Physicochemical Analysis of Selected Spring Water Samples Used for Drinking Purpose at Pithoragarh City, Uttarakhand, India

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Abstract

Springs are the main sources of natural water at hill areas, used for various purposes like drinking, washing and other house hold consumptions. Drinking water has always been a subject of concern with reference to the public health. The present study deals with the analysis of physico- chemical parameters of some of the spring water samples of Pithoragarh city, Uttarakhand. The selection of sampling sites was on the basis of their use, by maximum people, for drinking purpose. Total 9 stations were selected for the study. Out of these 9 stations, some of the well-known sites, which are being used at a wide level are Hudkana Dhara near Wadda, Mahadev Dhara near G.I.C. Pithoragarh, Rai Dhara and Dhara near Gurna Temple at Pithoragarh**.** There are factors like weathering of rocks, leaching of soil which affect the quality of natural water so there is a great requirement for the analysis of potable water time to time. The samples were collected during September- November 2017 and April-May 2018. Total 12 Parameters were taken under consideration during this analysis viz. Temperature, pH, TDS, Electrical conductivity, DO, Total Hardness, Alkalinity, chloride, fluoride, Phosphate, Nitrate, sulfate. The results were compared with standards prescribed by BIS (IS 10500: 2012). It was observed that out of 12 parameters for the 9 stations, some were below the acceptable limit, some were beyond the permissible limit and some were in between the acceptable limit and permissible limit.

Keywords: Spring water, Drinking water, Public health, Physico- chemical parameters

Introduction:

Water is an important resource on the earth for the survival. In earlier time, the settlement of any society used to be on the basis of availability of water in that area. (**1**). Water is an elixir on the earth. It is essential for the survival of humans as well as for animals and plants. Not only the quality but also the quantity of water is getting emaciated due to rapid population growth, deforestation, urbanization and industrialization. (**2).** There are many natural reasons also which are responsible for the deterioration of water quality viz, gases, soil, minerals, humus materials, domestic sewage, waste created by animals and the living organisms which are present in water**.** All the constituents present in any water body depends on its surrounding nature where the water body is situated. **(3).**

At the mountains, natural water is used widely for drinking purpose and other household activities. Natural water can be in the form of rivers, lakes, ponds, springs, streams etc. A spring can be defined as the natural source of water at hill areas in which water flows on the surface of the earth from below the earth surface. (**4**) and according to Santosh Singh and DK Tripathi, springs occur at those places where there is an inclined ground and ground water which is under high pressure, find its way to flow at the surface of the land. (**5,6**).

The present study deals with the analysis of physicochemical properties of spring water at Pithoragarh city of Uttarakhand. Those sites are selected for the analysis which is widely being consumed by the population of that area for drinking purpose. Mountain springs are known as *dharas* and *naulas*. *Dharas* are mainly divided into three categories depending upon their height and nature of flow. They are described as:

1. Sirpatia Dhara: where an individual can easily drink water from the source in a standing position
2. Murpatia Dhara: where an individual need to bend up to knee level to drink water.
3. Patveedia Dhara: Those springs which get recharge during rainy season. They are perennial in nature. (**7**).

Study Area:

Pithoragarh is a town at an elevation of 1645 metres from sea level and having the co-ordinates 29.4° to 30.3° in longitude and 80° to 81° latitude along the eastern and southern part of the central Himalayas with Indo-Tibetan watershed divide in the north and the Kali river. (**8**)

Material and Methods:

Total 9 spring water samples were collected. Details of sampling sites are mentioned in table no. 1.The samples were collected in clean polypropylene double capped 250 ml sample bottles in between the month September- November 2017 and April- May 2018 .Total 12 parameters were performed.All the tests were carried out by comparing the value with standards prescribed according to BIS (IS 10500: 2012) and WHO **(9,10).**

Some of the materials and methods used are as follows:

1. Multiparameter was used for the analysis of pH, TDS, EC, DO and temperature.
2. Total Hardness was made done through titration method using ammonia buffer, EBT as indicator and EDTA as titrant.
3. Total Alkalinity was performed through titration method.
4. Chloride was also analyzed through titration using Mohr's Method.
5. Multiparameter Photometer was used for the analysis of fluoride (by SPADNS method), nitrate (by Adaptation of the cadmium reduction method), phosphate (by Adaptation of the Ascorbic Acid method) and sulfate (by precipitation with barium chloride crystals).

