Water quality status of the Brahmaputra and its tributaries in Assam

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Abstract
In spite of having huge water resources, water quality is a major issue in the state of Assam. Based on both the primary and secondary data, this paper attempts to draw preliminary conclusion on water quality status of the Brahmaputra River and its tributaries in Assam. Primary data were generated by analyzing water samples collected from different locations of the Brahmaputra River. Secondary data on water quality of the tributaries were collected from records of Central Water Commission, Pollution Control Board, Assam. An attempt was made for use based classification of those rivers. 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). This paper also highlights some measures for restoration as well as rejuvenation of water quality of those rivers.
Keywords: *Water quality, Brahmaputra, Assam*

Introduction

In Assam, about 8,251 km^2 (10% of the total geographic area of the state) is occupied by surface water bodies, out of which about 6,503 km^2 is occupied by the river systems, including the Brahmaputra[1]. The Brahmaputra River basin occupies 30% of the country's total water resources and is 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. The major rivers are mostly precipitation dominated during monsoon season and many are snow fed type during the lean flow period. The rivers are still at a pristine state, as the level of industrialization in the region is still low. However, water quality issues deserve particular attention for alternative drinking water supply as arsenic contamination and fluoride contamination of groundwater has been identified in the Brahmaputra floodplains posing serious health threats[2]. In spite abundance of surface water, according to a UNICEF report, only 47% rural population of Assam has access to potable water. In this paper, water quality status of rivers of the Brahmaputra basin in Assam and the underlying causes has been studied based on both the primary and secondary data.

Materials and methods

Water samples were collected from *Dibrugarh, Dishangmukh* and *Tezpur* locations of the Brahmaputra River during Monsoon (June, 2012) and Post-Monsoon (November, 2012) months. Different water quality parameters were analysed using different instruments and procedures (Table 1)

Table 1 Water quality parameters and instruments

Parameter	Instrument/ Methodology
pH	pH meter
DO	Digital DO meter
Turbidity	Turbidity meter
Conductivity	Conductivity meter
Na, K, Ca	Flame photometer

Water quality data of the Brahmaputra River at *Pandu* and few major tributaries were collected from reports of Central Water Commission and Pollution Control Board, Assam. Different rivers were classified according to designated best use concept as suggested by CPCB[3,4] (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

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		

Results and discussions

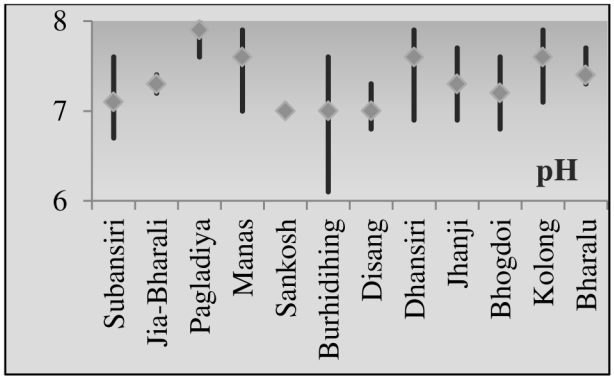
Different water quality parameters of the Brahmaputra and selected tributaries from chemical analysis and secondary data of CWC and PCBA are shown in Tables 3 & 4 and Figure 1.

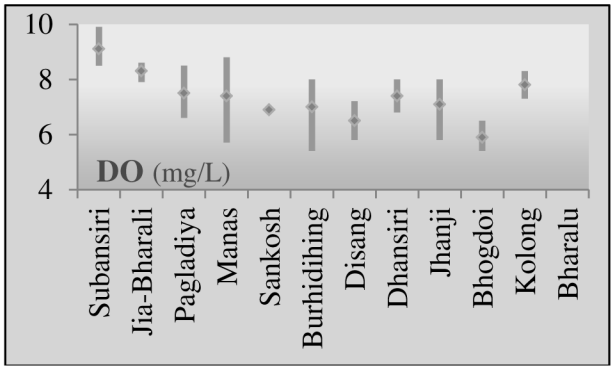
Table 3 Average water quality data for the Brahmapura River (at *Pandu*) from 2000-2010
(Source : CWC)

