	250	60	828	1	0	0.5	0.5	45	0	0
Pritampura	28 54'7"	77 5'54"	6.5	420	130	530	1296	1.5	0	0.5	0.5	45	0	0.2
Patla-2	28 55'21"	77 8'26"	7.5	500	290	250	1248	1	3	1	0.5	45	0	0
Nathupur	28 54'6"	77 6'20"	7.5	850	370	190	1692	3	0	1	1	100	0	0
Jat Joshi	28 58'7"	77 4'7"	7.5	370	360	280	1212	1.5	0	1	0.5	45	1	0
Jat Joshi-2	28 58'7"	77 4'29"	7.5	430	380	350	1392	1.5	0	1	0.5	45	0.5	0
Jakholi-2	28 55'30"	77 8'55"	6.5	100	240	750	1308	1.5	1	0.5	1	100	2	0.2
Sabauli	28 53'23"	77 5'42"	7.5	270	250	350	1044	3	0	0.5	1	100	0	0
Liwaspur	28 57'53"	77 5'11"	8.5	520	800	400	2064	1.5	0.3	1	0.5	45	0	0
Patla	28 54'53"	77 8'19"	7	340	500	180	1224	1	0	0.5	0.2	45	0	0
Nangal Kalan-1	28 54'23"	77 7'24"	7.5	240	450	80	924	3	0	1	1	75	1	0

Table 2: Drinking water standards (IS 10500:2012).

S. No.	Parameter	Potable		Non-Potable
		Desirable	Permissible	
1.	pH	6.5 to 8.5	--	<6.5 to >8.5
2.	Total Hardness (mg/l)	<200	200-600	>600
3.	Iron (mg/l)	<0.3	--	>0.3
4.	Chloride (mg/l)	<250	250-1000	>1000
5.	Total Dissolved Solids (mg/l)	<500	500-2000	>2000
6.	Nitrate (mg/l)	<45	--	>45
7.	Nitrite (mg/l)	<1.0	-	> 1.0
8.	Fluoride (mg/l)	<1.0	1.0-1.5	>1.5
9.	Phosphate (mg/l)	<1.0	-	> 1.0
10.	Residual Chlorine (mg/l)	<0.2	0.2-1	>1.0
11.	Ammonia (mg/l)	<0.5	--	>0.5
12.	Alkalinity (mg/l)	<200	200-600	>600

i. pH

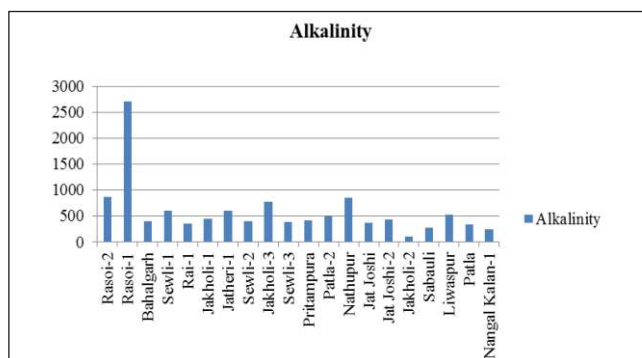
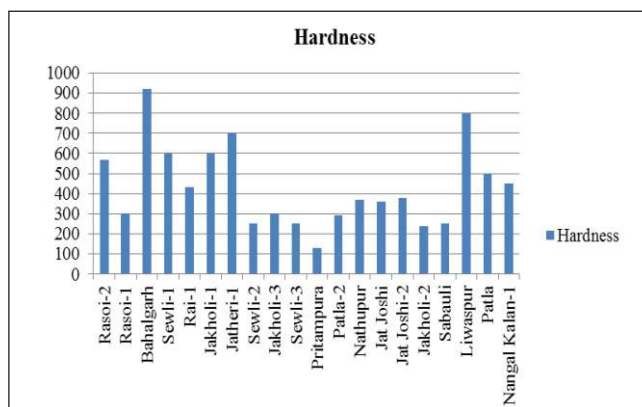
pH is a measure of acidity or basicity of water. Water is potable between the range 6.5 to 8.5 and non-potable below 6.5 and above 8.5. pH ranges 6.5 to 9 in the study area. In the study area pH is desirable at nineteen sample locations and non-potable at Rasoi-2 sample location (pH 9). (Table 1, Table 2, Figure 1).

