Journal of Science and Technology, 6(1 & 2): 153-160, December 2016

INVESTIGATION OF WATER QUALITY FROM BANGSHI RIVER AT TANGAIL IN BANGLADESH

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Abstract

The study was conducted to investigate the water quality parameters of the Bangshi River at Mirzapur upazila in Tangail district, Bangladesh during July 2015 to February 2016. The water samples were collected from three different stations indicated as St-1 (Mirzapur municipality), St-2 (Gorai) and St-3 (Ajgana), during dry and wet seasons to analyze water temperature, total dissolved solids (TDS), electrical conductivity (EC), pH, dissolved oxygen (DO), biochemical oxygen demand (BOD) and alkalinity. The mean temperature, TDS, EC, DO, BOD, pH and alkalinity of the Bangshi River water were found 31.65 and 20.2°C, 102.0 and 484.5 ppm, 145.0 and 820.5 µS/cm, 4.20 and 2.35 ppm, 3.8 and 6.4 ppm, 7.74 and 8.12, and 109.0 and 293.9 ppm in dry and wet seasons, respectively. The study revealed that the water temperature was highest in the wet season and lowest in the dry season. During the dry season, the TDS was highest and gradually decreased to the wet season. The EC and pH was found within the standard limit over the both wet and dry season. The DO and BOD content were not suitable for fisheries whereas alkalinity was suitable for fisheries during dry and wet seasons. The river water is not suitable for aquatic environment as well as for fish culture. However, to maintain sound and healthy aquatic environment of the Bangshi river appropriate steps should be taken immediately.

Keywords: Bangshi River, water quality, physicochemical parameters

Introduction

Water is the most vital element among the natural resources and is crucial for the survival of all aquatic organisms (Hasan *et al.*, 2014). The surface water is very much essential for any country because of its human and animal living, aquatic flora and fauna, navigation, agriculture, etc. It is also necessary for keeping alive the distributaries in the delta and maintaining the brackish water ecosystem along the sea, on an annual cycle (Haque, 2008). Bangladesh has extensive water bodies that have a high potential for fisheries production (Mustafa and Brooks, 2009). The productivity depends on the physicochemical characteristics of the water body (Islam *et al*., 2012). Besides these,

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surface water fluctuations are very common in the rivers of Bangladesh, as they vary on seasonal precipitation and remain dependent on the inflow from upland sources (Islam *et al*., 2015). The pollution from industrial and urban waste effluents and from agro chemicals into rivers has reached alarming levels; resulting in serious effects on aquatic organisms as well as fish species (Islam *et al*., 2014). Just by assessing the physical, chemical and biological characteristics of water, one can conclude about its quality (Barthwal, 2002) and water quality focuses on the various aspects of physicochemical parameters that detect the status of pollution and suitability of a particular water body for various aquatic organisms (Sabbir *et al*., 2010).

Moreover, Bangladesh is one of those polluted countries, which currently holds 1176 industries that discharge about 0.4 millions m^3 of untreated waste to the rivers in a day (Islam *et al*., 2012; Rabbani and Sharif, 2005). The existing tendency of industrialization, urbanization and unwise agricultural practice may contribute greatly to the poor quality of river water through indiscriminate disposal of solid waste, industrial effluents, agricultural runoff and other toxic wastes which are the major environmental issues posing threats to the existence of aquatic organisms as well as fisheries (Rahman *et al*., 2008; Giguere *et al*., 2004; Gupta *et al*., 2009). The water of Bangshi River is undergoing continuous changes in terms of quality and is getting polluted day by day as a result of increasing industrialization, urbanization, unwise agricultural practice and developmental activities. In this aspect, the present study was an attempt to investigate the present status of physicochemical parameters of the Bangshi River in relation to observe the seasonal variation and to compare the observed values with water quality standard for aquatic environment as well as for fisheries.

