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Assessment of Water Quality for Drinking and Irrigation Purpose: Jhajjar District (Haryana)

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ABSTRACT

Groundwater is an important source of drinking and agriculture in Haryana, India. The level of water below ground is temporal and dynamic in nature. In the present study, the physic-chemical characteristics of ground water of Jhajjar district were assessed for its suitability for drinking and irrigation purpose. The source of data is primary and secondary both. The water samples were collected from different villages of Jhajjar District,Haryana.In order to assess the ground water quality, the water samples were analyzed for different physic-chemical properties e.g. pH,electrical Conductivity (EC),total hardness(TH),total alkalinity (TA), calcium, magnesium, nitrate, chloride,fluride and sulphate concentration. The result were compared with the standards prescribed by WHO and Bureau of Indian standard (BIS).The pH value range indicating that the ground water is neutral to alkaline. The Highest shallow aquifer is by and large saline. But where the EC, and F values are within the permissible limit set by the BIS.10500; 1991, it is suitable in the district for drinking purpose. The suitability of ground water for irrigation as per calculated data reveals the ground water is for irrigation is saline, salinity increase with depth and water is more brackish.

Keywords: Groundwater, Agriculture, Aquifer, Salinity, Brackish

INTRODUCTION

Water resources are sources of usually fresh water that one useful or potentially useful to society for instance for agricultural, industrial or recreational use. Being a basic need of human development, health and wellness safe drinking water is an internationally accepted human right (WHO 2001). Groundwater is one of the primary source of fresh water. Groundwater is the water that seeps through rocks and soil and is stored below the ground. The rocks in which groundwater is stored are called Aquifers. Aquifers are typically made up of gravels, sand, sandstone or limestone.

Groundwater is supporting livelihood of over 26 % farmers and agricultural labours. Wells including dug, well, shallow tube wells and deep tube wells provide about 61.6% of water for irrigation from ground and rest surficial water bodies and precipitation provide about 38.4%. The mainproblem of water resource is concern withgroundwater resource because its level is going down rapidly and also changing in physic-chemical composition. The impact of changing in composition of water effect the human health and agricultural production. The main groundwater problem is salinity, water logging and other chemical changes. The present study aim is to describe the physic-chemical property of water to assess the suitability of water for drinking and agricultural use.

Study Area:
In the present study, the physic-chemical characteristics of ground water of Jhajjar district were assessed for its suitability for drinking and irrigation purpose. Many researchers was reported for poor groundwater quality in this district. As per the report of Ministry of Drinking water and Sanitation, ground water fluoride and salinity are major problem in Jhajjar District. Jhajjar district of Haryana lies between 28^0 22'to 28^0 49' North latitudes, and 76^0 18'to 76^0 59' East longitudes. The district lies in the south east of Haryana state. The district is having a geographical area of 1834 sq.km, which is 3.77 % of total area of the state. It is divided into three tehsils namely Jhajjar and Bahadurgarh & Beri, and sub-divided into five development blocks namely Jhajjar, Beri, Bahadurgarh, Matenhail and Salhawas. The district headquarter is situated in Jhajjar town at a distance of about 65 km from Delhi. On its north lies the Rohtak Subdivision of Rohtak District and in the South lies the Subdivision Rewari of Rewari District. In the East lies Tikri border of Delhi and in the West lies Charkhi Dadri District. In the eastern part of district, the area is considerably even.

Some area is uneven and also suffers from inundation and water logging during Monsoon season. The overall topography of the area is marked by alluvial plain and at some places by undulating dunes. The average plain elevation of the district is about 222 meters above mean sea level. There is a gentle slope from North South. The area forms a part of Indo- Gangetic alluvial plain ranging from Pleistocene to recent in age Aeolian deposits of Sub- recent age cap the plains. In absence of natural drainage the area is drained by main drain No.8 of the district. The canal system of the district, if required, is also utilized to drain rain water during rainy season.

