An Investigation Into The Water Quality Of Buriganga - A River Running Through Dhaka

Shaikh Sayed Ahammed, Sadia Tasfina, K. Ayaz Rabbani, Md. Adbul Khaleque

Abstract: Buriganga river is used for bathing, drinking, irrigation and industrial purposes and is considered to be the lifeline of Dhaka city. The water quality of Buriganga has become a matter of concern due to serious levels of pollution. The objective of the study was to determine the water quality of the selected section of Buriganga river which passes through Dhaka city. The water quality parameters were sampled during different seasons (summer, winter and autumn) and in 10 different sampling points along the river along the banks of the Buriganga River. The water quality parameters studied for this study were dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), pH, turbidity, conductivity, total dissolved solids (TDS), nitrate and phosphate. The results showed that DO, BOD, COD, TDS, turbidity, nitrate and phosphate are at an alarming level and a discussion on the possible sources of the pollution are presented.

Index Terms: Water quality, River pollution, Buriganga, Nitrate, Phosphate, Dissolved oxygen

1. INTRODUCTION

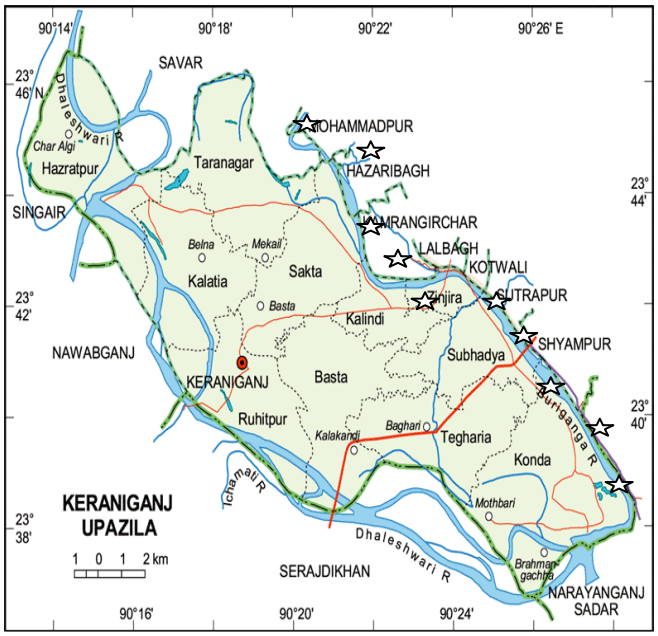

Fig: 1. *Map of Buriganga river with the study areas indicated as ☆[1]*

The capital of Bangladesh, one of the most populated countries in the world is Dhaka, a megacity with a population of over ten million [1], [2], [3]. Buriganga river is one of the largest rivers in Bangladesh and flows through west and south of Dhaka [4]. Buriganga is considered the lifeline of Dhaka city because it is a source of water used by the city residents for bathing, drinking, irrigation and industrial purposes [5].

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Buriganga is part of the Ganges, which is a trans-boundary river and flows through the nations of India and Bangladesh [6]. The Ganges is 2,525 km long and the Buriganga, which is the part of the Ganges in Bangladesh is 18km long. The Buriganga river is located on the south side of Dhaka city and is significantly polluted due to addition of industrial effluents, urban sewage and solid waste due to human activities in the area. There are also 343 tannery industries situated in Hazaribagh on the bank of Buriganga River [7]. Tanneries in the city's Hazaribagh area discharge some 21,600 square meters of liquid wastes everyday into the Buriganga River [8]. These harmful effluents, including chromium, lead, sulphur, ammonium, salt and other materials, are severely polluting the Buriganga River [9]. There are 627 dyeing industries are situated beside the Buriganga River near Jingira, Karanigang areas [10]. From these industries, 5000 square meters of effluents are discharged daily into the Buriganga River. These effluents contain some toxic chemicals such as epoxy, polyurethane, enamel, ductile-silvery white metal ,hydrochloric acid, alkalis, lime, caustic soda, aluminum, zinc chromate, zinc phosphate, asbestos etc. [11]. There are also 104 fertilizer industries situated in Fatulla, Faridabad, Bosilla, Damra on the bank of Buriganga River. From these industries, approximately 9000 square meters of effluents are discharged everyday into the Buriganga River [11]. The discharge of this huge amount of pollutants is causing the deterioration of the Buriganga river. In addition of these, the water of Buriganga is being polluted by man-made activities such as cleaning, washing, bathing etc. For these reasons, a study is needed to assess the present water quality of this river. The quality of a river is determined by measuring the water quality parameters. Studies have been done previously on the Buriganga and other rivers with similar parameters [8], [10], [11], [12]. This study looked at the parameters in different times of the year (summer, winter and autumn) from 10 locations along the river near Dhaka city. The water quality parameters tested were pH, temperature, turbidity, conductivity, TDS, turbidity, DO, BOD, COD, nitrate and phosphate.

