



ASSESSMENT OF GROUNDWATER QUALITY FOR DRINKING PURPOSE IN SONIPAT BLOCK OF HARYANA

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ABSTRACT

The study area Sonipat block is located in Sonipat district of Haryana state between the latitudes 28.93° N to 29.13° N and longitudes 76.81° to 77.10° E and covers an area of 341.22 sq. km. Geologically alluvium and geomorphologically alluvial plain are present in the study area. The main objective of the study was to assess groundwater quality for drinking purpose in the study area. In the study area twenty six groundwater samples were collected in 250 ml double capped plastic bottles. Geo-coordinates of sample locations were noted with the help of mobile GPS. Chemical analysis of twenty six groundwater samples were done using Tamilnadu Water Supply and Drainage (TWAD) Board, Chennai prepared Field Water Testing kit for twelve chemical parameters viz. pH, alkalinity, hardness, chloride, total dissolved solids (TDS), fluoride, iron, nitrite, nitrate, ammonia, phosphate and residual chlorine. Results of groundwater samples analysis were compared with BIS (IS 10500:2012) drinking water standards to know groundwater quality for drinking purpose. The study shows that in the study area pH ranges 6.5 to 8.5, alkalinity 70 mg/l to 650 mg/l, hardness 100 mg/l to 620 mg/l, chloride 10 mg/l to 710 mg/l, TDS 252 mg/l to 1824 mg/l, fluoride nil to 5 mg/l, iron nil to 0.3 mg/l, ammonia nil to 5 mg/l, nitrite 0.5 mg/l to 1 mg/l, nitrate 45 mg/l to 100 mg/l, phosphate nil to 1 mg/l, residual chlorine nil to 2 mg/l. The study is highly useful for planning and monitoring of groundwater for drinking purpose in the study area.

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References: 12

Keywords: Groundwater, quality, drinking, Sonipat, Haryana.

INTRODUCTION

Water is a precious natural gift by the nature to the planet Earth. Earlier there was a balance between recharge and withdrawal of groundwater, hence, the groundwater depth was shallow and quality deterioration was mainly from natural sources. But in the present time, groundwater recharge is less and withdrawal is more which have resulted in declining of groundwater depth as well as quality deterioration is due to anthropogenic reasons like using artificial manures and herbicides in agriculture and industrial wastes. The anthropogenic pollution of groundwater has made groundwater unsuitable for drinking purpose in many areas. Rajankar et al.(2009), Annapoorna and Janardhana (2015), Kumar et al. (2015), Punia et al. (2015), Deshpande and Patil (2016), Nagaraju et al.(2016), Nelly and Mutua (2016), Chaudhary and Satheeshkumar (2018), Khelif and Boudoukha (2018), Hanumantharao et al.(2019), Zhang et al. (2019) had done work on groundwater quality assessment for drinking purpose in many areas.

STUDY AREA

Sonipat block is located in Sonipat district, Haryana (Fig.1). The geo-coordinates of the study area are latitudes 28.93° N to 29.13° N and longitudes 76.81° to 77.10° E and covers an area of 341.22 sq. km. Geologically alluvium and geomorphologically alluvial plain are present.

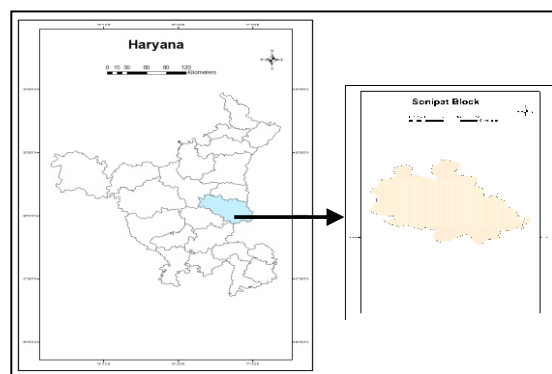


Fig.1: Location map of the study area.

