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Analysis of physico-chemical characteristics of Gandak River at Konhara Ghat, Hajipur, Bihar, India

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Abstract- The quality of water depends upon Physico-chemical and Hydro-biological characteristics, reflecting the biotic status of the ecosystem. Physico-chemical factors of Gandak River at Konhara Ghat, Hajipur, Vaishali (Bihar), India, was studied for a period of 18 months from October, 2019 to May, 2021. Monthly water samples were collected to analyse different physical and chemical parameters and results obtained were compared with standard values. The selected Physico-chemical factors analysed during investigation were Temperature, Turbidity, pH, Total Hardness, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Electric Conductivity (EC), Phosphate, Chloride. These properties were analysed and compared with standard values recommended by Bureau of Indian standards and World Health Organization (WHO). In the present investigations maximum values of different parameters were recorded as maximum temperature was 32.6°C in July, 2020, the maximum Turbidity was 28.3 NTU in September, 2020, maximum Electrical conductivity was 185µS/cm in December, 2019, the maximum pH value of water was 7 during several months, the maximum Total Hardness of water was 225mg/l in October, 2020 June, 2020 and November, 2019 while the maximum TDS was 88 mg/l in December, 2020 and DO was highest i.e. 9 mg/l in April 2020-2021. The Ammonia concentration was highest 0.5 mg/l during few months and that of chloride was maximum 1.2 mg/l in September, 2020. The Phosphate concentration was not found in Gandak River.

Key words: Organization, Chemical, Temperature, Standard.

INTRODUCTION

Water is the universal solvent in the world. Approximately 2.4 percent of total global water is situated on terrestrial region. And out of which only a little amount can be utilized as fresh water.¹ Rivers are vital and vulnerable freshwater systems that are critical for the sustenance of all lives. However, the declining quality of the water in these systems threatens their sustainability

and is therefore a cause for concern. Rivers are waterways of strategic importance across the world, providing main water resources for domestic, industrial and agricultural purposes.² The Gandak is a tributary of the Ganga River. It is one of the major rivers in Nepal and India also known by the name Kali Gandaki or Narayani after the confluence with Trisuli in Nepal. Konhara Ghat is a river bank at Hajipur in Bihar. It is one of the main ghat of the Ganga-Gandak Rivers where worship and cremation have been performed side-by-side for centuries. Water of River

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Gandak is used for domestic, agricultural and residential purpose. But unfortunately, it is being polluted through a number of polluting sources such as sewage, disposal of burnt and unburnt human and animals' carcasses and run off from agricultural fields containing pesticides and other agrochemicals. Although many researchers have studied on different river system but there is very few on Gandak River. Till now there are no sufficient baseline data regarding physico-chemical parameters of Gandak River at Konhara Ghat, Hajipur. Therefore, the present work was undertaken to study the physico-chemical characteristics of Gandak River in relation to fisheries and pollution. Purpose of the study was not only to enhance the physico-chemical condition of Gandak River but also to explore the possibilities for better management and development of these water resources.

MATERIALS & METHODS

Area of Study

The Gandak River is one of the major rivers of Nepal and India is a left bank tributary of the River Ganga in India. Gandak flows southeast across the Gangetic Plains of Bihar, eventually merging with the Ganga near Patna. Konhara Ghat is a River bank of Gandak River at Hajipur Town of Vaishali District of Bihar, India. Konhara Ghat, Hajipur, Vaishali Bihar is situated at Latitude-25.6783°N and Longitude-85.1956°E

Collection of samples

The water samples were collected in the plastic bottles. Bottles were washed initially by Distilled water there after bottles were rinsed with sample water. The bottle was dipped in the river below the surface and then bottle was opened inside and was closed again to bring it out at the surface. Samples were collected monthly for a period of eighteen months from October, 2019 to May, 2021.

Physico-chemical parameters

To study the physico-chemical properties of the River Gandak, water samples were collected from the river surface in a clean Plastic Bottles for the period of 18 months, October, 2019 to May, 2021. Samples were collected during morning hours in between 7.00 to 9.00 A.M. using one litre Water bottle.

Some of the parameter was tested at the site of sampling like pH, TDS, Conductivity and temperature. Apart from that sample is also fixed at the site of sampling for dissolved oxygen analysis. On site findings are recorded

separately. Collected water samples immediately carried to the laboratory for analysis. The analysis of physico-chemical parameters were carried out by using standard methods of American Public Health Association.³ The parameters pH and EC were analysed on spot with portable pH, TDS, and EC meters while rest of the parameters including Dissolve Oxygen (DO-mg/l), Total Hardness (mg/l), Phosphate (mg/l), Chloride (mg/l), Turbidity (NTU) etc. were analysed in laboratory.

Table 1. Instruments and methods employed in analysing Physico-chemical factors of water

Parameter	Instrument / Method used
Temperature	Digital Thermometer
pH	pH liquid
Conductivity	Conductivity meter
TDS	TDS meter
Total hardness	Total hardness testing kit
Phosphate	Phosphate testing kit
Ammonia	Ammonia testing kit
Chloride	Chloride testing kit
Dissolved oxygen	DO testing kit
Turbidity	Turbidity meter

RESULT & DISCUSSION

The monthly variations of different Physico-Chemical parameters of water in Gandak River are shown in Table 2. The results are also summarized on the monthly basis and compared with the surface water quality standard.

