Evaluation of Water Quality Varies Between Pre-monsoon and Post-monsoon Season of the Typical Contaminated Asan River of Doon Valley, Uttrakhand, India

Mitasha Kaushik[1], Manish Sharma[2]

[1,2]School of Science and Technology, Jigyasa University (Formerly Himgiri Zee University), Dehradun, Uttarakhand, India.

Corresponding Author: Mitasha Kaushik: mitashahbt@gmail.com

Abstract: The current research is performed to judge the Asan River water quality by the analyzing its physicochemical and biological parameters. River Asan which is branch of River Yamuna, it flows through the Dehradun district of Uttrakhand in India from north Himalayan state and it receives high untreated domestic wastes and industrial waste from the towns and areas that are situated on the edge of Asan River at the downstream of the river after it reaches Dehradun District, Uttrakhand. Observing all the locations and point sources of waste discharges, five sampling stations were collected from water starting to end point of Asan River with longitude and latitude. In this study of 29 parameters including temperature, pH, Electric conductivity, Dissolved oxygen, BOD, Chemical oxygen demand, TSS, TDS, turbidity, Total Hardness, Ca, Mg, Lead, Mercury, Sodium, Potassium, Alkalinity, Chloride, Sulphate, Nitrate, Flouride, Ammonia, Surfactants, sulphide, Iron, Phenol, Total bacteria count, E.Coli, Coliform were studied and compared to the accountable limits given by WHO for drinking water during Pre-monsoon and post monsoon (2024). Results data after analysis shows that some parameters of Asan River such as turbidity, sodium and potassium were higher in limits than given by WHO standard during the pre-monsoon season and some parameters like alkalinity, sodium, potassium TDS and TSS are higher during post-monsoon. Although, some parameters found were not in prescribed limit given by different standards. Due to which it has become important to work on waste treatment and important to monitor environment shield inhabitants from safety hazards.

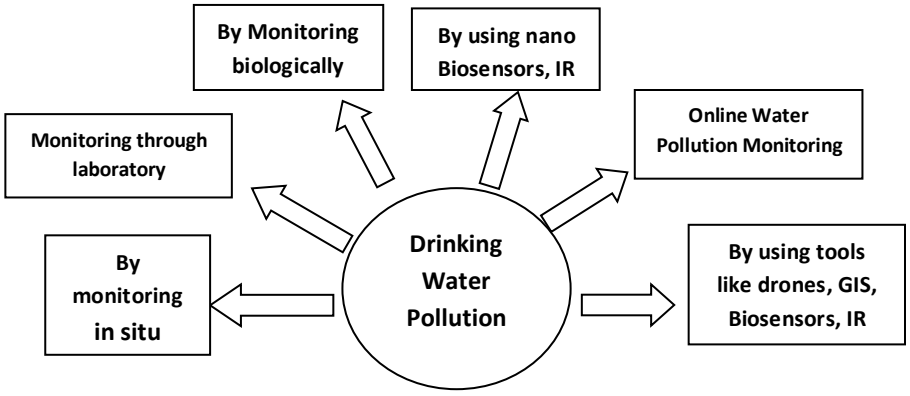
Keywords: physico-chemical parameters, Water pollution, Environment monitoring, waste management, waste treatment, environment management.

Introduction: Water is primary component on planet and it has a powerful relationship between river water and every types of life existence that rely on it to survive. As the time is passing with the growth of urbanization and industrialization the water is becoming poorly manageable in the growing countries. The profitable and environmental growth and progress of our country as well as states are all highly control by water. Physiographic and climatic condition of the country as well as districts is being highly responsible for the supply of fresh water. The fresh water of the country and all states are becoming unprotected, all is due to municipality wastewater, industrial wastes and agricultural practices with pesticides and insecticides. The quality of water not always depends on water itself is also rely on the harmful substances present in ecosystem.

The surface water chemistry is governed by distribution of many components given by nature such as rain and chemical weathering and other anthropogenic sewage sources, effluents from industries and solid wastes from mining and municipal and mining (Semwal 2009). Due to growth in industrialization, urbanization and chemical fertilizers application that are involved in agricultural grounds there is severely reduction in the condition of river water in which they are surrounded by.
The rivers are always counted as the most significant source of fresh water from the time of ancient history as rivers water is using for diverse segments such as public water supply, transportation, industry, agricultural (Shiddamallayya, 2008). In now days, most of the water is wasted for domestic waste, industrial waste and waste from sewage that is being discarded directly in the river water or around the river. The nitrate and chloride concentration is increase the water of both ground and surface due to which the penetration of industrial waste, sewage effluents and agro-waste (Hern and Feltz , 1998). The transform in ground water hydrochemistry is give rise by the interaction of water to rock and penetration of reduction-oxidation in the time of penetration through aquifers of water (Krishna Kumar et al. 2004). During the glacial melt in streams the ionic composition are detected in Bhagirathi river were analyzed individually to notice the ions contribution within the river. In Bhagirithi river the composition of cations observed as Ca>Mg > Na > K> NH4 and the composition of anion was HCO3> SO4>Cl> NO3. (Semwal 2009). In Himalayas the hydrochemistry of the rivers are chiefly ruled by basin lithology and least by anthropogenic sources (Semwal 2009).

The carbonate rocks weathering, carbonic from calcsilicates and albite and the dominated sulphuric in river basin of Himalayan (Semwal 2009). Weathering of carbonate rocks have supremacy in the rivers of Himalayas (Abhay Kumar Singh& Syed I. Hasnain).The most common cations (K, Na, Mg, Ca) and anions (SO4, PO4, HCO3, CL, NO3, F), that are used in to analyze the quality of water. The poor water grade is estimated through original figure are being considered by the strategies for management of remediation (Jotimani 2012). The studies done by various authors' shows that quality of water is commonly decreased by urbanization and industrialization in the Dehradun district in Uttrakhand (Dudeja 2010, Bahukhandi 2011 and Jain 2002).

Heath is harmed by polluted water many times when it is beyond the limit and causes various health risks, so it is important to monitor data by examining regularly, by observing and by using different techniques such as given in table.



