Physicochemical Analysis of Selected Springs Water Samples of Dehradun City, Uttarakhand, India

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Abstract

Spring water is the main source of water providing life in the mountain region. Spring is the natural sources of ground water. Due to human and industrial activities this ground water is contaminated. This is very serious problems now a day. The analysis of water quality is very important to preserve and perfect the natural eco system. Physicochemical characteristics of spring water and some river water in dehradun city by taking water samples from 13 different stations. The study was carried out by collecting 10 spring water samples and 3 river water sample during April 2015 to May 2015. The results were compared with standards prescribed by ISI 10500-2012. Total 16 parameters were analysed. It was found that all spring water samples location is below the permissible limit of IS 10500:2012 were some of locations are above the acceptable limit.
Keywords: Spring, Physico-chemical, Mountain, Valley, Dehradun

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I. Introduction

Water is the most important in shaping the land and regulating the climate. It is one of the most important compounds that profoundly influenced life. Water is the most widely distributed and abundant matter found in the nature. Water can occur as surface water in lakes, rain and stream as well as ground water in wells, boreholes and springs. In the total, there is 1400 million billion litre of water, but most of these water is not used for drinking purpose, because 97% is a sea water and only 3% is fresh water, out of which 2% is glacier, only 1% water is available for portable use where as more water go for irrigation than to drinking sanitation and all other uses.(WHO,2004)

Springs provide main source of freshwater for drinking and other household utilization in the Indian Himalayan Mountains. For drinking purpose mainly in rural areas of people depend on spring water. It also forms a main source of irrigation water in many parts of the mountain region. The mountain springs known as “Dharas”. Springs occur where inclined ground and impermeable strata intersect with ground water table. The water source of such springs, in most of cases, is unconfined aquifer where the flow of water is under gravity.

The water quality of springs has exhausted because the growth of population, deforestation, urbanization and industrialization in Doon valley. The rate change of recharge of natural spring is depleting continuously causing lowering of water table. Population of Doon Valley in Uttarakhand, outer Himalaya, has witness a noticeable increase of about 25% in the last decade (Census Report 2001). After the development of Uttarakhand state, pace urbanization, growth of population, introduction of industries and employment supplementary means of agriculture increased various in Uttarakhand region in general and in Dehradun district.

II. Study Area

Dehradun, is the capital city of the Uttarakhand state, lies between latitude 29º 55’ and 30º 30’ and logitudes77º 35’ and 78º24’ Fig 1. It falls in Survey of India toposheets Nos.53E, F, G, J and K. The district is bounded by Uttarkashi district on the north, Tehri Garhwal and Pauri Garhwal districts on the east and Saharnpur district (UP) on the south. Its western boundary adjoin Sirmour district of Himachal Pradesh separated by Rivers Tons and Yamuna. It comprise township of vikasnagar, industrial area of Selaqui and town of Rishikesh. The district head quarter lies in an intermontane Doon valley surrounded by the lesser Himalayan ranges in the north and Siwalik hill in the south, the river Ganga in the east, and the Yamuna in the west. The water divided of Ganga and Yamuna passes through the city. The study area has humid subtropical to tropical climate with heavy precipitation during July to September, moderate to high sunshine, humidity and evaporation. The average annual precipitation is about 205cm in Dehradun District. The average altitude in this area is 640m above MSL.

A. Physiography

In the shivalik range of outer Himalaya, there are number of longitudinal valley called Duns. The Doon valley is a synclinal depression between the Lesser Himalaya Mountain in the north and Sub Himalayan Siwalik hills in the south. Aligned parallel to the general trend of Himalaya, it is veritable intermount valley, bottom of which is filled up with detritus shed from overlooking hill slopes. Broadly the doon valley can be divided into three different slopes. North eastern slope of Siwalik, Doon Valley proper and southwestern slope of outer Himalaya range. The northeastern slopes of Siwalik are steep in higher reaches and have fewer gradients lower down. These are cut by a large number are very steep and are covered with poor vegetation.

