

Analysis of Water Quality Parameters of Chenab River Water and its Major Tributaries in Kishtwar and Doda Districts of Jammu and Kashmir

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Abstract: Water quality analysis is one of the most important aspects for assessing the pollution level. River Chenab has been a major source of water supply for many purposes and provides fertile lands, which support the development of its adjoining areas due to its favorable conditions. In the present study Chenab River water and its major tributaries between Padder (Kishtwar) and Assar (Doda) has been extensively studied to assess the overall water quality and to identify the major variables responsible for water quality variations. Water samples were collected in triplicate from 9 different sampling stations to evaluate the water quality status during Sept-Oct 2020. A total 16 water quality parameters analyzed were found within the permissible limit of drinking water quality, indicating good water quality status posing no serious threat for different human usage.

Keywords: Chenab River, Physico-Chemical parameters, Water quality, Water pollution

1. Introduction

Rivers are an important source of fresh water but are also vulnerable to kinds of pollution to both point and nonpoint sources. Anthropogenic activities related to extensive urbanization, agricultural practices, industrialization and population expansion have led to water quality deterioration in many parts of the world. [1, 2].

The Chenab valley is structural trough formed by great Himalayan and Pir Panjal ranges. The Chenab River is a major and one of the most important rivers that flow through this region. The River Chenab originates in the Kulu and Kangra districts of the Himachal Pradesh province of India. The two chief streams of the Chenab - the Chandra and the Bhaga - rise on opposite sides of Baralcha pass at an elevation of about 16,000 feet. These join at Tandi in the state of Jammu and Kashmir, nearly 9,090 feet above mean sea level. After a long journey from its headwaters, the river gains immense power and momentum on entering the Jammu/Kashmir region at Padder above Kishtwar. Proceeding in north-west course for a separation of around 56 kilometers, the Chenab is joined by Maru-sudar in Bhandarkot which is viewed as the greatest tributary of Chenab.[3,4] From Kishtwar to Thathri (about 50 km) the Chenab runs through class V and VI gorges. The combined streams, traversing about 135 miles, take a sharp turn along Pir Panjal near Kishtwar. The Chenab then flows along the northern base of the Pir Panjal range before entering the Doda area of Jammu. Kalgoni, Neeru, Bichleri, Raghi etc

are the other tributaries that join Chenab in the middle of Doda District. There after it cuts across this range through a spectacular gorge then flows along its southern base through Ramban, Riasi and Rajouri Districts of the Jammu region of Jammu and Kashmir, before entering into the plains of Punjab, Pakistan.

Water, a natural resource which has been used for different purposes, namely for drinking, domestic, irrigation and industrial, mainly depends on its intrinsic quality hence it is of prime importance to have prior information on quality and quantity of water resources available in the region, while planning developmental projects. Water quality index (WQI) is regarded as one of the most effective way to communicate water quality [5-9] The present study was aimed to assess rapid and accurate calculation of water quality of river Chenab and its major tributaries between Padder (Kishtwar) and Assar (Doda) in Jammu and Kashmir.

2. Materials and Methods

The water samples were collected from the Chenab River from the stretch between Padder to Assar at a total of 9 selected sampling sites in the Chenab network. The details of sampling locations are presented in Table 1. Surface water samples were collected in triplicate at a depth of 15–20 cm with 1-L plastic containers, which were pre-rinsed with trioxonitrate(v) and soaked overnight with distilled water to avoid an unpredicted change in the characteristic of the water samples.

Table 1: Water sampling locations of Chenab River and tributaries

Table 1 Water sampling locations of Chenab river and tributaries					
S. No.	Sample code	Sampling locations	Longitude (E)	Latitude (N)	Altitude (m)
1.	S -1	Chenab River at Padder Kishtwar	76.16 54 ⁰	33.2656 ⁰	1796.35
2.	S -2	Chenab River at Dool Kishtwar	75.8991 ⁰	33.3423 ⁰	1320.18
3.	S-3	Maru-Sudar stream at Bhandarkoot Kishtwar	75.7335 ⁰	33.3607 ⁰	1126.62
4.	S-4	Chenab River at Kandani Kishtwar	75.7742 ⁰	33.2658 ⁰	1069.46
5.	S-5	Kalgoni Stream at Thathri Doda	75.7975 ⁰	33.1353 ⁰	1008.07
6.	S-6	Chenab River at Premnagar Doda	75.6870 ⁰	33.1589 ⁰	906.82

Volume 10 Issue 4, April 2021

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7.	S-7	Neru Nalla at Pull Doda	75.5546 ⁰	33.1376 ⁰	840.59
8.	S-8	Chenab River at Khilani Doda	75.4821 ⁰	33.1479 ⁰	812.77
9.	S-9	Chenab River at Assar Doda	75.3286 ⁰	33.1595 ⁰	778.43

The water samples were analyzed for various physico-chemical parameters following the standard methods [10]. Analytical precision was assessed by the use of a control chart and blind samples [11]. The same laboratory

equipments were used for all the samples collected in order to control variability from sampling irregularities and the results are presented in Table 2.