The studies shows that main reason for water quality deterioration of Tons and Asan rivers are industrial activities and anthropogenic activities that are being showed by many researchers and it was observed that there are various abiotic elements that straight away harms the diversity of plankton and reason for

downfall of plankton. The Asan River and other catchment of Asan River has become polluted and keep on more contaminating due to waste discarded i.e. solid waste, sewage waste and runoff from agricultural fields such as application of pesticides, insecticides and addition of other chemical fertilizer and chemical runoff from industrial effluent (caused by improper method of treatments) and not proper throwing of unsafe waste. The most area of Asan river arrives in semi urban, slums or rural area from where the population living around it using fresh water through ground water or the water from surface (by deep hand pumps, tube wells and shallow hand pumps) for irrigation and drinking purposes. As increasing in population and industries in Dehradun district it is facing high pressure on all the resources in the area including resource of water. This pollution in water is not only the reason for declining quality of water but also causing decrease in water resources that are required by all and if this declining keeps in tread then in same way seems like there will be a great scarcity of water is near in future. The direct supply of water to villagers through tube well for drinking without any treatment and management can leads harm and affect to children and human health by diseases.

Recent many articles are in news reported by CPCB that Indian rivers are highly polluted rivers in the world and Yamuna is most polluted river in uttrakhand and it becoming highly polluted river in country if soon it is not monitored or managed by proper system or treatments. The increasing in industries with population growth around the area of Asan River and its Catchment is also one of the major reasons for pollution in surface and ground water looking towards it the study is done to observe for the objectives to study physico-chemical seasonal study is done to watch the affected area by industries and population growth on the Asan River water quality of surface and ground water. The study of both pre and post monsoon season on the level of water is being studied. Asan River lies in Dehradun district of Uttrakhand and is also known as Doon Valley the capital of Uttrakhand state within the northern India surrounded by Himalayas from northern border and southern side with Siwalik Hills where, Ganga River lies in its east and Yamuna flowing from the western part between the 29 ° 58 'and 31 ° 2' 30 "northern latitude and 77 ° 34 '45" and 78° 18' 30 "eastern longitude. River Tons is another Yamuna River's branch which arrives from southwest whereas Asan River is another more important tributary of River Yamuna which arrives from the Doon shivalik range and after few distance it joins the Yamuna River.

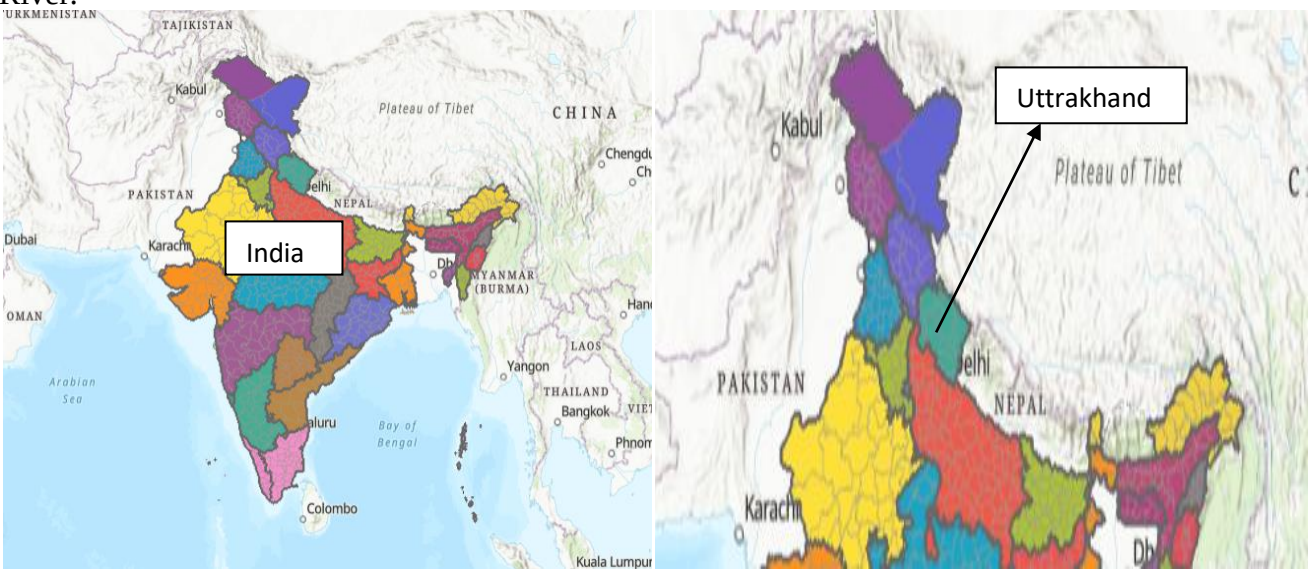


Figure 1.a): Country India

Figure 1. B): Uttrakhand region in India.

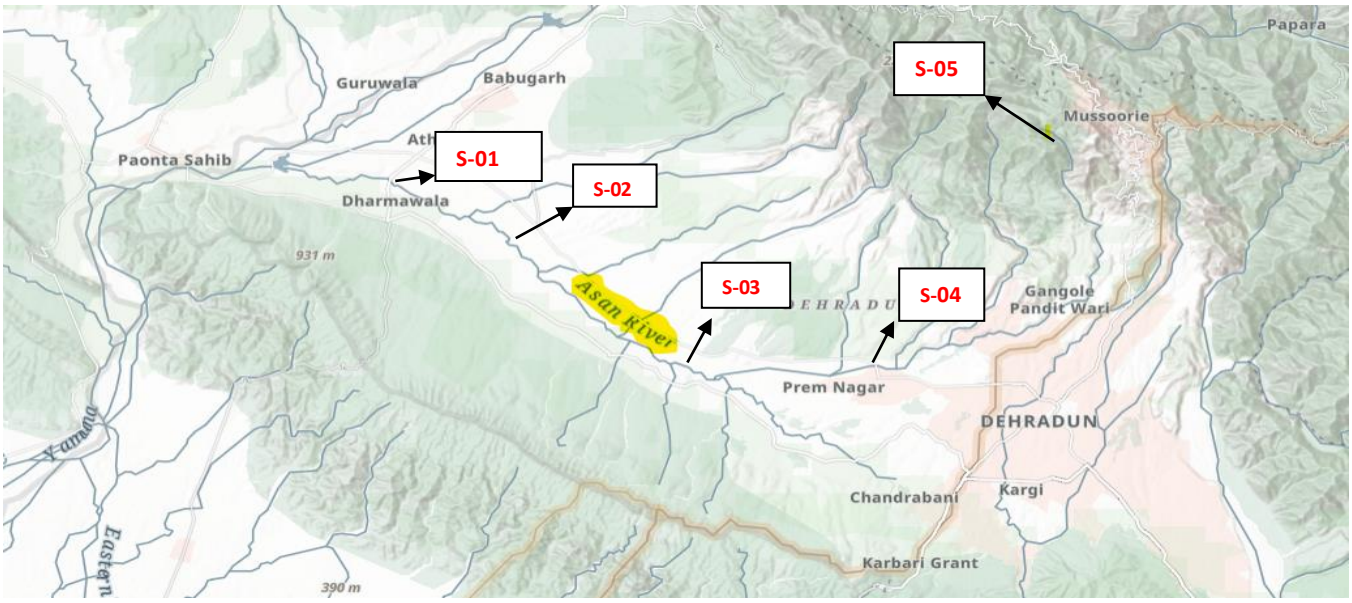


Figure1. c): Asan River with its streams and sampling station.