OBJECTIVE

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

MATERIALS AAND METHODOLOGY

In the study area twenty six groundwater samples were collected in 250 ml double capped plastic bottles. Geo-coordinates of sample locations were noted with the help of mobile GPS. Chemical analysis of twenty six groundwater samples were done using Tamilnadu

Water Supply and Drainage (TWAD) Board, Chennai prepared Field Water Testing kit for twelve chemical parameters viz. pH, alkalinity, hardness, chloride, total dissolved solids (TDS), fluoride, iron, nitrite, nitrate, ammonia, phosphate and residual chlorine (Table 1). Results of groundwater samples analysis were compared with BIS drinking water standards (IS 10500:2012) (Table 2) to know groundwater quality for drinking purpose.

Table 1: Result of chemical analysis of groundwater samples.

S. No.	Sample Location	Latitude	Longitude	pH	Alkalinity (mg/l)	Hardness (mg/l)	Chloride (mg/l)	TDS (mg/l)	Fluoride (mg/l)	Iron (mg/l)	Ammonia (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	Residual Chlorine (mg/l)
1	Sandal Kalan	28.92	77.07	7.5	450	500	50	1200	0	0	0.5	0.5	100	0	0
2	Jatheri	28.96	77.06	8	450	620	10	1296	1.5	0	1	0.5	100	0	2
3	Rardhana	28.93	77.07	8	610	550	50	1452	0	0	0.5	0.5	75	0.5	0.2
4	Liivan-1	28.97	77.05	7.5	650	350	270	1524	1.5	0	0.5	0.5	45	0	0
5	Bandpur	28.95	77.04	7	320	320	450	1308	3	0	0.5	0.5	45	0	0.5
6	Jagdishpur	28.97	77.03	7.5	520	180	50	900	1.5	0	0.5	0.5	45	0	0.2
7	Bayyanpur-1	29.01	76.97	6.5	250	520	640	1692	2	0	0.5	1	100	0	0
8	Barwasni-1	28.96	76.96	6.5	70	120	20	252	1	0	1	0.5	45	0	0
9	Kakroi	28.99	77.05	6.5	120	250	20	468	1.5	0	0.5	0.5	45	0	0
10	Garh Sahajanpur	28.95	77.04	7.5	550	100	80	876	5	0	0.5	1	100	0	0
11	Rardhana-2	29.01	76.96	7	130	130	40	360	0	0	0.5	0.5	45	0	0
12	Barwasni-2	28.96	77.08	7.5	480	620	420	1824	1.5	0	1	0.5	45	0	0.2
13	Bayyanpur-2	28.96	77.00	7.5	280	470	710	1752	2	0	1	0.5	45	1	0
14	Raipur-2	28.99	77.05	7.5	500	170	190	1032	3	0	0.5	0.5	45	0.5	0
15	Raipur-1	28.98	76.96	7.5	360	140	400	1080	3	0	0.5	0.5	45	1	0
16	Mehlana	29.01	76.96	7.5	100	120	30	300	3	0	0.5	0.5	45	0.5	0
17	Barwasni-3	29.01	76.96	7.5	120	370	20	612	1	0	0.5	1	100	0	0
18	Badhana	28.94	77.04	8	100	200	140	528	3	0.3	0.5	1	75	1	0
19	Jagdishpur-2	28.99	77.05	7	100	170	70	408	3	0	0.5	0.5	45	0	0
20	Fajilpur	28.99	77.05	8.5	520	340	120	1176	1.5	0	5	1	75	0	0
21	Liivan-2	28.94	77.07	7.5	330	310	40	816	1.5	0	0	0.5	45	0	0
22	Pinana	29.06	76.83	8	450	430	120	1200	1.5	0	0.5	0.5	45	0	0
23	Jatheri-2	28.92	77.08	7	140	200	30	444	1	0.3	0.5	0.5	45	0	0
24	Rewali	29.01	77.06	7.5	180	200	100	576	1	0	0	0.5	45	0	0
25	Sahpur Turk	29.03	76.95	7	200	130	190	624	1.5	0	0	0.5	45	0	0
26	Hullaheeri	28.92	77.07	7	300	270	160	876	1.5	0.3	0	0.5	45	0	0

