

Comparative Study on the Water Quality Parameters in Two Rural and Urban Rivers Emphasizing on the Pollution Level

¹Imtiaj Hasan, ¹Sultana Rajia, ²Kazi Ahmed Kabir and ³Gulshan Ara Latifa

¹Department of Biochemistry and Molecular Biology, Rajshahi University, Bangladesh
²School of Environmental Science and Management, Independent University Bangladesh
³Department of Zoology, University of Dhaka, Bangladesh

Abstract: Water of Buriganga River, beside Dhaka and of a rural river Panguchi was studied and compared for pollution by determining various water quality parameters for one year. The river Buriganga is subjected to severe pollution whereas Panguchi is considered a less polluted river. The pH range is 6.69 to 8.14 for the river Buriganga and 6.90 to 8.80 for the river Panguchi. The organic pollution in river Buriganga is much more severe as indicated by DO (4.22 to 6.84) and BOD (0.97 to 3.12) than river Panguchi as the values are 7.16 to 8.66 and 5.43 to 5.73 respectively. The overall study shows that the degree of river pollution is quite alarming for the urban population.

Key words: Urban • River • Pollution • Water quality • DO • BOD

INTRODUCTION

Buriganga River a tide-influenced river passing through west and south of Dhaka City. The Buriganga originated from the Dhaleshwari near Kalatia. Its average width and depth are 400 meters and 10 meters respectively. This river is only 27 km long. Water pollution in the River Buriganga is as it's highest. The river is seriously polluted by discharge of industrial effluents into river water, indiscriminate throwing of household, clinical, pathological and commercial wastes, fuel and sewage waste. The most significant source of pollution appears to be from the tanneries in Hazaribagh area. Up to 40, 000 tones of tannery waste flows into the river daily along with sewage [1]. The water of the river has become so polluted that abundance and diversity of aquatic life including fish has decreased alarmingly. Miraculously, when the water quality is not at its worst, River dolphins can still be seen [2].

The river Panguchi flows 15 kilometers South of Bagerhat town. It is a tidal river near the coast with mild salinity, originated from the river Kocha and extends upto Doratana river. It is approximately 25 kilometers in length and width varies between 0.5 to 1 kilometer.

MATERIALS AND METHODS

Two teams collected the midstream surface water samples from the river Buriganga and river Panguchi almost at the same time. Buriganga is an urban river considered as the most polluted river of the country and located behind the capital Dhaka. Panguchi is a river of rural area located in the south-western part of Bangladesh close to the coast under Morrelgonj Upazila of Bagerhat District (Fig. 1).

The samples were collected by 223451 Wildco Alpha™ Horizontal Water Bottle kits and stored in ice boxes after the determination of temperature, pH and electrical conductivity. The samples were further analyzed for some other physico-chemical and biological water quality parameters such as total dissolved solids, hardness, alkalinity, dissolved oxygen, biological oxygen demand, ammonia and nitrite-nitrogen concentration and carbon-dioxide content, . All the analysis was done by using Digital temperature meter (Two digit, Fisher, USA), pH meter (HANNA, Field X-2, Italy), TDS analyzing meter [3] and HACH water quality analysis Kit Box (FF2, USA) [4]. The MPN count of Coliform bacteria was carried out in the research laboratory of the Department of Microbiology, University of Dhaka.

