

# Spatial Variations of Water Quality Assessment for River Brahmaputra Around Guwahati City

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**Abstract** - Brahmaputra is one of the important rivers of Asia. It originates in Manasarovar lake region which comes under Tibet (China). It flows through three major countries i.e. China, India and Bangladesh. In India the river enters in Arunachal Pradesh where it is known by different names like Dihang, Siang etc. when it flows through Assam it is called as Brahmaputra. As Brahmaputra represents the life line of major civilisations and ecological hub for major animals and aquatic species. It is necessary to study and check the quality of the river for preservation and conservation of all the life forms. Hence a study was carried out to assess the quality of the water of the river around the Guwahati city. In this project five different sites (i.e. Chandrapur, Panikhaiti, Kachari, Bharalu, Pandu) around the Guwahati city to analysis the water quality index of the river. The necessary Laboratory tests were conducted for the samples in Public Health Engineering department, Govt. Of Assam Laboratory, Bamunimaidam. The parameters considered for analysing water quality are: pH, Turbidity, Total Hardness, Total Dissolved Solids (TDS), Electrical conductivity and Bacteriology analysis. Detailed analysis based on the WQI, it has been presented here the study shows that the water quality of the river Brahmaputra is degrading in alarming percentile. Therefore, the necessary remedial measures are suggested where ever possible according to the problem faced by the river Brahmaputra flowing around the Guwahati city.

**Key Words:** pH, Turbidity, Total Hardness, Total Dissolved Solids (TDS), Electrical conductivity and Bacteriology analysis.

## 1. INTRODUCTION

Water is vital and essential for every kind of life form. Water being so simple in chemical composition, it has exponential effects on survival of every life forms, whether on land or under water. Therefore, for future existence of every life forms, it is very essential to preserve, conserve and keep it pollution free. Water quality in its utmost sense describes the physical, chemical and biological characteristics which is suitable for a particular purpose. But with the ever increasing of industrialization, urbanization, indiscriminate dumping of toxic wastage, excessive use of chemical fertilizers, and use of primitive treatment process of wastages etc are some of the important factors which are degrading the quality of water in India and in the world as a whole. Water quality index (WQI) is the summarization of the various data obtained from variety of water quality

parameters. It is expressed in simple forms like excellent, good, poor etc. WQI provides a concrete idea about the water quality of a particular place at a particular time. Brahmaputra is the one the important river of Asia. It originates in the Manasarovar lake region located in Burang country of Tibet. It flows through three major countries i.e. China, India and Bangladesh. Brahmaputra is known by different names in different region. In china it is known as Yarlung Tsangpo river, which flows in Indian state of Arunachal Pradesh, where it is known as Dihang or Siang river, when it flows in Assam it is known as Brahmaputra river. Then it flows to Bangladesh where it known as the Jamuna river. And finally, it flows to the Bay Bengal. Total length of the Brahmaputra river is 2880km. In china it covers a length of 1625 km, whereas in India Brahmaputra covers a distance of 918 km flowing through Arunachal Pradesh and Assam. And the rest of the distance i.e. 337 km is covered in Bangladesh. The study of water quality of the Brahmaputra river around the Guwahati city will depict the current scenario of the water quality which are being used for various purposes like Domestic, public, industrial etc. it will also focus on the main causes of the pollution and also the various point-source pollution and non-point source of pollution. The study will give an idea about the current situation of the water quality and set a bench mark for future references. According to recent report by NITI Aayog, India stands on 120th Position out of 122 countries for Water Quality Index. This report shows the water quality of water that is being supplied to a country of 1.2 billion population, 2nd highest population in the world.

## 2. METHODS AND MATERIALS

The water samples were collected from 5 different locations around the Guwahati city. Those sites are Chandrapur, Panikhaiti, Kachari, Bharalu, and Pandu. Water samples were collected in plastic bottle. Samples were collected with standard procedures, on the same day collected samples were brought to Public Health Engineering Department Laboratory, Bamunimaidan, Guwahati for Physio-chemical analysis. Parameters for Physio-chemical analysis are pH, Turbidity, Total Hardness, Total Dissolved Solids (TDS), Electrical conductivity and Bacteriology analysis.