Table 2: BIS drinking water standards (IS 10500:2012)

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

RESULTS AND DISCUSSION

i. pH

In the study area pH ranges 6.5 to 8.5 (Table 1, Fig.2). As per BIS (IS 10500:2012) drinking water standards pH is desirable between 6.5 to 8.5 and non-potable if less than 6.5 and more than 8.5 (Table 2). pH is desirable in all the twenty six groundwater samples (Sandal Kalan, Jatheri, Rardhana, Liwan-1, Bandpur, Jagdishpur, Bayyanpur-1, Barwasni-1, Kakroi, Garh Sahajanpur, Rardhana-2, Barwasni-2, Bayyanpur-2, Raipur-2, Raipur-1, Mehlana, Barwasni-3, Badhana, Jagdishpur-2, Fajilpur, Liwan-2, Pinana, Jatheri-2, Rewali, Sahpur Turk, Hullaheri)..

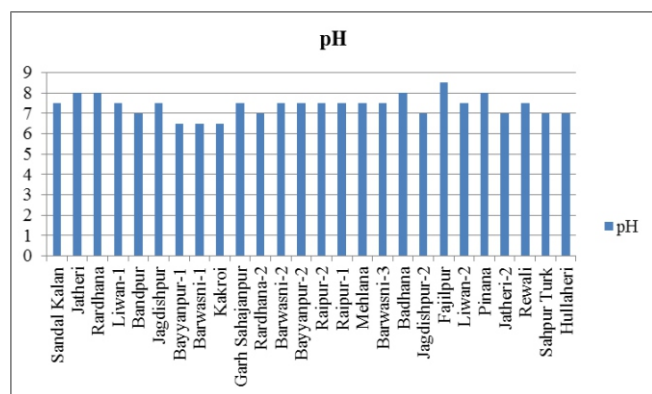


Fig.2: pH in groundwater samples.

ii. Alkalinity

In the study area alkalinity ranges 70 mg/l to 650 mg/l (Table 1, Fig.3). As per BIS (IS 10500:2012) drinking water standards alkalinity is desirable if less than 200 mg/l, permissible between 200 mg/l-600 mg/l and non-potable if more than 600 mg/l (Table 2). Alkalinity is desirable in nine groundwater samples (Barwasni-1, Kakroi, Rardhana-2, Mehlana, Barwasni-3, Badhana, Jagdishpur-2, Jatheri-2, Rewali), permissible in fifteen groundwater samples (Sandal Kalan, Jatheri, Bandpur, Jagdishpur, Bayyanpur-1, Garh Sahajanpur, Barwasni-2, Bayyanpur-2, Raipur-2, Raipur-1, Fajilpur, Liwan-2, Pinana, Sahpur Turk, Hullaheri) and non-potable in two groundwater samples (Randhana (610 mg/l), Liwan-1(650 mg/l)).

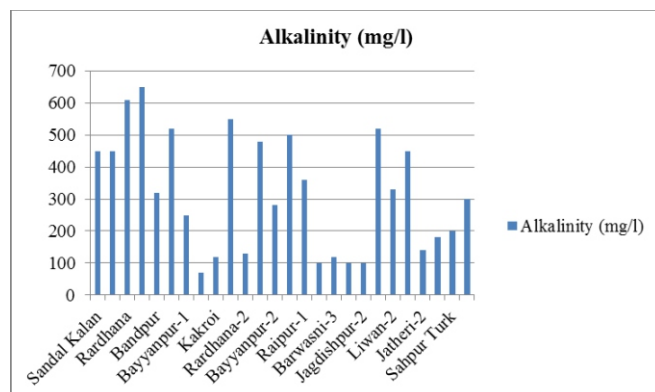


Fig. 3: Alkalinity in groundwater samples.