Objective of Study

In this research paper, the physic-chemical characteristics of ground water of Jhajjar district has been assessed for its suitability for drinking and irrigation purpose.were analyzed for different physic-chemical properties e.g. pH,electrical Conductivity (EC),total hardness(TH),total alkalinity (TA), calcium, magnesium, nitrate, chloride,fluride and sulphate concentration.

METHODOLOGY

Data source and methodology is the main part of research process which provide us scientific description and explanation. The present study is based on primary and secondary data sources. Form study area, Jhajjar District, we take water sample of 25 villages from different block. The secondary data were taken form department of Public Health Engineering, Water Testing Laboratory, Jhajjar. On the other hand, for the primary data ,we took sample form village hand pump and field tube well.

Table 1: **Sampling Villages of Jhajjar District**

Sample No.	Name of village
1	Bahu
2	Gawalison
3	Khanpur kalan
4	Amboli
5	Sunderheti
6	Jharli
7	Goria
8	Khanpur khurd
9	Salhawas
10	Kahri
11	Bhatera
12	Chandpur
13	Zahidpur
14	Khetawas
15	Chadwana
16	Koyalpuri
17	Khaperwas
18	Kheri Hasdarpur
19	Kheratharu
20	Dighal
21	Jhaswa
22	Bambolia
23	Mohanbari
24	Silani
25	Bhalgarh

Source: Prepared by Research Scholar

These samples were also analysed in Water Testing laboratory at Jhajjar. The present study is carried out to analyse for pH, electrical conductivity (EC), total dissolved solids (TDS), calcium (Ca2+), magnesium (Mg2+), total hardness (TH), total alkalinity (TA), chloride (Cl-), fluoride (F-) and Sulphate (SO42-).

Table 2: Values and Concentration of various water parameters in groundwater samples of Jhajjar District

Sample no.	TDS	TH	Ca2+	Mg2+	TA	Cl	F	pH	EC	SO4
1	743	330	48	50.4	250	205.9	1.88	7.43	740	37
2	970	570	112	69.7	440	319.5	.63	7.23	1070	61
3	275	190	56	12	190	106.5	0.21	7.18	800	28
4	598	370	96	31.2	310	291.1	1.18	7.68	1270	32
5	1753	580	96	81.6	240	532.5	0.57	7.10	6080	33
6	658	210	36	28.8	270	184.6	2.63	7.58	3015	55
7	850	350	56	50.4	480	347.9	1.18	8.11	7512	85
8	183	140	48	4.8	160	120.7	0.09	7.63	625	28
9	833	390	44	67.2	350	504.1	0.83	7.19	7900	240
10	326	210	48	21.6	240	56.8	0.18	7.05	640	34
11	180	130	36	9.6	130	130.2	0.19	7.00	782	36
12	200	160	36	16.8	170	138.8	0.25	7.21	625	36
13	165	150	48	7.2	150	113.6	0.28	7.50	1218	36
14	286	120	36	7.2	170	127.8	0.28	7.13	785	39
15	196	170	44	14.4	150	99.4	Nil	6.38	8318	32
16	176	150	48	7.2	150	38.4	0.34	7.43	880	36
17	890	420	84	88	380	53.8	0.83	7.19	5070	30
18	188	160	36	16.8	170	85.2	0.03	7.76	6035	26
19	430	250	52	28.4	180	163.3	0.01	7.22	6012	240
20	433	340	60	45.6	290	170.4	0.14	7.00	9350	240
21	793	330	60	52.8	270	269.8	0.88	7.42	5080	35
22	1250	340	96	24	380	350	2.64	7.65	6021	38
23	1380	450	76	62.4	430	546.7	1.14	7.83	6112	117
24	140	115	24	13.2	96	36	0.26	7.66	621	27
25	4050	1740	2220	285.6	450	1881.5	1.81	7.18	15500	750
Minimum	**140**	**115**	**24**	**4.8**	**96**	**36**	**0.01**	**6.38**	**621**	**26**
Maximum	**4050**	**1740**	**2220**	**285.6**	**480**	**1881.5**	**2.64**	**8.40**	**15500**	**750**

*Units of all the parameter are in mg/l except EC (µS cm1-) and pH.
Source: Prepared by Research Scholar based on data collecting by Survey