### 3. ANALYSIS OF VARIATION OF WATER QUALITY INDEX PARAMETERS AROUND THE BRAHMAPUTRA RIVER

#### 3.1 PH

The pH values of different sites for the month October 2018 are shown in the figure 5.1.



Figure 1 Variation of pH

As shown in the figure 1, the pH ranges from 5.09 to 5.39. The maximum pH is recorded in Chandrapur main village i.e. 5.39 and minimum pH is recorded in Bharalu i.e. 5.09. The above data indicates that Bharalu water is more Acidic as compared to other selected sites. As per the WQI the permissible limit for pH is 6.5 to 8.5. Hence the water is unsuitable for consumption. Bharalu flows through the heart of Guwahati city. The residents along the Bharalu river basin dump all the solid and liquid waste to the river.

#### 3.2 TURBIDITY

The Turbidity values of different sites for the month October 2018 are shown in the figure 2.

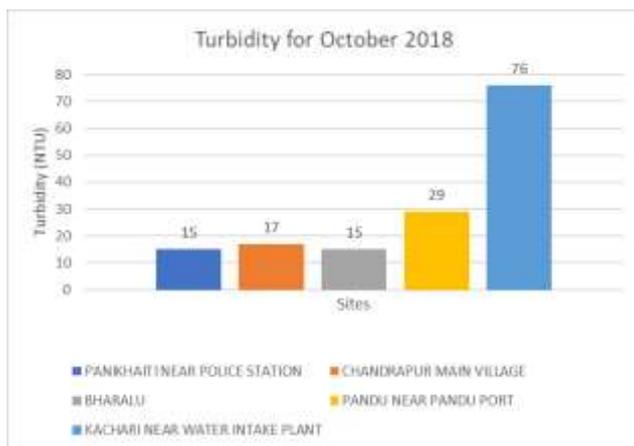


Figure 2 Variation of Turbidity

As shown in the figure 2, the Turbidity ranges from 15 NTU to 76 NTU. The maximum Turbidity is recorded in Kachari near water intake plant i.e. 76 NTU and minimum Turbidity

is recorded in Panikhaiti and Bharalu 15 NTU. Since the permissible turbidity ranges from 10-25 NTU. The turbidity in Pandu and Kachari is much higher than the permissible limit. Hence it is not suitable. Turbidity represents the presence of suspended particles that scatter the light making water cloudy. High turbidity significantly reduces the aesthetic quality of the river and other water bodies and less desirable to many purposes.

#### 3.3 TOTAL DISSOLVED SOLIDS (TDS)

The Total Dissolved Solids (TDS) values of different sites for the month October 2018 are shown in the figure 3.

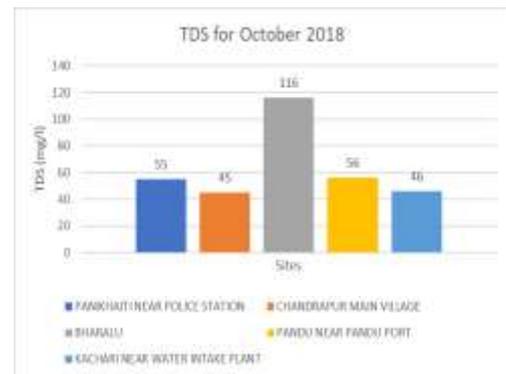


Figure 3 Variation of TDS

As shown in the figure 3, the TDS ranges from 45 mg/l to 116 mg/l. the maximum TDS is recorded in Bharalu i.e.116mg/l and minimum TDS is recorded in Chandrapur main village i.e. 45 mg/l. the permissible limit is up to 500 mg/l. As the maximum value of TDS is 116 mg/l which is under the permissible limit. TDS comprises of many inorganic salts. For example, calcium, sodium, bicarbonates, magnesium and potassium etc. the high TDS value may affect the aquatic life. Due to presence of salts it is corrosive in nature and it may damage certain items like pumping system, hot water heaters etc.

#### 3.4 TOTAL HARDNESS

The Total Hardness values of different sites for the month October 2018 are shown in the figure 4.



