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Water Quality Assessment: A Case Study of the Jhenai River in Bangladesh

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ABSTRACT

The study was conducted to investigate the physicochemical parameters of the Jhenai River during the period from February-April 2018. The water samples were collected from three different sampling stations as St-1 (Kalihati), St-2 (Bahala Hat) and St-3 (Hazipur Hat) for analyzing the physicochemical parameters such as temperature, electrical conductivity, total dissolved solids, pH, dissolved oxygen, biochemical oxygen demand and hardness in water. The physicochemical parameters were analyzed in the laboratory of the Department of Environmental Science, Patuakhali Science and Technology University, Patuakhali, Bangladesh, The result of the study showed that the temperature was ranged from 23.7-31.7°C, indicated an increasing rate from February to April. The contents of EC and TDS were varied from 655-698µS/cm and 524-582mg/l, respectively, indicated high ionic concentration in the river water. The contents of DO and BOD of all stations were ranged from 4.2-5.4 and 1.1-1.4mg/l revealed that organic waste pollution, whereas the pH (7.34-7.56) of all stations showed alkaline condition. The hardness contents were ranged from 132.20-143.40mg/l indicated suitable for aquatic environment. The result of the study concluded that the water can be used for various purposes as well as for aquatic organisms. To maintain the river water quality and conserve the aquatic life, proper measures should be taken to prevent the introduction of water pollutants into the river water.

KEYWORDS: Water Quality, Physicochemical, Aquatic Environment, Temperature, Bangladesh

1. INTRODUCTION

The surface water quality of the rivers of Bangladesh is getting highly polluted day by day (Alam et al. 2007) with the rapid population growth, urbanization, haphazard agricultural and industrial production, all gives rise to increased levels of emissions of organic and inorganic pollutants into the aquatic environment (DoE 1992). Various wastes are known to adversely affect natural life by direct toxic action or indirectly through qualitative alterations in the character of the water (Ahmed and Reazuddin 2000). Recently, surface water pollution is a major environmental concern; various anthropogenic activities continuously increase the amount of waste materials in the water bodies especially in the beel, lakes, canals and rivers (Malik et al. 2010). Aquatic organisms such as fish and shell fish are highly vulnerable and subsequently accumulate various metals to concentrations many times higher than present in water or sediment (Olaifa et al. 2004). They can take up metals concentrated at different levels in their different body organs (Khaled 2004). Certain environmental conditions such as salinity, pH, and hardness can play an important role in heavy metals accumulation in the living organisms up to toxic concentrations and cause ecological damage (Guven et al. 1999). There are over 24000 registered small-scale industrial units in Bangladesh and it is generally accepted there were an equivalent number unregistered, furthermore, industrial growth has continued rapidly in the past decade, many of these industries are highly polluting and as a consequence of their unregulated development, many ecosystems are now under threat (SEHD 1998).

The Jhenai River is one of the biggest wetlands in the area travelling approximately 133km in the wet season, but holding less of water in the dry season, when it receives most of its water from Old Brahmaputra River (BCAS 2009). The different types of small scale industries, unplanned waste generating market place are found bank of

the Jhenai River. As a result, water quality has gradually deteriorated to a level which was reportedly unsuitable for certain types of aquatic life (IWRB 1992). Dominant industries in the Jhenai river area include textile production (dyeing, printing, and washing), large-scale commercial poultry farming, and pharmaceutical manufacturing. Industrial development in the bank of the Jhenai River, however, is not well managed. Moreover, this pollution was found to be a serious problem affecting the aquatic ecosystem and the local people reported that the fish they caught had a bad smell and were difficult to sell or eat (Akter 2011). The aquatic environment for living organisms can be affected and bioaccumulation of harmful substances in the water-dependent food chain can occur. For this reason, the investigation of physicochemical parameters of water of the Jhenai River is essential since even slight changes in their concentration above the acceptable levels can result in serious environmental and subsequent human health problems.

2. MATERIALS AND METHODS

2.1. Study Area

The Jhenai River is located in Bangladesh. It forms as an offshoot of the old channel of the Brahmaputra River, most of the water of which now flows through the Jamuna. The Jhenai divides, with the main branch joining the Jamuna south of Sarishabari in Jamalpur District and another branch flowing south in Tangail District. The total length of the Jhenairiver is almost 133km with average depth 76m. It is a meandering river and the highest flow of the river is found July-September (Banglapedia, 2012).