Table 1. Table for the information of sampling sites:

S.No.	Sample Code	Name of the spring (if given)	Name of the location/ sampling site	GPS Co-ordinates
1	A	Hudkana Dhara	Wadda, Pithoragarh	N-29.56879° E-80.26696°
2	B	Mahadev Dhara	GIC Pithoragarh	N-29.57628°

				E-80.19933°
3	C	Rai Dhara	Rai, Pithoragarh	N-29.58928° E-80.22024°
4	D	Gurna Dhara	Gurna Temple, Pithoragarh	N-29.52176° E-80.15534°
5	E	Mahadev Dhara	Visad, Pithoragarh	N-29.56489° E-80.18012°
6	F	Mahadev Dhara	Pithoragarh Market	N-29.58446° E-80.21125°
7	G	Marh Dhara	Marh-Kharayat, Pithoragarh	N-29.61024° E-80.21635°
8	H	Subterranean spring	Chaira, Pithoragarh	N-29.62559° E-80.19305°
9	I	Subterranean spring	Satsiling, Pithoragarh	N-29.61894° E-80.23657°

Result and Discussion:

Observations found for various parameters are discussed separately as below:

1. **pH**: The pH ranges from 6.8-7.9 in pre monsoon while the range is from 6.99-7.89 in post- monsoon (table 5). The table 5 for the value of pH shows that the pH is decreased in post-monsoon season. The lower values of pH in post monsoon season can be due to turbidity causing excessive microbial activity, resulting in production of CO_2 due to which pH is decreased ***(11)*** This decrease doesn't cause any harmful effect. The Permissible limit for pH is 6.5-8.5 and the values obtained for pH, before and after monsoon are within limit.
2. **Total Dissolved Solids:** Total dissolved solids refer to the solids dissolved in water. High TDS decreases the water quality of drinking water since it contains more solids.

High TDS causes stomach related problems mainly **(12).** The TDS values for different samples in pre and post- monsoon are mentioned in table no. 6. The TDS ranges from 315-729 in pre- monsoon and 326-704 during post- monsoon. The desirable limit for TDS is 500mg/L for drinking water **(10).** All the samples are within desirable limit except of sample no. F (Mahadev Dhara at Market area) and sample no. G (Marh dhara) which is above desirable limit in both the seasons and sample H (subterranean spring at chaira) having higher value of TDS in post-monsoon season.

3. **Electrical Conductivity:** EC is the measure of total dissolved solids. **(13).** More the TDS, more will be the conductance because in this state water contains more solids in dissolved form. The desirable limit for EC is 300 µS /cm.EC ranges from 321-1103 in pre-monsoon and 365-1052 in post- monsoon. The results show that EC is increased during post- monsoon but in two samples viz, F (Mahadev dhara at Market) and I (Satsiling), the value is decreased (table no.7).

4. **Temperature:** The desired temperature of water is 10°C. The temperature value for samples in both the seasons is explained in table no.8.The temperature varies from 15.2°C-19.7°C in pre- monsoon and 13.1°C-25.7°C during post- monsoon. Table 8 shows that the temperature is increased in post- monsoon except of sample no. C (Rai Dhara) and G (Marh- Dhara) which having lower values in post- monsoon season.

5. **DO:** DO refers to the dissolved oxygen in water. The DO required for fish growth is 4 mg/L **(12).** The values observed for DO ranges from 4-8.9 in pre- monsoon season and 5.8-9.9 in post monsoon. (table no.9). The higher value of DO in post- monsoon may be due to less turbidity and increased photosynthetic activity of green algae present there. **(14).**

6. **Fluoride:** The limit for fluoride is 1-1.5 according to standards prescribed in table 10. The fluoride ranges from 0.01-0.35 mg/L for pre- monsoon and <0.01-0.28 mg/L for post-monsoon. (table no.10). The data shows that fluoride value is decreased in post- monsoon. Fluoride values are within acceptable limit for all the samples in both the seasons.

7. **Chloride:** Chloride ranges from 49.63- 148.89 mg/L for pre- monsoon and 49.63-106.35 mg/L for post- monsoon (table no.11). The results show that chloride is decreased during post- monsoon except of sample G (Marh Dhara) and one sample A (Hudkana Dhara) having same value of chloride in both the seasons. The limit for chloride is 250-1000 mg/L according to standard limit. All the values of chloride for both the seasons are within acceptable limit.

8. **Nitrate:** Nitrate value for drinking water should be <45 mg/L according to standard limit. The samples show that nitrate varies from <0.1- 18.3 for pre- monsoon and <0.1-18.4 mg/L for post- monsoon (table no.12). The nitrate value is increased in post-monsoon except of sample I (Subterranean stream at Satsiling). All the samples having nitrate value within the range of standards.