Fig.1 *(a) India map with all states. (b) Uttarakhand State map with uttrakhand location. (d) Map of sampling sites from Asan River Basin. Source: Maps are processed and prepared from Google Maps and ArcGIS.*

3.1 Materials and Methods:

The purpose of studying quality and river water is to examine level and status of the water pollution. As water has mixed and different components in vary percentage, it has different properties and different value of water quality parameters can affected in a different ways by pollution. The water quality Asan River with physicochemical and biological characteristics has become important to study characteristics of all types of water. It has become important to study and examine the level of water pollution conservation and manage pollution level in river water.

3.2 Materials:

In analysis this study is perform according to different seasons by following the India Meteorological Department (IMD), who identifies four different climatologically different seasons in India. The Pre-monsoon or rainy season sampling was done from June-September in (2024), while a Post-Monsoon/Autumn sampling done during the months of October-November (2024). In variation in water quality from one season to another, in which each sample is collected from five different locations discussed below:

- **Sample-Site1 (S-01) -** Herbertpur Asan Bridge from **30°25'44.60''N and 77°4312.60''E.**
- **Sample Site 2 (S-02) -** Rampur from **30°3621474'' N and 77°8230084'' E.**
- **Sample Site 3 (S-03) -** Dhoolkot from **30°3394825'' N and77°8840606'' E.**
- **Sample Site 4 (S-04) -** Premnagar from **30°3424044'' N and 77°9548893'' E.**

❖ **Sample Site 5(S-05)-** Gajiyawala (Birpur) from Grid reference **30°3686875''N and 78°0413942''E.**

3.3 Sampling

The Asan river water samples collected with variations in physicochemical and Biological properties of the River Asan during pre-monsoon and post monsoon seasons from different five sites- S1 to S5 district Dehradun. Sampling done by using high-density cleaned PVC bottles for sampling with thoroughly cleaned by rinsing with 8M HNO3 and after that cleaned with deionizer water by repeated washing with effluent sampled to avoid contamination and make minimum error and to locate the area from where the river is becoming highly polluted. All the samples were collected from down below the surface of effluents just to avoid contaminants that are floating on above surface of river. Aeration is also avoided during sampling.

3.4 Analytical methods

After the sample collection tests such as DO, COD, BOD and pH were recorded. The concentration of acid is analyzed using HNO3 (5 ml/l). Gravimetric method is used for analysis of Suspended solid. DO, EC, Ph and TDS were analyzed by using DO, Electrical Conductivity, Ph and Total Dissolved Solid meter respectively. Other methods and experiments done to analyze the quality of Asan River water are discussed below. All parameters were analyzed by following standards method of wastewater water methods to study (American Public Health Association (1998).

All the parameters with instruments tested are given below with its reference method.

- Color measured by spectroscopic method and reference method - APHA -2120C.
- Temperature by thermometer and reference to method APHA – 2012
- Odour by using Olfactometer method and reference method APHA -2150B.
- Ph by using pH meter and reference method - APHA -4500 B
- Turbidity (NTU) by Nephlometric meter and reference method IS: 3025(P-10:1984).
- Alkalinity by titration and reference method APHA -2320B.
- TH by Titrimetric Method and reference method APHA -2340C.
- Ca (mg/l) and Magnesium (mg/l) by EDTA Titrimetric Method and reference method APHA -3500.
- Ammonia (mg/l) by Ammonia Distillation Flask and reference method IS: 3025(P- 34):1998.
- BOD (mg/l) by BOD Test Method and reference method APHA -5210B.
- TDS (mg/l) by Total Dissolved solids Dried at 1800C Method and reference method APHA-2540C.
- TSS (mg/l) by Dried Method and reference method APHA 2540D.
- Chlorides (mg/l) by titration method and reference method IS:3025(P-32):1988.
- Sulphates (mg/l) by Turbidimetric Method and reference method IS: 3025(P- 24): 2022.
- Nitrate (as NO3-) (mg/l) by Spectrophotometer with reference method IS: 3025(P- 34): 1988.
- Fluoride (mg/l) by Spectrophotometer and reference method APHA 4500 F.D. 24th edition.
- Iron (mg/l) by ICP-MS method and reference method IS: 3025(P- 65): 2022.
- Phenol (mg/l) by Spectrophotometer and reference method IS: 3025(P- 43):2022.
- Sulphide (as H2S) mg/L by Test tube method and reference method IS:3025 (P-29): 1986.
- Surfactants (Anionic) (mg/l) by Spectrophotometer method and reference method Annex, KoF IS:13428-2005.
- Sodium (as Na+) and Potassium (as K+) by Flame Photometer method with reference method IS: 3025(P- 45- 1993).
- DO by Winkler's Iodometric method and reference method APHA 4500-O B.

- COD by Open Reflux Method and reference method APHA 5220B.
- Lead and mercury by using ICP-MS method and reference method IS: 3025(P- 65): 2022.
- Electrical Conductivity by Electrical conductivity meter and reference method APHA 2510B.
- The biological analysis counted by APHA methods (American Public Health Association (1998)).

3.4 River water quality index (RMPI)

Different pollutants present in water bodies are applied according to River Pollution Index. For metal concentrations identification the depiction of water quality is facilitates by RMPI [Chabukdhara M et al., 2016] and is calculated as per the Metal Index or River Metal Pollution Index equation [Chabukdhara M et al., 2016, Gabriella Tamasi G, Cini R (2004)

By examining the all parameters of Asan River in Dehradun District, Uttrakhand India, according to the average results of temperature, BOD, TSS, DO, EC shows that in pre monsoon season the quality of Asan River water was Average in water quality during both pre and post-monsoon season.