2.2. Sample Collection

The water samples were collected from 3 different sampling stations of the Jhenai River indicated as St-1 (Kalihati), St-2 (Bahala Hat) and St-3 (Hazipur Hat) during the dry season February to April 2018. To analyze the water quality, 500ml water was collected by plastic bottles with double stoppers from each sampling points. Before sampling, the bottle were cleaned and washed with detergent solution and treated with 5% nitric acid (HNO3) over night. The bottles were finally rinsed with deionized water and dried. At each sampling station, the sampling bottles were rinsed at least three times before sampling was done. Pre-prepared sampling bottles were immersed about 10cm below the surface water. After sampling, the bottles were screwed carefully and marked with the respective identification number and brought to the laboratory.

2.3. Sample Analysis

The physicochemical parameters of water samples were analyzed in the laboratory of the Department of Environmental Science, Patuakhali Science and Technology University, Patuakhali. The water temperature and pH were determined by the thermometer and digital pH meter (pH Scan WP 1,2; Malaysia), respectively. Digital EC and TDS meter (HM digital; Germany) was used to determine EC and TDS, respectively. The DO was determined by digital DO meter (Model: D.46974 and made in Taiwan) where sodium thiosulphate (0.025N) was used as a reagent. The BOD was measured by two steps where initial BOD (BOD1) was measured immediately after collection and after 5 days BOD (BOD5) was measured by incubation in the dark condition at 20 ºC for 5 days. Then the total BOD (BOD1-BOD5) was measured according to Trivedy and Goel (1984), and Huq and Alam (2005). The EDTA method was used to determine the hardness of water where Eriochrome Black T was used as indicator titration with EDTA solution.

2.4. Statistical Analysis

The collected data were compiled and tabulated in proper form and were subjected to statistical analysis. The Microsoft Office Excel software was used to present and interpret the collected data.

3. RESULTS AND DISCUSSIONS

The highest water temperature of the Jhenai river was 31.7ºC at St-1 in April and the lowest was 23.7ºC at St-2 in February, whereas the mean temperature of the Jhenai river water was 27.9ºC (Table 1). The standard limit of water temperature is 20-30ºC (EQS 1997) and the study showed that all the temperature was almost within the standard limit. The temperature ranged from 22.9-36.0ºC along the Shitalakhya river in dry season during the sampling period where higher temperature was April, compared to February and March due to high air temperature (Alam et al. 2006), which is almost similar to the present study. The temperature ranged from 24.6-28.2ºC at Ashulia point in the Turag River during the period from July to October (Khan et al. 2007).

The highest electrical conductivity (EC) of the Jhenai river water was 698µS/cm at St-3 in February while the lowest was 655µS/cm at St-1 in April with the mean EC of the river was 676µS/cm (Table 1). The standard limit of EC in water is 700µS/cm (EQS 1997) and the study showed that all the EC contents were within the standard limit. According to DWASA (2011) the content of EC was ranged from 108-991µS/cm at Kanchan and from 110-581 µS/cm at Kaligonj Kheyaghat in Shitalakhya River. According to Das et al. (2011), the EC of tannery effluent was 10455µS/cm and in Buriganga and Karnatoli River were 614.5 and 175.6µS/cm, respectively. All these studies are relatively similar to the present study.

The mean TDS content of the Jhenai river water was 556mg/l, whereas the highest TDS content was 582mg/l at Station-3 in February and the lowest was 524mg/l at Station-2 in March. The standard limit of TDS in water is 1000mg/l (ADB 1994) and the study showed that all the TDS contents were within the standard limit. The TDS contents of different sampling points of Turag River were ranged from 100-580mg/l (Rahman et al. 2012). The TDS concentrations of the Padma river water ranged from 129-166, 118-140 and

147-178mg/l over the pre-monsoon, monsoon and post-monsoon, respectively (Islam et al. 2014), and all these studies are similar to the present study.