2. MATERIALS AND METHODS

Water samples were collected by engine-boat in three different seasons of Spring (January), Summer (May) and Autumn (September) at 10 different sites of Buriganga River. In total, 30 samples were collected and analyzed for 10 different water quality parameters. The water quality parameters being tested was sampled and analyzed as per standard methods [13].

Each parameter was measured five times and the mean value of the readings is presented in this paper. 1L polypropylene bottles were used to collect the samples and before collecting the samples, all bottles were washed with distilled water then dried. All samples were collected at the depth of 1.5 meters and a few drops of sulfuric acid were added in each bottle to prevent any change in values of COD, BOD, nitrate and phosphate. Some of the parameters like pH, temperature and DO were measured on site and some measurements were taken at the Environmental Science labs of Independent University, Bangladesh. pH, temperature and conductivity was measured using a hand held pH-meter (SensION 156, HACH, USA). DO was measured on site using a hand held DO meter (HI 9147, Hanna, Romania). Turbidity was measured using the Turbidity meter (2100P, HACH, USA). BOD_5 was determined by measuring DO of the samples after 5 day of incubation at 20°C using phosphate buffer, calcium chloride, magnesium sulphate and iron (III) chloride solution (Merck, USA). COD was measured by COD kit (HACH, USA) with COD reactor (ET 108, Lovibond, Germany). TDS was measured gravimetrically using filter paper and dried in the oven (3606, Branstead, USA). Nitrate was measured using the NitraVer reagent kits (HACH, USA) and UV-Visible Spectrophotometer (Labomed-2602, USA). Phosphate was spectrophotometrically determined the molybdovanadate method and UV-Visible Spectrophotometer (Labomed-2602, USA).

3. RESULTS AND DISCUSSIONS

The objective of the study was to determine the water quality of the selected section of Buriganga river which passes through Dhaka city and compare it to other literature studies done on the Buriganga. All the parameters studied are presented in TABLE 1,
TABLE *2* and

TABLE *3*. The highest and lowest values of the particular parameters determined among all the 10 locations are indicated in the tables. The two highest and two lowest values among the group are shown. Notable parameters which show significant points of interest are shown in
Fig: *2*, Fig: *3*, Fig:, Fig: ***4*** and
Fig: ***5***. It is clear from the data that the water quality of the river near Hazaribagh is of the poorest quality of all the geographical points collected in this study. This is because of the location of this sampling point very close to the tannery industry. The tanneries produce tannery waste that has a profound effect on the water quality of the river. The standard value of DO in river water should be 8 mg/L of oxygen [6]. The average value of DO in Buriganga River is 1.11 mg/L with some areas almost zero. The DO of all sites were very low, expect for Pagla and Fattula sites which were both downstream locations (Fig. 2). This indicates that the decrease in DO in Buriganga is mainly due to its location beside the urban areas of Dhaka.