Materials and Methods

Study Area: The study was conducted in the Bangshi river at Mirzapur upazila of Tangail district, Bangladesh during the period from July 2015 to February 2016. The study area was approximately within latitude between 24˚06′34″ and 24˚07′82″N and longitude between 90˚05′50″ and 90˚10′26″E. The Bangshi was a distributaries of the old Brahmaputra flowed in the southwardly direction through Tangail and discharged in the river Dhaleshwari near Savar at Dhaka. The length of the river is 238km whereas, the average depth of the river is 30ft and maximum depth is 80ft (Kabir, 2014).

Sample Collection: The water samples were collected from three different sampling stations of the Bangshi river indicated as St-1 (Mirzapur municipality), St-2 (Gorai) and St-3 (Ajgana) during wet season (July to September 2015) and dry season (December 2015 to February 2016), respectively. Samples were collected by 500ml plastic bottles with double stoppers from each sampling points. The bottle were cleaned and washed with detergent solution and treated with 5% nitric acid (HNO_3) over night before sampling. Finally the bottles were rinsed with deionized water and dried. After sampling, the bottles were screwed carefully and labeled properly for identification.

Sample Analysis: The physicochemical parameters of water samples were analyzed in the laboratory of the Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University, Tangail. The water temperature and pH were determined by the thermometer and digital pH meter (Model: pH Scan WP 1, 2 Malaysia), respectively. Digital EC and TDS meter (Model: HM digital Germany) was used to determine EC and TDS, respectively. The DO was determined by digital DO meter (Model: D.46974 Taiwan). The BOD was measured by two steps where initial DO_1 was measured immediately after collection and after 5 days DO_5 was measured by incubation in the dark condition at 20ºC for 5 days. Alkalinity was determined by titration method with 0.1 N HCl after addition 2-3 drops of methyl-orange indicator.

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. The results of the study were presented in charts and tabular forms.

Results and Discussion

The water temperature recorded in the Bangshi river ranging from 30.4 to 32.9 and 19.3 to 21.1°C in wet and dry season, respectively and the result revealed that there were no significant variations among the water temperatures of all the three stations. The highest water temperature (32.9°C) was found at St-3 during wet season and lowest temperature (19.3°C) was found at St-1 during dry season, while the mean water temperature was found 32.16°C during wet season that exceeded the standard level for aquatic environment. It could be the result of climatic condition because it was summer season. At increased water temperature, the solubility rate of gases in water such as oxygen decreases and the respiration rate of aquatic organism increases that lead to greater consumption of oxygen and increase the rate of decomposition (Chapman and Kimstach, 1992).

The TDS contents were found to fluctuate from 62 to 142 and 408 to 561ppm during wet and dry season, respectively. The highest content of TDS (561ppm) was found at St-3 during dry season and lowest 62ppm was found at St-1 during wet season. During the dry season over the three stations the TDS contents were much higher than the standard level which is detrimental for aquatic organism as well as fish culture. The mean TDS content in the Brahmaputra River during dry season was found 73.87ppm (Islam *et al*., 2015), which is opposite to the present study. The enhanced TDS contents indicated that the presence of various salts into the river, this might be due to the discharged of waste and effluent from industry and municipality, agricultural runoff etc.

The EC were ranged from 121 to 169 and 772 to 869µS/cm during the wet and dry season, respectively in the Bangshi River, depicted that the higher ionic conductance

during dry season, it could be due to the dumping of solid waste, discharging of industrial effluent and run-off from agricultural activities (Islam *et al.*, 2015). The highest content of EC (869µS/cm) was found at St-3 during dry season and the lowest EC (121µS/cm) was found at St-1 during wet season. Overall, the EC contents of all sampling stations during the dry season were higher than the wet season, and the mean EC contents of the river water indicated that the water was suitable for fisheries production. A positive relation was found between EC and TDS where the EC contents increased with increasing the TDS contents.