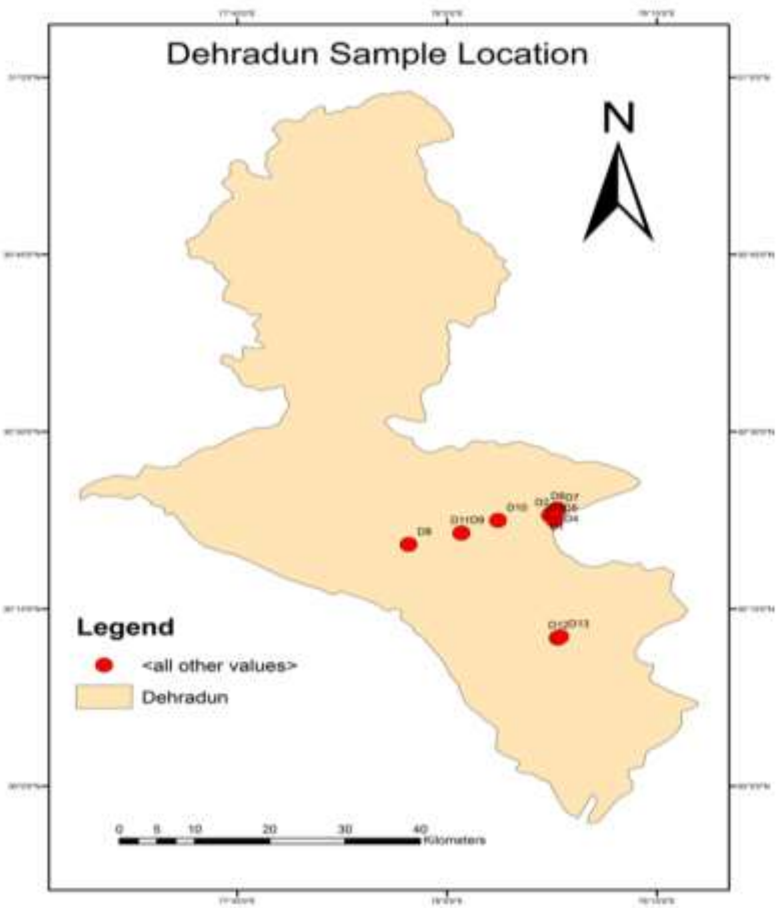

Fig. 1: Dehradun Sample Location Map

B. Climate

The Climate of the district is generally temperate. It varies greatly from tropical to severe cold depending upon the altitude of the area. The district being hilly, temperature variations due to difference in elevation are considerable. In the hilly regions, the summer is pleasant, but in the Doon, the heat is often intense, although not to such degree as in the plains of the adjoining district. The temperature drops below freezing point not only at high altitude but even at places like Dehradun during the winters, when the higher peaks are also under snow. The area receives an average annual rainfall of 2073.3 mm. Most of the annual rainfall in the district is received during the months from June to September, July and August being rainiest. Climate Data of Doon Valley for all the months is as under on the basis of mean of last 25 years.

Table – 1
Climate data of Dehradun District (CGWB, 2011)

Month	*Rainfall (mm)*	*Relative humidity (%)*	*Temperature Mean*		
February	*54.9*	*83*	*22.4*	*5.6*	*13.3*
March	*52.4*	*69*	*26.2*	*9.1*	*17.5*
April	*21.2*	*53*	*32*	*13.3*	*22.7*
May	*54.2*	*49*	*35.3*	*16.8*	*25.4*
June	*230.2*	*65*	*34.4*	*29.4*	*27.1*
July	*630.7*	*86*	*30.5*	*22.6*	*25.1*

August	*627.4*	*89*	*29.7*	*22.3*	*25.3*
September	*261.4*	*83*	*29.8*	*19.7*	*24.2*
October	*32.0*	*74*	*28.5*	*13.3*	*20.5*
November	*10.9*	*82*	*24.8*	*7.6*	*15.7*
December	*2.8*	*89*	*21.9*	*4.0*	*12.0*
Average Annual	*2051.4*	*76*	*27.8*	*13.3*	*20.0*

III. MATERIALS AND METHODS

To achieve the purpose of the study, 13 samples was collected from the study area by dip (or grab) sampling method during April 2015 to May 2015.The location were the samples was collected, are being widely used for drinking and other domestic purposes. All the samples are collected from mid channel of the stream and river thereby avoiding local in homogeneous along the bank. Some parameters like temperature, ph, and conductance were measured in the field at the time of sample collection using moveable kits. The sample collected should be small in volume, enough to correct represent the whole water body. Use only specific equipment, including sample containers and other sampling equipment and is better to use laboratory supplied containers. Ensure that sampling equipment is clean and is maintain in good working order before use and at the end of sampling. The charge balance (calculated by the formula: (TZ++TZ-)X100/(TZ+- TZ-) between the cations and anions (less than 10%) and the ratio of TDS and EC (1.1) are within acceptable limit, confirming the reliability of the analytical result.