9. **Sulfate:** Sulfate in drinking water should range from 200-400 mg/L. The samples show that sulfate ranges from 1-45 for pre- monsoon and 1-53 for post- monsoon. Two samples having same sulfate value in both the seasons, 5 samples having increased value of sulfate in post- monsoon and two sample having decreased value of sulfate in post- monsoon (table no. 13). The sulfate in various samples is within desired limit.

10. **Phosphate:** Phosphate value varies from <0.01-2.19 in pre-monsoon and <0.01-2.24 in post- monsoon. No significant relationship is obtained for phosphate variation in pre and post- monsoon (table no. 14).

11. **Total Hardness**: Ca and Mg are the key factors for hardness. Permanent hardness is caused by chloride and sulfate of metals. The desirable limit for hardness is 200 mg/L and permissible limit is 600 mg/L. The samples show the variation from 136-400 mg/L for pre- monsoon and 144-360 mg/L for post- monsoon. The results show that hardness is decreased in post- monsoon except of sample D (Gurna dhara). Rocks in the surrounding participate in the hardness of water. The reason for this decrease may be that there is not enough time for the interaction between the rain water and rocks, so that there is no runoff from rocks. 8 samples having hardness greater than desirable limit in both the seasons (table no. 15).

12. **Total Alkalinity:** Alkalinity of water may be defined as its capacity to neutralize acid. Desirable limit for alkalinity is 200 mg/L and permissible limit is 600 mg/L. The value of alkalinity varies from 192-360 mg/L for pre- monsoon and 128-368 mg/L for post-monsoon (table no.16). Alkalinity is increased in post- monsoon except of 3 samples namely F, H, I.

Correlation analysis:

The correlation table for pre- monsoon shows that pH is positively correlated with DO (0.586284) and similar results were found by Khanna *et al.* (2013) **(15).**

pH is positively correlate with fluoride (0.190674) also. and shows negative relationship with other parameters. pH shows negative correlation with EC and chloride, Selakoti B. also observed the same results. **(16).** TDS is strongly positively correlated with EC (0.999176), sulfate (0.935714) and negatively with DO (-0.94789). EC having strong positive correlation with

sulfate (0.934996), chloride (0.611472), phosphate (0.37883), fluoride (0.322152) and strong negative correlation with DO (-0.94871) and nitrate (-0.56295). The results show that sulfate, chloride, phosphate, fluoride is present in water samples in soluble form. Temperature is positively correlated with fluoride, nitrate, sulfate and phosphate while negatively with chloride, DO, Total hardness and total alkalinity. DO shows positive correlation with nitrate (0.538432) and negative with fluoride, chloride, sulfate, phosphate, total hardness and total alkalinity. Fluoride shows positive correlation with sulfate, total hardness, total alkalinity and negative with chloride, nitrate and phosphate. Chloride is positively correlated with phosphate (0.087254), sulfate, total hardness and total alkalinity, and negatively correlated with nitrate (-0.30611). Nitrate is negatively correlated with sulfate, phosphate, total hardness (-0.82585) and total alkalinity (-0.87354) shows positive correlation with phosphate, total hardness and total alkalinity, Phosphate shows positive correlation with total hardness and total alkalinity. Total hardness shows positive correlation with total alkalinity (0.752231) (table no.17).

In post- monsoon season, EC shows positive correlation with fluoride (0.871937), chloride (0.772893), nitrate (0.425608), sulfate (0.88687) and phosphate (0.177673) (table no.18). The results show that sulfate, chloride, phosphate, fluoride is present in water samples in soluble form.

The analysis revealed that TDS of three samples is higher than desirable limit, EC of all the samples is above prescribed limit for both the seasons. Eight samples having higher value of hardness and alkalinity value is also increased above desirable limit for most of the samples in both the seasons. Fluoride, chloride, nitrate, sulfate value for all the samples is within desirable limit of prescribed standards. pH of all the 9 samples is within BIS limit.

Different tables for the values of drinking water are mentioned below:

Table 2. BIS and WHO limits for different parameters (9 and10)

Parameters	Acceptable limit	Permissible limit
pH	6.5-8.5	-
TDS(ppm)	500	2000
EC(µS/cm)	300(WHO)	-
Temp. (^{o}C)	10	25
DO(ppm)	5	
F^{-}(ppm)	1	1.5
Cl^{-}(ppm)	250	1000
NO_3^{-}(mg/L)	<45	
PO_4^{-3} (mg/L)	-	-
Total Hardness(mg/L)	200	600
Total Alkalinity(mg/L)	200	600