1.pH

pH of water is most important Hydro-biological parameter which plays a crucial role in different life-sustaining chemical reactions. It indicates acidic and alkaline nature of water. Generally, confined inland waters in India are alkaline in nature. In this study, pH of surface water varied from 7 to 9. It was minimum during few months of study period, while maximum value was observed in March, 2021. The nature of water was neutral to alkaline throughout the study period and the mean pH of the Gandak river water was observed 7.6. All the samples were observed under the range of safe limit (6.5-8.5), suggested by BIS⁴ for surface water quality as illustrated in Table 2.

2. Electrical conductivity (EC)

The electrical conductivity of water is a measure to confirm the presence of different ions in it and also about its purity. It depends on the concentration of different ions,

nutrients, and dissolved solutes. During study EC recorded for water samples ranged from 143 µS/cm to 185 µS/cm. The minimum value of EC was observed during September, 2020 while the maximum was in December, 2019. The mean conductivity of the Gandak River water was observed 169.22 µS/cm. The high value of EC is an indication of pollution and eutrophic status of an aquatic ecosystem. EC of all samples was observed under the prescribed limit (< 2250 µS/cm) by BIS.⁴

3. Dissolved Oxygen (DO)

Dissolved Oxygen is very important, particularly for the fauna of aquatic ecosystems. Low DO value indicates about the organic pollution; while relatively high DO confirm the good health of an aquatic ecosystem. The variation of DO in this study was observed in a range of 7.0 mg/l to 9.0 mg/l. The Mean DO of the River water was observed 7.55 mg/l. It is reported in different studies that the DO is high during active photosynthesis, while it used to reduce when water temperature, organic load and microbial activity increase in the aquatic system. The fish needed at least 5 mg/l dissolved oxygen for development and growth of fish.⁵

4. Total Hardness

Hardness is the capacity of water to react with detergent. It is mainly because of Carbonate and Sulphate of Calcium and Magnesium. Total hardness of river water was found in a range of 125 mg/l to 225 mg/l. The minimum and maximum value of hardness was observed during several months. The values of total hardness were always found below the prescribed limit (300 mg/l) by BIS⁴, for all the samples during the study period. Kiran (2010)⁶ reported that water can be categorized according to degree of hardness as soft (0-75 ppm), moderately hard (75-150 ppm) and hard (150-300 ppm). Thus, the water of the Gandak River is hard.

5. Phosphate

Phosphorous is one of the most important micronutrients in deciding the productivity of an aquatic ecosystem. It occurs in different forms like particulate phosphorous, active phosphate, orthophosphate etc. The concentration of phosphate in water samples was not found in the present study. Stone and Thomforde (2004)⁷ stated that phosphate content \leq 0.06 mg /L is suitable for pisciculture.

6. Turbidity

The Turbidity of any water sample is the reduction of transparency due to the presence of particulate matter such as clay or silt, finely divided organic matter, plankton and other microscopic organisms. In the present study, the higher turbidity-28.3 NTU in September, 2020 and lower value-15.3 NTU in March 2020.

7. Total Dissolved Solids (TDS)

The highest total dissolved solids (TDS) were observed as 88 mg/l during December, 2020 while the lowest TDS was observed 75 mg/l during September, 2020. The maximum limit for TDS as suggested by W.H.O is 500 mg/l which indicated that the recorded TDS signifies the normal range.

8. Temperature

Temperature is an important factor which regulates the biogeochemical activities in the aquatic environment. The temperature of Gandak River ranges between 17.5°C to 32.6°C. The maximum temperature was recorded during July, 2020 and the minimum was recorded in December, 2020.

9. Chloride

Despite the chlorine properties that can control the water bone diseases, its side effects required regulations and standards to limit to a minimum level. Chlorine are found in all-natural surface waters, but in very low concentration in freshwater. It imparts a salty taste to water. The concentration of Chloride ions in water samples was found in a range of 00 mg/l to 1.2 mg/l. The minimum concentration of chloride was observed in several months of 2019-2020 and maximum in month of September, 2020. Its concentration in all water samples was always found below the given standard limit BIS⁴ standard for surface waters.

