Eco. Env. & Cons. 29 (November Suppl. Issue) : 2023; pp. (S54-S58)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i06s.008

Classification of Rivers of Brahmaputra Basin in Assam, India Based on Designated Best Use Concept

Rekha Bora, Lalit Saikia*, Larihun Jeengaph and Rupjyoti Payeng

Department of Earth Science, University of Science and Technology Meghalaya, 9th Mile, Meghalaya 793 101, India

(Received 25 May, 2023; Accepted 2 July, 2023)

ABSTRACT

River water quality is an important issue as rivers are one of the major sources of fresh water for drinking, agriculture, residential use, hydroelectric power plant, tourism, transportation, and others. In spite of abundance of surface water in Brahmaputra basin, only 47% rural population of Assam has access to potable water. It is important to check water quality at regular intervals and prevent and control their pollution. An attempt was made to study water quality of rivers of the Brahmaputra basin in Assam focusing designated best use concept. Water quality status was evaluated from analysis of water samples and secondary data from reports of Central Water Commission and Pollution Control Board, Assam. It is found that water of most of the rivers fall under 'B' and 'C' class (as per designated best use concept, class 'B' water can be used for bathing and class 'C' water can be used as drinking water source with conventional treatment followed by disinfection). Most of the rivers of the Brahmaputra basin have moderate or low pollution, mainly due to rejuvenated life every year during monsoon. However, with contemporary issues of population explosion, increasing demand for water, flood, growing pollution and climate change, it is imperative to take precautionary approach to the pristine as well as ecologically challenged rivers of Brahmaputra basin in India.

Key words: *Brahmaputra basin, Assam, Water quality, Designated best use concept*

Introduction

The Brahmaputra River basin occupies 30% of the country's total water resources and are the highest among all the river basins in the Indian subcontinent. The Brahmaputra along with the well-knit network of its tributaries controls the geomorphic regime of the entire region of the Brahmaputra valley (Mahanta and Saikia, 2015). The major rivers are mostly precipitation dominated during monsoon season and many are snow fed type during the lean flow period. In spite abundance of surface water, according to a UNICEF report, only 47% rural population of Assam has access to potable water. Due to contamination of ground water by arsenic, fluoride and iron, surface water sources, i.e., rivers are suitable options as drinking water sources. It is necessary to monitor water quality of rivers to prevent and control pollution.

Water quality of the Brahmaputra River in Assam have been extensively studied by many researchers (Dutta *et al.,* 2020; Barbulescu *et al.,* 2021). Multivariate statistical techniques were used in Jia Bharali river study for analysis and interpretation of complex datasets, and in water quality assessment, identification of pollution sources/factors and understanding temporal/spatial variations in water quality for effective water quality management (Khound and Bhattacharya, 2017). The overall index of pollution in Jia Bharali river was found to be 0.14 to 1.21

and the water is not fit for drinking purpose as the concentration of heavy metals is high (Chakravarty and Gupta, 2021). Water quality of Jatinga river was studied by collecting water samples seasonally in triplicate from five sites considering nine parameters (Singh *et al.,* 2020) namely potential of hydrogen, electrical conductivity, total dissolved solid, biological oxygen demand, dissolved oxygen, total alkalinity, total hardness, nitrate, phosphate. Central Pollution Control Board, New Delhi, has developed a concept of designated best use of water, according to which, out of the several uses of water of a particular body, the use which demands the highest quality is termed its designated best use (CPCB, 2023). Based on both the primary and secondary data, water quality of rivers of the Brahmaputra basin in Assam has been studied in this paper focusing designated best use concept.

Materials and Methods

Extensive review of literature was done on water quality status of the Brahmaputra and major tributaries in Assam. Secondary data were collected from reports of Central Water Commission and Pollution Control Board, Assam. River water samples were collected from different locations of the Brahmaputra River in Assam during Monsoon (July-August, 2022) and Post-Monsoon (November-December, 2022) months. Different water quality parameters were analyzed using different instruments and procedures (Table 1).