Table1. Water quality parameters of the Jhenai River (February-April, 2018)

Parameters	Sampling Stations	Months			Mean	Standard
		February	March	April		
Temp. (°C)	St-1	24.5	28.2	31.7	28.1	20.0-30.0 (EQS, 1997)
	St-2	23.7	27.9	31.2	27.6	
	St-3	24.1	28.3	31.6	28.0	
EC (µS/cm)	St-1	694	663	655	670	700 (EQS, 1997)
	St-2	697	677	665	679	
	St-3	698	676	669	681	
TDS (mg/l)	St-1	568	534	559	553	1000 (ADB, 1994)
	St-2	572	524	566	554	
	St-3	582	534	570	562	
DO (mg/l)	St-1	4.2	5.2	4.2	4.5	5.0 (EQS, 1997)
	St-2	4.4	5.3	4.5	4.7	
	St-3	4.5	5.4	4.5	4.8	
BOD (mg/l)	St-1	1.2	1.4	1.2	1.2	< 6.0 (ECR, 1997)
	St-2	1.1	1.3	1.3	1.1	
	St-3	1.2	1.3	1.4	1.3	
pH	St-1	7.35	7.52	7.46	7.45	6.50-8.50 (ECR, 1997)
	St-2	7.34	7.51	7.47	7.44	
	St-3	7.38	7.56	7.45	7.46	
Hardness (mg/l)	St-1	132.20	135.40	141.30	136.30	>100 (Rahman, 1992)
	St-2	135.30	137.80	143.40	138.83	
	St-3	135.10	136.20	142.30	137.87	

The highest DO content of the river water was observed 5.4mg/l at St-3 in March while the lowest was 4.2mg/l at St-1 in February and April, respectively, whereas the mean DO content was 4.6mg/l (Table 1). The standard limit of DO is 5.0mg/l (EQS 1997) and the study showed that most of the DO contents were lower than the standard might be due to the presence of organic waste into the water (Islam et al. 2014). The DWASA (2011) reported that the contents of DO ranged from 1.5-6.2mg/l at Kanchan and 4 .0-7.4mg/l at Kaligonj Kheyaghat in Shitalakhya river, which is almost similar to the present study. The mean DO content of the Padma river water were found 7.31, 7.59 and 6.82 mg/l over pre-monsoon, monsoon and post-monsoon, respectively (Islam et al. 2014).

At the March and April, highest BOD contents were found 1.4mg/l at St-1 and St-3, respectively, while the lowest BOD was found at St-2 (1.1mg/l) (Table 1), whereas the mean BOD contents was 1.2mg/l. The study showed that all the BOD contents of the Jhenai river water were within the standard limit <6.0mg/l (ECR, 1997). The mean BOD content of the Padma river water were found 1.76, 2.35 and 3.21 mg/l over the pre-monsoon, monsoon and post-monsoon, respectively, which were likely suitable for fish production (Islam et al., 2014) and closely parallel to the present study.

The highest pH was 7.56 at St-3 in March and the lowest was 7.34 at St-2 in February, with the mean pH was 7.45 (Table 1). The standard limit of pH is 6.5-8.5 (ECR 1997) and the study showed that almost all recorded pH was within the standard limit. The result of the study revealed that the river water tends to be alkaline, this may be due to the alkali contain waste and effluent into the water and heavy rainfall. Alam et al. (2004) found that the pH was 7.5 in rainy season and 7.4 in dry season at Demraghat in Shitalakhya River. The pH of Padma river water were ranged from 7.0-7.6, 7.61-8.20 and 7.5-7.8 over the pre-monsoon, monsoon and post- monsoon, respectively (Islam et al. 2014), all these studies are almost similar to the present study.

The highest and lowest hardness were found 143.40 and 132.20mg/l at St-2 and St-1 in April and February, respectively, whereas, the mean hardness content was found

137.66mg/l (Table 1). The standard of surface water hardness contents is >100 (Rahman, 1992) and the study revealed that hardness contents of the Jhenai river water was suitable for aquatic environment. According to Huq and Alam (2005), the hardness for aquatic organism is 123 ppm and study revealed that hardness contents were more or less suitable for fisheries. The average hardness in Tista river water of wet and dry seasons were found 98.48 and 102.46 ppm, respectively (Islam et al., 2015), which is closely analogous to the present investigation.

4. CONCLUSION

From the overall discussions, it can be concluded that the quality of water in the Jhenai River is suitable for utilizing in various purposes especially for fisheries. But though it already not hampers the aquatic lives and also the lives of adjacent people, the present status should not let continue that may get critical in near future. In order to achieve the suitable water quality for common uses and for conserving the ecosystem, proper measures should be taken to prevent the water pollution of the river. To maintain sound environment and healthy ecosystem of the river and the surrounding areas raising awareness among local people about the water pollution and their adverse effects on public health.

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