International Journal of Psychosocial Rehabilitation, Vol. 21, Issue 02, 2017
ISSN: 1475-7192

Physico-Chemical Characteristics of Ganga River Water at Two Selected Sites within Haridwar City, Uttarakhand: A Comparative Study

Aditi[1*], Dr. Ravi Bhatnagar[2],

ABSTRACT
This study is focused on the physico-chemical parameters of the Ganga River water during the year 2016. Water samples were collected monthly from two selected sites viz. Sapta Rishi Ghat and Har ki Pauri. During the present study, physicochemical parameters were monitored with the help of standard methods of APHA and Trivedi & Goel. Selected physicochemical parameters such as temperature, total Solids (TS), total dissolved solids (TDS), total suspended solids (TSS), turbidity, transparency, pH, dissolved oxygen (DO), Bio-chemical oxygen demand, total hardness, and chlorides were analyzed. It was found that anthropogenic activities were responsible for water quality degradation in the Ganga River.

Keywords: Physico-chemical parameters, Ganga River, Haridwar, Sapta Rishi Ghat, Har ki Pauri

1. INTRODUCTION

Water is the most precious gift of nature to human beings. The water is available in the form of rivers lakes, reservoirs, ice caps, atmospheric vapors etc. Conserving aquatic resources is a critical issue at the international level. Water is the most valuable resource on earth and a vital component to sustain life. Water is a habitat for different species such as fishes, phytoplankton zooplankton, reptiles, amphibians, mammals and some aquatic birds. Unfortunately, the water quality of aquatic bodies is depleting more fast than usual. Various anthropogenic activities such as deforestation, dumping of solid waste, excessive use of agrochemicals, urbanization, industrialization, mining etc. are responsible for water quality depletion. The water quality data of different reservoirs of the world showed that man-made activities are certainly responsible for water quality depletion. The human activities make the water unfit for utilization. Ganga River originates from Gaumukh and after a 2525 km journey, it falls into the Bay of Bengal. Through this journey, the Ganga River crosses various cities such as Rishikesh, Haridwar, Kanpur, Allahabad, Varanasi, Patna etc. Haridwar is known for its religious importance. Millions of devotees visit the Haridwar and take a bath in the Sacred Ganga River. Mass gatherings in Haridwar may deteriorate the quality of the Ganga River. This study is focused on finding out the impact of anthropogenic activities on the water quality of the Ganga River. Sapta Rishi Ghat is the point where the Ganga River enters Haridwar. It is experienced that most of the devotees visit the world-famous Har Ki Pauri, therefore this Sapta Rishi Ghat site is treated as the reference site.

2. MATERIALS AND METHODS

The study was carried out by a systematic collection of water samples from two spots namely Site-I i.e., Sapta Rishi Ghat and Site-II i.e., Har Ki Pauri. The following physicochemical parameters were analyzed by the standard methods of APHA (1995) and Trivedi & Goel (1986).

Corresponding Author: Aditi1*
1*Research Scholar, Department of Zoology, School of Science, Sunrise University, Alwar, Rajasthan, India
Email: 1*04aditiyadav@gmail.com
2Department of Zoology, School of Science, Sunrise University, Alwar, Rajasthan, India
Email: 2srualwar6560@gmail.com

Physical Parameters:

- Temperature
- Total Solids (TS)
- Total Dissolved Solids (TDS)
- Total Suspended Solids (TSS)
- Turbidity
- TransparencyChemical Parameters:
- pH
- Dissolved Oxygen
- Biochemical oxygen demand
- Total Hardness
- Chlorides

3. RESULTS AND DISCUSSION

The results obtained from the studies made during round the year 2016 at two sites namely Sapta Rishi Ghat and Har Ki Pauri are presented here. A total of 11 physicochemical parameters were studied. The monthly mean values, annual mean value and standard value are shown in Table 1.

Temperature is one of the most important parameters of aquatic ecosystems. Temperature is responsible for the distribution of aquatic ecosystems. During the present study, the highest and lowest mean values of temperature were observed at 31.2^0C and 15.2^0C on site-II i.e., Har Ki Pauri and Site-I i.e., Sapta Rishi Ghat during June and January, respectively. In the present study it was noticed that temperature declined from July to January and then gradually increased onwards. Similarly, Abowei (2010) observed a similar pattern of temperature in aquatic ecosystems. Total solids increase in riverine ecosystems due to soil, erosion, flood and other anthropogenic activities. During the present study i.e., 2016, the overall lowest and highest mean values of total solids were observed as 685 mg/l and 1902 mg/l on site-I i.e. Sapta Rishi Ghat and Site-II i.e. Har Ki Pauri during January and August, respectively.

