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GROUNDWATER QUALITY ASSESSMENT FOR DRINKING PURPOSE IN SOUTH-EASTERN PART OF PANCHKULA CITY, HARYANA, INDIA

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Abstract
Water is a precious natural resource available on the planet Earth. About two third is water on the planet Earth but the usable water mainly for drinking purpose is very less. Fast developmental activities have put pressure on surface water and groundwater. Groundwater is highly important for drinking, agriculture and industrial purposes in the world. Groundwater quality plays an important role for drinking purpose. Many diseases like fluorosis, methemoglobinemia, arsenocosis are due to poor quality of drinking water. In urban areas, groundwater quality is deteriorated due to solid and liquid wastes disposal. The present study has been carried out to assess groundwater quality for drinking purpose in south-eastern part of Panchkula city, Haryana. In the present study eight groundwater samples were collected in the month of June 2019 from different locations in the study area. Groundwater samples were analyzed using Field Water Testing Kit prepared by Tamilnadu Water Supply and Drainage Board (TWAD), Chennai for ten chemical parameters-pH,hardness, chloride, fluoride, iron, ammonia, nitrate, nitrite, phosphate and residual chlorine. Chemical analysis of groundwater samples show that in the groundwater samples pH ranges-7 to 7.5, hardness 100 mg/l to 250 mg/l, chloride 40 mg/l to 110 mg/l, fluoride 0.5 mg/l to 1 mg/l, iron nil, ammonia nil to 3 mg/l, nitrite 0.2 mg/l to 0.5 mg/l, nitrate 20 mg/l to 75 mg/l, phosphate nil to 1 mg/l, residual chlorine nil to 0.2 mg/l. As per BIS drinking water standards pH, chloride, fluoride, iron, nitrite, phosphate, residual chlorine is desirable in all the eight groundwater samples; hardness is desirable in four groundwater samples and permissible in four groundwater samples; ammonia is desirable in six groundwater samples and non-potable in two groundwater samples; nitrate is desirable in seven groundwater samples and non-potable in one groundwater sample. Groundwater quality at Govt. Primary School, Ramgarh, Govt. Senior Secondary School, Ramgarh and Sector-28-C, Panchkula is desirable and at Market Ramgarh, Sector-25, Panchkula, Sector-28-A, Panchkula, Sector-28-B, Panchkula is permissible and Sector-26, Panchkula is non-potable. The study gives a scenario of groundwater quality for drinking purpose in the study area. The study can be used for monitoring groundwater quality for drinking purpose.

Keywords
Groundwater, quality, assessment, drinking, Ramgarh, Panchkula, Haryana

Introduction

Water is important for survival of living beings. In the present developmental activities water resources are under stress due to utilization for drinking, irrigation and industrial purposes. Groundwater is vulnerable to anthropogenic activities wherever it is shallow and exploitation wherever there is high population pressure. In the present scenario it becomes necessary to have check on the industries polluting the groundwater as well as wise use of water in each sector. Further, in urban and semi-urban areas groundwater is under

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severe exploitation for drinking and industrial purposes which lead to pollution and decline of groundwater level.Abbulu and Srinivasa Rao (2013), Agrawal (2009), Deshpande and Aher (2012), Madhav et al. (2018), Tripathi etal. (2012), Zidi et al. (2017) had done work on groundwater quality assessment of urban areas. Here, the main objective of the study was to assess groundwater quality for drinking purpose in the study areas as discussed below.

Study area

The study area comprises of south-eastern part of Panchkula city (Sector 25, Sector-26, 27, 28, 29, 30 of Panchkula cityand Ramgarh town).The geo-coordinates of the study area are latitude30.64°N to 30.68°N and longitude 76.87°E to 76.89° E and covers 32.49 Km^2 area (Fig.1).

Collection of samples and analysis

Eight groundwater samples were collected in plastic 250 ml bottles during June 2019. Location of groundwater samples were marked using mobile GPS. All the eight groundwater samples were analyzed using Field Water Testing Kit prepared by Tamil Nadu Water Supply and Drainage Board (TWAD), Chennai for pH, hardness, chloride, fluoride, iron, nitrite, nitrate, ammonia, phosphate and residual chlorine. The results of chemical analysis of groundwater samples were put in MS Excel and bar graphs of each chemical parameter were prepared. Results were interpreted in comparison with BIS (IS 10500:2012) drinking water standards.