Results and Discussions: After sampling and analysis of all taken parameters in both pre and the post monsoon the following results were examined. Considering of water quality related it its parameters. It is important to examine the physicochemical parameters of water on systematical interval for preserving and to maintain water for people's essential requirements.

Table 1: *Representing results of all studied parameters that are analyzed during experimental research:*

		PRE- MONSOON					**POST- MONSOON**				
S.No.	**PARAMETERS**	***S-01***	***S-02***	***S-03***	***S-04***	***S-05***	***S-01***	***S-02***	***S-03***	***S-04***	***S-05***
1.	*Temperature (^0C)*	20.6	20.4	20.2	19.6	19.2	18.8	19.0	18.6	18.4	18.3
2.	*Ph*	7.84	7.9	8.00	8.12	7.5	7.5	7.3	7.2	7.8	8.0
3.	*Turbidity (NTU)*	<1.0	12	15	18	30	<1.0	<1.0	<1.0	<1.0	<1.0
	Total alkalinity (mg/l)	128.8	110.2	114.4	129.6	122.4	232.7	242.3	247.2	300.2	315.3
4.	*Total Hardness (mg/l)*	288.5	273.5	280.8	292.9	299.3	147.8	159.2	152.4	174.2	203.4
5.	*Calcium(mg/l)*	68.7	67.8	69.1	69.3	72.2	43.9	44.4	45.0	46.30	48.3
6.	*Magnesium(mg/l)*	28.4	25.3	26.3	29.1	28.1	23.2	20.2	21.3	23.9	24.3
7.	*DO (mg/l)*	3.1	3.4	3.9	3.3	3.2	5.2	5.6	5.3	5.2	5.4
8.	*COD (mg/l)*	3.2	3.8	2.8	2.1	3.5	4.3	4.6	5.1	4.5	3.9
9.	*BOD (mg/l)*	2.7	3.2	3.7	4.4	3.9	3.4	3.4	3.1	3.2	3.0
10.	*TDS (mg/l)*	260	289	293	326	349	573.2	575.4	545.3	570.3	589.3
11.	*TSS (mg/l)*	696	521	789	821	863	450.5	430.2	442.3	500.2	520.5
12.	*Chloride (mg/l)*	19.7	19.8	19.4	24.3	37.2	21.8	30.8	30.8	37.2	45.2

13.	*Sulphate (mg/l)*	38.2	32.1	31.6	39.2	39.9	19	30	28	31.1	39.0
14.	*Nitrates (mg/l)*	2.8	2.2	2.4	3.0	3.3	2.1	3.1	2.9	5.5	6.0
15.	*Fluoride (mg/l)*	0.64	0.58	0.59	0.69	0.72	0.55	0.69	0.62	0.82	0.92
16.	*Sodium (mg/l)*	30.2	28.6	28.3	32.6	34.8	18	25	23	27	36
17.	*Potassium (mg/l)*	6.8	5.9	5.8	6.9	7.2	3.8	6.5	6.0	6.7	7.8
18.	*Electrical Conductivity .(µm hocm-1)*	133	131	130	133	135	493	470	439	344	477
19.	*Total bacteria count/100ml*	11	08	09	10	09	12	8	11	13	14
20.	*E.Coli /100ml*	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present
21.	*Coliform per 100ml*	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present	Not Present

Kumar et al., 2012 in their study record that temperature is major parameter that affects all the physical, chemical and biological parameters of water. Temperature never remains stable even in day time temperature changes with time to time. The temperature analyzed between 19.2°C and 20.6 °C in pre-monsoon and 18.3 °C to 19.2 °C during the post-monsoon seasons. The temperature has only a positive correlation to COD during pre-monsoon season (>0.12) (in Table 3) and post-monsoon season temperature has powerful correlation with BOD (>0.85) (Table 4). The fluctuation in temperature continues time to time even in sampling time from one station to another there is always difference according to time changes (Charu Parashar et al., 2006). Same study with results difference given by was Khanna et al., 2011 of Ganga River in Haridwar.

Ph has significant part in creating all biological occupation in limited scope showed in study by Zafer and sultana (2007) shows pH during monsoon season is 7.6 to 7.55. In present study Ph analyzed between 7.5 to 8.12 in pre-monsoon and 7.2 to 8.0 during the post-monsoon seasons. The pH has a strong positive correlation to nitrate and fluoride during both pre-monsoon season (>0.93) (in table 3) and during post-monsoon season (>0.81) (table 4).

In the study by D.R. Khanna et al., 2012 noted the general cause and analyzed the affect of Turbidity during different season. In his study it was noted that turbidity increased highest during pre-monsoon and post-monsoon season. In the current study similar trend continues and turbidity results from <1.0 to 30 NTU during the monsoon season and <1.0 in post-monsoon respectively. In the pre-monsoon not in limit given by WHO and water was highly turbid during pre monsoon season. The turbidity has a strong

positive co-relation to TDS during both pre-monsoon season (>0.95) (in Table 2) and post-monsoon season (>0.81) (Table 3).

It is commonly found in many researches that TDS and TSS increased during pre monsoon season and both are at their lowest value during winter season on comparison to other seasons. Difference of TDS and TSS in Ganga River water was calculated by Khanna et al., 2003 showing similar results to study. In present research the value of TDS was observed between 260 to 349 mg/l during pre-monsoon whereas the TDS has a strong positive correlation to BOD (>0.82) (table 2) during pre-monsoon season and during post-monsoon season TDS do not have strong positive relation with (Table 3) any other and 573.2 to 589.3 in post-monsoon whereas, the value of TSS was obtained between 697 to 863mg/l during the pre-monsoon and 450.5 to 520.5 in the post-monsoon season whereas, the TSS has a strong positive correlation to TH (>0.82) (in table 2) during pre-monsoon season and during post-monsoon season temperature has strong positive relation with TH (>0.85) (Table 3).

Alkalinity is the calculation about the existence of mild acids. The amount of alkalinity can vary from season to season. Alkalinity also manages the activities of enzymes. Many times the rainfall waterfall quality of water is impacting alkalinity Venkateswalu 1996. In the present study the Alkalinity was observed between 110.2 to 129.6 in pre-monsoon and 232.7 to 315.3 during the post-monsoon seasons. The alkalinity has a strong positive correlation to TH, Nitrate and fluoride during pre-monsoon season (R2>0.83) (in table 2) and during post-monsoon season alkalinity has strong positive correlation with TSS, TH, Ph, Nitrate and fluoride (R2>0.72) (Table 3).