Figure 4 Variation of Total Hardness

As shown in the figure 4, the Total Hardness ranges from 60 mg/l to 100 mg/l. the maximum Total Hardness is recorded in Panikhaiti near police station and Bharalu i.e. 100 mg/l and minimum Total Hardness is recorded in Pandu i.e. 60 mg/l. the permissible limit is upto 300 mg/l. All the observed data are below the maximum permissible limit. Hardness of water is due to presence of calcium and magnesium. Hardness of water may affect human health (diseases like hypertension, kidney stones etc), it also causes corrosion of plumbing systems and it also increases the boiling point of water.

### 3.5 ELECTRICAL CONDUCTIVITY

The Electrical Conductivity values of different sites for the month October 2018 are shown in the figure 5.5.

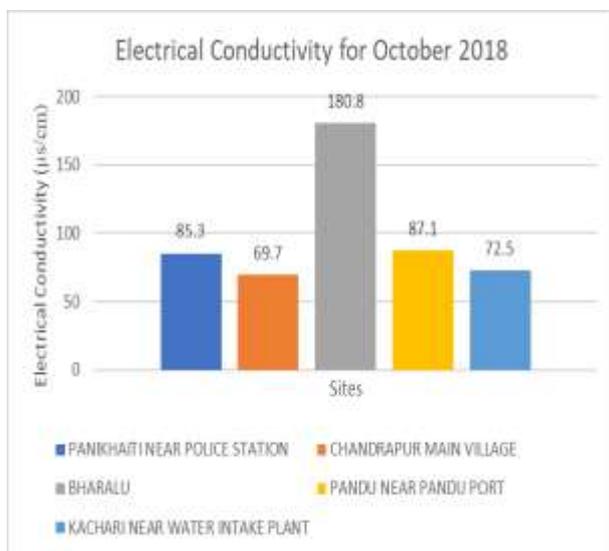


Figure 5 Variation of Electrical Conductivity

As shown in the figure 5, the Electrical Conductivity (EC) ranges from 69.7 µs/cm to 180.8 µs/cm. the maximum EC is recorded in Bharalu 180.8 µs/cm and minimum Electrical conductivity is recorded in Chandrapur i.e. 69.7 µs/cm. The permissible limit for EC is up to 250 µs/cm. Bharalu contains the highest EC as compared to other selected sites. EC of the river is mainly affected by the geology of the area through which the water flows.

### 3.6 BACTERIOLOGICAL ANALYSIS

The Bacteriological Analysis values of different sites for the month October 2018 are shown in the Table 1

Table 1 Bacteriological Analysis

BACTERIOLOGICAL ANALYSIS		
Sl. No.	PIN-POINT LOCATION	REMARKS
1	Panikhaiti near Police Station	Present
2	Chandrapur near main town	Present
3	Bharalu	Present
4	Pandu port	Present
5	Kachari water intake point	Present

### 3.7 ASSESSMENT OF WATER QUALITY INDEX OF THE BRAHMAPUTRA RIVER

The calculation of the WQI was done using **weighted arithmetic water quality index** which was originally proposed by Horton (1965) and developed by Brown et al (1972). The weighted arithmetic water index (WQIA) is in the following form:

$$WQIA = \frac{\sum w_i q_i}{\sum w_i}$$

Where,

n = the number of variables or parameters,

w<sub>i</sub> = relative weight of the i<sup>th</sup> parameter

q<sub>i</sub> = water quality rating of the i<sup>th</sup> parameter.

The unit weight (w<sub>i</sub>) of the various water quality parameters are inversely proportional to the recommended standards for the corresponding parameters. According to Brown et al (1972), the value of q<sub>i</sub> is calculated using the following equation:

$$q_i = 100 [(V_i - V_{id}) / (S_i - V_{id})]$$

where,

V<sub>i</sub> = observed value of the i<sup>th</sup> parameter,

S<sub>i</sub> = standard permissible value of the i<sup>th</sup> parameter

V<sub>id</sub> = ideal value of the i<sup>th</sup> parameter in pure water.