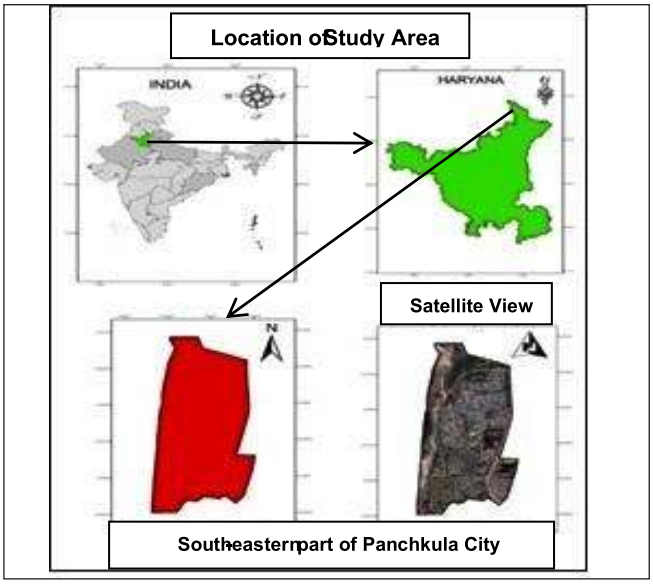

Figure 1: **Location map of the study area.**

Table 1: Groundwater samples location.

S. No.	Location	Source	Latitude	Longitude
1	Govt. Primary School, Ramgarh	Tube Well	30°39'2.65"N	76°53'20.04"E
2	Govt. Senior Secondary School, Ramgarh	Tube Well	30°38'48.85"N	76°53'5.54"E
3	Market, Ramgarh	Tube Well	30°38'44.20"N	76°53'3.10"E
4	Sector 28-A, Panchkula	Tube Well	30°38'47.89"N	76°52'57.88"E
5	Sector 28-B, Panchkula	Tube Well	30°38'52.81"N	76°52'53.38"E
6	Sector-28-C, Panchkula	Hand pump	30°38'48.35"N	76°52'33.65"E
7	Sector-26, Panchkula	Tube Well	30°39'27.41"N	76°52'51.02"E
8	Sector-25, Panchkula	Tube Well	30°40'7.40"N	76°52'38.96"E

Table 2: Results of groundwater samples analysis.

S. No.	Sample Locations	Source	pH	Hardness (mg/l)	Chloride (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	Govt. Primary School, Ramgarh	Tubewell	7.5	180	40	0.5	0.0	0.5	0.5	45	0.5	0.0
2	Govt. Senior Secondary School, Ramgarh	Tubewell	7.5	100	40	0.5	0.0	0.0	0.5	45	0.0	0.0
3	Sector-28-A, Panchkula	Tubewell	7.0	250	40	0.0	0.0	0.5	0.2	45	0.5	0.0
4	Sector-28-B, Panchkula	Tubewell	7.0	250	40	0.0	0.0	0.5	0.2	45	0.5	0.0
5	Sector-28-C, Panchkula	Handpump	7.5	200	110	1.0	0.0	3.0	0.2	20	0.5	0.2

6	Sector-26, Panchkula	Tubewell	7.5	140	40	0.5	0.0	1.0	0.2	75	1.0	0.0
7	Sector-25, Panchkula	Tubewell	7.0	240	40	0.0	0.0	0.5	0.5	45	0.0	0.0
8	Market, Ramgarh	Tubewell	7.0	250	40	0.5	0.0	0.0	0.5	45	1.0	0.0

Note: A,B,C represent the three sample locations in Sector-28,Panchkula, not the Sector-28A,28B and 28C.