The total hardness of water occurs due to the accumulation of particles of calcium and magnesium due to increase in industrialization, soil erosion and process of weathering is in process Bhatt et al (1999).In present study hardness of Asan River water analyzed between 273.5 to 299.3 in pre-monsoon and 147.8 to 203.4 during the post-monsoon seasons which is within the limit during both seasons. The hardness has a strong positive correlation to EC, Ph, nitrate and fluoride during pre-monsoon season (0.82) (in table 2) and during post-monsoon season temperature has strong positive relation with Ph, nitrate, and fluoride (>0.85) (Table 3).

Calcium and magnesium carbonates and bicarbonates plays the major role in hardness of water. During current analyses it was analyzed that Calcium and Magnesium analyzed are within the prescribed amount given by standards during both pre-monsoon and post-monsoon seasons. The calcium has a strong positive correlation to chloride, sodium, nitrate, TH, EC and fluoride during pre-monsoon season (>0.81) (in table 2) and in post-monsoon season calcium has strong positive relation with chloride, sodium, alkalinity, TSS, TH, fluoride (>0.90) (Table 3). The magnesium has a strong positive correlation to sulphate, potassium, alkalinity, TH, nitrate and fluoride during pre-monsoon season (>0.82) (in table 2) and during post-monsoon season TSS and Ph has strong positive relation with magnesium (>0.87) (Table 3).

The presence of chloride is the estimation of organic waste matter and origin of animal (Thresh et al., 1949).In present study chloride content present in water is within the permissible both pre-monsoon and post-monsoon seasons. The chloride has a strong positive co-relation to sodium, TDS, EC, Ph, nitrate and fluoride during pre-monsoon season (>0.81) (in table 2) and during post-monsoon season chloride has strong positive relation with sulphate, sodium, potassium, alkalinity, TSS, TH, Nitrate, fluoride (>0.92) (Table 3).

The quality of aquatic system present in water is determined by the value of Dissolved oxygen. The system with high rate of respiration and presence of high organic decomposition, in such condition the DO is low and the rate of photosynthesis is high. Temperature also has impact in determining DO of the aquatic system. The outcome result of DO was between 3.1 to 3.9 during pre-monsoon and 5.2 to 5.6 during the post-monsoon seasons that were within the limit and thus it signifies good seasonal change and quality of water. Khanna and Bhutiani (2003) also analysed the same in Ganga River in Haridwar.

In study by Ciaccio (1971), the organic compound that leads to the development of microorganisms is calculated by Biological oxygen demand. The power and waste water runoff from near areas and a different statistical study for pollution in water gives information about intrinsic water pollution and its causes. The larger degree of Biological oxygen demand, the larger will be the intake of oxygen with larger increment in pollution burden. In present research BOD level in Asan River was analyzed between 2.75 to 4.4 in pre-monsoon and 3.0 to 3.4 during the post-monsoon seasons.

In current study COD is analyzed between 2.1 to 3.8 in pre-monsoon and 3.9 to 5.1 during the post-monsoon seasons. Khanna and chugh in 2004 studied same kind of analyses and results were similar. The EC, DO, COD, BOD do not have strong positive correlation to any other during pre-monsoon season (in table 2) and during post-monsoon season EC (Table 3).

Sinha et al., (2000) study shows that the end left part after analyzed compound obtained after combustion of material has nitrogen and performance of micro organisms activities are made and it shows the denitrification process. There is always some difference recorded between nitrate, Calcium, magnesium as per the seasonal difference.

The chloride has a strong positive co-relation to sodium, TDS, EC, Ph, nitrate and fluoride during pre-monsoon season (>0.81) (in table 2) and during post-monsoon season chloride has strong positive relation with sulphate, sodium, potassium, alkalinity, TSS, TH, Nitrate, fluoride (>0.92) (Table 3).

The sulphate has a strong positive correlation to Sodium, potassium, alkalinity, TH, EC, Ph, nitrate and fluoride during pre-monsoon season (>0.87) (in table 2) and during post-monsoon season sulphate has strong positive correlation with Sodium, potassium, TH, nitrate and fluoride (>0.85) (Table 3).

The sodium has a strong positive correlation to potassium, EC, PH, nitrate and fluoride during pre-monsoon season (>0.90) (in table 2) and during post-monsoon season sodium has strong positive correlation with (>0.87) (Table 3).The potassium has a strong positive correlation to TH, EC, Ph, Nitrate and fluoride pre-monsoon season (>0.90) (in table 2) and during post-monsoon season potassium has strong positive correlation with TH, Nitrate and fluoride (>0.80) (Table 3).

In present study, Asan River was not polluted by chemicals like Ammonia, phenol, surfactants, sulphide, Iron, lead, mercury and also free from biological characteristics like Total bacteria count, E.Coli and Coliform during season of pre and post-monsoon . Sharma et al., 2015 and Matta et al., 2018a, 2018b, 2018c, 2018d also done same type of study and detailed analysis with absence of biological pollutants.

Figure 2: a, b, c, d Comparison of fluctuation between various physicochemical parameters in Pre-monsoon and Post-monsoon *in all five stations.*

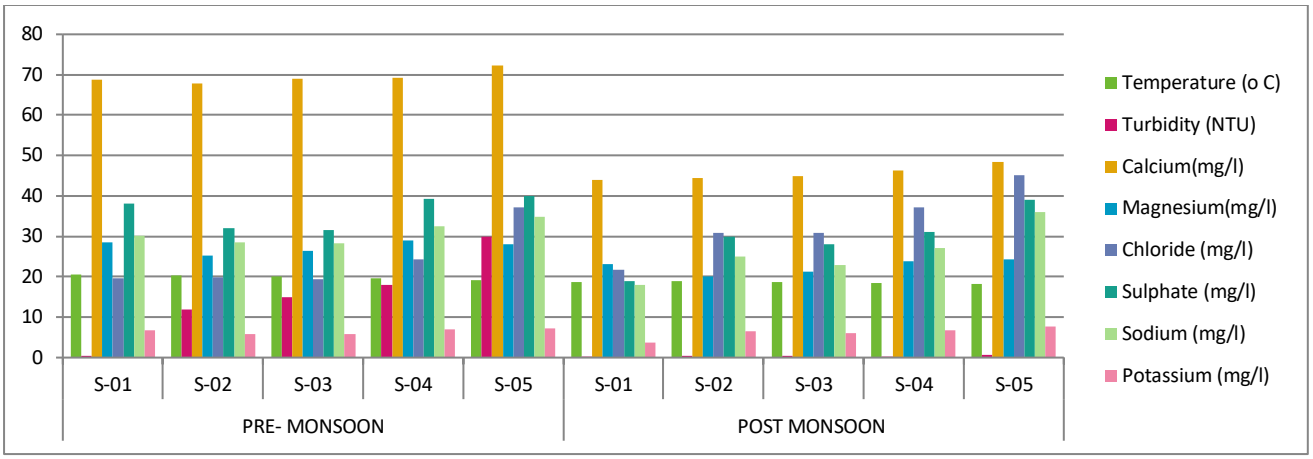


Fig: 2. a)