iii. Hardness

In the study area hardness ranges 100 mg/l to 620 mg/l

(Table 1, Fig.4). As per BIS (IS 10500:2012) drinking water standards hardness is desirable if less than 200 mg/l, permissible between 200 mg/l - 600 mg/l and non-potable if more than 600 mg/l (Table 2). Hardness is desirable in nine groundwater samples (Jagdishpur, Barwasni-1, Garh Sahajanpur, Rardhana-2, Raipur-2, Raipur-1, Mehlana, Jagdishpur-2, Sahpur Turk), permissible in fifteen groundwater samples (Sandal Kalan, Rardhana, Liwan-1, Bandpur, Bayyanpur-1, Kakroi, Bayyanpur-2, Barwasni-3, Badhana, Fajilpur, Liwan-2, Pinana, Jatheri-2, Rewali, Hullaheri) and non-potable in two groundwater samples (Jatheri (620 mg/l), Barwasni-2 (620 mg/l)).

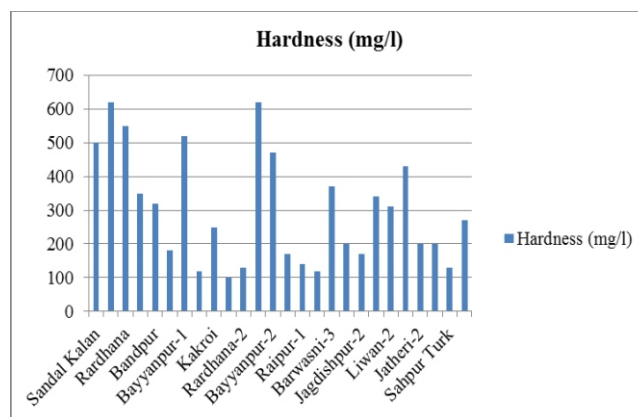


Fig. 4: Hardness in groundwater samples.

iv. Chloride

In the study area chloride ranges 10 mg/l to 710 mg/l (Table 1, Fig.5). As per BIS (IS 10500:2012) drinking water standards chloride is desirable if less than 250 mg/l, permissible between 250 mg/l - 1000 mg/l and non-potable if more than 1000 mg/l (Table 2). Chloride is desirable in twenty groundwater samples (Sandal Kalan, Jatheri, Rardhana, Jagdishpur, Barwasni-1, Kakroi, Garh Sahajanpur, Rardhana-2, Raipur-2, Mehlana, Barwasni-3, Badhana, Jagdishpur-2, Fajilpur, Liwan-2, Pinana, Jatheri-2, Rewali, Sahpur Turk, Hullaheri) and permissible in six groundwater samples (Liwan-1, Bandpur, Bayyanpur-1, Barwasni-2, Bayyanpur-2, Raipur-1).

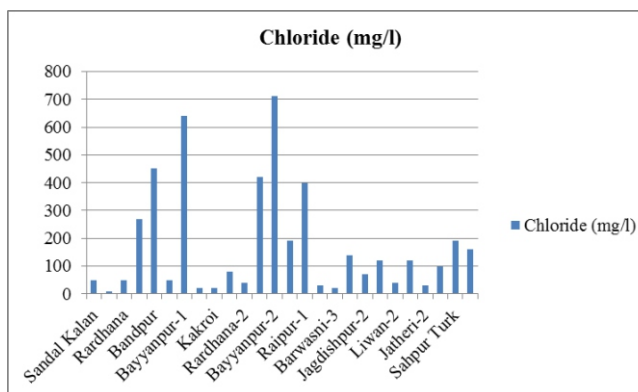


Fig. 5: Chloride in groundwater samples.

v. Total Dissolved Solids (TDS)

