Assessment of ground water quality of Laksar block in district Haridwar, Uttarakhand

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Abstract

The present study was aimed to identify the ground water contamination problems in Laksar block of district Haridwar. The ground water samples were collected from 6 different locations of Laksar block. The Physico -chemical parameters were assessed to check either the water is suitable or not for drinking purpose. The Physico-chemical parameters such Temperature, Total hardness (TH), Calcium Hardness (CaH), Acidity, Chloride, Sulphate, pH and Electrical Conductivity (EC) were analysed as per standard methods. In this study values of different parameters were recorded such as acidity (78.6 to 79.4 mg/l), pH (6.36 to7.11), chloride (111.8 to 113.8 mg/l) and total hardness (370.2 to 374.6 mg/l) respectively. This study revealed that water samples may raise concern on the safety of the water for human health may cause the various water borne disease, therefore, the proper hygiene and purification techniques should be recommended.

Key words: Assessment, Ground Water, Laksar Block, Haridwar

Introduction

Water is the important constituent of all things without water life is impossible on the earth (Arya *et al.,* 2011). Water is required to all forms of life and make up 50-97% of the weight of all plants and animals. About 70% of the water in India has become polluted due to the discharge of domestic sewage and industrial effluents into natural water source, such as rivers, streams as well as lakes (Sangu and Sharma, 1987). Almost 95% of rural population living in India depends on ground water for domestic use (Moharir *et al.,* 2002). Ground water is of great important in agriculture for both watering of crops and for irrigation of dry season crops. The term groundwater is used to denote that water which has saturated the pores or aperture of the sub-soil. About 45% of irrigation water requirement is met from ground water sources. The quality and abundance of ground water depends upon depth of water table, ecological factors and presence of dissolved solids. In India and certain parts of the world, water crisis is becoming a regular phenomenon, perhaps due to improper scientific management of water resources leading to

continued environmental degradation. In the last few decades, there has been a tremendous increase in the demand for freshwater resource due to rapid population growth and industrialization (Rama Krishna *et al*., 2009). The quality and depletion of ground water in most countries including India is directly affected by population, large scale disposal of urban and industrial wastes and use of chemical fertilizers and pesticides in agricultural fields (CGWB and CPCB, 2000; CGWB, 1999, 2000, 2001; Sharma and Jain, 2006). The ground water aquifers are the major source of the drinking water and important sources of surface water. Due to increased pollution, water becoming unsafe for consumption. The urban aquatic ecosystems are strongly influenced by long term discharge of untreated domestic and industrial wastewaters, storm water runoff, accidental spills and direct solid waste dumping. All these released pollutants have great ecological impacts on water quality of urban wetlands.

Material and Methods

Study area: The study was conducted in the Laksar Block of Haridwar, Uttarakhand. Laksar is a town and a panchayat in Haridwar district of Uttarakhand. It is an important sugar manufacturing

