Crossref
Similarity Check
Powered by iThenticate

Reason - A Technical Journal
ISSN 2277-1654
Volume XXI 2022

WATER QUALITY INDEX OF JALANGI RIVER IN NADIA DISTRICT OF WEST BENGAL

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

Paper submitted on October 25 2022, Accepted after revision on June 08 2023
DOI: 10.21843/reas/2022/49-56/222963

Abstract: The river waters of Jalangi got polluted at its downstream stretch at Krishnanagar due to municipal waste discharge as well as mixing of industrial effluent from The Kishan Cooperative Milk Producer Union Ltd even 7-8 years back. Jalangi River water is currently useable for outdoor bathing after drastic sewage treatment by chlorination for disinfection of faecal coliform bacteria as well as using screen and sedimentation tank for the precipitation of different solids remained in the domestic sewage at the outlets of eight drains of Krishnanagar municipality.The water quality rating applying the formula of water quality index shows 60% good and 40% fair conditions of surface water of Jalangi River for the months from January to May 2020 which was almost poor during 2013-14 and 2014-15 respectively. Application of modified standard values for individual parameters for the computation of WQI reveals similarities of WQI values with the data of physicochemical parameters of river waters of Jalangi.

Keywords: Water Quality Index, Water quality rating, Physicochemical parameters, Jalangi River, Churni, Anjana, Mathabhanga

1. INTRODUCTION

Jalangi originates from the Padma River in Murshidabad district and so, Jalangi is a distributary of Padma River and meets Bhagirathi in Nadia district i.e., Jalangi is a tributary of Bhagirathi River. The river is about 233 km in length without any headwater discharge from the river Padma. Moreover, for geographical reasons no tidal water enters river Jalangi at its confluence with river Bhagirathi as the riverbed of Jalangi is comparatively higher than that of Bhagirathi River. In such a perennial river, at its downstream stretch, Krishnanagar municipality and The Kishan Cooperative Milk Producer Union Ltd discharge domestic sewage as well as industrial effluents in the river waters of Jalangi. Apart from municipal wastes and industrial wastewater disposal, the local farmers are habituated to the processing of jutes by rotting raw jutes in the river water of Jalangi (Fig. 1). In this situation, chemical and microbial parameters like BOD (Biochemical oxygen demand) and most probable numbers of faecal coliform bacteria should not be the only criteria of water quality index (WQI) for prescribing the river water fitness for outdoor bathing as the aquatic environment of Jalangi River is a complex one for the mixture of domestic sewage, industrial effluents, and decomposed organic matters released from the rotting jutes. There must be other standardized physicochemical

parameters which are relevant and significant to this degraded environment for the classification of the river environment for human usage. Again, for the calculation of water quality index, standard values of such relevant and important parameters should be reconsidered for this particular environment at the downstream of Jalangi River. The examination of such relevant physicochemical parameters as well as reconsideration of standard values for the calculation of water quality index of Jalangi River, downstream of Krishnanagar in Nadia district is the objective of the present study.

2. Riverine Environment

Jalangi starts its course from Hasanpur of Murshidabad district as a distributary of Padma River where the river is not traceable at present, and it ends its journey at Swarupganj near Mayapur of Nadia district as a tributary of Bhagirathi River. The source of the Jalangi River is covered by only white sand, which makes it hard to identify which is the Padma River and which is the Jalangi. Jalangi river in Karimpur area has knee-deep water during the post-monsoon period. However, local people can be seen taking a dip in the Jalangi river near Tehatta in the lower course.

The water quality index is computed for Jalangi River in Nadia district of West Bengal that reveals the environmental degradation of river waters. The downstream of Krishnanagar, however, has a lot of water, even streams. Jalangi river water is polluted in Krishnanagar due to mixing municipal sewage. Even though the water of Jalangi River downstream at Krishnanagar was unfit for use some time ago, it has at least been suitable for bathing since May 2020, about two years ago. Due to the drastic initiative of the River Rejuvenation Committee as well as Krishnanagar municipality, the water of Jalangi is now suitable for outdoor bathing by rigorous water treatment of the drainage waters which is discharged in the river on a regular basis. The Water Quality Index revealed that the water quality of Jalangi is rather better than that of Churni River.

