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Water quality index of Churni and Jalangi rivers, West Bengal, India

Gautam Kumar Das
19, Raj Krishna Pal Lane, Kolkata–700 075, India
gkdas7@gmail.com

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Abstract

Industrial manufacturers like sugar mills and distillery plants, and milk units drain waste effluents into Churni and Jalangi rivers of Nadia district in West Bengal. Apart from industrial effluent discharge, Churni and Jalangi rivers receive domestic sewage on a regular basis through drainage systems from Ranaghat and Krishnanagar municipalities respectively. Industrial effluent as well as domestic and urban sewage enter Churni and Jalangi rivers from industrial, domestic, and municipal sources. The wastewater effluent and domestic sewage affect the aquatic environment resulting in drastic changes in the river water quality of Churni and Jalangi rivers which are deleterious to both aquatic flora and fauna. This is how most of the river stretches of Churni and Jalangi are almost polluted. For the determination of the magnitude of pollution, the water quality index of river water is computed. The obtained result reveals that the present condition of surface water of Churni is in worse condition wherethe situation of Jalangi River at its downstream is comparatively better.

Keywords: Churni River, Anjana River, Jalangi River, Water Quality Index, Physico-chemical parameters.

Introduction

A sugar manufacturing and distillery unit named Carew and Company at Darshana of Bangladesh discharges industrial effluent into Mathabhanga River that enters Churni River in India. Like Carew and Company, The Kishan Co-Operative Milk Producers' Union Ltd of Nadia district discharges wastewater effluent in Jalangi river. Churni and Jalangi rivers of Nadia are the two main waterways of the district, of which the Jalangi river is the longest (Figures-1, 2). Jalangi flows through Murshidabad and Nadia districts for about 233 km and joins Bhagirathi River at Swarupganj near Mayapur. Jalangi is thus a tributary of Bhagirathi River. Jalangi originates from the Padma River in Murshidabad district and so, Jalangi is a distributary of Padma River. On the other hand, the Churni River originates from Mathabhanga River near Majhdia in Nadia district and flows about 56 km to join the Bhagirathi River at Shibpur near Payradanga of the same district. Near Majhdia the river Mathabhanga bifurcates to form Churni and Ichamati rivers. It is said that King Krishnachandra of Nadia dug a canal from Majhdia to Krishnaganj in the 17th century to escape Bargi raids. This canal later took the form of the Churni River. It may also be that a canal was cut from the Mathabhanga River which morphs into the Churni River. The geographical reason behind the cut canal becoming a river is the local subsidence which stabilized later in the seventeenth century. For this reason, although almost all the rivers here flow in the south-east direction, the Churni and Jalangi rivers flow in the south-west direction which bears the evidence of the young age of these two rivers.

A river called Anjana connects Jalangi and Churni rivers almost at right angles. The length of Anjana River is only 23 km which has lost its current earlier and it is now in crisis of existence. Due to the navigability of this river at one time, it was very convenient to travel by water. But when Muslim invaders started using this waterway, Raja Krishna Chandra's predecessor Raja Rudra Ray blocked the source of Anjana River. At present, the urban people of Krishnagar are making illegal constructions on the Anjana, just like the farmers in the villages have started cultivating Anjana River by filling the riverbed. Later, during the British period, an attempt was made to control the flow of water by installing sluice gates on the source point of Anjana River from Jalangi River. The Anjana River gradually became sick due to the repeated obstruction of the flow of water in the course of the river. Now no flow is seen across the course of the river. Almost all the river is covered with aquatic weeds and this river is now standing on the verge of extinction (Figure-3). The encroachers are not only cultivating paddy in the riverbed but also making ponds for fish farming round the year in the river floodplain along its course.

The Anjana River had its origin for other reasons. In the estuary at Swarupganj near Mayapur, the water level of the Jalangi River is below the water level of the Bhagirathi River and that is why the water of Jalangi River cannot mix with Bhagirathi River. Then the water of Jalangi River started to flow backwards and flow through a slope. This is how the Anjana River originated as a tributary of the Jalangi River.

Churni and Jalangi rivers of Nadia district are now polluted. Mathabhanga River, source of Churni River, originates from Padma in Munshiganj, Bangladesh and enters Indian territory. Carew & Company discharges all its factory waste effluents into the Mathabhanga River 4 to 6 times a year near Darshana in

Bangladesh without any wastewater treatment. After dumping the polluted waste into the river, the effluent from the Mathabhanga River mixes with the water of the Churni River and within two to four days, the entire Churni River turns black. Then all the fish floated in the Churni River and died later, and river water became unfit for all kinds of domestic use including outdoor bathing and washing utensils. Similarly, a milk company named The Kishan Cooperative Milk Producer Union Ltd drains its wastewater into the Jalangi River which pollutes the river water. Also, in the lower reaches of the two rivers, Ranaghat and Krishnanagar Municipalities discharge wastewater through municipal drainage systems. Simultaneous discharge of industrial effluent and municipal wastewater degrades the quality of river water. Determination of water quality of both rivers by computing the water quality index applying the standard method is the objective of the present study.