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destination in the state. Laksar has an average elevation of 227 metres (745 feet). It is situated between the towns of Khanpur and Sultanpur, and close to the towns of Pathri, Jhabrera and Roorkee in Haridwar district. The water samples were collected from all sites in the jerry cans of 2 liters capacity. Spot sampling was used for samples collection. Samples were analyzed for the following physic-chemical parameters. Ground water quality monitoring was done at each locations and ground water samples were taken from private hand pump (30-40 feet), government hand pump (50-60 feet), as per CPCB guideline for Water Quality Monitoring. Two samples were taken from each of the locations once a month and analysed for various physico-chemical parameters with the help of APHA, 2012; Trivedy and Goel, 1986 and Khanna and Bhutiani, 2008.
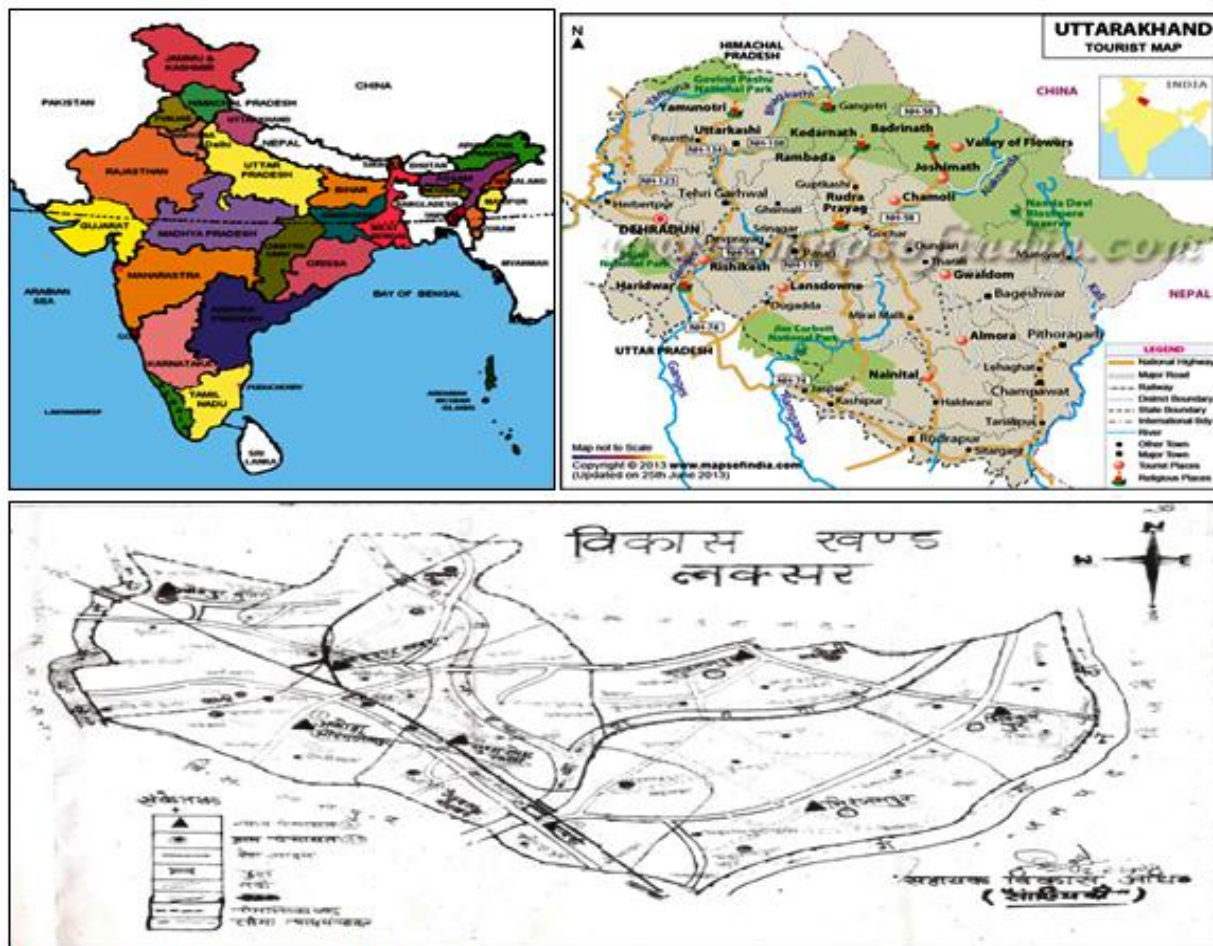

Figure.1 Location map of the study area

Table 1: Different sites selected for sampling of ground water

Sites	Latitude	Longitudes
SS-1 Laksar	29° 45' 13.8348'' N	78° 1' 17.3352'' E
SS-2 DabkiKalan	29° 44' 29.256'' N	78° 0' 39.5136'' E
SS-3 Akaudha	29° 44' 42.3924'' N	78° 3' 3.3408'' E
SS-4 Khandja	29° 43' 51.6936'' N	78° 2' 33.846'' E
SS-5 Raisi	29° 41' 58.0128'' N	78° 4' 49.17'' E
SS-6 Niranjanpur	30° 17' 50.6436'' N	78° 0' 36.4068'' E

Results and Discussion

Monthly average value of different parameters, Temperature, TS, TDS, EC, Turbidity, pH, DO, Total Hardness, Calcium Hardness, Chloride, Iron, Sulphate, Acidity presented was Given in table 1and2 respectively.

Temperature: During the present study, the minimum temperature (24.4 ±3.26 ^{0}C) was recorded from the samples of SS-3, while the maximum (25.6 ±30 ^{0}C) from PHP of SS-1site. Similarly, the samples collected from GHP show the minimum temperature (24.4±3.2 ^{0}C) at SS-3, while the maximum (25.7±3.33^{0}C) at SS-1 and monthly average value of temperature was 25.0 ±0.4^{0}C. A more or less similar trend was observed by Tyagi *et al.,* 2015.

TS: During the present study in samples of PHP, the minimum total solid (TS) value was 705.3±71.5 mg/l recorded from at SS-6 while the maximum (789.0 ±30.2 mg/l) from at SS-1 site. The monthly average value of total solid (TS) was 763.8 ±30.3 mg/l. Similarly the minimum total solid (TS) value was found 696.1 mg/l ±71.0 at GHP of at SS-6 while the maximum value (783.2 ±35.7 mg/l) was recorded from at SS-1. The monthly average value of total solid (TS) was 760.2 ±33.7 mg/l. Similar results were reported by Bhadja and Vaghela, 2013.

