

**Research Article**

# Assessment of water quality of a few surface water sources of Kokrajhar District, Assam, India

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Date Received: 13<sup>th</sup> March 2017; Date accepted: 21<sup>st</sup> March 2017; Date Published: 22<sup>nd</sup> March 2017**Abstract**

Kokrajhar is one of the important districts of Bodoland Territorial Council, Assam. The topography of the district is uneven. The district is situated on the southern side of the Himalayan plains. The northern part of the district contains dense forests with some of the finest timber varieties like teak (*Tectona grandis*), sal (*Shorea robusta*) and other evergreen species of flora. The southern part of the district is almost plain and alluvial agricultural area though there are some forest areas. The district is criss-crossed by a network of rivers consisting of Sonkosh, Damra, Madati, Garufela, Hel, Gangia, Saralbhangra, Samukha, Longa, Gourang, Tarong, etc., flowing from the north towards the Brahmaputra. There are also other water bodies like the Deeplai Beel and a number of wetlands. In this work, an attempt has been made to evaluate the water quality of 6 major rivers (Damra, Madati, Hel, Longa, Gourang, Tarong,) of the district by monitoring the common quality parameters like pH, conductivity, total dissolved solids, turbidity, hardness, bicarbonate, chloride, sulphate, nitrate, phosphate, fluoride, common metals like Ca, Mg, Na, K and trace metals like As, Cd, Cu, Fe, Mn, Ni and Zn. The study has shown important results indicating that even in an underdeveloped area, water quality problems exist. The

results have been explained on the basis of known water-related problems associated with the people living in the area.

**Keywords:** Surface water, water pollution, water quality, trace metal, Bodoland.

**Introduction**

All forms of life need quality water for survival. Rivers play an important role in the incorporation and transportation of domestic and industrial wastewater, which represents constant pollution sources and agricultural run-off, which is temporal and commonly affected by climate (Singh et al., 2004). The quality of water has become very important and can be determined by monitoring different parameters that define the system. Variety of wastes produced by plant remains, agricultural processing wastes, animal wastes, domestic garbage, rubbish, kitchen wastes, street sweepings, wastes of offices and institutions, wastes of mining, wastes of manufacturing, construction etc. are unwanted materials disposed off by man. The degradation of water quality due to these contaminants has changed species composition and creates health problems in general population as well as aquatic communities in the wetland and an overall loss of biodiversity (Ouyang, 2005). The rivers of urban area may be highly contaminated with heavy metals and other toxic compounds, indicating a significant non-point source of pollution to water bodies within and adjacent to the urban centers (Sansalone et al., 1997; Smullen et al., 1999). This type of urban runoff alters the vegetation pattern and natural infiltration properties of the watershed, causing the runoff to have a much higher surface flow component, a much smaller interior-flow component and some type of reduced base flow component and the surface runoff carries a higher concentration of pollutants to the receiving water bodies (Livingston, 1989). Rapid population growth, industrialization and urbanization in a country add many problems with regard to water quality (Jammel and Hussain, 2003). In developing and under developed countries most of the urban sewage is discharged to surface water without treatment. This increases the surface water contamination to a considerable extent. Due to different physico-chemical processes involving the pollutants and other constituents, the quality of water

get changed continuously. The water become turbid as it flows over soil surface due to dissolution different constituents and accumulation of sediment particulates. With the increase of residence time of the surface run-off, the extent of soil-water adsorption and ion-exchange reaction increases, which intern affect the quality of receiving water. Similar affects are also possible between chloride, used for disinfection of drinking water (e.g. bleaching powder) and other constituents of water generally the organic compounds. The domestic sewage contains oils, human excreta, dirt, paper, rags, sand grains, dissolved material such as detergents and inorganic compounds like sodium chloride, ammonium sulphate and ammonium phosphate, decomposed kitchen wastes. Human and animal excreta increase the level of chloride in water. If this sewage is directly disposed into the surface water sources, they may pollute the whole water and make it unsafe for human use. Road run-off generally increases trace metals, oil and grease, chlorides etc. in surface water. Industrial waste adds variety of metals both trace and heavy, inorganic chemicals and mineral substances, toxic chemicals including different types of organic compounds.

Many researchers have focused on river water quality evaluation studies carried out in different part of the world that resulted due to anthropogenic intervention mainly by agricultural activities and industrial and domestic wastewater discharges (Kaur et al., 1996; Mogal and Desai, 1998; Bhuvaneshwaran et al., 1999, Musaddiq, 2000, Alam et al. 2007, Venugopal et al. 2009, Bhardwaj et al., 2010 etc.).