**Figure 1: pH in groundwater samples****ii. Alkalinity**

Alkalinity is a measure of water's ability to neutralize acids. In the study area alkalinity varies from 100 mg/l to 2700 mg/l. At one sample location (Jakholi) alkalinity 100 mg/l is desirable (<200mg/l), at fifteen sample locations alkalinity is permissible (200-600 mg/l) and at four sample locations alkalinity is non-potable (>600 mg/l) (Table 1, Table 2, Figure 2).

iii. Hardness

Hard water has high concentration of calcium and magnesium carbonates. In the study area hardness varies from 130 mg/l to 920 mg/l. Hardness is desirable at one sample location (Pritampura 130 mg/l), permissible at sixteen sample locations and non-potable at three sample locations (Table 1, Table 2, Figure 3).

**Figure 2: Alkalinity (mg/l) in groundwater samples .****Figure 3: Hardness (mg/l) in groundwater samples.****iv. Chloride**

Chloride is available in nature as salts of sodium (NaCl), potassium (KCl), and calcium (CaCl₂). Chloride is an anion and formed when the element chlorine gains an electron or when a compound such as hydrogen chloride is dissolved in water or other polar solvents. In the study area, chloride varies from 20 mg/l to 750 mg/l. At eight sample locations chloride is desirable (<250 mg/l) and at twelve locations

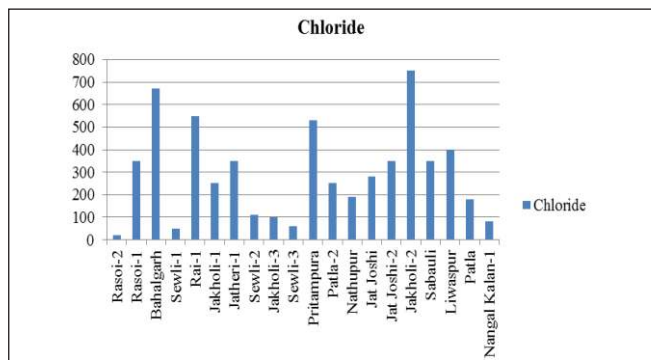


Figure 4: Chloride (mg/l) in groundwater samples.

chloride is permissible (250-1000 mg/l) (Table 1, Table 2, Figure 4).

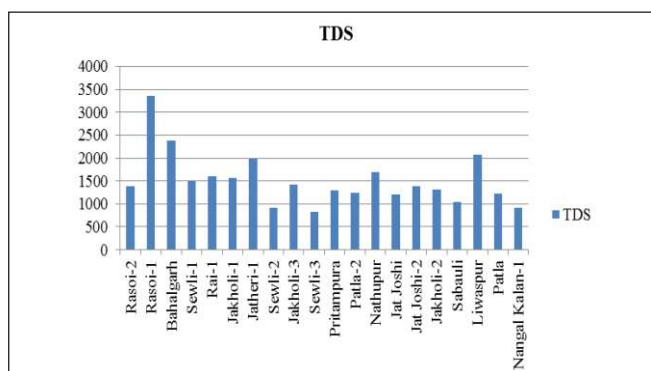


Figure 5: Total dissolved solids (TDS) (mg/l) in groundwater samples.

v. Total Dissolved Solids (TDS)

Total dissolved solids (TDS) represents the combined content of all inorganic and organic substance in water. In general, the TDS concentration is the sum of the cations and anions ions in the water. In the study area, TDS varies from 828 mg/l to 2388 mg/l. At seventeen sample locations TDS is permissible (500-2000 mg/l) and three sample locations non-potable (>2000 mg/l) (Table 1, Table 2, Figure 5).

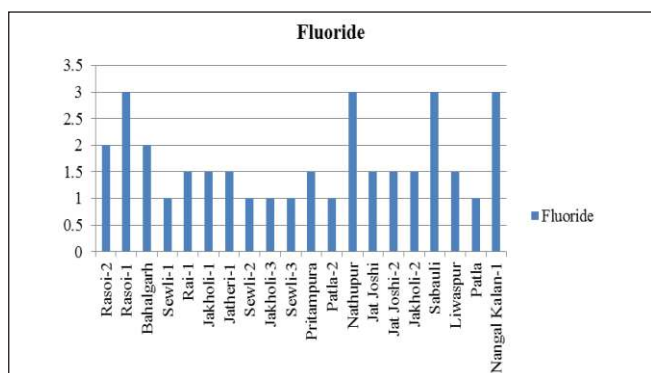


Figure 6: Fluoride (mg/l) in groundwater samples.

vi. Fluoride

Fluoride occurs naturally in soils and rocks. Fluoride more than 1.5 ppm in drinking water causes dental cavities, skeletal weakness and other bone diseases. In the study area, fluoride varies from 1 mg/l to 3 mg/l. At six sample locations fluoride is desirable (<1 mg/l), eight sample locations permissible (1-

1.5 mg/l) and six sample locations non-potable (>1.5 mg/l) (Table 1, Table 2, Figure 6).