Table 3: Comparison of water quality parameters of groundwater of Jhajjar District area with drinking water quality standard (Indian and WHO)

Parameters	Range of Samples		BIS Standard		WHO Limits
	Minimum	Maximum	Acceptable Limits	Maximum Limits	
TDS	140	4050	500	2000	500
TH	115	1740	300	600	100
Ca2+	24	2220	75	200	75
Mg2+	4.8	285.6	30	100	150
TA	96	480	200	600	----
Cl	36	1881.5	200	1000	200
F	0.01	2.64	1.0	1.5	1
pH	6.38	8.40	6.5-8.5	6.5-9.2	6.5-9.2
EC	621	15500	300	----	----
SO4	26	750	200	400	200

*Units of all the parameter are in mg/l except EC (µS cm-1) and pH.
Source:Prepared by Research Scholar

RESULTS AND DISCUSSION

pH value

pH is a term used to express the intensity of acidic or alkaline conditions. It is the expression of hydrogen ion concentration, more precisely, the hydrogen ion activity. pH is an important parameter in assessing the water quality. Acidic conditions will prevail as pH value decreases and alkaline conditions will prevail as the pH value increases. The BIS limit for drinking water is 6.5-8.5 shown in Table 3. pH value in analyzed water samples varied from 6.38(Chadwana village) to 8.40(Salhawas). The results show that all the water samples were within permissible limits.

Electrical Conductivity (EC) :

The ability of a solution to conduct an electrical current is governed by the migration of solutions and is dependent on the nature and numbers of the ionic species in that solution. This property is called electrical conductivity. It is a useful tool to assess the purity of water. The permissible limit for electrical conductivity (EC) is 300 µS cm-1. EC of the collected samples ranged from 621 to 15500 µS cm-1. All samples have above the permissible limit.

Total Dissolve Salts (TDS):

The electrical conductivity of water samples correlates with the concentration of dissolved minerals or with what is commonly known as the total dissolved salts of water samples. The acceptable range of TDS is 500 mg/l. The range of TDS of analyzed water samples varied between 140 to 4050 mg/l as shown in Table 3. The highest TDS value was observed at location no. 25. All the water sample are not non-saline as per the salinity classification (Table 4) suggested by Robinove et al. (1958). So, it can be concluded that 4 village's ground water is not suitable for drinking purposes from salinity point of view.

Table 4: Classification of groundwater on the basis of salinity values (Robinove et al., 1958)

TDS (mg/l)	Description	No. of villages
<1000	Non saline	21
1000-3000	Slightly saline	03
3000-10,000	Moderate saline	01
>10,000	Very saline	00
	Total	25

Source: Prepared by Research Scholar

Calcium (Ca2+) and Magnesium (Mg2+):

The calcium and magnesium are the most abundant elements in the groundwater. Calcium may dissolve readily from carbonate rocks and lime stones or be leached from soils. However, dissolved Mg2+ concentration is lower than Ca2+ in the groundwater. Other sources include primarily industrial and municipal discharges. Calcium is an essential nutritional element for human being and aids in maintaining the structure of plant cells and soils. Mg2+ is a constituent of bones and is essential for normal metabolism of Ca2+. Its deficiency may lead to protein energy malnutrition.The acceptable limits of Ca2+ and Mg2+ are 75 mg/l and 30 mg/l respectively. The estimated Ca2+ content from analyzed water samples ranged from 20 to 220 mg/l and Mg2+ concentration ranged from 4.8 to 285.6 mg/l as shown in Table 3. Around 24% of water samples showed Ca2+ concentration above the acceptable limit while in case of Mg2+, 44% samples were above the acceptable limit. Higher concentration of Ca2+ and Mg2+ were observed at village no.(Bhalgarh) 25.

Total Hardness (TH):

In groundwater hardness is mainly contributed by bicarbonates, carbonates, sulphates and chlorides of calcium and magnesium. So, the principal hardness causing ions are calcium and magnesium. The acceptable limit of total hardness is 200 mg/l. The hardness of analyzed water samples varied from 115 to 1740 mg/l. The highest value of total hardness was observed at location no. 25, as shown in Table 2. The present study revealed that 56% of water samples showed TH concentration above the acceptable limit and water are hard in nature.