In the study area TDS ranges 252 mg/l to 1824 mg/l (Table 1, Fig.6). As per BIS (IS 10500:2012) drinking

water standards TDS is desirable if less than 500 mg/l, permissible between 500 mg/l -2000 mg/l and non-potable if more than 2000 mg/l (Table 2). TDS is desirable in six groundwater samples (Barwasni-1, Kakroi, Rardhana-2, Mehlana, Jagdishpur-2, Jatheri-2) and permissible in twenty groundwater samples (Sandal Kalan, Jatheri, Rardhana, Liwan-1, Bandpur, Jagdishpur, Bayyanpur-1, Garh Sahajanpur, Barwasni-2, Bayyanpur-2, Raipur-2, Raipur-1, Barwasni-3, Badhana, Fajilpur, Liwan-2, Pinana, Rewali, Sahpur Turk, Hullaheri).

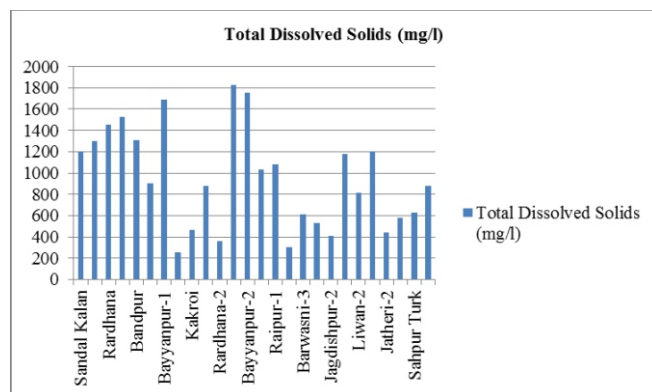


Fig. 6: TDS in groundwater samples.

vi. Fluoride

In the study area fluoride ranges nil to 5 mg/l (Table 1, Fig.7). As per BIS (IS 10500:2012) drinking water standards fluoride is desirable if less than 1.0 mg/l, permissible between 1.0 mg/l -1.5 mg/l and non-potable if more than 1.5 mg/l (Table 2). Fluoride is desirable in three groundwater samples (Sandal Kalan, Rardhana, Rardhana-2), permissible in fourteen groundwater samples (Jatheri, Liwan-1, Jagdishpur, Barwasni-1, Kakroi, Barwasni-2, Barwasni-3, Fajilpur, Liwan-2, Pinana, Jatheri-2, Rewali, Sahpur Turk, Hullaheri) and non-potable in nine groundwater samples (Bandeypur (3 mg/l), Bayyanpur-1 (2 mg/l), Garh Sahajanpur (5 mg/l), Bayyanpur-2 (2 mg/l), Raipur-2 (3 mg/l), Raipur-1(3 mg/l), Mehlana (3 mg/l), Badhana (3 mg/l), Jagdishpur-2 (3 mg/l)).

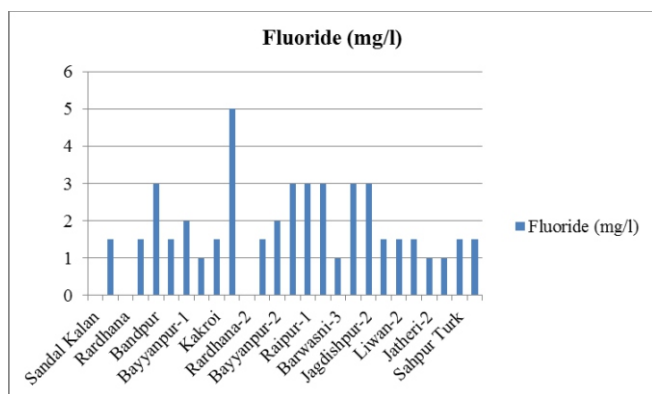


Fig. 7: Fluoride in groundwater samples.