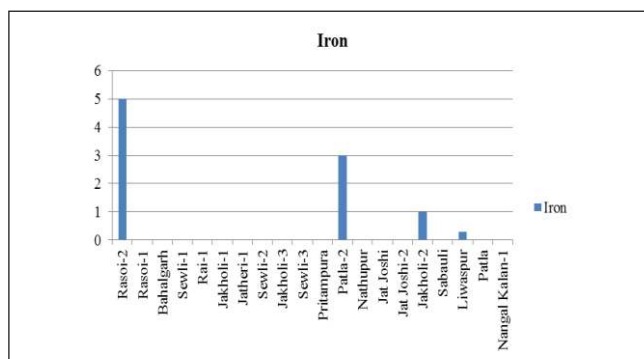


Figure 7: Iron (mg/l) in groundwater samples.

vii. Iron

Iron is commonly found in nature in its oxides form and occurs in soils, sediments and rocks. Iron is the second most abundant metal in the Earth's crust. In the study area iron varies between nil to 5 mg/l. At seventeen sample locations iron is desirable (<0.3 mg/l) and three sample locations non-potable (>0.3 mg/l) (Table 1, Table 2, Figure 7).

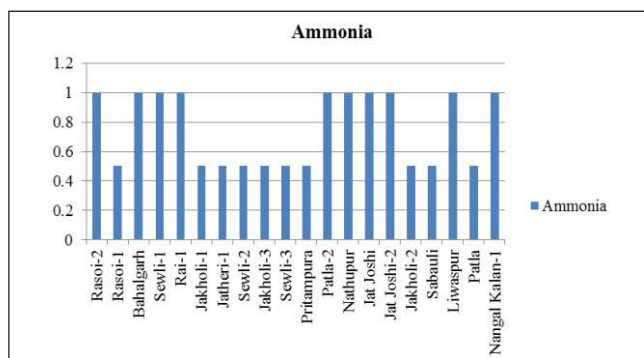


Figure 8: Ammonia (mg/l) in groundwater samples.

viii. Ammonia

Ammonia is a compound contains nitrogen and hydrogen. In the study area, ammonia varies from 0.5 to 1 mg/l. At ten sample locations ammonia is desirable (<0.5 mg/l) and ten sample locations non-potable (> 0.5 mg/l) (Table 1, Table 2, Figure 8).

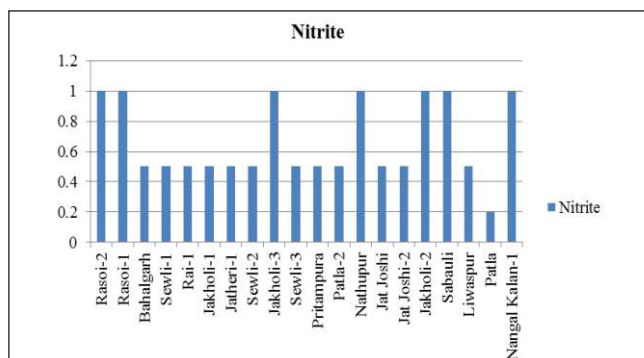


Figure 9: Nitrite (mg/l) in groundwater samples.

ix. Nitrite

Nitrite is ion having chemical formula NO₂. In the study area,

nitrite varies from 0.2 mg/l to 1 mg/l. At all the twenty sample locations nitrite is desirable (<1 mg/l) (Table 1, Table 2, Figure 9).

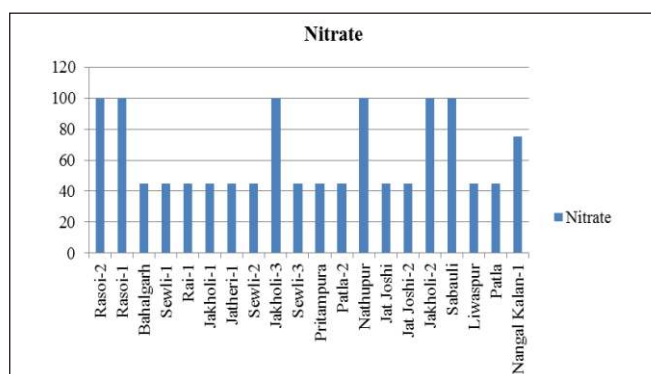


Figure 10: Nitrate (mg/l) in groundwater samples.

x. Nitrate

Nitrate (NO₃) is inorganic compound. High nitrate level in drinking water can cause blue baby disease (Methemoglobinemia) especially in infants less than six months old. In the study area nitrate varies from 45 mg/l to 100 mg/l. At thirteen sample locations nitrate is desirable (<45 mg/l) and seven locations non-potable (> 45 mg/l) (Table 1, Table 2, Figure 10).