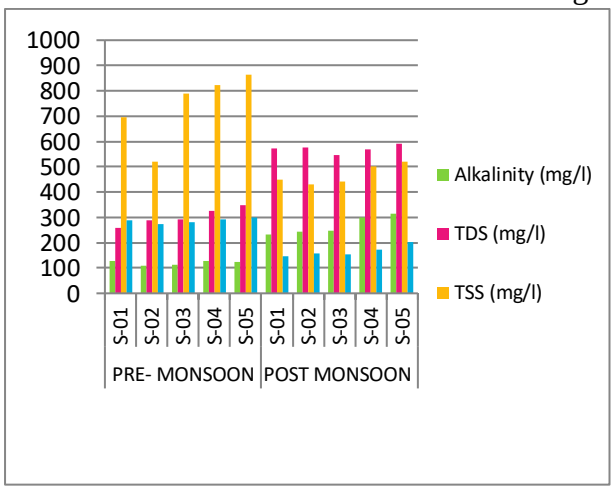


Fig 2 b)

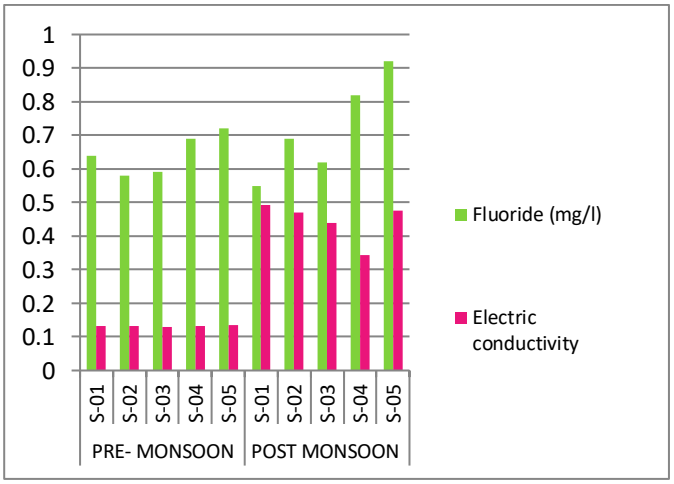


Fig 2 c)

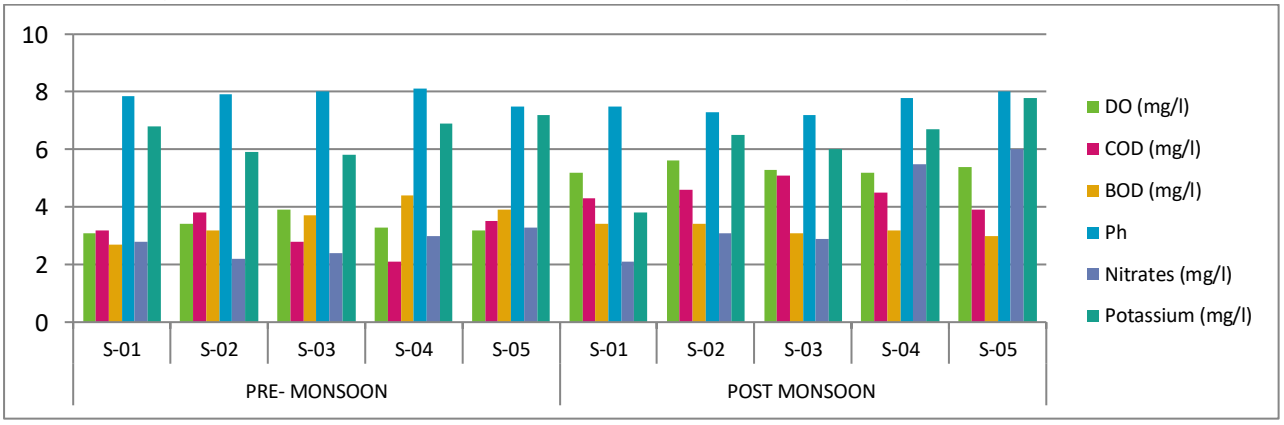


Fig 2 d)

Table: 3. Pre monsoon correlation data

TDS (mg/l)	Alkalinity (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Sulphate (mg/l)	Chloride (mg/l)	Magnesium (mg/l)	Calcium(mg/l)	Turbidity (NTU)	Temperature (o C)	
-0.98383	-0.27469	-0.62603	-0.8768	-0.58864	-0.89367	-0.46116	-0.85883	-0.92758	1	*Temperature (o C)*
0.965879	-0.10123	0.330346	0.67658	0.269234	0.838491	0.101075	0.795018	1		*Turbidity (NTU)*
0.793204	0.29503	0.688979	0.85565	0.622775	0.952167	0.455805	1			*Calcium(mg/l)*
0.313684	0.978973	0.877647	0.720683	0.919028	0.401502	1				*Magnesium(mg/l)*
0.858037	0.24104	0.719712	0.909578	0.649831	1					*Chloride (mg/l)*
0.461113	0.874844	0.993771	0.887881	1						*Sulphate (mg/l)*
0.800902	0.593608	0.917509	1							*Sodium (mg/l)*
0.502935	0.822122	1								*Potassium (mg/l)*
0.120621	1									*Alkalinity (mg/l)*
1										*TDS (mg/l)*
										TSS (mg/l)
										Total Hardness (mg/l)
										Electric conductivity
										DO (mg/l)
										COD (mg/l)
										BOD (mg/l)
										Ph
										Nitrates (mg/l)
										Fluoride (mg/l)