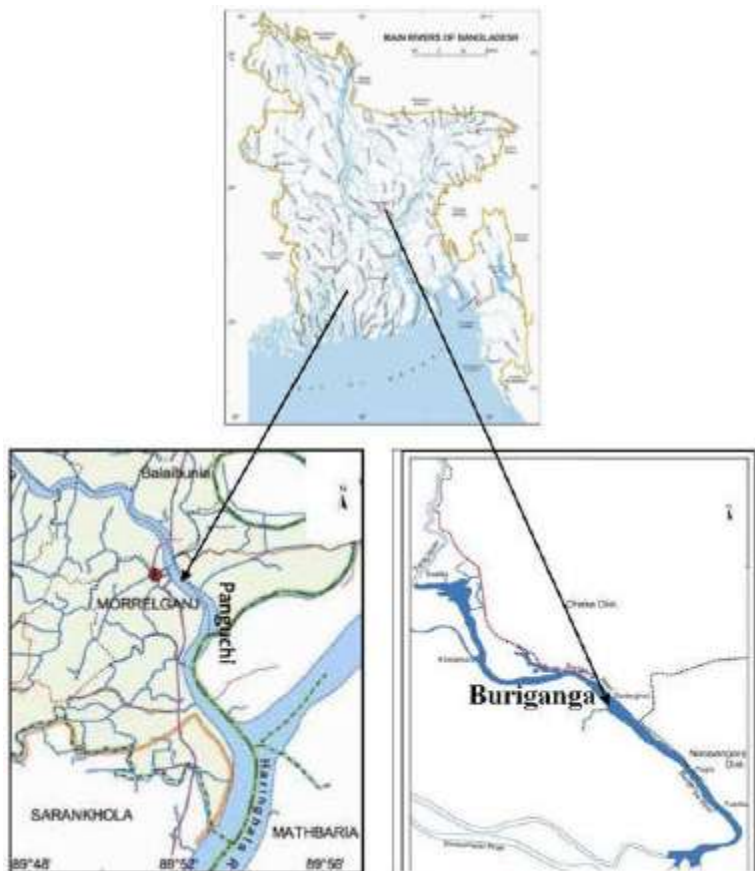


Fig. 1: Study areas

RESULTS AND DISCUSSIONS

Temperature: Temperature varied from 22.8°C to 28.6°C in Buriganga whereas the range is from 27.4 to 32.3°C for the river Panguchi. Comparative seasonal variation is shown in graph (Fig. 2). The higher temperature in Panguchi river water suggests that it has fewer amounts of insoluble pollutants.

pH: It is a major water quality parameter. But unfortunately we observed no significant variation in two study areas. In Buriganga the pH range was 6.92 to 7.52 and for Panguchi, it was 7.23 to 8.09. Comparative seasonal variation is shown in graph (Fig. 2). Perhaps pollutants in Buriganga have less influence on pH.

Total Dissolved Solids (TDS): TDS analysis has great implications in the control of biological and physical waste water treatment processes. A large amount of total solids makes the river water more turbid and increases its

electrical conductivity [5, 8]. The maximum value recorded for Buriganga was 789 mg/L during summer and for Panguchi it ranges from 228 to 284 mg/L. Comparative seasonal variation is shown in graph (Fig. 2).

Conductivity: The electrical conductivity has a direct relation with the total solids. As expected, the values for Buriganga were found to be greater than those of Panguchi. In present observations the electrical conductivity for Panguchi ranges from 201.96 to 465.87. Panguchi becomes a bit saline during winter and the conductivity is the highest (465.87) in that season. Comparative seasonal variation is shown in graph (Fig. 2). High electrical conductivity indicates a larger quantity of dissolved mineral salts [6]. The water of Buriganga is not saline but interestingly it got even higher conductivity values from 685.80 to 1093.47. We can assume that it happened due to the presence of a large amount of total dissolved solids as a result of severe pollution.