Table 3: BIS Drinking Water Standards (IS 10500:2012)

S. No.	Constituent	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	Chloride (mg/l)	<250	250-1000	>1000
4	Fluoride (mg/l)	<1.0	1.0-1.5	>1.5
5	Iron (mg/l)	<0.3	-	>0.3
6	Ammonia (mg/l)	<0.5	-	>0.5
7	Nitrite (mg/l)	<1.0	-	>1.0
8	Nitrate (mg/l)	<45	-	>45
9	Phosphate (mg/l)	<1.0	-	>1.0
10	Residual Chlorine (mg/l)	<0.2	0.2-1	>1.0

RESULTS AND DISCUSSION

pH

In the study area, pH varied from 7 to 7.5 and desirable in all eight groundwater samples (Fig.2).

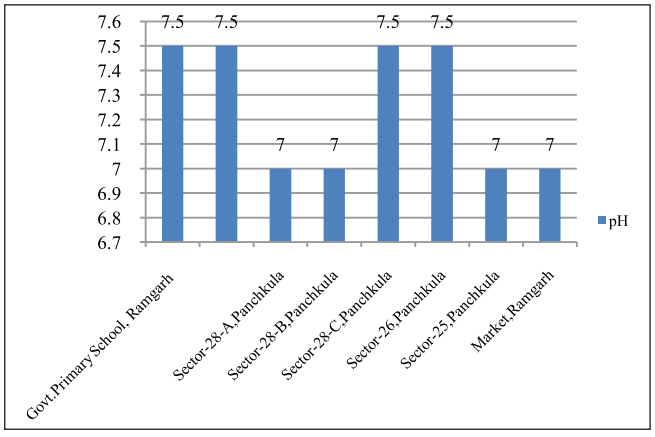

Figure 2:pH in groundwater samples.

Hardness

Hardness varied from 100 mg/l to 250 mg/l in the study area. Hardness in groundwater samples was desirable at Govt. Primary School Ramgarh (180 mg/l), Govt. Senior Secondary School Ramgarh (100 mg/l), Sector-28-C, Panchkula (200 mg/l), Sector-26, Panchkula (140 mg/l) and permissible at Sector-28-A, Panchkula (250 mg/l), Sector-28-B, Panchkula (250 mg/l), Sector- 25 (240 mg/l) and Market Ramgarh (250 mg/l) (Fig.3).

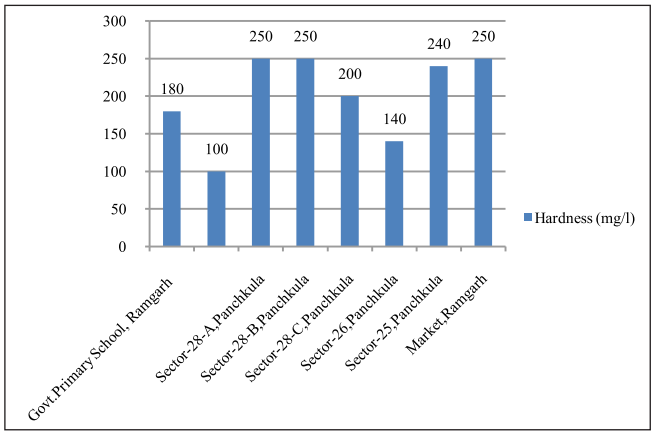

Figure 3: Hardness in groundwater samples.

Chloride

Chloride was present in range from 40 mg/l to 110 mg/l in the study area. Chloride in groundwater samples was within desired limits in all eight groundwater samples (Fig. 4).

Fluoride

Fluoride had values from 0.5mg/l to 1mg/l in the study area, thus being within desirable limits in all eight groundwater samples (Fig. 5).

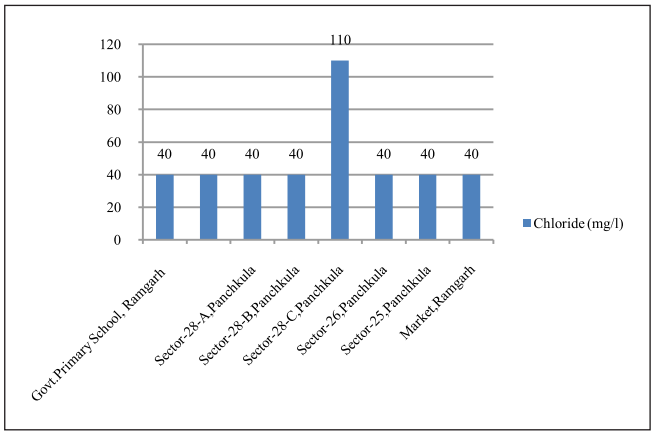

Figure 4: Chloride in groundwater samples.