3.Table for physico chemical parameters at pre monsoon

Sample code	pH	TDS (ppm)	EC (µS/cm)	Temp. (°C)	DO (ppm)	F^{-} (ppm)	Cl^{-} (ppm)	NO_3^{-} (mg/l)	SO_4^{2-} (mg/L	PO_4^{3-} (mg/l)	Total hardness (mg/l)	Total Alkalinity (mg/l)
A	7.9	321	478	19.2	8.8	0.35	49.63	<0.1	1	0.01	232	208
B	7.45	349	507	18.9	8.7	0.13	77.99	18.4	1	0.06	296	280
C	7.8	357	509	15.2	8.1	0.12	120.53	<0.1	1	0.17	328	288

D	7.9	315	448	18.1	8.9	0.02	106.35	<0.1	1	0.1	136	192
E	7.6	434	642	19.7	6.1	0.24	70.9	<0.1	1	<0.01	352	216
F	7.12	729	1103	19.2	4	0.31	148.89	11.8	45	0.23	344	360
G	7.68	553	843	19.3	5.2	0.15	99.26	10.6	22	2.19	400	336
H	7.45	492	730	16.3	6.4	0.1	99.26	7.9	10	0.05	352	360
I	6.8	446	658	18.8	6.2	0.01	106.35	1.6	20	0.8	240	208

4. Table for physico chemical parameters at post monsoon:

Sample code	pH	TDS (ppm)	EC (µS/cm)	Temp. (°C)	DO (ppm)	F^- (ppm)	Cl^- (ppm)	NO_3^- (mg/l)	SO_4^{2-} (mg/L	PO_4^{3-} (mg/l)	Total hardness (mg/l)	A
A	7.61	323	486	21.2	8.8	0.08	49.63	<0.1	1	0.22	216	
B	7.45	367	543	19.5	9.9	<0.01	42.54	18.4	3	0.02	256	
C	7.55	369	556	13.1	8.4	0.09	85.08	<0.1	4	0.17	312	
D	7.89	326	492	19.8	9.3	<0.01	63.81	<0.1	1	0.1	176	
E	7.18	443	672	22.4	7.5	0.16	63.81	<0.1	2	0.06	296	
F	7	704	1052	25.7	5.8	0.28	106.35	11.8	53	0.01	328	
G	7.36	565	845	16.8	7.1	0.12	106.35	14.4	21	2.24	360	
H	7.24	521	753	19.1	7.6	<0.01	63.81	15.1	12	<0.01	320	
I	6.99	245	365	20.6	5.9	0.08	56.72	1.6	3	0.86	144	

Tables for different values of parameters in pre- monsoon and post-monsoon seasons are given below:

5.pH table:

Sample Code	Pre-monsoon	Post-monsoon
A	7.9	7.61
B	7.45	7.45
C	7.8	7.55
D	7.9	7.89

E	7.6	7.18
F	7.12	7
G	7.68	7.36
H	7.45	7.24
I	6.8	6.99

8.Temperature table

Sample Code	Pre-monsoon	Post-monsoon
A	19.2	21.2
B	18.9	19.5
C	15.2	13.1
D	18.1	19.8
E	19.7	22.4
F	19.2	25.7
G	19.3	16.8
H	16.3	19.1
I	18.8	20.6

6.TDS TABLE

Sample Code	Pre-monsoon	Post-monsoon
A	321	323
B	349	367
C	357	369
D	315	326
E	434	443
F	729	704
G	553	565
H	492	521
I	446	245

7.EC TABLE

Sample Code	Pre-monsoon	Post-monsoon
1	321	486
2	507	543
3	509	556
4	448	492
5	642	672
6	1103	1052
7	843	845
8	730	753
9	658	365

9.DO Table:

Sample Code	Pre-monsoon	Post-monsoon
A	8.8	8.8
B	8.7	9.9
C	8.1	8.4
D	8.9	9.3
E	6.1	7.5
F	4	5.8
G	5.2	7.1
H	6.4	7.6
I	6.2	5.9

10.Fluoride Table:

Sample Code	Pre-monsoon	Post-monsoon
A	0.35	0.08
B	0.13	<0.01
C	0.12	0.09
D	0.08	<0.01
E	0.24	0.16
F	0.31	0.28
G	0.15	0.12
H	0.1	<0.01
I	0.01	0.08

11.Chloride Table:

Sample Code	Pre-monsoon	Post-monsoon
A	49.63	49.63
B	77.99	42.54
C	120.53	85.08

D	106.35	63.81
E	70.9	63.81
F	148.89	106.35
G	99.26	106.35
H	99.26	63.81
I	106.35	56.72

12.Nitrate Table:

Sample Code	Pre-monsoon	Post-monsoon
A	<0.1	<0.1
B	18.4	18.4
C	<0.1	<0.1
D	<0.1	<0.1
E	<0.1	<0.1
F	11.8	11.8
G	10.6	14.4
H	7.9	15.1
I	<0.1	1.6