Table 2: Variation in physico-chemical parameters of Chenab River water and its tributaries at different sampling stations in Sep. - Oct. 2020

01.	Parameters	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9
02.	Water Temperature °C	15.8	16.3	16.2	18.5	16.8	20.5	19.4	22.4	22.6
03.	pH	7.3	7.4	7.2	7.4	7.2	7.7	7.3	7.7	7.8
04.	Conductivity (µs/cm)	177	192	209	207	235	211	218	204	212
05.	BOD (mg/l)	1.8	2.2	1.9	2.7	2.1	2.9	2.5	3.3	3.4
06.	COD (mg/l)	1.0	1.2	1.1	1.2	1.2	1.3	1.2	1.4	1.4
07.	Free NH ₄	0.3	0.5	0.3	0.8	0.5	1.0	0.6	1.2	1.3
08.	TDS (ppm)	78	78	82	80	84	82	83	83	84
09.	Total Hardness (mg/l)	84	88	89	94	102	96	104	103	104
10.	Chloride (mg/l)	12.6	13.9	12.2	14.4	13.3	16.7	13.7	18.8	20.3
11.	Sodium Hardness (mg/l)	1.8	2.4	3.6	3.1	3.4	3.2	4.1	3.5	3.7
12.	Potassium Hardness (mg/l)	1.7	1.7	1.9	1.7	2.0	1.8	2.2	1.8	1.9
13.	Sulphate (mg/l)	54.8	62.5	75.2	66.4	80.6	77.2	88.3	82.5	96.2
14.	Nitrate (mg/l)	2.5	3.7	3.8	5.2	4.2	5.9	3.4	6.7	8.3
15.	Orthophosphate (mg/l)	0.16	0.23	0.22	0.24	0.29	0.32	0.31	0.38	0.41
16.	Turbidity (NTU)	14	18	08	21	06	22	09	28	42

Note: The various values presented in the table are depicted as mean value of all three samples of a particular sampling location

Parameters like water temperature, pH and TDS were measured on the spot with the help of pen-type digital pH and TDS meter. Conductivity and dissolved oxygen (DO), of the river water samples were measured with the help of a digital multi-parameter monitoring instrument in the laboratory. Total alkalinity, total hardness, calcium, magnesium and chloride were analyzed by the titration method. Five-day biochemical oxygen demand (BOD₅) was measured using Winkler's azide methods and chemical oxygen demand (COD) using a dichromate reflex technique. Parameters like nitrate and sulfate were analyzed using the double-beam UV-visible spectro- photometer.

The instruments used in situ were calibrated using a specific calibration solution before each measurement [10]. Suspended solids (SS) and dissolved solids (DS) were separated gravimetrically; filtering the water through a 0.45-µm filter paper and determined according to a standard procedure[10]. (NH₄)⁺ was determined using a molecular absorption spectrophotometer. Turbidity was directly measured with a turbidimeter (Hach 2100 AN). In order to maintain detection precision, internal standard reference materials (SRM) were used for every ten samples.

3. Results and Discussion

A total of 14 physicochemical variables were analyzed from 9 sampling points in the Chenab River. Temperature is one of the most important parameter of water as it affects the biotic as well as abiotic component of the ecosystem. The present water quality analysis showed water temperature varied from 15.8°C in sampling point 1 to 22.6 °C in sampling point 9, which is within the portable range of 20 – 32 °C specifications for potable water by the central

Pollution control Board (CPCB) of India, Bureau of Indian Standards (BIS) for Drinking Water - Specification IS 10500: 1991 and World Health Organization (WHO)[12-13]. The fluctuation in river water temperature is attributed to the geographic locations and hilly terrain. The present study revealed that the pH value is within the acceptable limit of 6.5–8.5 [14,15] varying between 7.3 and 7.8, with the maximum limit of 7.8 at sampling point 9. The electrical conductivity of all the samples showed a range between 177 – 235 µS/cm. Electrical conductivity (EC) is an indirect measure of total dissolved salts. Usually higher EC value indicates the presence of higher content of dissolved salts in river water [16,17]. BOD₅, COD, and NH₄ of the water samples varied from 1.8 to 3.4 mg/L, from 1.0 to 1.4 mg/L, and from 0.3 to 1.3 mg/L, respectively which reflect low anthropogenic influences on the river. BOD and COD concentrations in all the sampling points show that the value is within the acceptable limits[18]. TDS describes all solids (usually mineral salts) that are dissolved in water. In the present study the total dissolved solid ranged between 78 and 84 mg/L. Total hardness reported was in the range of 84–104 mg/L in all selected sampling sites. Chloride concentration is one of the most indicators of water pollution and one of the major anions found in water[19]. In present study chloride concentration ranged between 12.2 and 20.3 mg/L. Sodium and potassium in the water ranged between 1.8–4.1 and 1.7–2.2 mg/L, respectively. Sulphate, Nitrate and Phosphate are three other constituents responsible for water quality parameters. During the present study sulphate, nitrate and Phosphate content were found in the range of 54.8 – 96.2, 2.5 – 8.3 and 0.16–0.41 mg/L respectively.

Turbidity of water is actually the expression of optical property in which the light is scattered by the particles present in the water. Turbidity in the present case under study ranged between 6 and 42 NTU. Turbidity is observed to be higher side as the river flow is rapid and turbulent due to steep gradient and higher rate of erosion in the catchment area.

4. Conclusion

The study provides us with valuable information about the overall water quality status of the Chenab River water and its main tributaries between locations Padder of Kishtwar District and Assar of Doda District. As per the observation, no considerable changes in water quality parameters at different locations (sampling sites) were observed except in few sites (tributaries), where a modest increase in a couple of parameters was observed. The overall water quality parameters, however, indicated good water quality status. All the physicochemical parameters of water analyzed were within the permissible limit of drinking water quality, and at present, they do not pose a serious threat for different human usage. In the present study, pH, DO and BOD played a significant role in affecting the water quality of the river. Though in the case of nutrient parameters, no such significant roles were observed.

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