TDS: During the present study In the PHP, the minimum total dissolve solid (TDS) value was found 539.8 ±45.55 mg/l at SS-1 while the maximum was found 580.4 ±54.3 mg/l at SS-5 and monthly average value was observed 534.9±38.6 mg/l while in GHP, the minimum total dissolve solid (TDS) value was found. 454 ±82.5 mg/l at SS-6 while in the maximum was found 573.8 ±28.7 mg/l at SS-2 and monthly average value was observed 524.5 ±40.2 mg/l Similar results were reported by kumar *et al.,* 2017.

EC: During the present study In the PHP, the minimum electronic conductivity value was found 1343.5±8.7(*micro mho cm-1*) at SS-6 while the maximum was found 1467.7±3.6(*micro mho cm-1*) at SS-3 and monthly average value of electronic conductivity was observed 1400.01 (*micro mho cm-1*)±42.6 While in GHP the minimum electronic conductivity value was found 1345.2±0.6(*micro mho cm-1*) at SS-6 while the maximum was found 1469.6 ±17.2 (*micro mho cm-1*) at SS-3 and monthly average value of was

observed 1398.81 ±44.0(*micro mho cm-1)* similar results were observed by Zawar *et al.,* 2015.

Turbidity: Turbidity is an important indicator, which determines the amount of suspended sediment in water. These particles can block light to aquatic plants, smother aquatic organisms, and carry contaminants and pathogens, such as lead, mercury, and bacteria. During this study, the minimum turbidity value (1.11 ±0.6 .7 NTU) was recorded in samples from the PHP of at SS-6, while the maximum (5.1 ±2 NTU) at SS-1 site. The monthly average value was 3.71 ±1.4 NTU. The minimum turbidity (0.33 ±0.7 NTU) was recorded from the samples of GHP at SS-6 site, while the maximum (4.33 ±2.0 NTU) at SS-4. The monthly average value observed 3.31 NTU±1.6 3. Similar trend was found by Mandloi, 2014 and Bhutiani *et al.,* 2015.

pH: During the present study In the PHP, the minimum pH value was found 6.9±0.5 at SS-6 while the maximum was found 7.7±0.6 at SS-1 and private hand pump monthly average value of pH was observed 7.11±0.3 while in GHP , the minimum pH value was found. 6.8±0.6 at SS-6 while the maximum was found 7.5±0.1at SS-5 and GHP monthly average value of pH was observed 7.11±0.3 Similar trend was found by Saxena and Saxena 2015.

DO: During the present study In the PHP, the minimum DO value was found 6.1 ±0.5 mg/l at SS-2 while the maximum was found 6.5±0.5 mg/l at SS-6 monthly average value of DO was observed 6.2 ±0.1 mg/l while in GHP , the minimum DO value was found. 6.1 mg/l ±0.5 mg/l at SS-3 while the maximum was found 6.6 ±0.5 mg/l at SS-6 and monthly average value of DO was observed 6.2 ±0.2 mg/l Similar trend was found by jai *et al.,* 2014.

Total Hardness: During the present study In the PHP, the minimum total hardness (TH) value was found 330.5 ±42.4 mg/l at SS-6 while the maximum was found 396.8 ±65.9 mg/l at SS-5 and monthly average value of total hardness(TH) was observed 374.2 ±22.6 mg/l while in GHP the minimum at total hardness(TH) value was found. 325.7 ±46.2 mg/l at SS-6 while the maximum was found 377.0 ±36.2 mg/l at SS-1 and monthly average value was observed 370.6 ±23.4 mg/l similar result reported by Ramakrishnaiah *et al.,* 2009.

Table 2. Physical characteristics of ground water of different sites of Laksar Block.