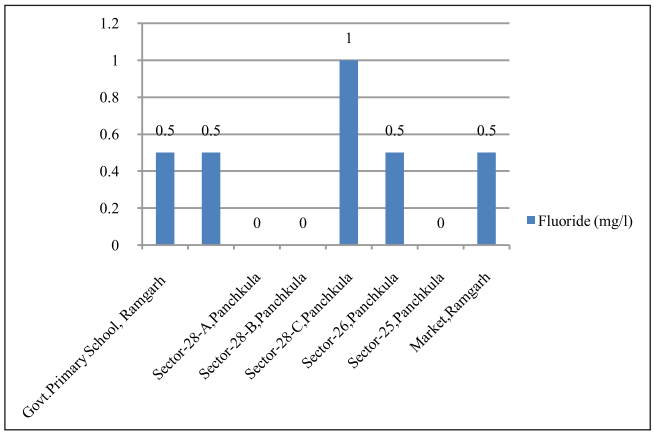

Figure 5: Fluoride in groundwater samples.

Iron

Iron was absent in all eight groundwater samples, hence, desirable for drinking purpose (Fig.6).

Ammonia

Ammonia varied over nil to 3 mg/l in the study area. Ammonia was in prescribed values atGovt. Primary School, Ramgarh (0.5 mg/l), Govt. Senior Secondary School Ramgarh (0.0 mg/l), Sector- 28-A, Panchkula (0.5 mg/l), Sector- 28-B, Panchkula (0.5 mg/l), Sector- 25, Panchkula (0.5 mg/l), Market Ramgarh (0.0 mg/l) and non-potable at Sector-28-C, Panchkula (3.0 mg/l) and Sector-26, Panchkula (1 mg/l) (Fig.7).

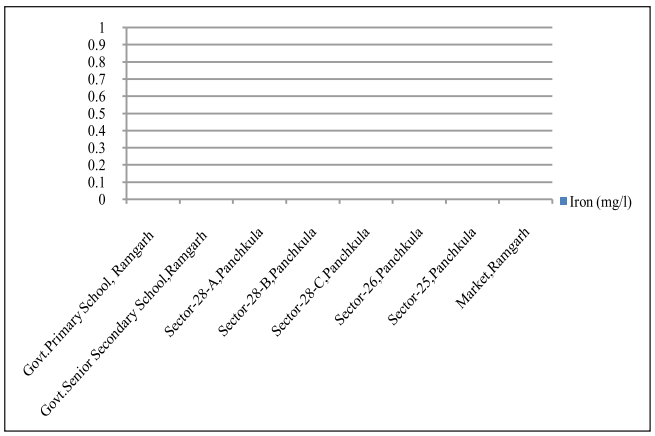

Figure 6: Iron in groundwater samples.

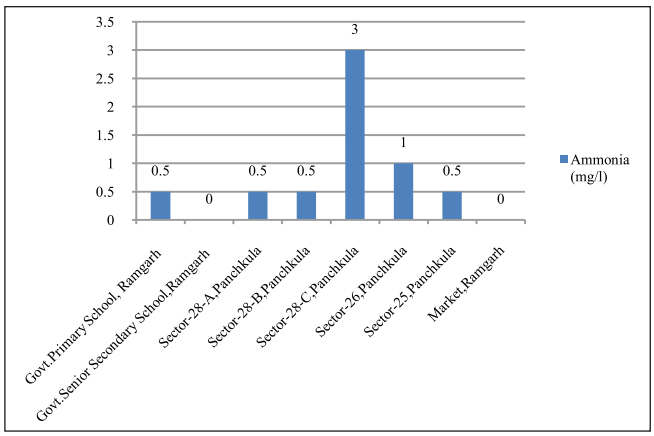

Figure 7: Ammonia in groundwater samples.