Table 1. Water quality parameters and instruments

Parameter	Instrument
pH	pH meter
DO	Digital DO meter
Turbidity	Turbidity meter
Conductivity	Conductivity meter
Na, K, Ca	Spectrophotometer

Different rivers were classified according to designated best use concept as suggested by CPCB (Table 2).

Table 2a. Designated best use concept

Class A	Drinking water source without conventional treatment but after disinfection
Class B	Outdoor bathing
Class C	Drinking water source with conventional treatment followed by disinfection
Class D	Fish culture and wild life propagation
Class E	Irrigation, industrial cooling or controlled waste disposal

Results and Discussion

Based on review of literature, major uses of a few rivers are mentioned in Table 3. River water is being used for household purposes, irrigation, other ecosystem services including hydropower generation.

Different water quality parameters of the Brahmaputra and selected tributaries from chemical analysis and secondary data are shown in Tables 4 and 5.

The Brahmaputra River at Guwahati (collected from CWC) reveals high TDS, CO_3^{2-}, HCO_3^{-}, Cl^{-}, Ca^{2+}, Mg^{2+}, Na^{+} and Iron in non-monsoon season compared to monsoon season (Table 4) and this can be attributed to less dilution effect coupled with dominant chemical weathering. However increased sediment load facilitated by erosion during monsoon season contribute to high turbidity in river water. High SO_4^{2-} and PO_4^{3-} in monsoon months may be attributed to run off from agricultural field. Water quality data of Brahmaputra River and its tributaries were collected from Pollution Control Board, Assam and an attempt was made for use based classification of those rivers. As per the primary water quality criteria (ISI-IS: 2296-1982), water of most of the rivers fall under 'B' and 'C' class (as per designated best use concept, class B water can be used for bathing and class 'C' water can be used as drinking water source with conventional treatment followed by disinfection whereas class 'A' type is the best one which can be used as drinking water source without conventional treatment but after disinfection). Bacteriological contamination is a major concern for all the rivers and low per capita income along with poor sanitation facility are the two main causes. In the Brahmaputra River, high level of total coliform MPN indicates every possibility of the presence of pathogenic bacteria in river water for which the water is not suitable for drinking purpose without treatment. Water quality of Jhanji, Jia Bharali, Pagladiya, Burhi Dihing, Dikrong, Jiadhal and Subansiri Rivers are within the tolerance limit of class 'A' when pH (6.5-8.5) and DO (6.0 mg/l) are considered (Table 4). Total coliform in those rivers is

Table 2b. Tolerance limit for different classes of water

Water quality parameters	Tolerance				
	Class A	Class B	Class C	Class D	Class E
pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
EC				1000	2250
DO	6.0	5.0	4.0	4.0	
BOD	2.0	3.0	3.0		
Nitrate	20		50		
Total Coliform	50	500	5000		

Table 3. Uses of river water

River	State	Uses	References
Manas	Assam, Arunachal Pradesh	Water supply for human settlement, irrigation	Wang *et al*., 2020; Wang *et al*., 2021
Kameng/ Jiabharali	Assam, Arunachal Pradesh	Drinking, various household purposes, crop irrigation, fish culture, Poultry rearing	Khound and Bhattacharya, 2017
Dhansiri	Assam, Nagaland	Bathing, irrigation, municipal sewage treatment, wildlife and fish propagation, industrial effluent management	Farooq and Debnath, 2022; Barman and Goswami, 2015; CPCB, 2019
Dihing	Assam, Arunachal Pradesh	Fish culture, domestic purposes	Bailung and Biswas, 2021
Bhogdoi	Assam, Nagaland	Fish production, aquatic economic resources	Acharjee and Sharma, 2012
Kopili	Assam, Meghalaya	Irrigation, Hydropower	Nath *et al*., 2020
Ronganadi	Arunachal Pradesh, Assam	Hydropower generation, fishing, drinking water	Buli, 2020
Dikhou	Nagaland	Tourist attraction, important sources of people's livelihood	Sarmah *et al.,* 2020