Total solids were higher at Site-II i.e., Har Ki Pauri and it may be due to manmade activities. The highest values of Total Solids were recorded during the monsoon months and it is certainly due to high floods in the region. Similar results were also observed by Agarwal and Saxena, 2011, Alam et al. (2007) and Ayoade et al. (2009). Dissolved solids in the water are solids which are dissolved in the water. During the present study i.e., 2016, the lowest and highest mean values of total dissolved solids were observed at 98 mg/l and 923 mg/l on site-I i.e., Sapta Rishi Ghat and Site-II i.e., Har Ki Pauri during January and August, respectively. Total dissolved solids were also higher during the monsoon season as compared to the winter and summer seasons. Similar observations were also found by Chaturvedi *et.al.* (1981), Deshmukh et al. (1964) and Dulo and Otieno (2008). Total suspended solids are solids which are not in dissolved form. During the present study i.e., 2016, the overall lowest and highest mean values of total suspended solids were observed at 625 mg/l and 1148 mg/l on site-Site-II i.e., Har Ki Pauri during January and October, respectively. Turbidity is the haziness or cloudiness of water. Turbidity may increase due to algal growth, total solids, debris etc. During the present study i.e., 2016, the overall lowest and highest mean values of turbidity were observed at 9 NTU and 350 NTU on site-I i.e., Sapta Rishi Ghat and Site-II i.e. Har Ki Pauri during January and September, respectively.

During the study period, the values of turbidity were higher during the monsoon months and minimum values were found during the winter months. similar patterns of turbidity were also illustrated by George & Koshy (2008) and Griffith (1955). It was also found that the values of turbidity were higher at the most polluted site i.e., Har Ki Pauri which means turbidity is an indicator of pollution level in aquatic ecosystems. Similarly, Huey and Meyer (2010) also point out that turbidity is an indicator of bad water quality. Transparency is an indicator of the clarity of the water, transparency was recorded by the Secchi disc method. During the present study i.e., 2016, the overall lowest and highest mean values of transparency were observed as 1.0 cm and 12.7 cm on site-II i.e., Hari Ki Pauri and site-I i.e. Sapta Rishi Ghat during September and January, respectively. During the present investigation, it was also observed that transparency was higher during the winter season and lower during the monsoon month. It means it showed a negative correlation with turbidity. Jain *et al*. (2018) also showed similar observations. pH is the scale which determines the acidic or basic nature of any solution. It also affects aquatic organisms. During the present study i.e., 2016, the overall lowest mean value of pH was observed at 7.8 at site-I i.e., Sapta Rishi ghat. The highest mean value of pH 8.36 was recorded at site-II i.e., Har Ki Pauri during January. Similarly, Joshi (2002) also showed similar patterns of pH in aquatic ecosystems. Dissolved oxygen is one of the most important parameters of water quality.

Aquatic organisms depend on dissolved oxygen for their survival. In the present study i.e., 2016, the overall lowest and highest mean values of dissolved oxygen were observed at 7.0 mg/l and 9.3 mg/l at site-II Har Ki Pauri and site-I Sapta Rishi Ghat during June and January. During the study period, it was found that dissolved oxygen was higher during the winter months and minimum during the summer season. It was found that dissolved oxygen showed a negative correlation with temperature and biochemical demand. Similar observations were also shown by Kala Sharma (2002) and Kduka et al. (2008). In the present study i.e., 2016, the overall lowest and highest mean values of pH were observed

at 7.0 mg/l and 8.2 mg/l at site-II i.e., Har Ki Pauri during July and January. Similar findings were also observed by Kishor *et al*. (2005).

Biochemical oxygen demand is dissolved oxygen required by microorganisms to degrade the organic matter. During the present study i.e., 2016, the overall lowest and highest mean values of biochemical oxygen demand were recorded at 1.2 mg/l and 3.1 mg/l at site-I i.e., Sapta Rishi Ghat and site-II i.e., Har Ki Pauri during January and June. In the present study i.e., 2016, the overall lowest and highest mean values of total hardness were observed at 83.7 mg/l and 106.30 mg/l at site-II i.e., Har Ki Pauri during June and January, respectively. Similar findings were also observed by Kishor et al. (2005). During the present study i.e., 2016, the overall lowest and highest mean values of chlorides were recorded at 10.88 mg/l and 46.10 mg/l at site-I i.e., Sapta Rishi Ghat and site-II i.e., Har Ki Pauri during January and September, respectively.