Table 1. Physicochemical parameters of the Bangshi river during wet and dry season

Parameters	Sampling stations	Wet season (Jul.-Sep.)	Dry season (Dec.-Feb.)	Standard for fisheries
Temperature (°C)	St-1	31.27	19.87	25°C (EPA, 2001)
	St-2	32.07	19.93	
	St-3	32.3	20.6	
	Mean ± SD	32.16±0.13	20.13±0.41	
TDS (ppm)	St-1	75	429	<400ppm (Meade, 1998)
	St-2	94	496	
	St-3	133	539	
	Mean ± SD	100±29.43	487.3±54.19	
EC (µS/cm)	St-1	135	803	1000µS/cm (ADB, 1994)
	St-2	147	829	
	St-3	153	848.3	
	Mean ± SD	145±9.17	826.6±22.59	
Alkalinity (ppm)	St-1	61.2	221.67	80-200ppm (Bhatnagar *et al.*, 2004)
	St-2	136.6	271.17	
	St-3	121.1	349.37	
	Mean ± SD	155.39±39.85	280.74±64.39	
pH	St-1	7.7	8.06	6.5-8.5 (ECR, 1997)
	St-2	7.78	8.16	
	St-3	7.79	8.22	
	Mean ± SD	7.76±0.05	8.15±0.08	

The study revealed that the pH was ranged from 7.64 to 7.84 and 7.76 to 8.47 in wet and dry season, respectively. The result of the study showed that the water was a tendency to become alkaline at all stations in all the seasons. This might be due to lower level of waste and effluent into the water, heavy rainfall and upstream runoff of water (Islam *et al.*, 2014). The pH was slightly fluctuated between wet and dry season and all the stations showed relatively similar value. The highest value of pH (8.47) was found at St-3 during dry season and lowest pH (7.64) was found at St-1 during wet season. The standard limit of pH for inland surface water is 6.5 to 8.5 (EQS, 1997). It may be inferred from the study that pH of all the sampling stations was within the acceptable range for aquatic organisms.

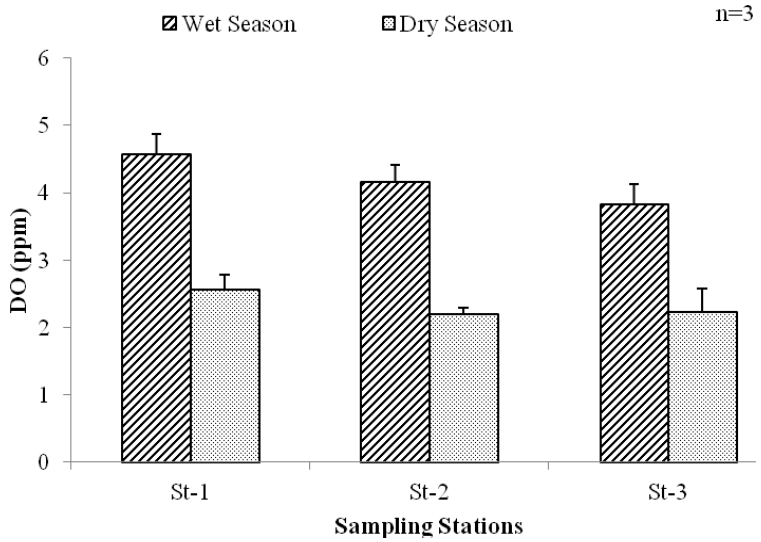

Fig. 1. The DO contents of different sampling stations in the Bangshi river during the wet and dry season.

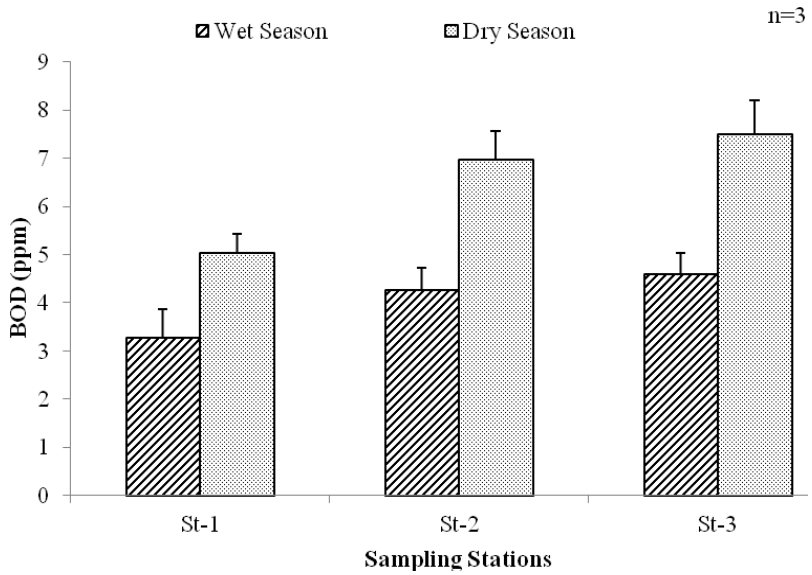

Fig. 2. The BOD contents of different sampling stations in the Bangshi river during wet and dry season.