Table 4. Average water quality data for the Brahmaputra River

Water quality parameter		Monsoon	Non-monsoon
Physical	Temperature (°C)	24.7	18.8
	pH	7.5	7.6
	EC (µmho/cm)	98	158
	TDS (mg/l)	158	176
	Turbidity (NTU)	4.6	3.2
Chemical	DO (mg/l)	7.1	6.8
	CO_3^{2-} (mg/l)	0.2	0.6
	HCO_3^-(mg/l)	55	78
	Cl- (mg/l)	9.5	12
	Ca^{2+} (mg/l)	18.3	23
	Mg^{2+} (mg/l)	4.4	5.8
	Na^+ (mg/l)	1.9	3.9
	K^+ (mg/l)	1.6	1.7
	SO_4^{2-} (mg/l)	1.7	1.6
	Iron (mg/l)	0.4	0.5
	PO_4^{3-} (mg/l)	0.5	0.4

much higher than the assigned value of 50 MPN/ 100 ml for class'A' water. Total coliform in almost all the rivers is higher in monsoon months than that of post-monsoon months. Water of urban rivers like Bharalu and Kolong is highly contaminated with domestic, municipal and industrial wastes.

Conclusion

Most of the rivers of the Brahmaputra basin have moderate or low pollution, mainly due to rejuvenated life every year during monsoon. Water of most of the rivers fall under 'B' and 'C' class (as per designated best use concept, class B water can be used for bathing and class 'C' water can be used as drinking water source with conventional treatment followed by disinfection whereas class 'A' type is the best one which can be used as drinking water source without conventional treatment but after disinfection). With the present trend of urbanization and increasing population and industrialization,

Table 5. Water quality of the Brahmaputra River and its tributaries (PCBA, 2023)

River	DO (mg/l)		BOD (mg/l)		Total Coliform (MPN/100 ml)	
	Mnsn	Post Mnsn	Mnsn	Post Mnsn	Mnsn	Post Mnsn
Brahmaputra at Dibrugarh	7.4	7.4	2.1	2.3	1500	2000
Brahmaputra at Guwahati	9.1	8.7	2.4	2.4	1100	2000
Jhanji	6.8	7.5	2.4	2.5	730	720
Bhogdoi	5.6	7.5	2.3	2.7	2000	1400
Bharalu	1.6	0.3	34.8	36.8	4300	4200
Kolong	5.4	4.3	2.3	2.5	1600	1100
Jia Bharali	7	6.8	2.1	2.3	2100	910
Pagladiya	9	9.3	2.3	2.8	1600	1400
BurhiDihing	6.5	5.2	2.2	2.2	2100	1600
Dikrong	6.6	6.6	2.3	2.4	2100	1200
Dhansiri	6	6	2.3	2.5	1500	1200
Jiadhal	7.2	8.9	2.3	2.4	1100	1100
Subansiri	7.5	8.9	2.5	2.5	1600	1600
Manas	5.4	5.4	2.4	2.5	1200	1200
Sankosh	5.3	5.3	2.2	2.5	910	910

Mnsn: Monsoon (August, 2022)
Post Mnsn: Post Monsoon (December. 2022)

there is a serious threat to many rivers. With contemporary issues of population explosion, increasing demand for water, flood, growing pollution and climate change, it is imperative to take precautionary approach to the pristine as well as ecologically challenged rivers of Brahmaputra basin in India.

Acknowledgement

The authors are thankful to Department of Earth Science, University of Science and Technology, Meghalaya for support in collection and analysis of water samples.

References

Acherjee, S. and Sharma J.N. 2012. A study of wetlands and their role in geoecological environment of Bhogdoi Basin, Jorhat, Assam using Remote Sensing and GIS. *International Journal of Plant & Soil Science.* 2(10): 310-323.