Jalangi River got polluted for the release of domestic sewage from Krishnanagar municipality in their downstream stretches. At present, Jalangi River flows in the abandoned channel of Bhairav River which (Bhairab River) is relatively older in the geographical areas of Nadia and Murshidabad districts because the Bhairab River became an abandoned channel long ago. Here the rivers used to flow along the southeast direction. But some forces like local subsidence pull the Mathabhanga, Churni and the Jalangi rivers towards the southwest direction, though there is no evidence of this force in Nadia and Murshidabad districts for almost three centuries. So, these rivers of Nadia district are young by origin. But no one knows how old they are, no one tried to find out. However, after the seventeenth century, these rivers became stable as geologists have proved it with evidence. Apart from Jalangi River in Nadia district, Churni River originates from Mathabhanga River which is younger than Jalangi River in age.

Apart from Krishnanagar downstream, all along the course of the Jalangi river is a long and gloomy scene of waterlessness. All the

garbage from the villages and towns around the river gets mixed in the water of this river. No trees can be seen on the banks of the river. But there are a lot of floating plastic packets which become shiny when the sun shines on the river water. Already Jalangi river course is narrow, there is no flow current, the riverbed is loaded with huge quantities of silt and mud for sedimentation. Even after all this, the daily load of domestic sewage is released in the water of Jalangi River. But one day the Jalangi used to flow with the rhythm of the waves with the water brought from the Padma River. In the past, some of the water hyacinths, jute sticks, or straws floated in the water and were lost in the estuary where the Jalangi meets the waters of the Bhagirathi River. But presently, the river has no current for most of the year, it swells and floods with monsoon water and water from the Padma River. What's more, floods occur along with the erosion of the riverbank. Planned or unplanned development along the banks of the Jalangi River causes such narrowing or reduced water capacity of the riverbed. However, the real reason is the population explosion. Another reason seems to be the urban migration of people. For all this the once vibrant Jalangi is endangered today.

3. PHYSICOCHEMICAL PARAMETERS

In surface waters of the Jalangi River including other rivers, 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 [6-9].

Jalangi River, including other rivers of West Bengal is generally alkaline and has 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]. River water is classified based on total dissolved solids as very soft (0-70 mg/l), soft (70-140 mg/l), slightly hard (140-210 mg/l), modera-

tely hard (210-320 mg/l), hard (320-530 mg/l), and very hard (> 530 mg/l). TDS, TSS, and TFS values are rather higher for the river water of Jalangi in the upstream than that of the downstream stretch except a few exceptional cases [14]. Uses and utilization of river waters are generally determined by some selected physico-chemical parameters like pH, conductivity, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), total suspended solids (TSS), total fixed solids (TFS), total alkalinity (TA), total hardness (TH), calcium, magnesium, faecal coliform, etc. [15]. Water quality index is computed averaging the data of pH, conductivity, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), total suspended solids (TSS), total fixed solids (TFS), total alkalinity (TA), and total hardness (TH) based on the report of West Bengal Pollution Control Board in 2013-14 and 2014-15 respectively [2,16].

4. WATER QUALITY INDEX

For computation of water quality index considering the present situation of Jalangi River at its downstream, the standard values of individual parameters for calculation of WQI (water quality index) should be 1000 mg/l for TDS, TSS, and TFS or the river water samples as TDS, TSS, TFS, and turbidity are interrelated where discharge of both industrial effluent and domestic sewage occurred on regular basis. Individual standard values for dissolved oxygen (DO) should be 5 mg/l which is its upper limit as standard value where pH remains constant at 7.5 though the river is alkaline throughout all seasons round the year. Standard values of BOD and COD should be 5 mg/l and 50 mg/l respectively because the industrial effluents are released without treatment (Table 1). Moreover, Jalangi is a river without head-water discharge from Padma River as well as tidal flow from the Bhagirathi River although it is a perennial river.