IV. RESULT AND DISCUSSION

S.No	Sample Id	DO	BOD	TDS	pH	EC	TH	Ca	Mg	Na	K	HCO_3	Cl	SO_4	NO_3	PO_4	F	Si
		mg/l	mg/l	mg/l		µcs/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	D1	2.5	1	641.9	7.69	958	203.43	190.4	13.03	8.3	1.9	240.4	6.4	192	1.8	0.9	0.66	0.5
2	D2	2.6	0.15	622.5	7.85	929	140.8	102.4	38.4	8.4	1.7	260	5.6	120.8	1.8	1	4.13	0.58
3	D3	2.1	0.7	622.5	7.81	929	152.83	101.6	51.23	5.3	1.6	216	8.4	206.2	1.5	0.8	3.84	0.33
4	D4	2.2	0.8	628.5	7.77	938	184.99	165.2	19.79	7.8	1.9	210.8	9.6	207.4	1.1	1.4	2.1	0.42
5	D5	2.1	1.7	561.5	7.85	838	136.83	106.4	30.43	4.9	1.3	253.2	10.6	65.7	2.9	1.2	2.21	0.75
6	D6	2.1	3.6	276.1	7.57	412	80.14	33.92	46.22	9.9	1.6	92.4	9	135.61	3.2	1.2	0.45	0.25
7	D7	1.8	1.6	263.4	7.98	393	61.34	31.2	30.14	10.4	1.7	113	7.8	78.5	1.1	0.8	0.71	0.25
8	D8	3.6	0.7	351.8	7.74	525	121.16	55.2	65.96	19.6	0.9	173.8	11.6	188.4	1.8	0.4	0.66	0.17
9	D9	6.23	1	519.3	8.37	775	109.61	54.4	55.21	15.3	3.3	155.2	16.4	157.9	1.1	1.2	0.9	0.17
10	D10	6.31	1	348.4	7.95	520	113.17	112	1.17	11.7	1.1	171.8	11.8	66	12.8	0.8	2.44	0.25
11	D11	6.5	1.26	505.9	8.09	755	120.87	66	54.87	12.5	1.6	307.2	13.2	21.5	3.2	1	1.6	0.08
12	D12	7.69	0.1	394.7	8.06	589	82.29	43.6	38.69	12	2.1	112	9.4	138	7.9	1.5	0.52	0.66
13	D13	8.2	1.22	441.6	7.89	659	81.67	45.6	36.07	6.9	1.5	101.6	11	148	4.7	1.1	0.31	0.49
	Average	4.15	1.15	475.24	7.9	709.24	122.25	85.22	37.01	10.24	1.71	185.19	10.07	132.77	3.46	1.03	1.58	0.38
	Max	8.2	3.6	641.9	8.37	775	203.43	190.4	65.96	19.6	3.3	307.2	16.4	207.4	12.8	1.5	4.13	0.75
	Min	1.8	0.15	263.4	7.57	393	64.34	31.2	1.17	4.9	0.9	92.4	5.6	21.5	1.1	0.4	0.31	0.08

A. pH and Electrical conductivity (EC)

The analytical data, calculated values, and statistical parameters like average, maximum, minimum are given in Table no 6.5. In the study area the pH of the springs water ranges from 7.57 to 8.37 with a average value of 7.9 and EC varies from 393 to 775micro mhos per cm and has average of 709.24 micro mhos per cm. The spring water in the study area falls in slightly alkaline categories. Very large variations in the electric conductivity may be attributed to variation to total dissolved solids. (sanchez- perez and Tremoliers 2003).Electrical conductivity is indirect method for salinity measurement (Hem,1989).

B. Total Dissolved Solid

The total dissolved solid represents summation of all concentration of cation and anions.The range of total dissolved solids in the water of springs was 263.4 to 641.9 mg/l and average TDS value 475.24 mg/l . The acceptable and permissible limit as per IS: 10500-2012 is 500 and 2000 mg/l respectively.

C. Total Hardness

It is indicator for presence of calcium and magnesium in water. Hardness can be precipitated by water heating. Total Hardness results from the presence of divalent metallic cations of which calcium and magnesium are the most abundant in groundwater. As per IS 10500-2012 desirable limit and permissible limit for hardness is les between 200 to 600 mg/l respectively. Hardness is important at evaluating the local use of water springs. The range of hardness for springs was 64.34 to 203.43 mg/l and the average was 122.25 mg/l.