Nitrite

Nitrite varied from 0.2 mg/l to 0.5 mg/l in the study area, desirable for drinking purpose in all eight groundwater samples (Fig.8).

Nitrate

Nitrate varies from 20 mg/l to 75 mg/l in the study area, desirable in seven groundwater samples and non-potable in Sector-26 (75 mg/l) groundwater sample (Fig.9).

Phosphate

Phosphate was present over nil to 1mg/l in the study area, thus at desirable values in all eight groundwater samples (Fig.10).

Residual Chlorine

Residual Chlorine had values from nil to 0.2 mg/l in the study area (desirable) (Fig.11).

Groundwater quality at sample sites

Groundwater Quality at Govt. Primary School, Ramgarh

In groundwater sample collected at Govt. Primary School, Ramgarh, the various chemical drinking water parameters studied were found to be withindesirable limits (Fig.12).

Groundwater quality at Govt. Senior Secondary School, Ramgarh

In groundwater sample collected at Govt. Senior Secondary School, Ramgarh chemical drinking water parameters were in desirable limits (Fig.13).

Groundwater quality at Market, Ramgarh

In groundwater sample collected at Market Ramgarh analyzed chemical drinking water parameters pH, chloride, fluoride, iron, ammonia, nitrite, nitrate, phosphate, residual

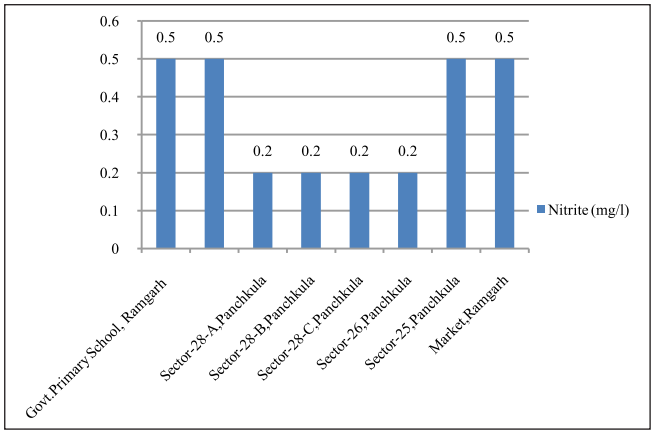

Figure 8: Nitrite in groundwater samples.

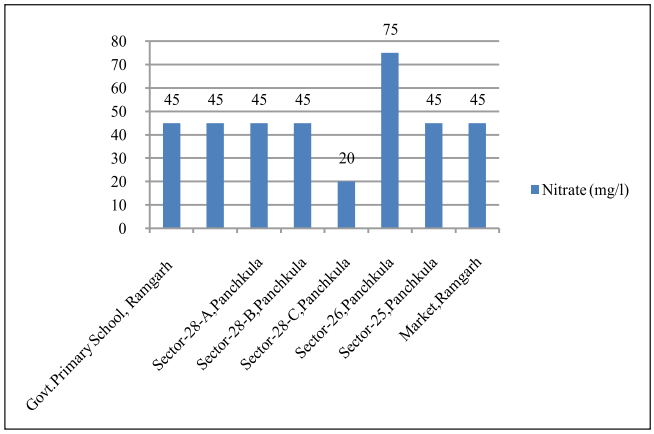

Figure 9: Nitrate in groundwater samples.

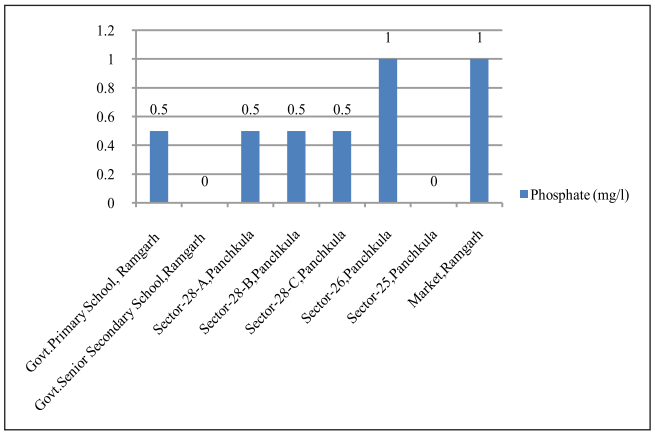

Figure 10: Phosphate in groundwater samples.