13.Sulfate table:

Sample Code	Pre-monsoon	Post-monsoon
A	1	1
B	1	3
C	1	4
D	1	1
E	1	2
F	45	53
G	22	21
H	10	12
I	20	3

14.Phosphate Table:

Sample Code	Pre-monsoon	Post-monsoon
A	0.01	0.22
B	0.06	0.02
C	0.1	0.17
D	0.05	0.1
E	<0.01	0.06
F	0.23	0.01
G	2.19	2.24
H	0.05	<0.01
I	0.8	0.86

15. Total Hardness:

Sample Code	Pre-monsoon	Post-monsoon
A	232	216
B	296	256
C	328	312
D	136	176
E	352	296
F	344	328
G	400	360
H	352	320
I	240	144

16.Total Alkalinity:

Sample Code	Pre-monsoon	Post-monsoon
A	208	256
B	280	312
C	288	320
D	192	232
E	216	368
F	360	328
G	336	384
H	360	336
I	208	128

Table No. 17: Correlation table for pre monsoon

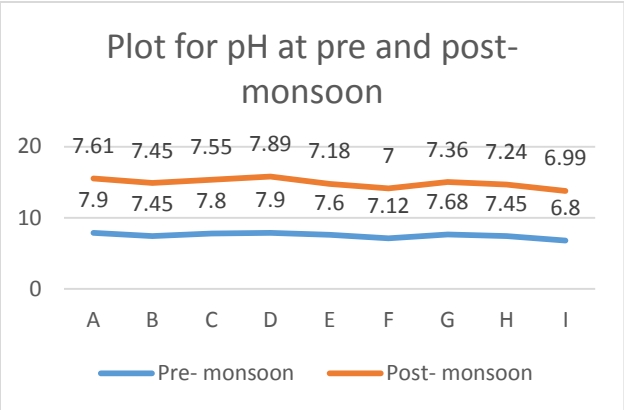
Parameters	pH	TDS (ppm)	EC (µS/cm)	Temp. (°C)	DO (ppm)	F^- (ppm)	Cl^- (ppm)	NO_3^- (mg/l)	SO_4^{2-} (mg/L	PO_4^{3-} (mg/l)	Total hardness (mg/l)	Total Alkalinity (mg/l)
pH	1	-0.545163	-0.53454	-0.21033	0.58624	0.19064	-0.4205	-0.50754	-0.63978	-0.10166	-0.15745	-0.19932
TDS (ppm)		1	0.99916	0.233417	-0.94789	0.30314	0.63731	-0.55622	0.935714	0.359183	0.602937	0.716907
EC (µS/cm)			1	0.25771	-0.94871	0.32212	0.61142	-0.56295	0.934996	0.37883	0.608237	0.713556
Temp. (°C)				1	-0.28176	0.40175	-0.32694	0.517036	0.278467	0.35072	-0.03915	-0.27268
DO (ppm)					1	-0.21864	-0.5342	0.538432	-0.85535	-0.50843	-0.65363	-0.58442
F^- (ppm)						1	-0.23695	-0.37127	0.213901	-0.14072	0.317559	0.16173
Cl^- (ppm)							1	-0.30611	0.698041	0.087254	0.166636	0.521166
NO_3^- (mg/l)								1	-0.27392	-0.14905	-0.82585	-0.87354
SO_4^{2-} (mg/L									1	0.36166	0.35908	0.57308
PO_4^{3-} (mg/l)										1	0.461282	0.227135
Total hardness (mg/l)											1	0.752231
Total												1

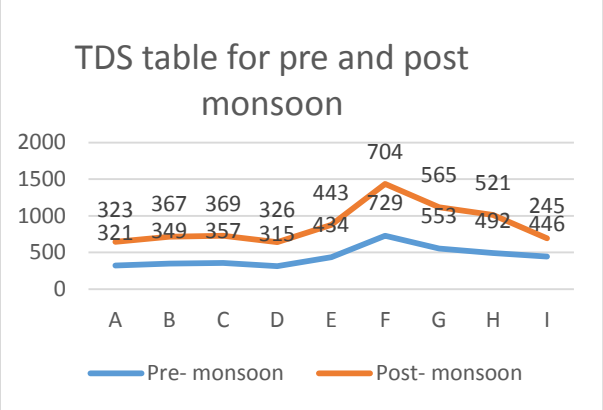
Alkalinity (mg/l)												