All the ideal values (V<sub>id</sub>) are taken as zero for drinking water except pH and dissolved oxygen (Tripaty and Sahu, 2005). For pH, the ideal value is 7.0 (for natural / pure water) and a permissible value is 8.5 (for polluted water). Therefore, the quality rating for pH is calculated from the following equation:

$$q_{pH} = 100 [(V_{pH} - 7.0) / (8.5 - 7.0)]$$

where,

V<sub>pH</sub> = observed value of pH.

For dissolved oxygen, the ideal value is 14.6 mg/L and the standard permissible value for drinking water is 5 mg/L. Therefore, its quality rating is calculated from the following equation:

$$qDO = 100[(VDO - 14.6) / (5.0-14.6)]$$

where,

VDO = observed value of dissolved oxygen.

Table below shows a classification of water quality, based on its quality index due to Brown et al (1972), Chatterji and Raziuddin (2002) etc.

Table 2 Classification of water quality based on weighted arithmetic WQI method

SL. No.	WQI	STATUS
1	0-25	Excellent
2	26-50	Good
3	51-75	Poor
4	76-100	Very Poor
5	Above 100	Unsuitable for drinking

Table 3 gives the observed values (vi) of the five (5) physico-chemical parameters of five (5) selected sites of water samples (collected in the month of October), standard drinking water values (si) according to World Health Organisation (WHO, 1993), unit weights (wi), water quality rating (qi) and wiqi.

Table 3 Calculated Value for the month October

SL. NO.	PARAMETERS	SITES	OBSERVED VALUES (vi)	STANDARD VALUE (Si)	UNIT WEIGHT (wi)	QUALITY RATING (qi)	WEIGHTED VALUE (wiqi)
1	pH	Panikhaiti	5.36	8.5	0.1176	-109.3	-12.85
		Chandrapur	5.39	8.5	0.1176	-107.3	-12.62
		Bharalu	5.09	8.5	0.1176	-127.3	-14
		Pandu	5.37	8.5	0.1176	-108.7	-12.78
		Kachari	5.37	8.5	0.1176	-108.7	-12.78
2	Turbidity	Panikhaiti	15	25	0.04	60	2.4
		Chandrapur	17	25	0.04	68	2.72
		Bharalu	15	25	0.04	60	2.4
		Pandu	29	25	0.04	116	4.64
		Kachari	76	25	0.04	304	12.16
3	Total Hardness	Panikhaiti	100	300	0.0033	33.33	0.11
		Chandrapur	68	300	0.0033	22.67	0.0748
		Bharalu	100	300	0.0033	33.33	0.11
		Pandu	60	300	0.0033	20	0.066
		Kachari	68	300	0.0033	22.67	0.0748
4	TDS	Panikhaiti	55	500	0.002	11	0.022
		Chandrapur	45	500	0.002	9	0.018
		Bharalu	116	500	0.002	23.2	0.0464
		Pandu	56	500	0.002	11.2	0.0224
		Kachari	46	500	0.002	9.2	0.0184
5	Electrical Conductivity	Panikhaiti	85.3	250	0.004	34.12	0.1365
		Chandrapur	69.7	250	0.004	27.88	0.1115
		Bharalu	180.8	250	0.004	72.32	0.2893
		Pandu	87.1	250	0.004	34.84	0.1394
		kachari	72.5	250	0.004	29	0.116

The water quality index (WQI) of Brahmaputra river was then calculated using the weighted arithmetic index formula as follows:

$$WQI \text{ (site 1 Panikhaiti)} = \sum wiqi / \sum wi = 15.52/0.1669 = 92.99$$

$$WQI \text{ (site 2 Chandrapur)} = \sum wiqi / \sum wi = 15.55/0.1669 = 93.17$$

$$WQI \text{ (site 3 Bharalu)} = \sum wiqi / \sum wi = 17.83/0.1669 = 106.84$$

$$WQI \text{ (site 4 Pandu)} = \sum wiqi / \sum wi = 17.65/0.1669 = 105.76$$

$$WQI \text{ (site 5 Kachari)} = \sum wiqi / \sum wi = 25.15/0.1669 = 150.69$$

Table 4 Water Quality Index of different sampling sites

Sl. No.	Sampling Sites	Water Quality Index Value for the month of October
1	Panikhaiti	92.99
2	Chandrapur	93.17
3	Bharalu	106.84
4	Pandu	105.76
5	Kachari	150.69