vii. Iron

In the study area iron ranges nil to 0.3 mg/l (Table 1, Fig.8). As per BIS (IS 10500:2012) drinking water standards iron is desirable if less than 0.3mg/l and

non-potable if more than 0.3 mg/l (Table 2). Iron is desirable in all the twenty six groundwater samples (Sandal Kalan, Jatheri, Rardhana, Liwan-1, Bandpur, Jagdishpur, Bayyanpur-1, Barwasni-1, Kakroi, Garh Sahajanpur, Rardhana-2, Barwasni-2, Bayyanpur-2, Raipur-2, Raipur-1, Mehlana, Barwasni-3, Badhana, Jagdishpur-2, Fajilpur, Liwan-2, Pinana, Jatheri-2, Rewali, Sahpur Turk, Hullaheri).

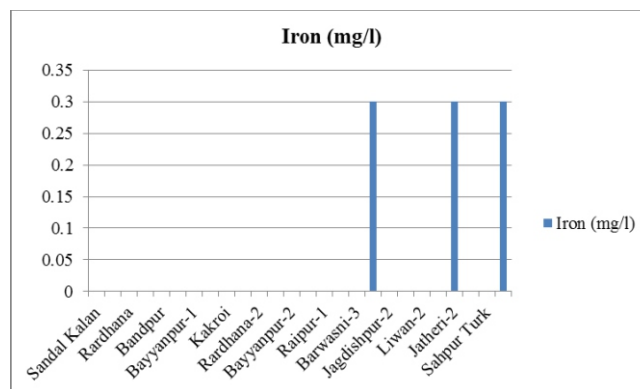


Fig. 8: Iron in groundwater samples.

viii. Ammonia

In the study area ammonia ranges nil to 5 mg/l (Table 1, Fig.9). As per BIS (IS 10500:2012) drinking water standards ammonia is desirable if less than 0.5 mg/l and non-potable if more than 0.5 mg/l (Table 2). Ammonia is desirable in twenty one groundwater samples (Sandal Kalan, Rardhana, Liwan-1, Bandpur, Jagdishpur, Bayyanpur-1, Kakroi, Garh Sahajanpur, Rardhana-2, Raipur-2, Raipur-1, Mehlana, Barwasni-3, Badhana, Jagdishpur-2, Liwan-2, Pinana, Jatheri-2, Rewali, Sahpur Turk, Hullaheri) and non-potable in five groundwater samples (Jatheri (1 mg/l), Barwasni-1(1mg/l), Barwasni-2 (1 mg/l), Bayyanpur-2 (1mg/l), Fajilpur (5 mg/l)).

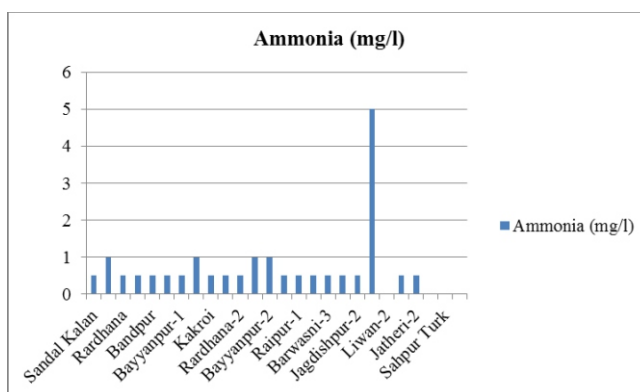


Fig. 9: Ammonia in groundwater samples.

ix. Nitrite

In the study area nitrite ranges 0.5 mg/l to 1 mg/l (Table 1, Fig.10). As per BIS (IS 10500:2012) drinking water standards nitrite is desirable if less than 1.0 mg/l and non-potable if more than 1.0 mg/l (Table 2). Nitrite is desirable in all the twenty six groundwater samples (Sandal Kalan, Jatheri, Rardhana, Liwan-1, Bandpur, Jagdishpur, Bayyanpur-1, Barwasni-1, Kakroi, Garh Sahajanpur, Rardhana-2, Barwasni-2, Bayyanpur-2,

Raipur-2, Raipur-1, Mehlana, Barwasni-3, Badhana, Jagdishpur-2, Fajilpur, Liwan-2, Pinana, Jatheri-2, Rewali, Sahpur Turk, Hullaheri).