Sites/ Parameters	Laksar		Dabki kalan		Akaudha		Khandja		Raisi		Niranjanpur		Average	
	PHP	G	P	G	P	G	P	G	P	G	P	G	P	G
Temperature	25.6 ±3.1	25.7 ±3.3	24.8 ±3.3	24.7 ±3.3	24.8 ±3.2	24.4± 3.2	25.1 ±3.4	24.9 ±3.4	25.1 ±3.5	25.2 ±3.4	24.9 ±3.4	24.9 ±3.4	25.1 ±0.3	25.0 ±0.4
Total Solids (TS)	789.0 ±30.2	783.2 ±35.7	770.4 ±13.6	771.9 ±20.1	777.0 ±15.4	774.6 ±20.8	780.9 ±10.7	778.6 ±18.8	760.1 ±40.7	751.4 ±33.5	705.3 ±71.5	696.1 ±71.0	763.8 ±30.3	760.2 ±33.7
Total Dissolved Solids (TDS)	539.8 ±45.5	528.2 ±58.5	535.8 ±32.9	573.8 ±28.7	541.6 ±38.6	536.4 ±40.8	548.6 ±30.9	543.3 ±30.4	580.4 ±54.3	511.2 ±62.2	463.3 ±83.8	454 ±82.5	534.9 ±38.6	524.5 ±40.2
Electrical Conductiuvity (EC)	1379.0 ±23.0	1366.0 ±20.8	1423.8 ±4.2	1422.0 ±8.0	1467.7 ±3.6	1469.0 ±17.2	1382.0 ±10.2	1386 ±13.7	1403.0 ±7.8	1402.0 ±14.1	1343.0 ±8.7	1345.0 ±0.6	1400.0 .±42.6	1398.0 ±44.0
Turbidity	51.00 ±2.	5.00 ±2.1	4.44 ±1.9	3.55 ±2.4	3.66 ±2.2	3.66 ±2.2	4.33 ±2.0	4.33 ±2.0	3.55 ±1.5	3.15 ±1.7	1.11 ±0.6	0.33 ±0.7	3.71 ±1.4	3.31 ±1.6

Table 3. Chemical characteristics of ground water of different sites of Laksar Block.

Sites/Parameters	Laksar		Dabki kalan		Akaudha		Khandja	Raisi		Niranjanpur		Average		
	P	G	P	G	P	G	P	G	P	G	P	G	P	G
pH	7.7 ±0.6	7.3 ±0.61	6.9 ±0.7	6.9 ±0.7	7.0 ±0.6	7.0 ±0.7	7.0 ±0.8	7.2 ±0.7	7.3 ±0.2	7.5 ±0.1	6.9 ±0.5	6.8 ±0.6	7.11± 0.3	7.11 ±0.3
Dissolved Oxygen (DO)	6.2 ±0.5	6.2 ±0.5	6.1 ±0.5	6.2 ±0.5	6.1 ±0.4	6.1 ±0.5	6.2 ±0.5	6.1 ±0.5	6.2 ±0.5	6.2 ±0.5	6.5 ±0.5	6.6 ±0.5	6.2 ±0.1	6.2 ±0.2
Total Hardness (TH)	381.8 ±32.8	377.0 ±36.2	377.7 ±29.0	373.2 ±32.6	377.6 ±26.4	377.1 ±31.8	380.7 ±27.5	374.4 ±23.7	396.8 ±65.9	395.2 ±61.5	330.5 ±42.4	325.7 ±46.2	374.2 ±22.6	370.6 ±23.4
Calcium Hardness (CaH)	331.3 ±32.5	325.1 ±34.5	329.1 ±31.5	324.0 ±35.9	327.3 ±30.8	320.5 ±37.7	330.0 ±31.0	323.7 ±33.3	326.4 ±57.9	315.5 ±49.4	290.7 ±57.0	288.7 ±55.5	322.5 ±15.7	316.3 ±13.9
Chloride (Cl)	137.3 ±8.7	132.2 ±10.2	125.0 ±5.6	123.7 ±7.5	119.1 ±7.2	116.4 ±11.3	114.0 ±5.8	113.5 ±7.2	96.6 ±8.6	95.0 ±11.9	90.6 ±9.9	90.2 ±14.1	113.8 ±17.5	111.8 ±16.3
Acidity	89.7 ±6.2	89.4 ±6.2	82.0 ±5.4	82.7 ±4.4	86.4 ±8.1	86.0 ±6.1	78.4 ±4.4	77.7 ±4.0	76.4 ±8.3	75.4 ±6.8	63.3 ±5.2	61.1 ±3.8	79.4 ±9.3	78.7 ±10.1
Iron (Fe)	0.3 ±0.0	0.3 ±0.0	0.3 ±0.0	0.3 ±0.0	0.4 ±0.0	0.3 ±0.0	0.3 ±0.0	0.3 ±0.0	0.2 ±0.0	0.2 ±0.0	0.2 ±0.0	0.2 ±0.1	0.3 ±0.1	0.3 ±0.1
Sulphate (SO_4)	40.2 ±3.1	39.0 ±4.9	40.2 ±1.5	38.0 ±2.3	42.4 ±1.8	41.0 ±5.4	45.1 ±0.7	42.2 ±1.4	42.1 ±42.1	41.3 ±41.3	32.3 ±5.6	30.2 ±6.4	40.4 ±4.4	38.8 ±4.4

PHP- Private hand pump and GHP- Government hand pump

Calcium Hardness: During the present study In the PHP, the minimum calcium hardness (CaH) value was found 290.7 ±57.0 mg/l at SS-6 while the maximum was found 331.3±32.5 mg/l at SS-1 and monthly average value of calcium hardness (CaH) was observed 322.5±15.7 mg/l while in GHP the minimum at calcium hardness (CaH) value was found. 288.7±55.5 mg/l at SS-6 while the maximum was found 325.1±34.5 mg/l at SS-1 and monthly average value was observed 316.3±13.9.mg/l. Similar results were reported by Shankar, 2007.