Figure-1: Blackish water flow along the course of Churni River at Aranghata of Nadia district, West Bengal.

Figure-2: Jute processing by the local farmers in the river waters of Jalangi at downstream of Krishnanagar in Nadia district of West Bengal.

Figure-3: Anjana River at Badkulla of Nadia district covered with aquatic weeds.

Materials and methods

Uses and utilization of river waters are generally determined by some selected physico-chemical parameters like pH, Conductivity, DO, BOD, COD, TDS, TSS. TFS, TA, TH, Calcium, Magnesium, faecal coliform etc., and water quality index are computed averaging weight of some of the selected water parameters like pH, Conductivity, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, total dissolved solids, total suspended solids, total fixed solids, total alkalinity, and total hardness according to their significance and importance in a particular environment. In the present study, water quality index (WQI) is calculated applying the standard statistical formula considering the minimum and maximum values of individual physico-chemical parameters of Churni, Jalangi, and Mathabhanga rivers based on Database on environment and forestry statistics of West Bengal[1,2]. After computation of water quality index, water quality index rating is applied on the obtained values as per standard water quality rating values for WQI.

Results and discussion

Generally, three types of adverse effects are observed when the river water receives the wastewater from the canals or drainage systems that flow directly from the industrial plants, municipality, or urban areas. Changes in turbidity, temperature, water colour including several other surficial properties may be considered as physical pollution[1,2]. Oxygen depletion or eutrophication results can cause either organic or inorganic nutrient pollution[3-5]. Changes of toxicity, acidity, alkalinity, or salinity alternations are directly related to chemical pollution which are revealed by the determination of pH, conductivity, DO, BOD, COD, TDS, TSS, TFS, TA, TH, and most probable number (MPN) of microbial organisms like faecal coliform in the river waters contaminated with the liquid effluents from the industrial plants along with domestic sewage released from the

municipality and urban areas is considered as organic microbial pollution[6-8]. Industrial water effluents mixed in the Mathabhanga River water at Darshana of Bangladesh contaminate river waters of Churni thougha portion of the riverbank of Mathabhanga is covered with bushes and jungles near Gede border areas[9]. Like sugar manufacturing plants of Bangladesh, The Kishan Cooperative Milk Producer Union Ltd discharges wastewater effluent into Jalangi that pollutes the river waters.

The rivers of West Bengal are generally alkaline and have an influence on climate change mitigation by absorbing atmospheric carbon dioxide. For the analysis of BOD, two factors like temperature and time are very important to obtain accurate and reproducible results[10]. Like BOD, the occurrences of microbial populations are influenced by the availability of dissolved oxygen, temperature, pH, and ultimately the composition of wastes and sewage released in the river water[11]. COD analysis is concerned with rigorous chemical oxidation and for this reason, COD values show no relationship with that of BOD[12]. For wastewater treatment, chemical parameters of the river water like pH, conductivity, DO, BOD, COD, TDS, TSS, TFS, TA, TH, TKN etc. are to be standardized to the permissible limit for domestic or agricultural usage[13]. River water has a greater amount of dissolved solids as the part of direct run-off enters the river system soon after precipitation in the form of rain. Some dissolved substances in the form of total dissolved solids are present in the natural uncontaminated river waters[14]. TDS, TSS, and TFS values are rather higher for the river water of Mathabhanga in the upstream than that of Churni River in the downstream only except a few exceptional cases[15,16].

Water Quality Index: Water quality index (WQI), a good indicator for the determination of river water conditions is computed by averaging the relevant values of physico-chemical parameters of surface waters which is likely to be significant for the interpretation of the present conditions of the water bodies (Table-1, 2 and 3).

From the computed water quality index, water quality rating indicates that Mathabhanga river water contains about 25% good water, 66% poor water, and only 9% fair water as per standard water quality rating chart during three principal seasons of South Bengal i.e., pre-monsoon, monsoon, and post-monsoon in a year. For the existence of 66% poor surface water of the river, Mathabhanga river water is not suitable for outdoor bathing.