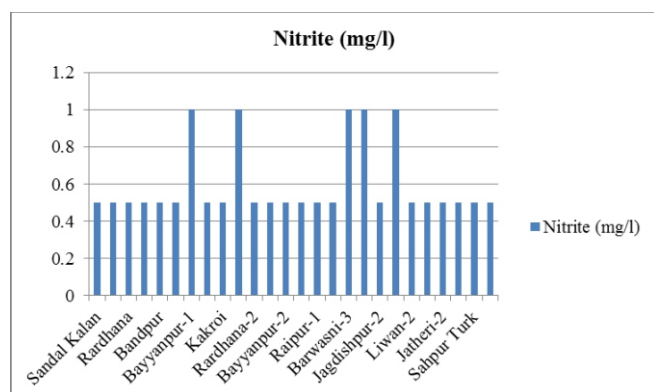


Fig. 10: Nitrite in groundwater samples.

x. Nitrate

In the study area nitrate ranges 45 mg/l to 100 mg/l (Table 1, Fig.11). As per BIS (IS 10500:2012) drinking water standards nitrate is desirable if less than 45 mg/l and non-potable if more than 45mg/l (Table 2). Nitrate is desirable in eighteen groundwater samples (Liwan-1, Bandpur, Jagdishpur, Barwasni-1, Kakroi, Rardhana-2, Barwasni-2, Bayyanpur-2, Raipur-2, Raipur-1, Mehlana, Jagdishpur-2, Liwan-2, Pinana, Jatheri-2, Rewali, Sahpur Turk, Hullaheri) and non-potable in eight groundwater samples (Sandal Kalan (100mg/l), Jatheri (100mg/l), Rardhana (75 mg/l), Bayyanpur-1 (100mg/l), Garh Sahajanpur (100mg/l), Barwasni-3 (75 mg/l), Badhana (75mg/l), Fajilpur (75 mg/l)).

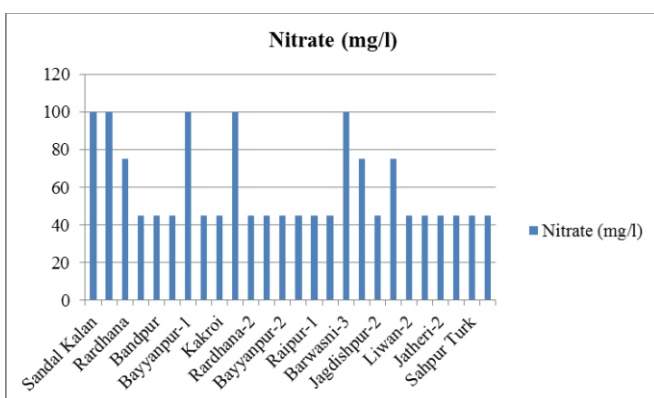


Fig. 11: Nitrate in groundwater samples.

xi. Phosphate

In the study area phosphate ranges nil to 1 mg/l (Table 1, Fig.12). As per BIS (IS 10500:2012) drinking standards phosphate is desirable if less than 1.0 mg/l and non-potable if more than 1.0 mg/l (Table 2). Phosphate is desirable in all the twenty six groundwater samples (Sandal Kalan, Jatheri, Rardhana, Liwan-1, Bandpur, Jagdishpur, Bayyanpur-1, Barwasni-1, Kakroi, Garh Sahajanpur, Rardhana-2, Barwasni-2, Bayyanpur-2, Raipur-2, Raipur-1, Mehlana, Barwasni-3, Badhana, Jagdishpur-2, Fajilpur, Liwan-2, Pinana, Jatheri-2, Rewali, Sahpur Turk, Hullaheri).