ISSN: 2278-0181

Fluoride (mg/l)	Nitrates (mg/l)	Ph	BOD (mg/l)	COD (mg/l)	DO (mg/l)	Electric conductivity	Total Hardness (mg/l)	TSS (mg/l)
-0.82838	-0.77083	-0.84179	-0.8136	0.233487	0.165195	-0.83887	-0.76062	-0.74093
0.579178	0.514417	0.618957	0.763922	-0.02094	0.088872	0.659107	0.503478	0.578839
0.814036	0.835932	0.796022	0.462126	0.027837	-0.23634	0.870193	0.839185	0.779784
0.831888	0.853855	0.751937	0.339858	-0.58767	-0.5871	0.662294	0.865156	0.681864
0.834606	0.815466	0.868518	0.467506	0.149006	-0.38737	0.93451	0.789199	0.611836
0.938704	0.943242	0.915626	0.275002	-0.26431	-0.78662	0.872471	0.922831	0.586478
0.983542	0.956123	0.994233	0.52805	-0.14211	-0.59166	0.989707	0.930051	0.680527
0.952411	0.959455	0.937187	0.26231	-0.17886	-0.78731	0.913833	0.936186	0.591143
0.7214	0.754084	0.638414	0.17531	-0.56325	-0.63092	0.541447	0.764352	0.548001
0.728964	0.651429	0.764725	0.835221	-0.17115	-0.08259	0.764968	0.634452	0.637198
0.741108	0.780454	0.631671	0.657214	-0.56844	0.028334	0.615088	0.832192	1
0.971098	0.995062	0.91783	0.447945	-0.31489	-0.5239	0.906601	1	
0.958792	0.939082	0.981155	0.423464	-0.00423	-0.63719	1		
-0.59933	-0.58808	-0.65428	0.218655	-0.19671	1			
-0.27617	-0.26007	-0.162	-0.6262	1				
0.522442	0.433335	0.5076	1					
0.983915	0.949329	1						
0.986161	1							
1								

Table:4 Correlation data for Post monsoon:

Alkalinity (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Sulphate (mg/l)	Chloride (mg/l)	Magnesium (mg/l)	Calcium(mg /l)	Turbidity (NTU)	Temperature (o C)	
-0.88391	-0.55434	-0.6841	-0.61652	-0.7679	-0.79772	-0.87427	0.264805	1	*Temperature (o C)*
-0.02852	-0.27062	-0.01496	-0.1803	-0.15798	0.294127	-0.06162	1		*Turbidity (NTU)*
0.958446	0.817085	0.948503	0.887214	0.960647	0.654815	1			*Calcium(mg/l)*
0.719686	0.141278	0.425065	0.251136	0.452221	1				*Magnesium(mg/l)*
0.930485	0.943782	0.979095	0.974146	1					*Chloride (mg/l)*
0.828383	0.985038	0.973503	1						*Sulphate (mg/l)*
0.883662	0.922548	1							*Sodium (mg/l)*
0.782635	1								*Potassium (mg/l)*
1									*Alkalinity (mg/l)*
									TDS (mg/l)
									TSS (mg/l)
									Total Hardness (mg/l)
									Electric conductivity
									DO (mg/l)
									COD (mg/l)
									BOD (mg/l)
									Ph
									Nitrates (mg/l)
									Fluoride (mg/l)

ISSN: 2278-0181

Fluoride (mg/l)	Nitrates (mg/l)	Ph	BOD (mg/l)	COD (mg/l)	DO (mg/l)	Electric conductivity	Total Hardness (mg/l)	TSS (mg/l)	TDS (mg/l)
-0.73417	-0.82787	-0.76875	0.868717	0.362622	0.448696	0.443268	-0.75238	-0.90764	-0.17061
0.033006	-0.03257	0.3825	0.516047	-0.77498	0.118217	0.458893	0.136486	0.124162	0.816702
0.940343	0.938946	0.836588	-0.8375	-0.56941	0.011847	-0.21954	0.971474	0.917822	0.490376
0.540426	0.64317	0.894223	-0.45107	-0.70093	-0.62484	-0.23933	0.616306	0.884368	0.483504
0.970576	0.944434	0.72062	-0.79138	-0.43401	0.211332	-0.29633	0.946437	0.813446	0.437895
0.926423	0.861618	0.581425	-0.72956	-0.35483	0.418106	-0.19925	0.895924	0.668673	0.415617
0.9566	0.896974	0.726763	-0.7357	-0.54546	0.325449	-0.10947	0.971013	0.781685	0.561619
0.893057	0.832081	0.48534	-0.67881	-0.22216	0.454056	-0.30149	0.819711	0.586718	0.319202
0.959127	0.991976	0.890041	-0.72881	-0.55468	-0.10283	-0.44282	0.931814	0.958152	0.495863
0.590879	0.505499	0.738779	0.022759	-0.94449	0.286347	0.269611	0.669386	0.555456	1
0.865502	0.920262	0.963697	-0.6775	-0.68372	-0.29284	-0.34172	0.890682	1	
0.962433	0.926733	0.866704	-0.70049	-0.69843	0.160945	-0.11035	1		
-0.33645	-0.47501	-0.21702	0.207428	-0.28681	0.403365	1			
0.179484	-0.01215	-0.23111	0.133631	-0.02046	1				
-0.56737	-0.52312	-0.83845	0.133956	1					
-0.65291	-0.68373	-0.48226	1						
0.82395	0.857334	1							
0.979176	1								
1									

Conclusion: In the research analysis of various seasonal physicochemical and biological parameters of Asan River in pre-monsoon and post-monsoon 2024. Study was not very satisfactory. During study it was found that the pattern of seasonal distribution was found to be affected by various environmental

elements. But, the high weathering was noticed in river water during pre monsoon season due to variation in rainfall, fast growing developing improving and lack of property management plans. In this study of 29 parameters were studied and compared to the allowable boundary given by WHO. Results after analysis shows that some parameters such as turbidity, sodium and potassium were higher in range WHO standard during the pre monsoon season and some parameters like alkalinity, sodium, potassium TDS and TSS are higher during post monsoon. However, all parameters were not in the prescribed limits of drinking water standards. The water quality index shows that water of Asan River has average quality.According to which it is mandatory look towards the environment monitoring and work on waste treatment to protect population from health risk.

Acknowledgements: Author thankful and highly responsible to honorable Prof. (Dr.) Manish Sharma , Dean of research and my guide from Jigyasa University who encourage and motivate me to research on this and providing special dispensation to do (carry out) work at Jigyasa University Dehradun, Uttrakhand, India and my husband Mr. Saransh Dogra for financial help and support me to do research.