Bailung, B. and Biswas, S.P. 2021. Determination of water quality and ecology of river Dihing river: A tributary of almighty Brahmaputra, Assam, N.E. India. *AGBIR*. 37(5): 172-176

Barbulescu, A., Barbes, L., and Stefan Dumitriu, C. 2021. Assessing the Water Pollution of the Brahmaputra River Using Water Quality Indexes. *Toxics*. 9(11): 297

Barman, P. and Goswami, D.C. 2015. Evaluation of Sinuosity Index of Dhansiri (South) River Channel and Bank Erosion, Assam in GIS. *International Advanced Research Journal in Science, Engineering and Technology*. 2(5).

Bui, Y. 2020. Public Awareness, Concerns and Perceptions about Anthropogenic Impacts and Climate Change in Ranganadi River Basin, Arunachal Pradesh, India. *International Journal of Environmental Sciences & Natural Resources.* 26(4): 127-133.

Chakravarty, T. and Gupta, S. 2021. Assessment of water quality of a hilly river of south Assam, north east India using water quality index and multivariate statistical analysis. *Environmental Challenges*. 5: 100392.

CPCB, 2013. Designated Best Use Water Quality Criteria. Central Pollution Control Board, New

Delhi. https://cpcb.nic.in/wqm/Designated_Best_Use_Water_Quality_Criteria.pdf. Accessed 11-05-2023

CPCB, 2019. Action Plan for Rejuvenation of River Dhansiri, Dimapur, Nagaland, Nagaland River Rejuvenation Committee.

Dutta, S. and Nayek, S. 2020. Water Quality of the Ganges and Brahmaputra Rivers: An Impact Assessment on Socioeconomic Lives at Ganga–Brahmaputra River Basin. In: *Sustainability in Environmental Engineering and Science.* Springer. 237-241

Farooq, S.H. and Debnath, S. 2022. Hydrogeochemistry of Garampani and Gelekipung thermal clusters of Dhansiri river basin, Assam, India. *Environmental Earth Sciences*. 81(69).

Khound, N.J. and Bhattacharyya, K.G. 2017. Multivariate statistical evaluation of heavy metals in surface water sources of Jia Bharali river basin, North Brahmaputra plain, India. *Applied Water Science.* 7: 2577-2586.

Kotoky, P. and Sarma, B. 2017. Assessment of Water Quality Index of the Brahmaputra River of Guwahati City of Kamrup District of Assam, India. *International Journal of Engineering Research & Technology*. 6(3).

Mahanta, C. and Saikia, L. 2015. The Brahmaputra and Other Rivers of the North-East. In: Iyer R R: *Living Rivers, Dying Rivers.* Oxford University Press. 149-181.

Nath, D., Dutta, R., Bhagawati, S.K., Sarmah, R., Pokhrel, H., Ahmed, A.M. and Mudoi, L.P. 2020. Assessment of water quality status of river Kopili, in Karbi Anglong district of Assam using water quality index. *International Journal of Chemical Studies*. (5): 261-267.

PCBA. 2023. Water Quality Index for the State of Assam under NWMP.

https://www.pcbassam.org/wqi.php Date: 11-05-2023. Accessed 11.05.2023.

Sarmah, R., Dutta, R., Bhagabati, S. K., Nath, D., Mudoi, L., P, Pokhrel, H. and Ahmed, A.M. 2020. Seasonal variation of water quality parameters of river Dikhow in Nagaland and Assam, *International Journal of Chemical Studies.* 8(5): 1429-1434.

Singh, K. R., Goswami, A. P., Kalamdhad, A. S., and Kumar, B. 2020. Surface water quality and health risk assessment of Kameng river (Assam, India). *Water Price and Technology*. 15(4): 1190-1201.

Wang, G., Lu, J., Tong, Y., Liu, Z., Zhou, H. and Xiayihazi, N. 2020. Occurrence and pollution characteristics of microplastics in surface water of the Manas River Basin, China. *Science of the Total Environment.* 710:136099

Wang, G., Lu, J., Li, W., Ning, J., Zhou, L., Tong, Y., Liu, Z., Zhou, H. and Xiayihazi, N. 2021. Seasonal variation and risk assessment of microplastics in surface water of the Mans River Basin, China. *Ecotoxicology and Environmental Safety.* 208:111477