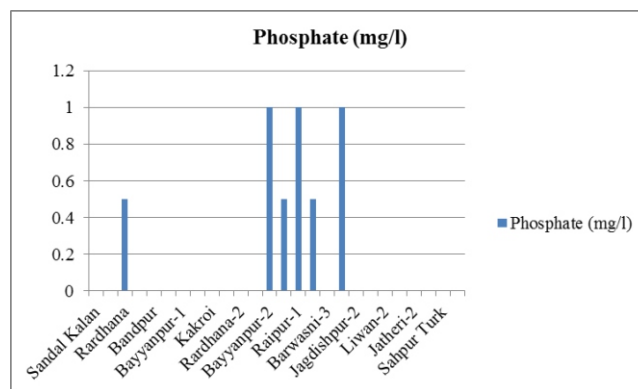


Fig. 12: Phosphate in groundwater samples.

xii. Residual Chlorine

In the study area residual chlorine ranges nil to 2 mg/l (Table 1, Fig.13). As per BIS (IS 10500:2012) drinking water standards residual chlorine is desirable if less than 0.2 mg/l, permissible between 0.2 mg/l-1 mg/l and non-potable if more than 1.0 mg/l (Table 2). Residual chlorine is desirable in twenty one groundwater samples (Sandal Kalan, Liwan-1, Bayyanpur-1, Barwasni-1, Kakroi, Garh Sahajanpur, Rardhana-2, Bayyanpur-2, Raipur-2, Raipur-1, Mehlana, Barwasni-3, Badhana, Jagdishpur-2, Fajilpur, Liwan-2, Pinana, Jatheri-2, Rewali, Sahpur Turk, Hullaheri), permissible in four groundwater samples (Rardhana, Bandpur, Jagdishpur, Barwasni-2) and non-potable in one groundwater sample (Jatheri (2 mg/l)).

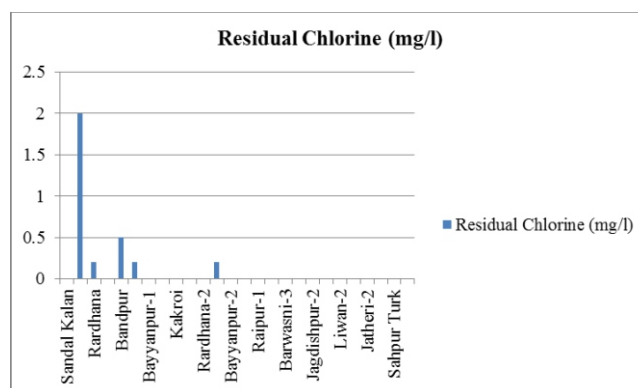


Fig. 13: Residual Chlorine in groundwater samples.

CONCLUSIONS

In the study area pH, iron, nitrite, phosphate are desirable in all the twenty six groundwater samples. Alkalinity is desirable in nine groundwater samples, permissible in fifteen groundwater samples and non-potable in two groundwater samples. Hardness is desirable in nine groundwater samples, permissible in fifteen groundwater samples and non-potable in two groundwater samples. Chloride is desirable in twenty groundwater samples and permissible in six groundwater samples. TDS is desirable in six groundwater samples and permissible in twenty groundwater samples. Fluoride is desirable in three groundwater samples, permissible in fourteen groundwater samples and non-potable in nine

groundwater samples. Ammonia is desirable in twenty one groundwater samples and non-potable in five groundwater samples. Nitrate is desirable in eighteen groundwater samples and non-potable in eight groundwater samples. Residual Chlorine is desirable in twenty one groundwater samples, permissible in four groundwater samples and non-potable in one groundwater sample. The study is highly useful for planning and monitoring of groundwater for drinking purpose in the study area.

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