References:

1. Abhay Kumar Singh& Syed I. Hasnain 1998. Major ion chemistry and weathering control in a high altitude basin: Alaknanda River, Garhwal Himalaya, India, Hydrological Sciences Journal, ISSN: 0262-6667 (Print) 2150-3435 (Online) Journal homepage: www.tandfonline.com/journals/thsj20.
2. American Public Health Association (1998) Standard methods for the examination of water and wastewater analysis, 20th edn. APHA, AWWA
3. Bahukhandi Kanchan (2011). Assessment of Water quality in Dehradun district" In: National Symposium on Advance in Biotechnological Research in Agri-Horticultural Crops for Sustaining Productivity, Quality Improvement and Food Security on September 14th to 16 , 2011 by Centre of Excellence in Agricultural Biotechnology, at Sardar Vallabhbhai Patel University of Agri. & Tech., Merrut (UP).
4. Bureau of Indian Standards (2004–2005) Specifcation for drinking water. Indian Standard (IS: 10500), New Delhi
5. Bhatt, L.R., Lacoul, P., Lekhak, H.D and Jha, P.K.1999 Physicochemical characteristics and phytoplankton of Taudahalake, Kathmandu Poll. Res., 18(4):353-8.
6. Ciaccio, L. 1971, Water and Water pollution, Vol. I. New York: Marcel Dekker, Inc.
7. Charu Parashar*1, Savita Dixit2 and Rajnish Shrivastava1. 2006. Seasonal Variations in Physico-chemical Characteristics in Upper Lake of Bhopal, Asian J. Exp. Sci., Vol. 20, No. 2, 2006, 297-302.
8. Chen TB, Zheng YM, Lei M (2005) Assessment of heavy metal pollution in surface soils of urban parks in Beijing, China. Chemosphere 60:542–551
9. Chabukdhara M, Gupta SK, Nema AK (2016) Assessment of seasonal variation of surface water quality: environmetrics and indexing approach. IIOABJ 7(11):16–24
10. Dudeja Divya, Kuamr Bartarya Suresh, Biyani A.K. (2011). Hydrochemical and water quality assessment of groundwater in Doon Valley of Outer Himalaya, Uttarakhand, India, Environ Monit Assess. Fetter, C. W. (1990). Applied Hydology, New Delhi India , CBS Publication and Distributors.
11. Hern, J., Feltz, H.R., (1998). Effects of irrigation on the envrionment of selected area of the Western United States and implications to the world population gowth and food prodcution . J. Envriron. Manag. 353 – 360.

12. Jain, C.K (2002). Ground water quality district Dehradun, National Institute of Hydrology, Jal Vigyan Bhawan, CS(AR) 10/96-97
13. Jothimani . P, C. Mayilswami, Valliammai A. and Chellamuthu (2012). Monitoring of Groundwater quality in the Parambikulam – Aliyar Basin of Tamil Nadu" Conferecne Proceeding - Fift International Groundwater Conference (IGWC – 2012).
14. Krishnakumar, S. (2009). Quality Charaterization and Geocehmical Charateristics of Lower Gadilum River Basin, Tamil Nadu, India, Dissertation , University of Madras.
15. Khanna, D.R and Chugh T. 2004. Microbial ecology: a study of river Ganga, Discovery publication house New Delhi, 1-277.
16. Khanna, D.R. and Bhutiani R, 2003. Limnological status of Satikund pond at Haridwar (U.A.) Indian J. Env. Sc., 7(2); 131-136.
17. Kumar, A., Rawat, S., Shrivastava, M. and Bhushan, V., Physico-Chemical Analysis and Isolation of Bacteria from Water Samples of Maharana Pratap Sagar, Kangra District of Himachal Pradesh.(2012)
18. Khanna, D.R. , Bhutiani R, kulkarni Deepali Bhaskar 2011. A study on pollution status and its impact on water quality of Ganga River at Haridwar Env. cons., J. 129(1&2) 9-15..
19. Matta, G.; Laura, G.; Kumar, A. and Machel, J. (2018): Hydrochemical characteristics and planktonic composition assessment of River Henwal in Himalayan Region of Uttarakhand using CPI, Simpson's and Shannon-Weaver Index. Journal of Chemical and Pharmaceutical Sciences. 11(1).
20. Parashar C., Dixit S and shrivastav R 2006. Seasonal variation in Physico-chemical characteristics in upper lake of Bhopal, Asian J exp. Sci., 20(2):297-302.
21. Sharma, P.K.; Pandey, R.;Raghuvanshi, D.; Shukla,D.N. (2015). Assessment of physico-chemical parameters to investigate pollution status of River Ganga at Haridwar, Uttarakhand,India, Asian J. Biochem. Pharm. Res., 4 170-177.
22. Singhal, V., Kumar, A., Rai, J. P. N., (2005), Bioremediation of pulp and paper mill effluent with Phanerochaete chrysosporium, Journal of Environmental Research, 26(3), pp 525-529.
23. Sinha A.K., Singh V. P. and Srivastava K.2000. Physico-chemical studies on river ganga and its tributaries in Uttar Pradesh –the present status. Pollution and biomonitoring of Indian Rivers.(ed) R.K. Trivedi.(ED) ABD publishers, Jaipur 1-29.
24. Semwal N and Jangwan JS (2009). Major Ion Chemistry of River Bhagirithi and River Kosi in the Uttarakahnd Himalaya" Int. J. Chem. Sci.: 7 (2), 2009, 607 – 616.
25. Shiddamallayya N, and Pratima M, (2008). Journal of Environ Bioloy, 29:303 –308.
26. Tamasi G, Cini R (2004) Heavy metals in drinking waters from Mount Amiata (Tuscany, Italy) Possible risks from arsenic for public health in the province of Siena. Sci Tot Environ 327(1–3):41–51
27. Thresh J.C., Beale J.F and Suckling E.V 1949. The examination of water and water supply B.W. Taylor, London.
28. Venkateswarlu V. 1969. An ecological study of the algae of River Moosi, Hyderabad India. With special reference to water pollution-I Physicochemical complexes Hyderobiologia; 33:1 17-43.
29. WHO Guidelines for Drinking Water Quality (Vol.2), Health Criteria and other supporting informations, 2nd edition, World Health Organisation, Geneva, 231-233 (2004).nm
30. Zafer, A. and Sultana, N 2007.Seasonal analysis in water quality of River Ganga Disaster ecology and environment . Arvind kumar (Ed.) Daya publishing house, India 57-62.