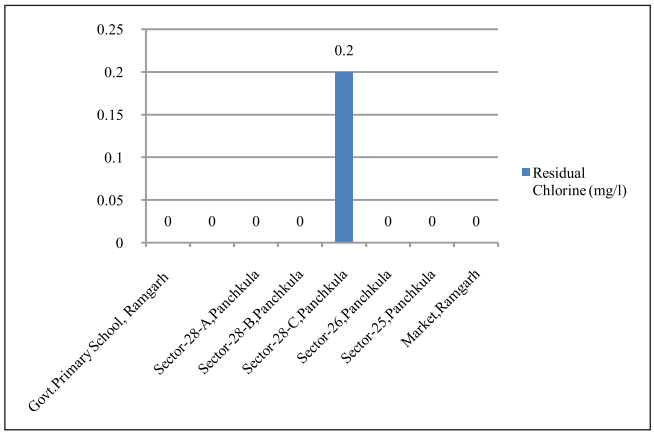

Figure 11: Residual Chlorine in groundwater samples.

chlorine were in values as permissible for drinking water (Fig.14).

Groundwater quality at Sector-25, Panchkula

In groundwater sample collected at Sector-25, Panchkula the pH, chloride, fluoride, iron, nitrite, ammonia, nitrate, phosphate, residual chlorine parameters adhered to permissible drinking water limits (Fig.15).

Groundwater quality at Sector-26, Panchkula

In groundwater sample collected at Sector-26, Panchkula the chemical drinking water parameters were under limited to desirable values and ammonia, nitrate were proper for non-potable drinking water (Fig.16).

Groundwater quality at Sector-28-A, Panchkula

In groundwater sample collected at Sector-28-A, Panchkula the different drinking water parameters were found to be

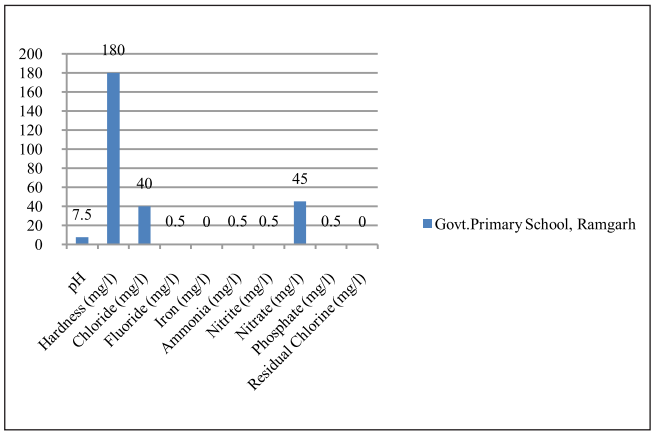

Figure 12:Groundwater quality at Govt. Primary School, Ramgarh.