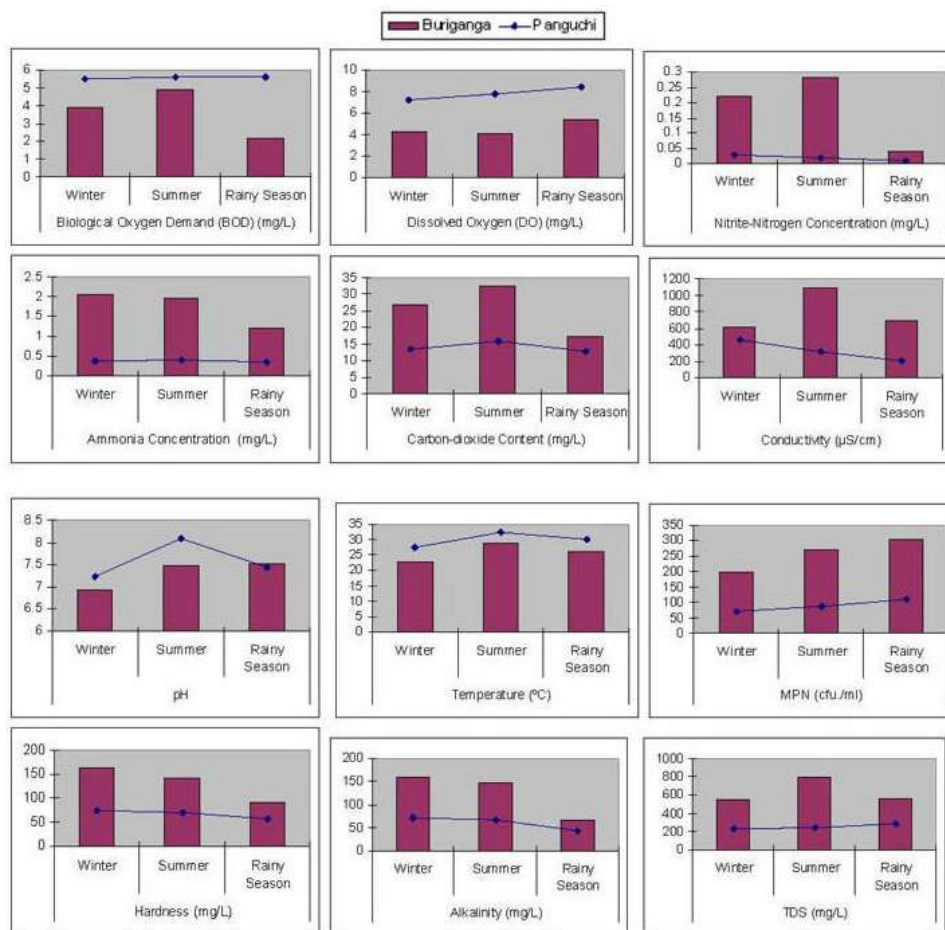


Fig. 2: Comparative water quality of river Buriganga and Panguchi

Table 1: Mean values of Physico-Chemical and Biological parameters of River Buriganga and River Panguchi showing seasonal variations

	Temperature (°C)			pH			TDS (mg/L)			Conductivity (µS/cm)		
	Winter	Summer	Rainy Season	Winter	Summer	Rainy Season	Winter	Summer	Rainy Season	Winter	Summer	Rainy Season
Buriganga	22.8	28.6	26.2	6.92	7.48	7.52	544	789	555	622.20	1093.47	685.80
Panguchi	27.4	32.3	30.2	7.23	8.09	7.43	228	238	284	465.87	311.22	201.96
	Hardness (mg/L)			Alkalinity (mg/L)			Dissolved Oxygen (DO) (mg/L)			Biological Oxygen Demand (BOD) (mg/L)		
	Winter	Summer	Rainy Season	Winter	Summer	Rainy Season	Winter	Summer	Rainy Season	Winter	Summer	Rainy Season
Buriganga	163.10	140.51	91.94	159.42	146.10	67.43	4.24	4.07	5.41	3.90	4.86	2.21
Panguchi	74.79	70.40	56.68	71.16	66.79	42.66	7.23	7.75	8.44	5.52	5.60	5.62
	Ammonia Concentration (mg/L)			Nitrite-Nitrogen Concentration (mg/L)			Carbon-dioxide Content (mg/L)			MPN (cfu /ml)		
	Winter	Summer	Rainy Season	Winter	Summer	Rainy Season	Winter	Summer	Rainy Season	Winter	Summer	Rainy Season
Buriganga	2.05	1.95	1.20	0.22	0.28	0.04	26.79	32.59	17.47	197	268	304
Panguchi	0.36	0.38	0.34	0.03	0.02	0.01	13.47	15.94	12.71	71	86	109

Hardness: In present study the observed values ranged from 56.68 to 74.79 mg/L for the river Panguchi. For Buriganga, the minimum value was 91.94 and the maximum was 163.10 mg/L. Comparative seasonal variation is shown in graph (Fig. 2). Although hard water has no known effects on health but is unsuitable for domestic uses. It also forms heat-insulating scales in the boilers reducing their efficiency [7, 8]. Therefore, the water of Buriganga is unsuitable for industrial uses whereas the water of Panguchi is milder enough.