D. Calcium

Calcium is the most abundant of the alkaline-earth metals and is a main constitute of many common rock minerals. It is an essential element for plant and animals life forms and is a major component of the solutes in most natural water. The most general forms of calcium in sedimentary rocks are carbonates. The two crystalline forms, calcite and aragonite, both have the formula $CaCO_3$, and mineral dolomite can be represented as $CaMg\ (Ca_3)_2$. A carbonate rock is commonly termed dolomite if the magnesium is present in amounts approaching the theoretical 1:1 mole ratio with calcium. The range of calcium in water of the springs was 31.2 to 190.4 mg/l and average value is 85.2. The acceptable limit of calcium according to (IS 10500:2012) is 75mg/l and permissible limit is 200 mg/l.

E. Magnesium

Magnesium is an alkaline-earth metal and has only oxidation state of significance in water chemistry, Mg^{2+}. It is a common element and is essential in plant and animal nutrition.High magnesium content in groundwater in coastal area indicates seawater contamination. The range of magnesium in water of the springs was 1.17 to 65.96 mg/l and average value is 37.01. The acceptable limit of magnesium according to (IS 10500:2012) is 30 mg/l and permissible limit is 100 mg/l.

F. Sodium

Most of the sodium salts are soluble in water but take no active part in chemical reactions as do the salts of alkaline earths. Sodium salts tend to remain in solution unless extracted during evaporation.

G. Potassium

Potassium is virtually as abundant as sodium in igneous rocks and metamorphic rocks but its concentration in drinking water is one-tenth or even one hundredth of sodium. The potassium is derived from silicate minerals like orthoclase, microcline, nepheline, leucite and biotite. Parity in concentrations of sodium and potassium is found only in water with less mineral contents.

H. Carbonate and Bicarbonate

The dissolved carbon dioxide derived from rain is the primary source of carbonate and bicarbonate ions in spring water. As it enters the soil or rocks, it dissolves more carbon dioxide in water.

The range of bicarbonate in the water of the springs was 90.2 to 307.4 mg/l & the average was 185.9mg/l. The desirable limit and permissible limit of bicarbonate in water 200 mg/l to 600 mg/l.

I. Chloride

Chloride bearing rock minerals such as Sodalite and Chlorapatite, which are very small constituents of igneous and metamorphic rocks and liquid inclusions which comprise very unimportant fraction of the rock volume, are minor sources of chloride in spring water. Chloride salts being highly soluble and free from chemical reactions with minerals of reservoir rocks, remain stable once they enter in solution.The range of chloride in the water of the springs was between 5.6 mg/l to 16.4 mg/l and the average was 10.07 mg/l. The desirable limit and permissible limit of chloride in water 250 mg/l to 1000 mg/l.

J. Sulphate

Water present in igneous or metamorphic rocks contains less than 100 ppm sulphate (Davis and Dewiest 1966). The range of sulfate in the water of the springs was 21.5 mg/l to 207.4 mg/l and average value of sulfate 132.77 mg/l. The desirable and permissible limit of sulfate is 200mg/l & 400mg/l)

K. Nitrate

The concentration of Nitrate in springs water range from 1.1 to 12.8mg/l and average value is 3.46 mg/l.Nitrate is present in raw water and mainly it is a form of N_2 compound (of oxidized state.).The method to measure quantity of nitrate is by UV spectrometer. As per IS: 10500-2012 desirable limit for nitrate is maximum 45 and no relaxation in permissible limit.

L. Fluoride

The fluoride occurs as fluorspar, rock phosphate, triphite, phosphorite crystal etc, in nature. Among factor which controls the concentration of fluoride are the climate of the area and the presence of accessory minerals in the rock minerals assemblage through which the ground water is circulating. As per IS 10500-2012 desirable limit for fluoride is 1 and 1.5 mg/l in permissible limit. The concentration of Fluoride in spring's water range from 0.31 to 4.13mg/l and average value is 1.58 mg/l.

M. Silica

The crystalline form of silica, feldspars, feldspathoids, amphiboles, pyroxene and mica the silicate minerals are the chief source of silica in spring water. In the freshwater, silica comes next in abundance to bicarbonate, but at higher concentrations the silica content is usually less than sodium bicarbonate, sulphate and chloride. Normal concentrations of silica are found in some highly alkaline waters, and also in some acidic waters.

V. CONCLUSION

From the above papers we have concluded all the parameter which are analyzed are within the permissible limit as per IS10500-2012 but some of parameter are above the acceptable limit. Hence there is a no need of proper analysis of water and prior treatment.

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