Chloride: During the present study In the PHP, the minimum Chloride value was found 90.6±9.9 mg/l at SS-6 while the maximum was found 137.3±8.7mg/l at SS-1 and monthly average value of Chloride was observed 113.8±17.5 mg/l while in GHP, the minimum Chloride value was found. 90.2 ±14.1 mg/l at SS-6 while the maximum was found 132.2±10.2 mg/l at SS-1 and monthly average value was observed 111.8 ±16.3 mg/l. Similar trend was found by Saxena and Saxena, 2015.

Acidity: During the present study In the PHP, the minimum Acidity value was found 63.3±5.2 mg/l at SS-6 while the maximum was found 89.7 ±6.2 mg/l at SS-1 and private hand pump monthly average value of Acidity was observed 79.4 ±9.3 mg/l while in GHP , the minimum at Acidity value was found. 61.1±3.8 mg/l at SS-6 while the maximum value was found 89.4 ±6.2 mg/l at SS-1 and monthly average value of was observed 78.7 ±10.1 mg/l

Iron: During the present study In the PHP, the minimum Iron value was found 0.2 l ±0.0 mg/l at SS-5 while the maximum was found 0.4 ±0.0 mg/l at SS-3 and monthly average value of Iron was observed 0.3 ±0.1 mg/l while in GHP, the minimum at Iron value was found. 0.2±0.0 mg/l at SS-5 while the maximum was found 0.3 ±0.0 mg/l at SS-1 and monthly average value of Iron was observed 0.3 ±0.1 mg/l Similar result were observed by Zawar *et al.,* 2015.

Sulphate: During the present study In the PHP, the minimum Sulphate value was found 32.3±5.6mg/l at SS-6 while the maximum was found. 45.1 ±0.7 mg/l at SS-4 and private hand pump monthly average value of Sulphate was observed 40.4 ±4.4 mg/l while in GHP, the minimum at Sulphate value was found 30.2 ±6.4 mg/l at SS-6 while the maximum was found. 42.2 ±1.4 mg/l at SS-4 and GHP monthly average value of Sulphate was observed 38.8 ±4.4 mg/l Similar trend was found by Mandloi 2014.

Table 4. Showing average values of different parameters and standard limits of WHO and BIS

Parameter	PHP	GHP	WHO	BIS
Temperature	25.1	25.0	-	-
Total Solids (TS)	763.8	760.2	-	-
Total Dissolved Solids (TDS)	534.9	524.5	500 mg/l	500 mg/l
Electrical Conductiuvity (EC)	1400	1398		
Turbidity	3.71	3.31	5.0 NTU	5.0 NTU
pH	7.11	7.11	7.0 - 8.5	6.5–8.5
Dissolved Oxygen (DO)	6.2	6.2	14	-
Total Hardness (TH)	374.2	370.6	200	-
Calcium Hardness (CaH)	322.5	316.3	-	75
Chloride (Cl)	113.8	111.8	250	250
Acidity	79.4	78.7	-	-
Iron (Fe)	0.3	0.3	0.3 mg/l	0.3 mg/l
Sulphate (SO$_4$)	40.4	38.8	-	200

Conclusion
During the present study total dissolved solids (TDS) was found slightly higher than the limits of WHO and BIS while calcium hardness (CaH) was found approximately four to five times higher than the limits of WHO and BIS. The average values of iron was presently found equal to the limits of WHO and BIS but at some sites the values of iron was found above the limits of WHO and BIS. Rest of the parameters analyzed during the study such as Temperature, TS, EC, PH, DO, Total Hardness (TH), Chloride Acidity and Sulphate was found

under the limit of WHO and BIS. On the basis of clinical survey it was found that peoples were suffering from different water related disease such as typhoid, Dysentery and kidneys stones. Some allergic problems were also reported during the study period. On the basis of present study we can conclude that area under the present study was in normal condition presently with reference to ground water pollution but if the trend of industrialization will continue, it will result in bad condition of ground water.

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