Alkalinity: It is the quantitative capacity of water sample to neutralize a strong acid to a designated pH. In the present study observed values range from 42.66 to 71.16 mg/L in case of Panguchi and in Buriganga water the alkalinity ranges from 67.43 to 159.52 mg/L. Comparative seasonal variation is shown in graph (Fig. 2). Higher values may be found due to the industrial effluents and this alkalinity level lowers in the rainy season probably because of increased dilutions [9].

Dissolved Oxygen (DO): In Panguchi the DO varies from 7.23 to 8.44 mg/L throughout the year, clearly indicating the presence of enough oxygen. But in Buriganga the DO ranges between 4.07 to 5.41 mg/L and more than 5.0 mg/L only in the rainy season. Comparative seasonal variation is shown in graph (Fig. 2). During summer and winter the water becomes moderately polluted as the DO values were between 4.07 to 4.24 mg/L. Maximum fall of DO in Buriganga was in summer and may be because of higher decomposition due to highest tannery waste disposal.

Biological Oxygen Demand (BOD): pH, types of microorganisms, presence of toxins, some reduced mineral matters and nitrification process are the important factors influencing the BOD test. In this test the amount of biochemically oxidisable carbonaceous matter is determined and the result indicates the presence of organic pollution [10]. For the river Buriganga it ranges from 2.21 to 4.86 mg/L with an exceptional rise of 6.82 mg/L in the months of February-March. This value was probably obtained due to the release of a large amount of tannery wastes just after the Eid-ul-Azha. The BOD values for the river Panguchi were comparatively steady ranging from 5.52 to 5.62 mg/L. Comparative seasonal variation is shown in graph (Fig. 2).

Ammonia and Nitrite-Nitrogen Concentration: The differing forms of nitrogen are relatively stable in most river systems with ammonia transforming into nitrite that slowly transforming into nitrate in well oxygenated rivers

like Buriganga [11]. In winter the ammonia and nitrite-nitrogen concentration raised to 2.05 and 0.22 mg/L respectively and in the rainy season the values became reduced to 1.20 and 0.04 mg/L due to simple dilution. Because of this elevated levels of nitrogen eutrophication is observed in many shallow patches near the bank of this river. The ammonia concentration for Panguchi varied from 0.34 mg/L in the rainy season to 0.38 mg/L in summer. The range of nitrite-nitrogen concentration for Panguchi was 0.01 to 0.03 mg/L. Comparative seasonal variation is shown in graph (Fig. 2).

Carbon-dioxide Content: In Buriganga the carbon-dioxide content varies from 17.47 mg/L to 32.59 mg/L. For Panguchi it ranged from 12.71 mg/L to 15.94 mg/L. Comparative seasonal variation is shown in graph (Fig. 2). For both the rivers maximum and minimum values were obtained in summer and in the rainy season respectively. This finding proves the direct correlation of BOD with carbon-dioxide content.

MPN of Coliform: The Coliform group of bacteria has been the principal indicator for the suitability of water for domestic use [12]. In the present study, MPN count in the river Buriganga and Panguchi rises to the maximum in the rainy season and minimum in winter. Comparative seasonal variation is shown in graph (Fig. 2). The highest relative values in rainy season may be attributed to the favorable conditions of temperature and nutrients [13, 14].

The present study reveals that being a tidal river and of rural location Panguchi contains almost no pollutant other than agricultural wash off. On the other hand Buriganga, well known as a polluted river, shows severe pollution. Especially it exceeds the pollution tolerance for aquatic life after Eid-ul-Azha. Result of present study supports this. In addition during our sampling in the month of February and March we found lots of floating dead animals from surface to benthic niche to support previous statement. During our study we have identified accidental oil spilling by the oil tankers in Panguchi River. Because of high tidal influence no significant impact of oil spilling was observed in the sapling area. But it is expected that accumulation of spilled oil in downstream may have negative impact on aquatic life.

CONCLUSION

Overall comparisons between the two rivers show significant variation in water quality all the year round. Water resource use pattern and geographical location has been identified as the cause of difference in pollution

level. Special attention should be paid to control pollution of Buriganga to keep it suitable for survival of aquatic life and also because of its use and aesthetic value.

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