Apart from physico-chemical parameters like pH, DO, BOD, COD, TDS, TSS, TFS, TA, TH, presence of microbial organisms in river water like faecal coliform bacteria may determine the water quality of Jalangi River [17, 18]. If these important parameters in majority are taken into account for the computation of water quality index, the obtained results may be better than applying the conventional standards of the chemical parameters fixed by the Central Pollution Control Board. It is observed that more physicochemical parameters are incorporated in the calculation of water quality index, the computed values show more precise results. And when standard values of individual parameters are modified, the obtained results show better water quality index values where similarities are found with the physicochemical parameters as recorded by the River Rejuvenation Committee [17].

Table 1: Modified standard values of individual parameters for the computation of water quality index (WQI)

Modified standard values of individual parameters for calculation of WQI						
pH	Conductivity	DO	BOD	COD	TDS, TSS, TFS	TA, TH
7.5	250 µs/cm	5 mg/l	5 mg/l	50 mg/l	1000 mg/l	200 mg/l

The faecal coliform bacteria occur in the river surface waters making a large colony form off and on. The number of faecal coliform bacteria varies from thousands to millions in such a colony. If the water sample is collected from such a surface area of river water containing a huge bacterial colony, it affects bacterial counts and generally the obtained data will not reflect the average number. Sometimes such abnormal numbers of faecal coliform bacteria are observed in the report of River Rejuvenation Committee [17, 18]. The computation of water quality index considering faecal coliform bacteria as one of the parameters shows varied results for the surface water quality rating for Jalangi River. For this reason, faecal coliform bacteria are excluded in computation of WQI.

Fig. 1: Seasonal jute processing activities by the locals in Jalangi River at the outskirt of Krishnanagar municipal areas

From the computed water quality index applying conventional standard values of individual parameters, water quality rating indicates that Jalangi river water contains about 58% good water, 34% fair water, and 8% poor water conditions as per standard water quality rating chart during three principal seasons of South Bengal i.e., pre-monsoon, monsoon, and post-monsoon (Table 2).

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 [18]. 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 high number of faecal coliform bacteria is nothing but the consequence of the discharge of municipal wastewater of Krishnanagar into Jalangi River through the drainage systems of the municipality.

In the months of February, March, and May 2020, the numbers of faecal coliform bacteria are 1700, 3000, and 2000 MPN/100 ml respectively. For this reason, the most probable number of faecal coliform bacteria is not included in the calculation of water quality index not only for these months, but for the remaining two months of January and

Table 2: Water Quality Index (WQI) of water samples of Jalangi River at Krishnagar

Year	WQI of Jalangi River Downstream, Krishnagar					
	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)

Table 3: Water quality index of river waters of Jalangi at downstream of Krishnanagarfor the period from January to May 2020

Jalangi River Downstream of Krishnanagar					
Months(2020)	January	February	March	April	May
WQI	45.09(Good)	44.62 (Good)	51.85 (Fair)	47.35 (Fair)	33.5 (Good)

(Rating of water quality within parenthesis)

May 2020. The water quality index ranges from 33.5 to 51.85 for these 5 months from January to May 2020 that indicates good to fair conditions of the surface water as per the water quality rating table (Table 3). The surface water quality index reveals that the Jalangi river water downstream of Krishnanagar is almost usable for outdoor bathing. The water quality index shows 60% good and 40% fair conditions of surface water for the months from January to May 2020 (Table 3).

5. REMARKS

Water quality rating indicates that Jalangi river water contains about 58% good water, 34% fair water, and 8% poor water conditions in average as per standard water quality rating chart based on the computed water quality index applying conventional standard values of individual parameters in 2013-14 and 2014-15 respectively. In 2020, after treatment before draining the wastewater, the surface water quality index reveals that the Jalangi river water downstream of Krishnanagar is almost usable for outdoor bathing.

6. CONCLUSION

Jalangi River is the lifeline of Krishnanagar city. But jute rotting is going on in the river Jalangi which flows along Krishnanagar city which makes the water of the river unfit for use. The level of water pollution has been reduced to some extent by treating sewage effluents from municipal areas and releasing them into rivers. From the point of view of the concentration of biochemical oxygen demand, the water pollution level of Jalangi river is currently considered in the category of Priority IV by the Central Pollution Control Board [19].The biochemical oxygen demand level of Jalangi river water has decreased from 8.3 to 6.2 mg/l in 2022 as compared to 2018 as reported by CPCB. At the same time, the river stretch of pollution has decreased from Laldighi to Krishnanagar in 2018 to along Krishnanagar city in 2022.