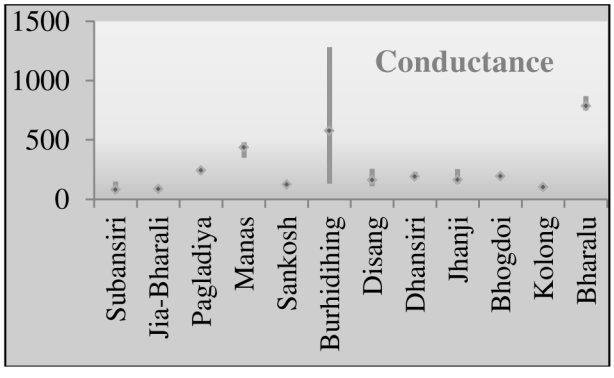
Water quality parameter		Monsoon	Non-monsoon
Physical	Temperature (^oC)	24.7	18.8
	pH	7.5	7.6
	EC (µmho/cm)	98	158
	TDS (mg/l)	158	176
	Turbidity (NTU)	4.6	3.9
Chemical	DO (mg/l)	7.1	6.8
	CO_3^{2-} (mg/l)	0.2	0.6
	HCO_3^- (mg/l)	55	78
	Cl- (mg/l)	9.5	12
	Ca^{2+} (mg/l)	18.3	23
	Mg^{2+} (mg/l)	4.4	5.8
	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

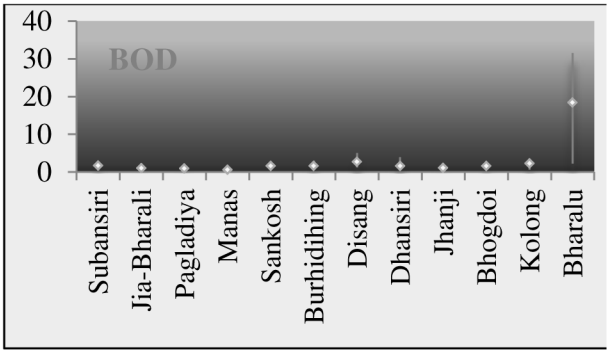
Table 4 Water quality of the Brahmaputra River and its tributaries[5]

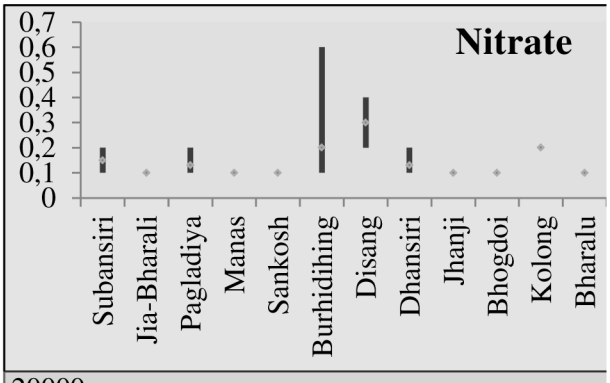
River/ Tributaries	pH	Conductance (µmho/cm)	DO (mg/l)	BOD (mg/l)	Total coliform (MPN/100ml)	Faecal coliform (MPN/100ml)
Brahmaputra at Dibrugarh	7.2	211	7.2	1.6	390	90
Brahmaputa at Guwahati	7.2	179	8.0	1.8	31577	3499
Brahmaputa at Dhubri	7.1	173	7.6	2.0	1610	680
Subansiri	7.1	81	9.1	1.7	91	Nil
JiaBharali	7.3	87	8.3	1.0	575	Nil
Manas	7.6	437	7.4	0.6	4630	750
Pagladiya	7.9	243	7.5	0.9	2330	180
Sonkosh	7.0	125	6.9	1.6	Nil	Nil
BurhiDihing	6.9	354	6.6	1.5	500	75
Disang	7.0	161	6.5	2.7	220	Nil
Dikhou	7.1	172	6.1	1.2	770	120
Bhogdoi	7.2	196	5.9	1.6	913	180
Dhansiri	7.6	192	7.4	1.6	685	90
Kolong	7.6	104	7.8	2.3	1508	438
Bharalu	7.4	785	Nil	18.4	40467	9267