Similarly, Kumar and Choudhary (2016)⁸ in a study of Water Quality and Phytoplankton of River Gandak, Bihar (India), The water temperature fluctuated between 13.2°C to 17.2°C. Minimum turbidity 6 NTU and maximum 43.5 NTU recorded. Total dissolved solids ranged from 152.4-356 ppm. Conductivity of water ranged from 246.3-578.9 ppm. pH of water ranged from 7-8 i.e., from neutral to slightly alkaline. Dissolved oxygen content levels were minimum 6.5 ppm and the maximum were recorded 10.8 ppm. Total hardness values ranged from 134-180 ppm. Phosphate- phosphorus values ranged from 0.033-0.05. Sharma *et al.* (2020)⁹, reported Temperature varied from

18°C to 31.2°C. The pH of the water in all studied months was within the WHO¹⁰ Standard of 6.85-8.5. Turbidity varied from 8.7-58.37 NTU. The observed TDS values varied from 183.27mg/l to 247.1mg/l. Conductivity values were minimum 363.8mg/l and maximum 511.8mg/l. Total hardness values varied from 187.5 mg/l- 246 mg/l. Dissolved oxygen values varied from 4.9mg/l to 8.71 mg/l. High phosphates value 0.071 mg/l was observed and minimum 0.045 mg/l. Nitrate value was between 0.037mg/l and 0.065 mg/l, in study of the Budhi Gandak River at Khagaria Bihar India. Singh *et al.* (2017)¹¹ States that, Temperature was found to be in range of 19.46°C to 24.36°C at Ghaghara and 22.67°C to 26.°C at Gandak River. pH was found to be in range of 7.83 to 8.23 at Ghaghara and 8.03 to 8.3 at Gandak River. P. R. Singh and A.K. Verma (2016)¹² reported in their Observations on Hydrobiological Conditions of River Ganga at Daraganj, Allahabad. Water temperature between (°C) 15.40–32.3, Conductivity (μs/cm) 300-495, pH 7.9–8.2 and D.O. ranges between (mg/l) 6.1–9.5.

Similarly, Sarvesh (2020)¹³ reported temperature ranged between 18.5°C to 33.5°C, Dissolved oxygen level ranged between 4.6mg/l to 10.0 mg/l Budhi Gandak River Samastipur Bihar. Verma *et al.* (2012)¹⁴ reported temperature ranges between 17°C to 30°C, Electrical Conductivity ranges between 3.25μs/cm to 4.16 μs/cm, Turbidity ranges between 19 NTU to 24 NTU, TDS ranges between 828 ppm to 1014 ppm, pH value recorded ranges between 8.7 to 9.5, TH recorded ranges between 320 ppm to 368 ppm, DO ranges between 2.10 ppm to 4.12 ppm, chloride recorded in the water of ranges between 116 ppm to 133 ppm, phosphate ranges between 1.18 ppm to 2.12 ppm, Chandola lake of Ahmedabad and Dalal *et al.* (2013)¹⁵ reported physico-chemical of parameter of River Dham, the range of pH was 6.62-8.24. The total hardness of water samples ranges from 266.2-324.51 mg/l. TDS ranges 264.828-367, DO was found to be in the range of 1-16 ppm. Chloride value range from 137.54 to 172.1 mg/l.

Table 2: Showing Physico-Chemical factors of Konhara Ghat from October 2019 to May 2021

Month	Temp. (°C)	pH	Conductivity (μs/cm)	TDS (mg/L)	Total hardness (mg/L)	Chloride (mg/L)	DO (mg/L)	Turbidity (NTU)	Phosphate
Oct-19	27.2	7	167	77	175	0	7	22.4	-
Nov-19	23.4	8	167	79	225	0	8	21.5	-
Dec-19	17.9	7	185	80	150	0	8	17.7	-
Jan-20	19.1	7	170	86	200	0	8	19.8	-
Feb-20	21.1	8	172	83	175	0	7.5	16.9	-
Mar-20	26.3	8	166	83	200	0	8	15.3	-
Jun-20	31.9	7	178	82	225	0	7	25.6	-
Jul-20	32.6	7	162	76	175	0	8	24.1	-
Aug-20	32.4	7	147	76	175	0	7.5	25.5	-
Sep-20	30.7	8	143	75	125	1.2	7.5	28.3	-
Oct-20	26.8	7	175	79	225	0	7	16.6	-
Nov-20	24.7	8	166	85	150	0	7.5	17.7	-
Dec-20	17.5	7	169	88	175	0	8	16.9	-
Jan-21	17.9	8	172	80	200	0	7.5	18.2	-
Feb-21	22.4	8	173	76	175	0	7	18.3	-
Mar-21	26.7	9	180	84	125	0	6.5	17	-
Apr-21	30.4	8	171	86	200	0.4	9	18.5	-
May-21	30.6	8	183	86	150	0.4	7	18.5	-

SUMMARY AND CONCLUSION

The present investigation attempts to assess the hydrobiological characteristic of water of River Gandak Hajipur with reference to its suitability for sustention of ecology and aquatic lives in the river. Nevertheless, a total of nine physico-chemical parameters have been analysed

and the results of comparative analysis indicate that most of the important quantities such as total dissolved solids, pH, TDS in Gandak River are under the upper threshold of the W.H.O, BIS⁴ guidelines. The river has got high potential for aquatic lives as the most important of the water quality parameters were suitable to sustain the

ecology and aquatic life in the river. Indeed, all parameters such as Temperature, pH, Total Dissolved Solids, Chlorides, EC, Turbidity, Total Hardness, and Dissolved Oxygen were found within the permissible limit.

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