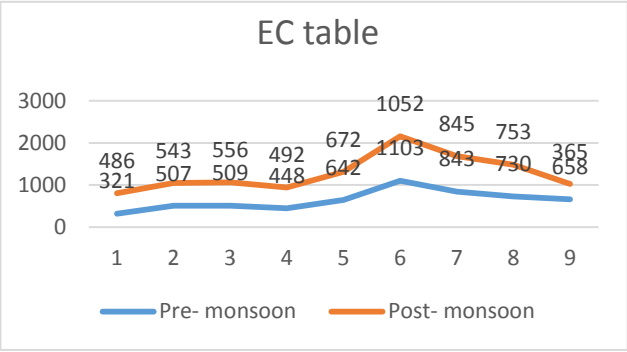
Table No. 18: Correlation table for post- monsoon

Parameters	pH	TDS (ppm)	EC (µS/cm)	Temp. (°C)	DO (ppm)	F^- (ppm)	Cl^- (ppm)	NO_3^- (mg/l)	SO_4^{2-} (mg/L	PO_4^{3-} (mg/l)	Total hardness (mg/l)	Total Alkalinity (mg/l)
pH	1	-0.41806	-0.41132	-0.45151	0.844176	-0.5643	-0.2602	0.809737	-0.50842	-0.15395	-0.23568	-0.07184
TDS (ppm)		1	0.998916	0.324179	-0.45367	0.871292	0.7587	0.439289	0.883941	0.181476	0.818762	0.765681
EC (µS/cm)			1	0.330133	-0.45578	0.871937	0.772893	0.425608	0.88687	0.177673	0.817397	0.770015
Temp. (°C)				1	-0.37742	0.669283	-0.05863	-0.2541	0.465034	-0.34552	-0.1671	-0.05738
DO (ppm)					1	-0.54954	-0.55909	0.749888	-0.61412	-0.34906	-0.18455	0.030069
F^- (ppm)						1	0.594416	0.497204	0.884333	-0.29247	0.504018	0.509191
Cl^- (ppm)							1	0.021765	0.765178	0.453119	0.673132	0.52407
NO_3^- (mg/l)								1	0.07732	-0.09006	0.712804	0.837041
SO_4^{2-} (mg/L									1	0.110451	0.53905	0.42705
PO_4^{3-} (mg/l)										1	0.2761	0.117719
Total hardness (mg/l)											1	0.940467
Total Alkalinity (mg/l)												1

Plots for physico- chemical parameters of samples in pre and post monsoon seasons are given below:


Plot for pH at pre and post-monsoon
20
10
0
7.61 7.45 7.55 7.89 7.18 7 7.36 7.24 6.99
7.9 7.45 7.8 7.9 7.6 7.12 7.68 7.45 6.8
A B C D E F G H I
Pre- monsoon
Post- monsoon


TDS table for pre and post monsoon
2000
1500
1000
500
0
323 367 369 326 443 704 565 521
321 349 357 315 434 729 553 492 446 245
A B C D E F G H I
Pre- monsoon
Post- monsoon