### Objective of the study

The main objectives of the study are – to assess the present water quality of few surface water sources of Kokrajhar District of Assam, through analysis of some selected water quality parameters like pH, conductivity, total dissolved solids, turbidity, hardness, bicarbonate, chloride, sulphate, nitrate, phosphate, fluoride, common metals like Ca, Mg, Na, K and trace metals like As, Cd, Cu, Fe, Mn, Ni and Zn.

To compare the results obtained with the international and Indian standards.

An attempt has been made to study and present the environmental condition along the rivers and

predict the pollution status.

### Methodology

#### Study area

The present study was conducted in Kokrajhar district of Assam, India. The district is located on the north bank of river Brahmaputra shares the international boundary with Bhutan in the north and interstate boundary with West Bengal in the west. Its location is strategically important. The district is bounded by Himalayan kingdom of Bhutan on the north, Dhubri district on the south, Chirang and Bongaigaon district on the east and state of West Bengal on the west. The district is the gateway to Assam and other North Eastern states by road as well as railways. Kokrajhar district lies roughly between 89°46' to 90°38' east longitudes and between 26°19' to 26°54' north latitudes. The area enjoys comparatively mild subtropical climate with a dry pre-monsoon from February to May, wet and hot monsoon from June to October and cool, foggy winter from November to January. A large number of rivers and tributaries viz., Sankosh, Gongia, Gaurang, Champa, Hel, Tarong, Saralbhong, Longa etc. flow from north (mostly originating from Bhutan) to south of the district and meet Brahmaputra.

The whole district is underdeveloped. The people collect water from traditional sources like ring wells, tube wells and rivers. This may generate an unhygienic conditions and waterborne diseases like diarrhea, dysentery, typhoid and paratyphoid fever, hepatitis, gastroenteritis, liver and intestinal infection, skin rash, etc.

#### Water sample collection

Water samples are collected from 6 major rivers viz. Damra, Madati, Hel, Longa, Gourang, Tarong for this work (Table 1). Sampling was carried out in triplicate for each sampling site in 2L pre-cleaned polythene jars for three seasons as per Standard Methods (APHA, 1995) and were analyzed using standard equipments (Hitachi 3210 UV-Visible spectrophotometer, PerkinElmer AAnalyst 200 Atomic Absorption Spectrophotometer).

**Table 1. Locations of the sampling sites of the selected rivers**

Sample No.	River	Location name	Latitude (N)	Longitude (E)
1	Damra	Srirampur	26°26.002'	89°53.631'
2	Madati	Gossaigaon	26°28.124'	89°58.767'
3	Longa	Dotoma	26°28.124'	90°09.188'
4	Hell	Fakiragram	26°21.734'	90°10.748'
5	Gourang	Kokrajhar	26°24.522'	90°15.172'
6	Tarang	Charaikhola	26°23.994'	90°19.148'

### Results and Discussion

Water samples were collected from the six selected rivers during three seasons- pre-monsoon, monsoon and post monsoon and tested for physical qualities and chemical contents. pH is the indicator of acidic or alkaline condition of water status. The standard for any purpose in-terms of pH is 6.5–8.5, in that respect; the mean value of all the rivers indicates slightly alkaline water. The range of pH obtained in river water was 6.9 (river 2 and 4) to 8.1 (river 3 and 6). The electrical conductivity ranged from 40  $\mu$ S/cm (river 4 and 6) to 173  $\mu$ S/cm (river 3). The conductivity is determined by the major ions, Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, HCO<sub>3</sub><sup>-</sup> and Cl<sup>-</sup> (Ettler et al, 2008). TDS values (Range: 21 to 114 mg/L) were within the maximum permissible limit of 1000 mg/L (WHO, 2008). The range of turbidity lays between 4 NTU (river 4 and 6) to 27 NTU (river 3) in river water. Higher values of turbidity are obtained in monsoon season which may be due to the presence of silt and clay particles in the river water. The total hardness of the river water varied from 12 mg/L (river 6) to 76 mg/L (river 3). These values are well within the WHO permissible limit of 500 mg/L, although there are some variations from one river to another.