Table 1: Showing mean values of physicochemical parameters of Ganga River at site-I i.e., Sapta Rishi Ghat

Parameters	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct.	Nov.	Dec.	Mean	SD (±)
Temp. (^{0}C)	15.2	18	20.1	24.1	25.6	27.2	26.1	25.2	24.6	23.9	20.2	18.5	22.3	±3.82
TS (mg/l)	685	709	713	816	905	1090	1709	1812	1715	1031	1000	780	1080.4	±422.4
TDS (mg/l)	98	112	128	167	212	402	705	820	725	113	102	100	307	±281.3
TSS (mg/l)	587	597	585	649	693	688	1004	992	990	918	898	680	773.4	±171.5
Turb. (NTU)	9	15	28	31	46	55	161	232	253	135	56	20	86.8	±86.6
Trans. (cm)	12.7	11.5	8.5	7.5	8.2	6.5	3.2	2.5	2	6	10.2	12.1	7.6	±3.7
pH	8.2	8	7.9	7.7	7.5	7.3	7.2	7.3	7.5	7.6	7.8	7.9	7.7	±0.3
DO (mg/l)	9.3	9	8.9	8.7	8.5	7.5	7.9	8.1	8.2	8.3	8.8	9.2	8.5	±0.5
BOD (mg/l)	1.2	1.4	1.4	1.6	1.8	2.6	2.3	2	1.9	1.5	1.5	1.4	1.7	±0.4
T. H (mg/l).	105.95	104.6	95.65	95.45	94	93	98.34	99.21	99.9	100.1	102.3	104.8	99.4	±4.4
Chl. (mg/l)	10.88	12.04	15.53	18.53	20.74	21.88	22.04	24.53	26.5	19.98	18.88	14.8	18.9	±4.8

Table 2: Showing mean values of physicochemical parameters of Ganga River at site-II i.e., Har Ki Paur

Parameters	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct.	Nov.	Dec.	Mean	SD (±)
Temp. (^{0}C)	18.5	20.6	25.4	26.1	27.9	31.2	27.5	27.1	25.4	24.9	24	19.5	24.84	3.71
TS (mg/l)	745	812	815	910	956	1240	1810	1902	1812	1435	1310	1030	1231.4	423.7
TDS (mg/l)	120	140	183	192	280	531	825	923	850	287	231	187	395.8	303.2
TSS (mg/l)	625	672	632	718	676	709	985	979	962	1148	1079	843	835.7	186.8
Turb. (NTU)	32	27	30	39	57	68	209	332	350	245	86	70	128.8	121.3
Trans. (cm)	5.2	9.4	6.5	5	4.8	4	2	1.5	1	3	8.2	6.5	4.8	2.6
pH	8.1	8.2	7.8	7.5	7.4	7.2	7	7.5	7.6	7.8	7.9	7.9	7.7	0.4
DO (mg/l)	8.8	8.6	8	7.7	7.5	7	7.7	7.9	8	8.2	8.4	8.6	8	0.5
BOD (mg/l)	1.4	1.7	1.9	2	2.6	3.1	2.8	2.6	2.5	2.3	2	1.9	2.2	0.5
T. H (mg/l).	106.3	100.5	90.4	87.3	84.2	83.7	88.4	95.15	97.2	99.3	100.2	102.7	94.6	7.6
Chl. (mg/l)	13.9	15	18.8	28.7	34.12	35.7	39.15	45.3	46.1	31.1	24.8	20.1	29.4	11.1