EC table
3000
2000
1000
0
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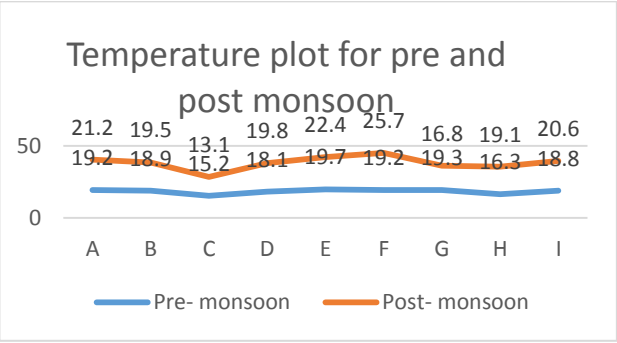
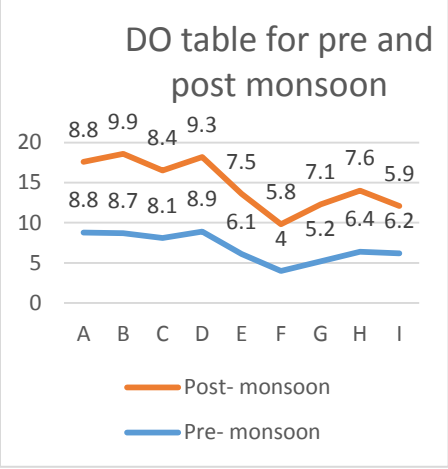
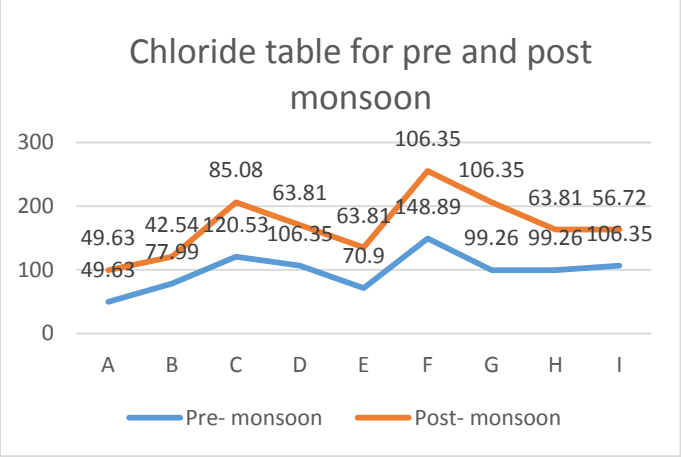
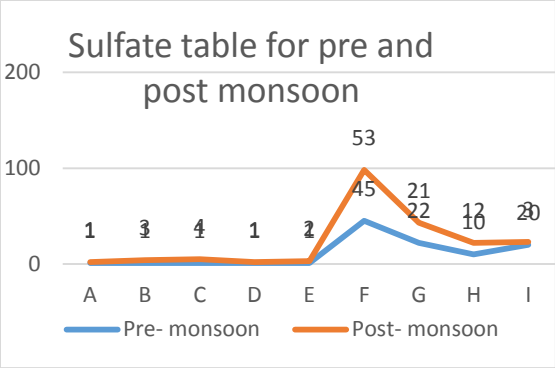
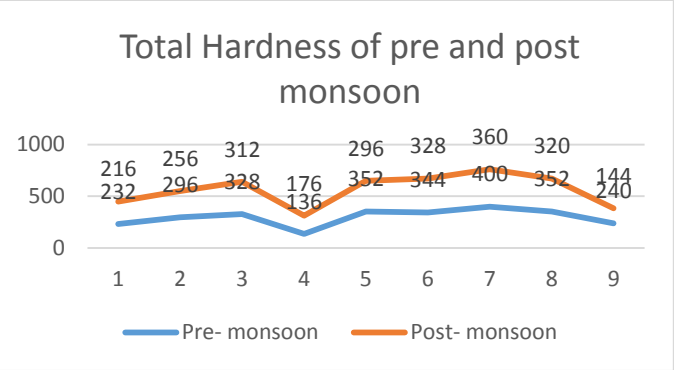
321 507 509 448 642 1103 843 730 658
1 2 3 4 5 6 7 8 9
Pre- monsoon
Post- monsoon

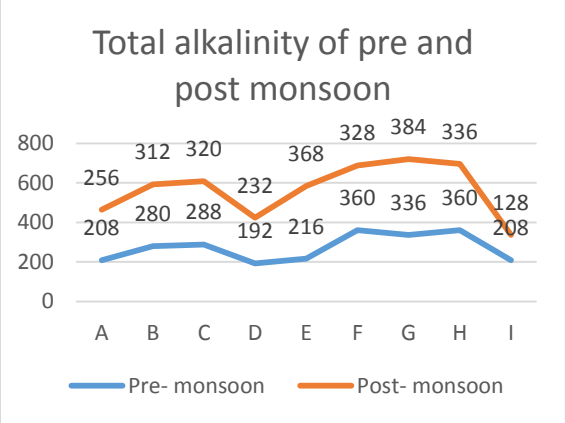

Temperature plot for pre and post monsoon
50
0
21.2 19.5 13.1 19.8 22.4 25.7 16.8 19.1 20.6
19.2 18.9 15.2 18.1 19.7 19.2 19.3 16.3 18.8
A B C D E F G H I
Pre- monsoon
Post- monsoon


DO table for pre and post monsoon
20
15
10
5
0
8.8 9.9 8.4 9.3 7.5 5.8 7.1 7.6 5.9
8.8 8.7 8.1 8.9 6.1 4 5.2 6.4 6.2
A B C D E F G H I
Post- monsoon
Pre- monsoon


Chloride table for pre and post monsoon
300
200
100
0
49.63 42.54 85.08 63.81 63.81 106.35 106.35 63.81 56.72
49.63 77.99 120.53 106.35 70.9 148.89 99.26 99.26 106.35
A B C D E F G H I
Pre- monsoon
Post- monsoon







Conclusion:

From the above study it is clear that almost all the parameters for the samples are within the range prescribed by the standards followed (BIS and WHO). High TDS values of samples can be reduced through distillation method or reverse osmosis process. Biological activities should also get checked before drinking purpose and suitable methods for the same can be applied according to availability. Various purification methods can be used to remove sediments, bacteria, parasites which are not visible by bare eyes. Some of the methods are boiling, filtration, distillation, chlorination. Almost all the sampling sites which are selected for analysis are at less populated areas and the sources are being used as primary source for drinking purpose, so government should also look after them time- by- time so that all these sites can be retained in good condition for its use by local public.