The bicarbonate concentration was from 24.5 mg/L (river 1) to 100.0 mg/L (river 2, 3 and 4). The variation is interesting in the way that CO<sub>2</sub> capture varies a lot depending on the local environment and the composition of the water. In the study area, the

minimum and maximum values of chloride obtained were 7.1 mg/L (rivers 2, 5 and 6) and 31.2 mg/L (river 6) respectively. Since the most important source of chlorides in water is the discharge of domestic sewage including human and animal excreta, the rivers might have received some input of sewage. However, the values are quite low compare to the WHO limit for drinking water (250 mg/L). The sulphate lies below detectable level, BDL (river 2) to 6.7 mg/L (river 5). The values are much less than the prescribed limit of WHO.

Nitrate is a naturally occurring ion that is found everywhere in the environment. It is the product of the oxidation of nitrogen by microorganisms in plants, soil or water. After a period of time, the nitrate seeps into the water table. Nitrate produces no color or odor in water and can cause cancer in humans when consumed over a long period of time (Jahed et al. 2008). In the present study, the concentration of NO<sub>3</sub><sup>-</sup> varied from BDL (river 4) to 1.5 mg/L (river 5), which is very low compared to the maximum acceptable limit in drinking water, i.e., 45 mg/L. The low concentration of nitrate is mainly due to less use of nitrogenous fertilizers as it is derived mostly from residual chemical fertilizers applied to agricultural land to increase productivity (Basu et al. 2007). Seasonal variation pattern shows higher nitrate contents during the rainy season indicating runoff input.

The concentration of fluoride varied from BDL to 0.14 mg/L (river 1). The values are much below the

maximum permissible limit of 1.0 mg/L (WHO). Fluoride in water can originate from the dissolution of fluorine-bearing minerals, and the low level of fluoride is due to the lack of fluorine-bearing minerals in the strata through which the water is filtering. WHO (2008) has recommended a limit of 0.1 mg/L of phosphate for drinking water. This limit is exceeded by the average phosphate content (taking all the seasons) of water of river 3 and 6 of present study. High phosphate can lead to atrophic conditions.

The major cations are in the order of  $\text{Ca}^{2+} > \text{Na}^+ > \text{K}^+ > \text{Mg}^{2+} > \text{Fe}^{3+}$  with respect to their mean values. The values of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  content varied from 4.0 mg/L (river 1) to 16.0 mg/L (river 3, 4) and from 1.2 to 8.8 mg/L (river 3), respectively, which are well within the desirable limits recommended by the WHO. The  $\text{Mg}^{2+}$  values are consistently lower than the  $\text{Ca}^{2+}$  independent of seasonal variation. Sodium content of the water varied from 0.4 mg/L (river 1) to 7.9 mg/L (river 6). The values do not exceed the maximum permissible value (200 mg/L).  $\text{K}^+$  content had values from 3.5 mg/L (river 6) to 6.9 mg/L (river 6), and  $\text{Fe}^{3+}$  from 0.01 mg/L (river 2) to 1.0 mg/L (river 5, 6). All the rivers of present study area have average iron concentration higher than WHO permissible limit (0.3 mg/L). Iron and manganese are common metallic elements found in the earth's crust. Water percolating through soil and rock can dissolve minerals containing iron and manganese and hold them in solution. Iron is not considered hazardous to human health. In fact, iron is essential for good health because it transports oxygen in the blood. But iron in excess of 0.3 mg/L causes staining of cloths and utensils, and is also not suitable for processing of food, beverage, ice, dyeing, bleaching and many other activities. Iron in higher concentrations may also cause vomiting.

The ranges of the metals in this study are As: BDL to 3.6  $\mu\text{g/L}$  (river 5), Cd: BDL (river 1, 6) to 0.20 mg/L (river 3, 4), Cu: 0.20 to 0.9 mg/L (river 2), Mn: BDL to 0.60 mg/L (river 2), Ni: 0.1 to 0.8 mg/L (river 2) and Zn: BDL to 0.2 mg/L (river 4, 6) respectively. Many of the sources have Cd and Ni above permissible limits (Cd 0.003 mg/L; Ni 0.07 mg/L; WHO 2008). Cu and Zn contents are much less than the permissible limits (Cu 2 mg/L; Zn 3 mg/L; WHO 2008).

## Conclusion

The results from data analysis show that, the water is unfit for drinking purposes without any form of treatment with respect to some parameters, but for other usage, it still could be considered quite acceptable. This may be due to the industrially backwardness of the district. But as we know, once a trend in pollution starts, it generally accelerates to cause greater deterioration. So few years from now, serious water quality deterioration could take place.

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