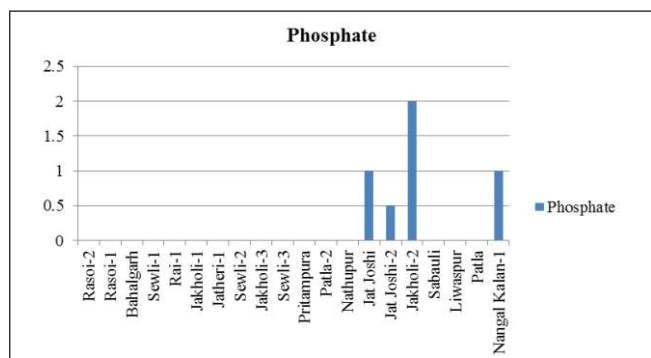


Figure 11: Phosphate (mg/l) in groundwater samples.

xi. Phosphate

Phosphate is a compound containing phosphorus. In the study area, phosphate varies from nil to 2 mg/l. At nineteen sample locations phosphate is desirable (< 1mg/l) and one sample location non-potable (>1 mg/l) (Table 1, Table 2, Figure 11).

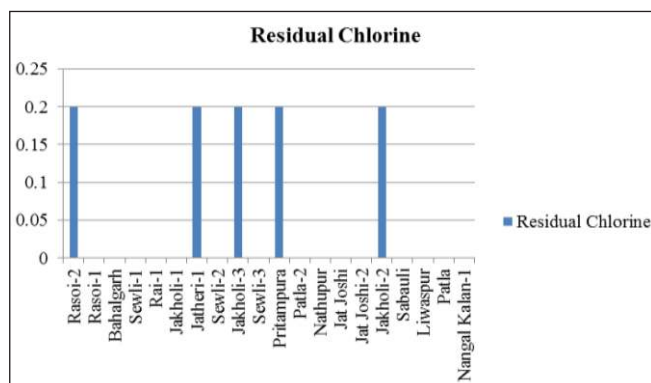


Figure 12: Residual chlorine (mg/l) in groundwater samples.

xii. Residual Chlorine

Presence of residual chlorine in drinking water indicates that a sufficient amount of chlorine is added to the water to deactivate the bacteria and viruses that cause diarrhea. In the study area, residual chlorine varies from nil to 0.2 mg/l. At all the twenty sample locations residual chlorine is desirable (< 0.2 mg/l) (Table 1, Table 2, Figure 12).

CONCLUSION

Groundwater is non-potable at fifteen sample locations viz. Rasoi-2 (pH 9, alkalinity 860 mg/l, fluoride 2 mg/l, iron 5 mg/l, ammonia 1 mg/l, nitrate 100mg/l), Rasoi-1 (alkalinity 2700 mg/l, TDS 3350 mg/l, fluoride 3 mg/l, nitrate 100 mg/l), Jakholi-3 (alkalinity 780 mg/l, nitrate 100 mg/l), Nathupur (alkalinity 850 mg/l, fluoride 3 mg/l, ammonia 1 mg/l), Bahalgarh (Hardness 920 mg/l, TDS 2388 mg/l, fluoride 2 mg/l, ammonia 1mg/l), Jathari-1 (Hardness 700 mg/l), Liwaspur (Hardness 800 mg/l, TDS 2064 mg/l, ammonia 1 mg/l), Sabauli (fluoride 3 mg/l, nitrate 100 mg/l), Nangal Kalan (fluoride 3 mg/l, ammonia 1 mg/l, nitrate 75 mg/l), Patla-2 (iron 3mg/l, ammonia 1 mg/l), Jakholi-2 (iron 1 mg/l, nitrate 100 mg/l, phosphate 2 mg/l), Sewli-1 (ammonia 1mg/l), Rai-1 (ammonia 1 mg/l), Jat Joshi (ammonia 1 mg/l), Jat Joshi-2 (ammonia 1 mg/l). Groundwater is potable at Patla, Pitampur, Sewli-2, Sewli-3 and Jakholi-1 sample locations. The study is highly useful for monitoring groundwater quality for drinking purpose in the study area.

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