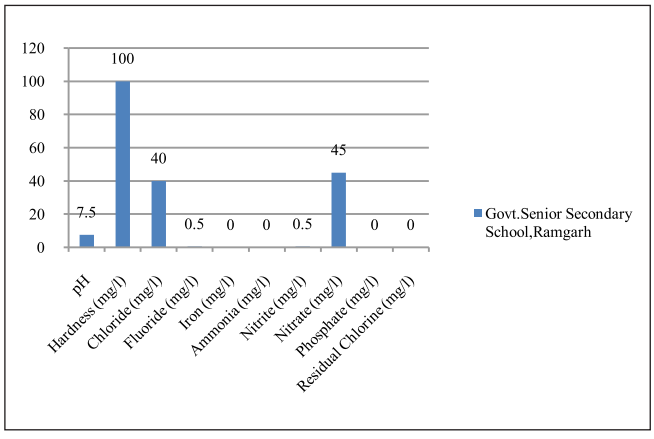

Fig.13: Groundwater quality at Govt. Senior Secondary School, Ramgarh

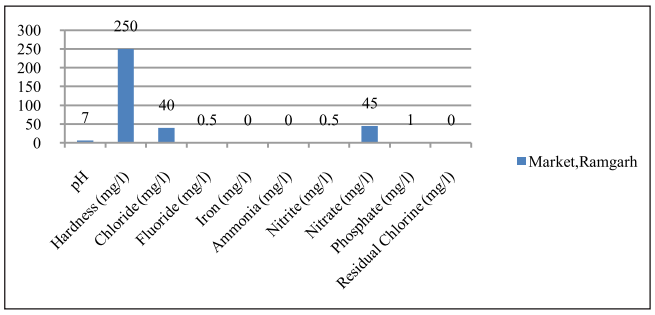

Figure 14:Groundwater quality at Market, Ramgarh.

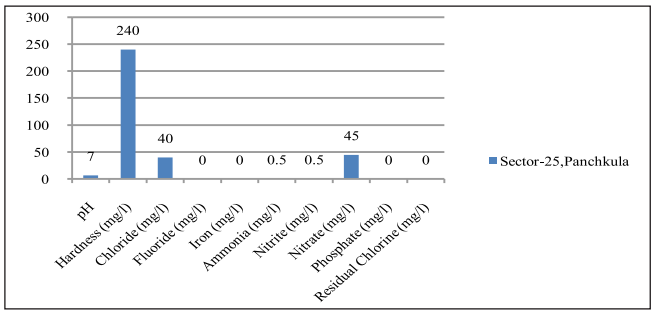

Figure 15: Groundwater quality at Sector-25, Panchkula.

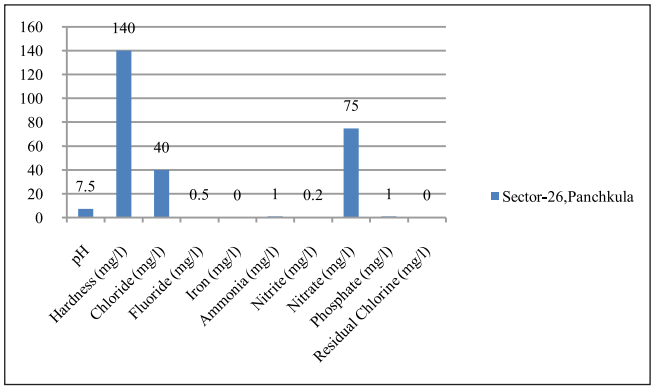

Figure 16: Groundwater quality at Sector-26, Panchkula.

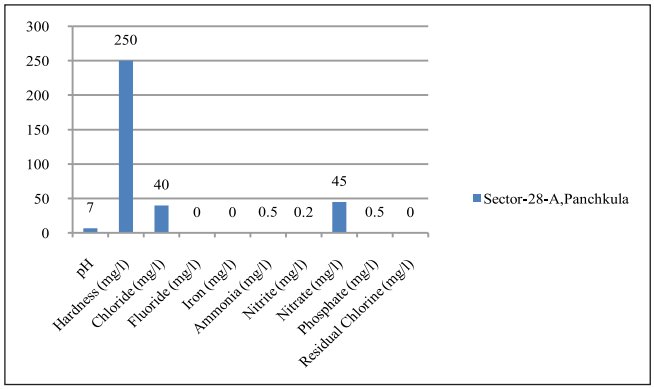

Figure 17: Groundwater quality at Sector-28-A, Panchkula.

desirable and hardness was permissible for drinking water purposes (Fig.17).

Groundwater quality at Sector-28-B, Panchkula

In groundwater sample collected at Sector-28-B, Panchkula,the chemical drinking water parameters pH, chloride, fluoride, iron, ammonia, nitrite, nitrate, phosphate, residual chlorine were found to be within desirable limit and hardness under permissible drinking water limit (Fig.18).