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Authors are thankful to BRNS, Health Physics Division, Bhabha Atomic Research Centre, Trombay, Mumbai for providing financial assistance under project.

References:

1.Mahmoud A, Emmanuel E, Joseph J, Bobby L (2001) Chemical evaluation of commercial bottled drinking water from Egypt. Journal of Food Composition
and Analysis 14: 127-152.

2. Santosh Singh, R.S. Negi , Rekha Dhanai and M.K. Parmar, Science Park Research Journal(2014). Physico-chemical Study of Springs: A Case Study of Muchlad Gad Watershed Garhwal Himalaya, Uttarakhand, India.Vol-2, Issue-19, 20 Nov 2014.Impact Factor: 1.6200[UIF-2013])

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ISSN 2319–1414
Vol. 3(12), 44-51, December (2014) *Int. Res. J. Environment Sci.)*

4.Ibeneme, S.I.1, Ukiwe, L.N.2, Essien, A.G.1, Nwagbara, J.O.1, Nweze, C.A.2, Chinemelu, E.S.1 And Ivonye, C.A.1 1Department of Geosciences, Federal University of Technology,Owerri, Imo State, Nigeria. 2Department of Chemistry, Federal University of Technology,Owerri, Imo State, Nigeria. Assessment of the Chemical Characteristics of a Spring Water Source at Ife-Owutu, Ezinihite-Mbaise, Southeastern Nigeria.
American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936
Volume-02, Issue-10, pp-282-290 www.ajer.org, 2013)

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© 2014 IJEDR | Volume 2, Issue 4 | ISSN: 2321-9939. A study of physico-chemical parameters of springs around Srinagar Garhwal valley, Uttarakhand.

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IJIRST –International Journal for Innovative Research in Science & Technology| Volume 2 | Issue 05 | October 2015. ISSN (online): 2349-6010.

7. AS Rawat (2009)**,**Traditional knowledge of water management in Kumaon Himalaya nopr.niscair.res.in/bitstream/123456789/3942/1/IJTK%208(2)%20249-254.pdf. Cited by 15 - Related articles

8.(http://msmedihaldwani.gov.in/)

9.Indian Standard DRINKING WATER — SPECIFICATION (Second Revision) ICS 13.060.20, IS 10500 : 2012, pp:1-2.

10.Mumtazuddin S, Azad A.K, Bharti Prabhat and Ranjan Rakesh, Physico-chemical analysis of groundwater of the Budhi Gantak belt in Muzaffarpur district, India*), I. Res. J.Environme Sci.*, 1(1), 7-11 (2012).

11.APHA-AWWA-WPCF Standard methods for the Examination of Water and Wastewater, Editor A.D.. Eaton, 18th ed*., American Public Health Association.*

12. Shivayogimath C. B, Kalburgi P.B, Deshannavar U.B and Virupakshaiah D.B.M, Water Quality Evaluation of River Ghataprabha (India*), I. Res. J.EnvironmeSci.*, 1(1), 12-18 (2012).

13.Bhattacharya T, Chakraborty S. And Tuck Neha, Physico-chemical characterization of ground water of Anand dietrict, Gujarat, India *Int. Res. J. Environmental Sci,* 1(1), 28-33 (2012).

14.STUDIES ON PHYSICOCHEMICAL PARAMETERS TO ASSESS THE WATER QUALITY OF River GANGA FOR DRINKING PURPOSE IN HARIDWAR DISTRICT
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Vol.2, No.1 (2009), 195-203 ISSN: 0974-1496 CODEN: RJCABP, RASAYAN J. CHEM.)

15. Khanna, D.R., Rana Rajni, and Ishaq Fouzia 2013. Impact of water quality on the phytoplankton abundance of paniyala fish pond in Roorkee, District Haridwar, Uttarakhand. Environment Conservation Journal. 14(3):29-32.

16. Babita Selakoti* and S.N. Rao, Radhe Hari Government Post Graduate College Kashipur, Uttarakhand, India, A study on seasonal fluctuations in physico-chemical variables in spring fed Kosi River at Almora province from central Himalaya, India, Int.J.Curr.Microbiol.App.Sci (2015) 4(4): 418-425, ISSN: 2319-7706 Volume 4 Number 4 (2015) pp. 418-425)