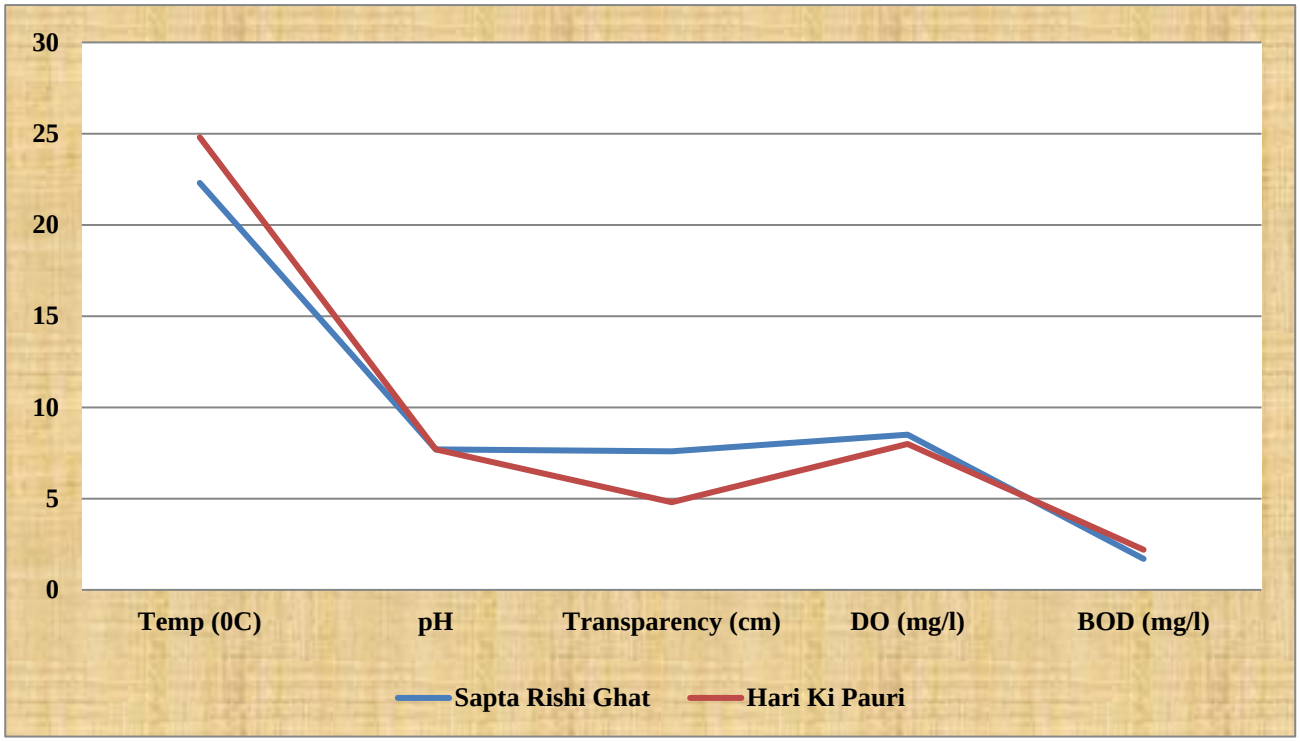

Fig. A

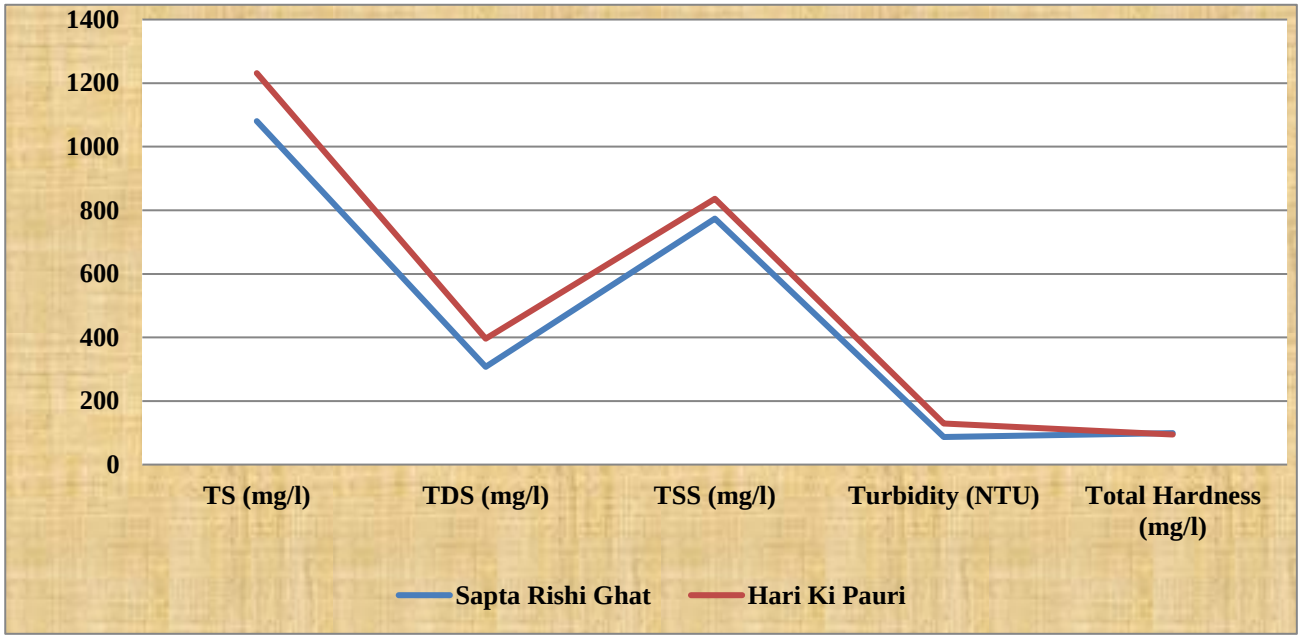

Fig. B

Fig. A & B: Comparative Graph of water quality parameters

4. REFERENCES

1. Abowei, J.F.N. (2010). Salinity, Dissolved oxygen, pH and surface water temperature condition in Nkoro River, Niger Delta, Nigeria. *Adv. J. Food Sci. Tech.* 2(1): 36-40.
2. Agarwal, A. and Saxena, M., (2011). Assessment of pollution by Physicochemical Water Parameters Using Regression Analysis: A Case Study of Ganga River at Moradabad- India, *Adv. in App. Sci. Res.*, 2(2): 185 -189.
3. Alam, M.J.B., Islam, M.R., Muyen, Z., Mamun, M. and Islam, S. (2007). Water quality parameters along rivers. *Int. J. Environ. Sci. Tech*. 4(1): 159-167.
4. APHA (1995). Standard Method for Examination of Water Wastewater. 20th edition, American Public Health Association Washington D.C.
5. Ayoade, A.A., Agarwal, N.K. and Chandola, S.A. (2009). Changes in physicochemical features and plankton of two regulated high-altitude rivers Garhwal Himalaya, India. *Euro. J. Sci. Res*. 27(1): 77-92.

6. Chaturvedi, L.D., Joshi, B.D. and Gahtori, O.D. (1981). Physico-chemical characteristics of two pond ecosystems at Moradabad Part I. From Feb. to July 1979. *J. Environ. Res*. 2(2): 15.
7. Deshmukh, S.B., Phadke, N.S. and Kothandaraman (1964). Physico-chemical characteristics of Ambazari Lake water. *Environ. Health*. VI (3): 186-188.
8. Dulo. and Otieno, S. (2008). Determination of some physico-chemical parameters of the Nairobi River, Kenya. *J. App. Sci. Environ. Manage*. 12(1):57-62.
9. George, A.V. and Koshy, M. (2008). Water quality studies of Sasthamkotta Lake of Kerala. *Poll. Res*. 27(3): 419-424.
10. Griffith, R.S. (1955). Analysis of plankton yields concerning certain physical and chemical factors of Lake Michigan. *Ecology*. 36 (4): 343-552.