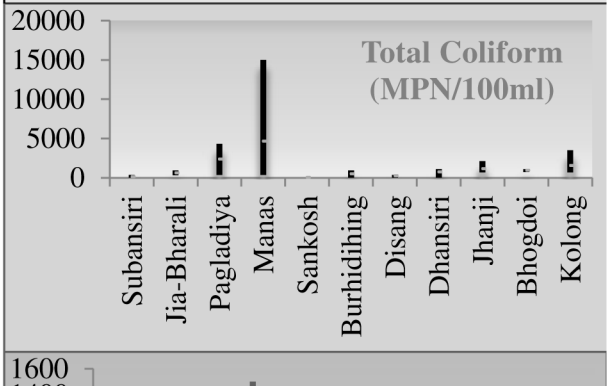


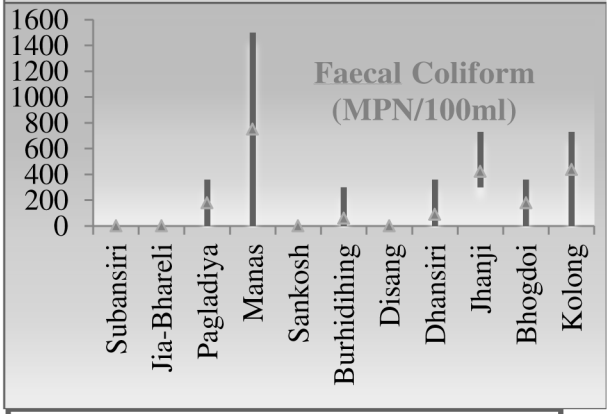


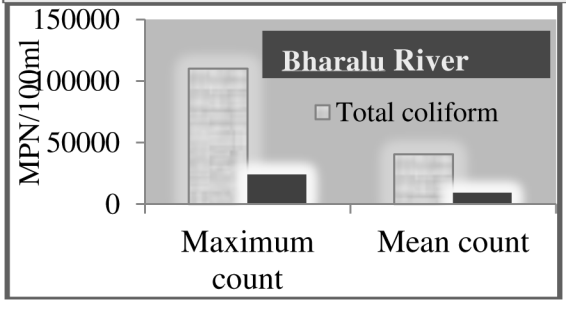


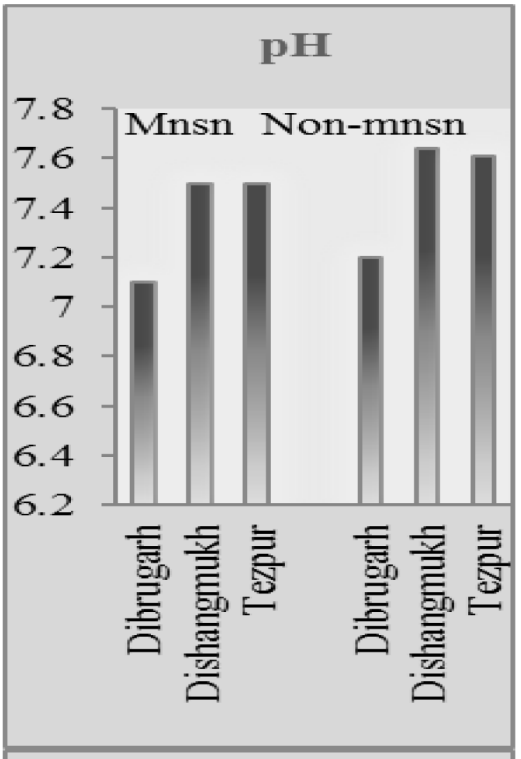

BOD
40
30
20
10
0
Subansiri
Jia-Bharali
Pagladiya
Manas
Sankosh
Burhidihing
Disang
Dhansiri
Jhanji
Bhogdoi
Kolong
Bharalu