Groundwater quality at Sector-28-C, Panchkula

In groundwater sample collected at Sector-28-C, Panchkula, the drinking water parameters analyzed viz. pH, hardness, chloride, fluoride, iron, ammonia, nitrite, nitrate, phosphate, residual chlorine were under desirable limit (Fig.19).

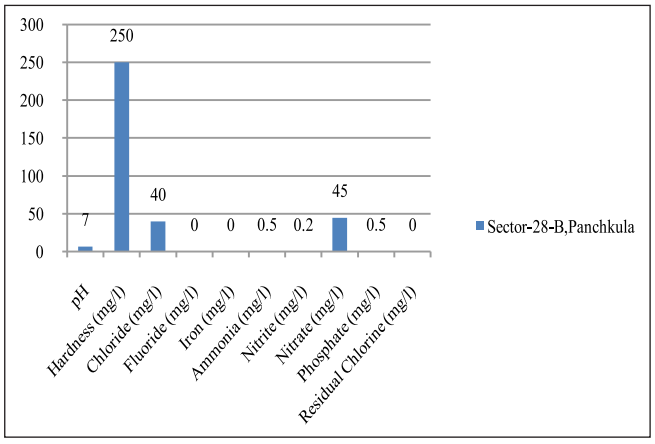

Figure 18: Groundwater quality at Sector-28-B, Panchkula.

Conclusion

In the study area, for all the eight groundwater samples pH, chloride, fluoride, iron, nitrite, phosphate, residual chlorine were in desirable limits for drinking purpose. Hardness was desirable at Govt. Primary School, Ramgarh (180 mg/l), Govt. Senior Secondary School, Ramgarh (100 mg/l),Sector-28,Panchkula (200 mg/l), Sector-26, Panchkula (140 mg/l) and permissible at Sector-28-A, Panchkula (250 mg/l), Sector-28-B, Panchkula (250 mg/l), Sector-25 (240 mg/l), Market, Ramgarh (250 mg/l). Ammonia was desirable atGovt. Primary School,Ramgarh (0.5mg/l), Govt. Senior Secondary School, Ramgarh (nil), Sector- 28-A, Panchkula (0.5 mg/l), Sector-28-B, Panchkula (0.5 mg/l), Sector-25, Panchkula (0.5 mg/l), Market Ramgarh (nil) and non-potable

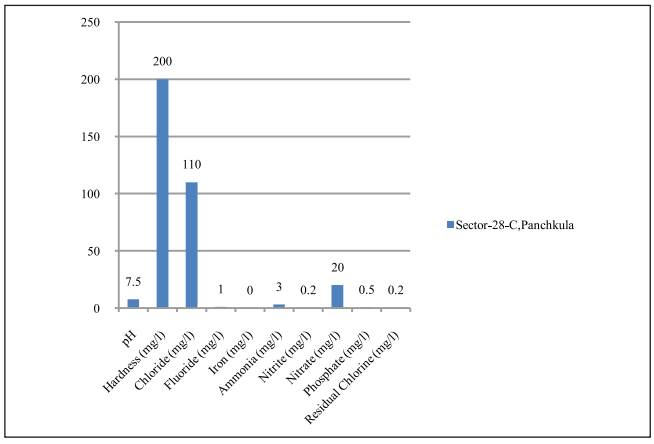

Figure 19: Groundwater quality at Sector-28-C, Panchkula.

at Sector-28-C, Panchkula (3.0 mg/l) and Sector-26,Panchkula (1 mg/l).Nitrate was desirable in seven groundwater samples and non-potable (75 mg/l) in one groundwater sample (Sector-26, Panchkula). Groundwater quality at Govt. Primary School, Ramgarh, Govt. Senior Secondary School, Ramgarh and Sector-28-C, Panchkula was desirable, at Market Ramgarh, Sector-25, Panchkula, Sector-28-A, Panchkula, Sector-28-B, Panchkula was permissible and Sector-26, Panchkula was found as non-potable. The data from the present study is highly useful for monitoring the groundwater quality in the study area and will serve as a reference for further related surveys.

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