11. Huey, G.M. and Meyer, M.L. (2010). Turbidity as an indicator of water quality in diverse watersheds of the upper Pecos River Basin. *Water*. 2: 273-284.
12. Jain, C.K., Malik, D.S. and Tomar, G. (2018). Seasonal variation in physicochemical and phytoplankton diversity of Alaknanda River at Garhwal region (Uttarakhand). *Int. J. Fish. Aqua. Stud*. 6(2): 353-357
13. Joshi, B.D. (2002). On the status of some eco-biological parameters of river Bhagirathi Ganga and its few minor tributaries. In: Bio-diversity, eco-physiology & conservation of freshwater animals. edt. by J.Ojha, *NPH Publ*. New Delhi.
14. Kala, R. and Sharma, R.C. (2002). Effect of physicochemical factors on phytoplankton population in the lotic environment of Alaknanda River. Garhwal Himalaya. *Indian. J. Ecol*. 29 (2): 221-226.
15. Kausar, P. and Salim, M. (2006). Effect of Water Temperature on the Growth Performance and Feed Conversion Ratio of *Labeo Rohita. Pakistan Vet. J*. 26(3): 105-108.
16. Kduka, J.K., Orisakwe, E.O. and Ezenwe. (2008). Some physicochemical parameters of potable water supply in Warri, Niger Delta area of Nigeria. *Scientif. Res. and Assay*. 3 (11): 547-551.
17. Kishor, K., Joshi, B.D. and Deepali (2005). Physico-chemical characteristics of pond water at Khanpur village, in Bareilly district. *Him. J. Env. Zool.* 19(1):89-92.
18. Pathani, S.S., Upadhyay, K.K. and Joshi, S.K. (2002). Some physicochemical parameters and primary productivity of river West Ram Ganga (Uttaranchal). *Him. J. Env. Zool*. 16(2):151-158.
19. Singh, A. K. &Tiwari, R. K. (2009). Physico-chemical characteristics of Ganga River water at Varanasi, *Jour. of Ecobio.* 25 (1): 45-56.
20. Trivedi, R.C., (2010). water quality of Ganga river- an overview. *Aquatic Ecosys. Hlth & Manag.* 13: 4, 347-351
21. Trivedi, R.K. and Goel, P.K. (1986). In: Chemical and biological methods for water pollution studies. *Environmental publication Karad.*