About 25% good water, 25% fair water, and 50% poor water conditions are observed for Churni River in 2013-14, and 2014-15 respectively as per water quality rating obtained from the water quality index values after computation applying standard statistical formula. The WQI values revealed that the water quality of Churni River is rather better than that of Mathabhanga River in terms of water quality index (WQI).

Table-1: Computed water quality index of river waters at downstream stretch of Mathabhanga.

Year	Sample Locations	Pre-monsoon		Monsoon		Post-monsoon	
		Min	Max	Min	Max	Min	Max
2013-14	Gobindapur	66.04 (Poor)	83.85 (Poor)	37.16 (Good)	62.59 (Poor)	34.0 (Good)	71.26 (Poor)
2014-15	Gobindapur	63.03 (Poor)	74.33 (Poor)	32.16 (Good)	74.42 (Poor)	60.6 (Fair)	74.27 (Poor)

Rating of water quality within parenthesis.

Table-2: Computed water quality index of river waters at different locations of Churni**.**

Year	Sample Locations	Pre-monsoon		Monsoon		Post-monsoon	
		Min	Max	Min.	Max.	Min.	Max
2013-14	Majhdia	53.414 (Fair)	73.341 (Poor)	31.006 (Good)	58.462 (Fair)	43.89 (Good)	72.743 (Poor)
2014-15	Majhdia	60.061 (Fair)	73.377 (Poor)	30.929 (Good)	54.504 (Fair)	60.458 (Fair)	73.478 (Poor)
2013-14	Ranaghat	65.291 (Poor)	74.245 (Poor)	37.136 (Good)	64.186 (Poor)	34.759 (Good)	76.197 (Poor)
2014-15	Ranaghat	57.411 (Fair)	80.621 (Poor)	31.113 (Good)	69.145 (Poor)	61.92 (Poor)	75.328 (Poor)

Rating of water quality within parenthesis.

Table-3: Computed water quality index of river waters of Jalangi at Krishnagar.

Year	Pre-monsoon		Monsoon		Post-monsoon	
	Min	Max	Min	Max	Min	Max
2013-14	38.35 (Good)	58.35 (Fair)	31.33 (Good)	39.37 (Good)	33.40 (Good)	57.21 (Fair)
2014-15	40.77 (Good)	58.07 (Fair)	28.92 (Good)	48.07 (Fair)	35.81 (Good)	67.31 (Poor)

Rating of water quality within parenthesis.

From the computed water quality index, water quality rating indicates that Jalangi river water contains about 58% good water, 34% poor water, and only 8% poor water conditions as per standard water quality rating chart during three principal seasons of South Bengal.

Water quality index reveals that water quality of Jalangi River downstream of Krishnagar is in good conditions for most part of the year where poor water condition is only observed during the month of January in post-monsoon season in 2014-15 due to increasing values of total dissolved solids. Except for the post-monsoon period, the water quality of Jalangi River in its downstream stretch is either fair or good during 2013-14 and 2014-15. Despite such river water conditions, Jalangi River is not befitted for outdoor bathing as the most probable number of faecal coliform bacteria is very high and beyond the permissible limit. The most probable number of faecal coliform bacteria ranges from 1700 to 300000 in 100 ml river water samples during 2013-14 and from 4000 to 110000 per 100 ml river water in 2014-15. Such a drastic bacterial occurrence is nothing but the consequence of the discharge of municipal wastewater of Krishnagar into Jalangi River through the drainage systems.

Conclusion

The criteria of polluted surface water are determined by BOD values and MPN of faecal coliform bacteria present in the river waters. In Jalangi River, the BOD value ranges from 1.05 to 5.6, 1.0 to 6.0, and 1.6 to 5.7 mg/l in 2017, 2018, and 2019 respectively[17]. For this reason, water quality is poor a little bit for the bacterial number and higher content of BOD. After primary treatment initiated by the River Rejuvenation Committee since September 2019 applying screens and sedimentation tank on Jalangi River, the BOD value ranges from 2.0 mg/l in February 2020 to 3.25 mg/l in the month of May 2020 with only an exception of 6.35 mg/l in the month of March 2020. Similarly, the faecal coliform bacteria in the river water of Jalangi varies from 33000 to 300000, 4000 to 500000, 2000 to 500000 MPN/100 ml during 2017, 2018, and 2019 respectively. But after sewage treatment like chlorination on the mouths of all municipal drains, the faecal coliform bacterial numbers declined to 400 MPN/100 ml in the month of May 2020 that leads to almost fit for outdoor bathing in the river water of Jalangi[17]. But the water quality of Churni River will be remaining the same until and unless the sugar manufacture and distillery plant under the Bangladesh Government takes a drastic step for the treatment of industrial wastewater effluent before its discharge into Mathabhanga River.

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