The DO contents were varied from 3.5 to 4.9 and 1.9 to 2.8ppm in wet and dry season, respectively which were much lower than the standard limit as well as unfavorable condition of the water body for fisheries. Adequate DO is necessary for good water quality, survival of aquatic organism and decomposition of waste by microorganism (Islam *et al.,* 2010). The study showed that the DO contents were much lower during the

dry season than the wet season. The highest content of DO (4.9ppm) was found at St-1 during wet season whereas the lowest DO (1.9ppm) was found at St-3 during dry season. This variation might be due to the dumping of waste and effluents into the less water body in dry season because the pollutants were diluted with heavy rainfall and upstream runoff of water during wet season (Islam *et al*., 2014). However, all the observed values including the average contents during the wet season (4.19ppm) and dry season (2.33ppm) were much lower than the standard limit (≥ 5ppm) for fishing given by ECR (1997). The lower DO contents indicate that higher level of organic pollutants and lower level of oxygen concentration in water (Islam *et al*., 2012).

The observed BOD contents were within ranged from 2.7 to 4.9 and 4.6 to 8.2ppm in wet and dry season, respectively, while the mean content of BOD was 4.05 and 6.5ppm during wet and dry season, respectively. Concentrations of BOD were found to be higher during dry season than wet season, might be due to the presence of comparatively more organic waste in the river water. The highest BOD (8.2ppm) content was found at St-3 during dry season and lowest BOD (2.7ppm) content was found at St-1during wet season. When BOD level is high DO level decreases because the oxygen available in the water is being consumed by bacteria (Sawyer *et al.,* 2003). According to EQS (1997) the standard level of BOD for fishing purpose is 2ppm or less. If there is no organic waste present in the water, there would not be as many bacteria present to decompose it and thus the BOD will tend to be lower and the DO level will tend to be higher (Rahman *et al*., 2012).

The alkalinity of Bangshi river water was ranged from 53.3 to 165 and 216.6 to 371.2ppm in wet and dry season, respectively. All the sampling stations showed much higher alkaline water during dry season compared to wet season. It indicates that the water contains higher amount of carbonates and bicarbonates enriched compounds as well as pollutants (Islam *et al.,* 2015). Total alkalinity more than 100mg/l should be present in a highly productive water bodies (Rahman, 1992). The highest value of alkalinity (371.2ppm) was found at St-3 during dry season and the lowest value of alkalinity (53.3ppm) was found at St-1 during wet season. The probable causes of these variations were due to, the river banks were widely used for agricultural practices and most of the crops were harvested during pre-monsoon season (Islam *et al*., 2014).

Conclusion

The study observed that the highest water temperature was found during the wet season that exceeded the standard level for aquatic environment and the lowest temperature was found during the dry season. During the dry season both the TDS and EC contents was much higher than the wet season, while TDS content slightly exceeded the standard limit and EC content of the water was suitable for fisheries production. DO content was much lower during the dry season than the wet season whereas BOD content was found to be higher during dry season than wet season this might be due to the presence of

comparatively more organic waste into the river water. The result also depicted that the water was a tendency to become alkaline over the all stations in the both seasons and much higher alkaline water was found during the dry season compared to wet season. The overall study concluded that the river water is not suitable for fish culture. To maintain sound environment and healthy ecosystem of the river, it is obvious to raise awareness regarding the water quality problems and river management through education, monitoring and research.

Acknowledgements

Sincere gratitude to Mr. Tanmoy Roy Tusher (Assistant Professor) of the Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh for his kind cooperation and valuable suggestions throughout the study period.

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