

## LIMNOLOGICAL CHARACTERISTICS OF THE RIVER GANGA AT HARIDWAR (UTTARANCHAL)

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Haridwar is stretched in an area of about 12,032 sq. kms at an altitude of about 292.7 m. The Ganga is a holy river of India with whom people are sentimentally attached since time immortal. The river Ganga regarded as the Cradle of Indian Civilization, has been gradually shrinking on account of its over exploitation in the most clandestine and notorious way starting from the foot hills. The present study has been carried out to assess the pollution load of the river Ganga at foot hills of Garhwal Himalaya during the year 2002 in different seasons. The samples were collected from three different sites viz. Har-ki-pauri, Prem Nagar ashram ghat and Jatwarapul ghat. Various physico-chemical parameters such as water temperature, total solids, total dissolved solids, total suspended solids, velocity, turbidity, conductivity, pH, alkalinity, acidity, dissolved oxygen, BOD, free CO<sub>2</sub> and hardness were analyzed. Besides these parameters qualitative and quantitative distribution were also examined.

### INTRODUCTION

Our rivers have been most precious to us since time immortal. The very name Ganga conjures up a picture of holiness of peace and joy, of all that is uplifting in the mind of a man. It is not just a river, it is a symbol of something higher than what the world has to offer. Ganga is a river formed by the confluence of two rivers, is one of them is Bhagirathi, while the other is Alaknanda. The Ganga is called Bhagirathi from origin at Gomukh to Dev Prayag. After going a distance of about 220 km in the Himalayas, it enters the plains at Haridwar. From Haridwar, the Ganga starts slowing down its pace. After meandering over a distance of about 2,229 km in the plains through Uttaranchal, Uttar Pradesh, Bihar and West Bengal, it joins the Bay of Bengal through a large number of tributaries flowing in India and Bangladesh. Haridwar, is the place where Ganga leaves the hilly path and enters the Indo-gangetic plain. The Ganga attracts the tourists from all over the world at Haridwar.

Increasing impact of population and industrial effluents have caused a direct bearing on the hydrobiological status of each aquatic system. The holy Ganga has no exception to this generalization. Thus, Haridwar is the first place where organic pollution starts. With crores of pilgrims washing away their sins in the Ganga every day, considerable deterioration has been witnessed in the quality of water during peak bathing hours. During recent years it has also been estimated that its water quality has also degraded by dumping the things like flowers, ashes and bones of the dead bodies after cremation. Add to that the effect of years of water pollution and the defilement of the sacred river is complete. According to a study conducted by Uttar Pradesh Pollution Control Board, the dissolved oxygen (DO) level recorded on the main bathing days was considerably low. The pollution has also posed a serious threat to the aquatic life in the river as the level of biological oxygen demand (BOD) has been marginally beyond permissible limits in the months immediately preceding the Kumbh.

It is important that the natural environment of the river should be conducive to the extent that fish may thrive, grow and reproduce to the best. On the contrary, the discharge of sewage, domestic wastes, turbidity, siltation and bathing of larger number of pilgrims in the water body

change the physico-chemical characteristics to such an extent that they sometimes lead to high fish mortality. The objective of the present study is to analyze the physico-chemical parameters of Ganga water at three different sites with its planktonic count and identification.

### MATERIALS AND METHODS

The study area is situated at Haridwar district in Uttaranchal. The altitude of Haridwar is 800 m from sea level. Various sampling sites are as follows :

- Site I : Water samples were collected from Har-Ki-Pauri  
 Site II : Prem Nagar Ashram Ghat which is 4.5 km down Site I  
 Site III : Jatwarapul Ghat which is about 3.5 km down Site II

Samples were collected from surface water by keeping and opening the mouth of container against the flow of water. Samples for pH, hardness, alkalinity, free CO<sub>2</sub>, TDS, TS, TSS were collected in cleaned plastic jerricans. While for determination of DO and BOD two samples were collected in 300 ml cleaned BOD bottles.

Various physico-chemical parameters were analyzed using standard methods APHA (1998) and Trivedy & Goel (1986). Plankton were identified according to Needham & Needham (1972).

### RESULTS AND DISCUSSION

The results of various physico-chemical and biological parameters of river Ganga are Tabulated (Table I-IV). In the present study the average temperature of Ganga water ranged between 13.13 to 12.17<sup>o</sup>C *i.e.* the temperature decreases as the distance increases. Chopra & Hasim (1990) reported the mean value of water temperature of Ganga at Haridwar ranged between 12.5-13.5<sup>o</sup>C. According to Sharma (1986) the water temperature of river Bhagirathi ranged between 12.0 to 19.8<sup>o</sup>C around Tehri. The average value of total solids ranged between 216.33 to

**Table I :** Average value of physico-chemical parameters of river Ganga during 2002.

S.No.	Parameters	Site I	Site II	Site III
1.	Temperature ( <sup>o</sup> C)	13.13 ± 0.99	12.67 ± 0.89	12.17 ± 0.83
2.	Total solids (mg/l)	216.33 ± 0.77	218.67 ± 0.93	219.67 ± 0.97
3.	Total dissolved solids (mg/l)	76.97 ± 0.47	75.70 ± 0.37	74.93 ± 0.27
4.	Total suspended solids (mg/l)	139.37 ± 0.53	142.97 ± 0.73	144.73 ± 0.79
5.	Velocity (m/sec)	0.68 ± 0.03	0.65 ± 0.02	0.63 ± 0.01
6.	Turbidity (JTU)	63 ± 0.21	61.0 ± 0.10	60.0 ± 0.05
7.	Conductivity (µMhos/cm)	205.20 ± 0.39	202.63 ± 0.29	199.93 ± 0.19
8.	pH	7.34 ± 0.81	7.29 ± 0.79	7.19 ± 0.69
9.	Alkalinity (mg/l)	80.40 ± 0.66	78.21 ± 0.56	75.30 ± 0.46
10.	Acidity (mg/l)	5.53 ± 0.57	5.30 ± 0.47	4.97 ± 0.37
11.	DO (mg/l)	12.80 ± 0.43	12.23 ± 0.37	11.97 ± 0.27
12.	BOD (mg/l)	2.30 ± 0.12	1.97 ± 0.10	1.60 ± 0.08
13.	Free CO <sub>2</sub> (mg/l)	1.43 ± 0.91	1.13 ± 0.81	1.01 ± 0.71
14.	Hardness (mg/l)	67.60 ± 0.80	64.10 ± 0.71	62.77 ± 0.62