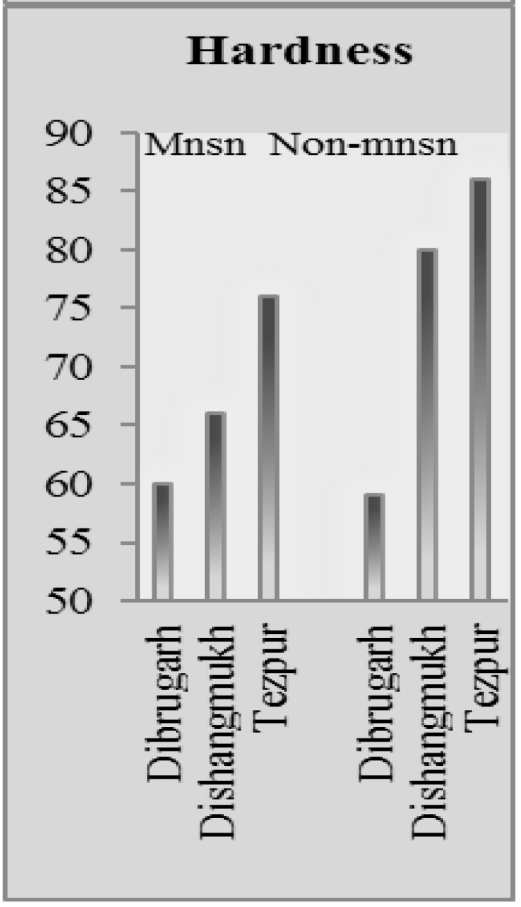

Nitrate
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
Subansiri
Jia-Bharali
Pagladiya
Manas
Sankosh
Burhidihing
Disang
Dhansiri
Jhanji
Bhogdoi
Kolong
Bharalu


Total Coliform
(MPN/100ml)
20000
15000
10000
5000
0
Subansiri
Jia-Bharali
Pagladiya
Manas
Sankosh
Burhidihing
Disang
Dhansiri
Jhanji
Bhogdoi
Kolong


Faecal Coliform
(MPN/100ml)
1600
1400
1200
1000
800
600
400
200
0
Subansiri
Jia-Bhareli
Pagladiya
Manas
Sankosh
Burhidihing
Disang
Dhansiri
Jhanji
Bhogdoi
Kolong


MPN/100ml
150000
100000
50000
0
Bharalu River
Total coliform
Maximum count
Mean count


pH
Mnsn
Non-mnsn
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
Dibrugarh
Dishangmukh
Tezpur
Dibrugarh
Dishangmukh
Tezpur


Hardness
Mnsn
Non-mnsn
90
85
80
75
70
65
60
55
50
Dibrugarh
Dishangmukh
Tezpur
Dibrugarh
Dishangmukh
Tezpur