The graphical presentation of water quality index of five sampling sites in the month of October are shown in figure 6

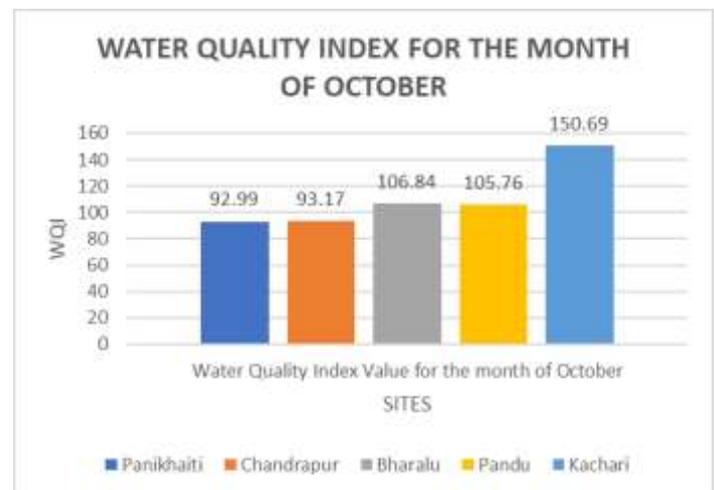


Figure 6 Calculated WQI Value for the month of October

#### 4. CONCLUSION

The objective of the project is to calculate the WQI for the Brahmaputra river in and around the Guwahati city for the month October 2018. From the Figure 6, it is observed that the WQI ranges from 92.99 to 150.69. The highest WQI is observed at Kachari near Water intake Plant and the lowest WQI is observed in Panikhaiti near Police station i.e. 92.99. According to Table no. 5.4 the WQI range between 75-100

shows very poor and above 100 is unsuitable for drinking. Since the calculated WQI value for the selected sites are above the 92.99. The water very poor. Therefore, the water needs a treatment before it used for various purpose.

#### ACKNOWLEDGEMENT

We pay our sincere homage to Late Prof. (Dr.) U.C kalita (Former Academic Director, ADTU and chairperson, Faculty of Engineering & Technology, Assam down town University) for his approbation and giving us the opportunity to bring out this project work successfully. We are extremely indebted to our guide Prof. (Dr.) Mimi Das Saikia (Professor in CIVIL ENGINEERING Department, Assam down town University) for her guidance, valuable advice, constructive criticism and her extensive discussion around our work. We are also thankful to Er. Milanjit Bhattacharya (Executive Engineer PHED,) for his approbation to conduct physio-chemical analysis of the water samples in Public Health Engineering Department, District Water Analysis Laboratory, Bamunimaidam.

#### REFERENCES

1. Amarasinghe, U. A., Sharma B.R., Aloysius N., Scott C., Smakhtin V, de Fraiture C, and Shukla A.K. (2004) "Spatial Variation in Water Supply and Demand across the River Basins of India". Colombo, Sri Lanka. Volume 83. pp.6
2. Arnab jan deka and tess joyce, july 2009, "Brahmaputra parot ephanki rhode" pp 97
3. Arnell N.W. (1999) "Climate Change and Global Water Resources", volume 9, pp31-49.
4. Barooah, Arindam (18 April 2015). "The Assam Tribune".
5. Bhandari 2007 "carried out analysis for the physicochemical characteristics of Kosi River system", in North India. Pg 46
6. Bolch T., Kulkarni A., Käab A., Huggel C., Paul F., Cogley J.G., Frey H., Kargel J.S., Fujita K., Scheel M., Bajracharya S. and Stoffel M. (April 20 2012) "The State and Fate of Himalayan Glaciers, Science", vol.336
7. Brahmaputra Board (1995) "Additional Volume for Master Plan of Brahmaputra basin, India". Pp2-26
8. Brahmaputra Board (2000). "The Brahmaputra Board, Ministry of Water Resources, Government of India", volume 55, no.2, pp. 45-49.