EFERENCES

[1] Anonymous, Standards for liquid effluents, gaseous emissions, automobile exhaust,

noise and ambient air quality, Central Pollution Control Board (CPCB), Ministry of Environment and Forests, Government of India, Pollution Control Law Series, PCL/4/1995-96, 1996.

[2] Anonymous, Database on environment and forestry statistics of West Bengal, Bureau of Applied Economics and Statistics, Department of Statistics and Programme Implementation, Government of West Bengal, 2015.

[3] Das, G. K., Sunderbans – Environment and Ecosystem, Sarat Book House, Kolkata, 2006.

[4] Das, G. K., Estuarine Morphodynamics of the Sunderbans, Springer, Switzerland, pp.1-211, 2015.

[5] Das, G. K., Tidal Sedimentation in the Sunderban's Thakuran Basin, Springer, Switzerland, pp.1-151, 2017.

[6] WHO, World Health Organization, Health risks from drinking demineralized water, WHO, USA, 2004.

[7] WHO/UNICEF. Water for life: Making it happen, 2005.

[8] WRN, Water Research Net, pH in the Environment (Accessed on 3rd June 2016), available from: http://www.water-research.net/index.php/ph-in-theenvironment, 2016.

[9] Das, G. K., Forests and Forestry of West Bengal– Survey and Analysis, Springer, pp.1-231, 2021. DOI: 10.1007/978-3-030-80706-1

[10] Muralikrishna, I. V. and Manickam, V., Analytical Methods for Monitoring Environmental Pollution, Environment Management, pp.495-570, 2017. DOI: 10.1016/B978-0-12-811989-1.00018-X

[11] Bartha, C., Jipa, M., Caramitu, A. R., Voina, A., Tókos, A., Circiumaru, G., Micu, D. D. and Lingvay I., Behavior of Microorganisms from Wastewater Treatments in Extremely Low-Frequency Electric Field, 12(4), pp.5071-5080, 2022. DOI: 10.33263/BRIAC124.50715080,

[12] Tyagi, V. K. and Lo, S. L, Energy and Resource Recovery From Sludge: Full-Scale Experiences, Environmental Materials and Waste, Resource Recovery and Pollution Prevention, pp.221-244, 2016. DOI: 10.1016/B978-0-12-803837-6.00010X

[13] Langone, M., Sabiab, G., Pettab, L., Zanettic, L., Leonic, P. and Bassoc, D., Evaluation of the aerobic biodegradability of process water produced by hydrothermal carbonization and inhibition effects on the heterotrophic biomass of an activated sludge system, Journal of Environmental Management, 299, 2021. DOI: 10.1016/j.jenvman.2021.113561

[14] Subramanian, V., A Textbook of Environmental Chemistry, I.K. International Publishing House Ltd., New Delhi, pp.1-482, 2011.

[15] Weide, T., Brügging, E., and Wetter, C., Anaerobic and aerobic degradation of wastewater from hydrothermal carbonization (HTC) in a continuous, three-stage and semi-industrial system, Journal of Environmental Chemical Engineering, 7(1), 2019. DOI: 10.1016/j.jece.2019.102912

[16] Galal Uddin, Md., Nash, S., and Agnieszka, I. O., A review of water quality index models and their use for assessing surface water quality, Ecological Indicators, 107218, p.122, 2021. DOI: 10.1016/j.ecolind.2020.107218

[17] Anonymous, Action Plan for Rejuvenation of River Jalangi Krishnagar, West Bengal, Priority – IV, Nodal Agency Municipal Engineering Directorate Department of Urban Development & Municipal Affairs Government of West Bengal, River Rejuvenation Committee, West Bengal, pp.1-14, 2020.

[18] Ayana, Essayas, Determinants of Declining Water Quality, World Bank, Washington, DC, 2019.

[19] CPCB Report, Polluted river stretches for restoration of water quality, Water Quality Management (I) Division, Central Pollution Control Board (CPCB), Ministry of Environment, Forests & Climate Change (MoEF & CC), Parivesh Bhawan, East Arjun Nagar, Delhi, 94p, November, 2022.