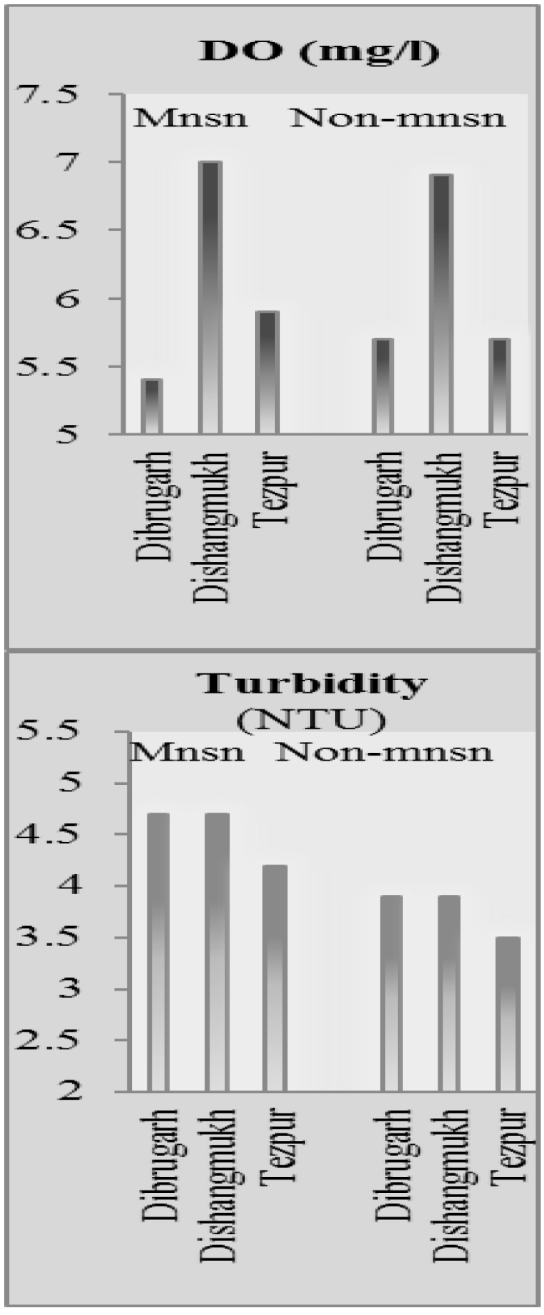


Figure 1 Water quality parameters of tributaries and the Brahmaputra River in Assam

The Brahmaputra River at *Pandu* for the period of 2000-2010 (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 3) 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 used 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). From the values of Total coliform (MPN/100 ml), pH, DO and BOD, water quality of the *Sankosh* River can be designated as 'A' class among all the tributaries and rivers including the Brahmaputra. Average values of Total coliform (MPN/100 ml), pH, DO and BOD *of Sankosh* River water at *Dhubri* are 0, 7, 6.9 and 1.6 respectively. 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, the total coliform values range from zero to 240000 MPN/100ml and faecal coliform values range from zero to 24000 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 *Subansiri, Jia Bharali, Manas, Pagladiya, Burhi dihing, Dikhou, Bhogdoi* and *Dhansiri* Rivers are within the tolerance limit of class 'A' when pH (6.5-8.5), DO (6.0 mg/l) and BOD (2.0 mg/l) are considered (Table 4). But total coliform in those rivers is much higher than the assigned value of 50 MPN/100ml for class-'A' water. Range of total coliform in the *Subansiri, Jia Bharali* and *Manas* River are Nil-360, 300-910 and 360-15000 respectively.

In spite of quality threat in rural rivers from bacteriological contamination, water quality of some urban rivers like that of *Kolong* in *Nagaon, Bhogdoi* in *Jorhat* and *Bharalu* in Guwahati city is highly degraded due to industrial, municipal and domestic wastes. Dissolved oxygen which determines the health of an aquatic ecosystem is very low in river like *Bhogdoi* in *Jorhat* and it is completely zero in *Bharalu* in Guwahati. Very high value of EC (785 µmho/cm) and BOD (18.4 mg/l) in

Bharalu indicate excess of industrial effluent (contributing to EC) along with municipal waste (increasing BOD). These urban rivers not only have been deprived from natural fresh water flow from upstream, they have essentially turned into urban drainages.

Conclusions

This paper addresses water quality status of the Brahmaputra River and a few major tributaries based on both the primary and secondary data. Most of the rivers fall under 'B' and 'C' class, i.e., these are not much polluted. Since anthropogenic interventions have still not reached gargantuan proportions due to less industrial activity in the region and annual flooding also acts as a cleansing mechanism, most of the rivers flowing through rural areas have moderate or low pollution. However, bacteriological contamination is a major concern for all the rivers. Again, there are serious concerns about some relatively smaller but highly polluted rivers flowing through densely populated areas. These polluted rivers need special attention with strong policy interventions.

Considering contamination of ground water and increasing demand on surface water sources, specific scientific intervention including waste water treatment plants, bank development practices, best management practices etc. are essential for restoration and maintenance of rivers in Assam. There is also urgent need of mass awareness to make people not to pollute the river any more, to involve local youths and school children in cleaning and keeping an eye on the river so that nobody else can throw solid waste and other waste to river and as well as for quality monitoring. A timely intervention for the relatively pristine rivers of the Brahmaputra Basin will be a wise step for sustainability of this last water frontier of the world.

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