± = Standard Deviation

to 219.67 mg/l. While that of total dissolved solids ranged between 74.93 to 76.97 mg/l. The value increases due to increased human activities. Pathak & Bhatt (1989) while studying the hydrobiological profile at Sarju river observed that total dissolved solids ranged from 14.1 to 78.6 mg/l. In the present study average value of total suspended solids were found between 139.37 to 142.97 mg/l. Khanna (1993) studied the Ganga water at Haridwar and observed the annual average of total solids was 129.5 mg/l, total dissolved solids were 94.50 mg/l and total suspended solids was 1.50 mg/l. In the present study the velocity ranged between 0.63 to 0.68 m/sec. Khanna & Singh (2000) recorded very low velocity of Suswa river.

Turbidity in water is caused by suspended and colloidal matter such as clay, slit, finely divided organic and inorganic matter. The average value of turbidity ranged between 60 to 63 JTU. Joshi & Singh (1999) study on some physico-chemical values of river Ganga between Devprayag and Rishikesh and observed the turbidity range between 70 to 88 JTU. The average value of conductivity of Ganga water ranged between 205.20 to 199.93  $\mu$  Mhos/cm. Vars *et al.* (1979) noted specific conductance in Jhelum river in the range of 133 to 234  $\mu$ Mhos/cm. Viel & Bhargava (1989) found conductivity in the range of 20 to 120  $\mu$ Mhos/cm on river surgeon at Vietnam. According to Shukla *et al.* (1989) electrical conductance of upstream of river Ganga of Varanasi ranged between 190 to 160  $\mu$ Mhos/cm.

pH of water has an important bearing on plankton production a pH of 7.2 to 8.5 is favourable for growth of plankton. In the present study pH ranged between 7.19 to 7.34, Bhowmick & Singh (1985) observed the pH range between 6.2 to 7.9 in river Ganga at Patna. The average value of alkalinity was observed between 75.30 mg/l to 80.40 mg/l. According to Bisht & Kumar (1993) total alkalinity in Ganga canal was noticed in the range of 76.6 to 144 mg/l. Acidity is an important property of water which contributes to corrosiveness. Chopra & Hashim (1990) observed acidity in the range of 4.25 to 5.39 mg/l in few bathing ghats of Haridwar.

**Table II :** Average value of plankton present in Ganga water during 2002.

S.No.	Parameter	Site I	Site II	Site III
1.	Zooplankton	97	94	91
2.	Phytoplankton	774	767	780
3.	Total plankton	871	861	871

**Table III :** Average number of plankton present in a different group during 2002.

S.No.	Group	Site I	Site II	Site III
1.	Bacillariophyceae	493	492	495
2.	Phytoplankton	183	178	187
3.	Myxophyceae	98	96	98

The average value of DO and BOD was found between 12.80 to 11.97 mg/l and 2.30 to 1.60 mg/l respectively. Vats *et al.* (1979) found the similar observations. The average value of free CO<sub>2</sub> and hardness ranged between 1.43 to 1.01 mg/l and 67.60 to 62.17 mg/l respectively. Gautam (1990) recorded CO<sub>2</sub> in river water of Bhagirathi ranged between 0.36 to 2.15 mg/l. Chakraborty *et al.* (1959) reported hardness with a range of 35 to 185 mg/l in river Yamuna at Allahabad.

In the present study the average of total phytoplanktonic concentration ranged between 780 to 767 units/l and the average of total zooplankton concentration ranged between 97 to 91 units/l.

**Table IV :** Average number of different genera of plankton in river Ganga during 2002.

S.No.	Genera	Site I	Site II	Site III
1.	<i>Navicula</i>	155	154	155
2.	<i>Diatoms</i>	196	198	195
3.	<i>Tabellaria</i>	98	98	99
4.	<i>Synedra</i>	43	42	46
5.	<i>Ulothrix</i>	81	77	84
6.	<i>Spirogyra</i>	58	58	58
7.	<i>Microspora</i>	44	43	44
8.	<i>Anabena</i>	25	24	26
9.	<i>Rivularia</i>	50	53	50
10.	<i>Oscillatoria</i>	22	20	21
11.	<i>Paramecium</i>	34	33	33
12.	<i>Oikomonas</i>	15	15	14
13.	<i>Amoeba</i>	20	20	19
14.	<i>Euglena</i>	27	26	26

Eddy (1934) and Chandler (1940) pointed out that the plankton production is mainly influenced by temperature. Badola & Singh (1981) reported high values of plankton during January to March. According to Das & Pathani (1978) increase in turbidity reduces the plankton production. According to Khanna (1993) the plankton were maximum in the month of winter probably due to low temperature, high content of dissolve oxygen, low velocity and transparency of water and other suitable conditions. Allen (1920) stated that water current is the chief factor influencing the plankton of stream. In the present observation the quantum of abundance was found in the following order Bacillariophyceae > Chlorophyceae > Myxophyceae.

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