Total Alkalinity (TA):

Alkalinity of water is its acid neutralizing capacity. The alkalinity of groundwater is mainly due to carbonates and bicarbonates. The acceptable limit of alkalinity is 200 mg/l and in the absence of alternate water source, alkalinity upto 600 mg/l is acceptable for drinking. The phenolphthalein alkalinity of most of the water samples is zero but the total alkalinity of analyzed water samples varied from 96 to 480 mg/l as given in Table 3. Total alkalinity of all samples was below the permissible limit. It is itself not harmful to human being and plants.

Chloride (Cl):
Chloride is an anion found in variable amount in groundwater. Chloride may present naturally in groundwater and may also originate from diverse sources such as weathering, leaching of sedimentary rocks and infiltration of seawater etc. The maximum permissible limit of chloride in potable water is 250 mg/l. It produces salty taste at 250mg/l to 500mg/l . In the analyzed water samples, the concentration of chloride varied from 36 to 1881.1 mg/l. The chloride content of the water sample when compared with BIS standard then it was found that 68% samples showed concentration within the permissible limit. The maximum Cl concentration was observed at location no. 25, as shown in Table 2.

Fluoride (F):
The sources of fluorides are mainly, industries of iron, steel production, petroleum refining and phosphate fertilizer. Higher concentration of fluoride causes bone and dental fluorosis. The BIS permissible limit for fluoride in groundwater is 1mg/l as given in Table 3. However, in temperate region this limit is 1.5 mg/l, where, water intake is low. Fluoride (F-) varied from permissible limit for F concentration is 1-1.5 mg/l according to WHO (2003). Fluoride concentration less than 0.8 mg/l leads to dental caries. Hence it is essential to maintain fluoride concentration between 0.8 to 1.0 mg/l in drinking water. The concentration of fluoride in groundwater samples varied from 0.01 to 2.64 mg/l as shown in Table 2. Fluoride concentration in all these samples not found to be well within permissible limit. Bambolia and Jarli reported relatively high ranges of fluoride contamination, values above 2.0 mg/l.

Sulphate (SO4):
Sulphur in groundwater is normally present in sulphate form. Sulphate may enter into groundwater through weathering of sulphide bearing deposits. The acceptable limit of sulphate is 200 mg/l. The sulphate content in analyzed water samples varied from 26 to 750 mg/l as shown in Table 2. Only 4samples were not found to be well within permissible limit. Tha highest concentration of sulphate was reported in sample village no. 25.

The present study revealed that there was some villages in Jhajjar district that have not good quality of groundwater. Water of these villages not suitable for drinking and irrigation purpose. Bhalgarh village have very worst quality of water in Jhajjar district. Other villages name Jarli and Salhawas, bombolia, Bahu are also not in good condition.

CONCLUSION

In this study characterization of the physiochemical parameters of groundwater from twenty five tube wells at different locations in Jhajjar District was carried out. To assess the quality of ground water each parameter was compared with the standard desirable limits prescribed by World health organization (WHO) and Bureau of Indian Standard (BIS). From the study it can be concluded that groundwater is not safe for drinking purposes from the point of view of levels of pH, EC, TDS, Ca2+, Mg2+, TA, Cl, F and SO4–throughout the Jhajjar distirct. The total hardness varied in between 115 -1740 mg/l, which indicates that water in the deep aquifer is moderately hard. So, it is suggested to the cantonment localities to soften the tube well water before consumption. Floride concentration in some village is above the permissible limit that create serious health issue like dental and bone fluorosis disease. On the other hand salinity is also a major problem in this district. 5 sample village have not patable water. For irrigation purpose, ground water quality is not suitable. TDS, TH and Total Alkalinity limits are not under permissible or highest limit, it affects the vegetation and crops growth. It is also necessary to find out the source of contaminants which is due to soil types, industrialization, water chemistry and other human activities. .

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