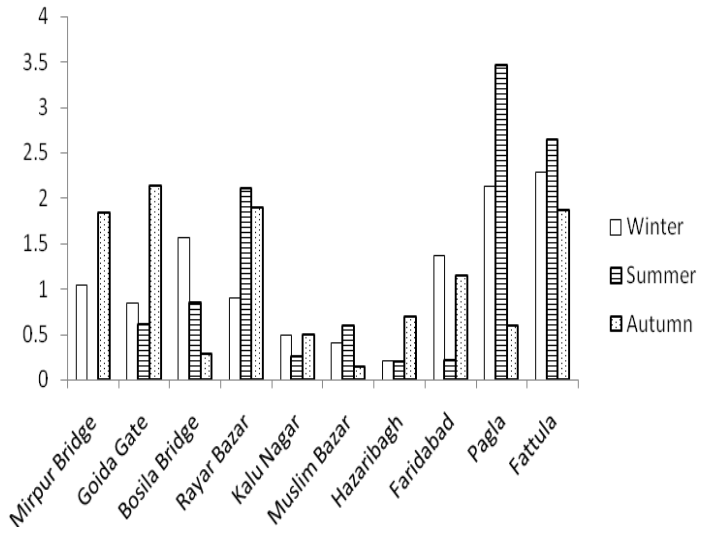

Fig: 2. *DO values at different seasons and points of Buriganga river*

Rayerbazaar was also an interesting site, since both the BOD and COD values were high but the DO values were very low. Rivers usually have a BOD value in the range of 1 to 8 mg/L [6]. From this study, it was got the average value of Biological Oxygen Demand (BOD) in Buriganga River of 82.3 mg/L (Fig 3). This indicates that there are a lot of organic pollutants in the river. This could also be the reason that the DO is so low. It is important to note that there was domestic sewage and industrial effluent streaming straight to the river through a pipe at this point which could be the reason for the high BOD value. High average Chemical Oxygen Demand (COD) values mirror that of BOD values (Fig 4).

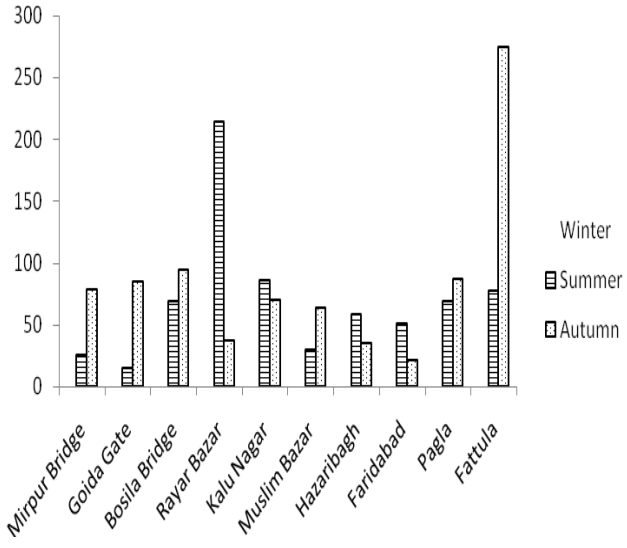

Fig: 3. *BOD values at different seasons and points of Buriganga river*

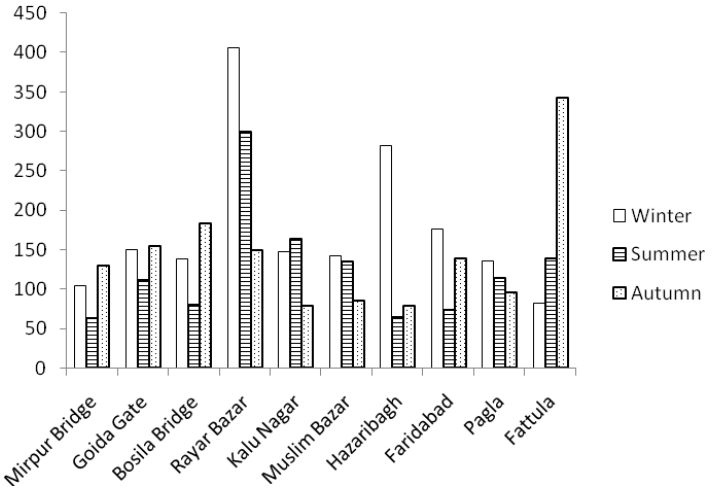

Fig: 4. *COD values at different seasons and points of Buriganga river*

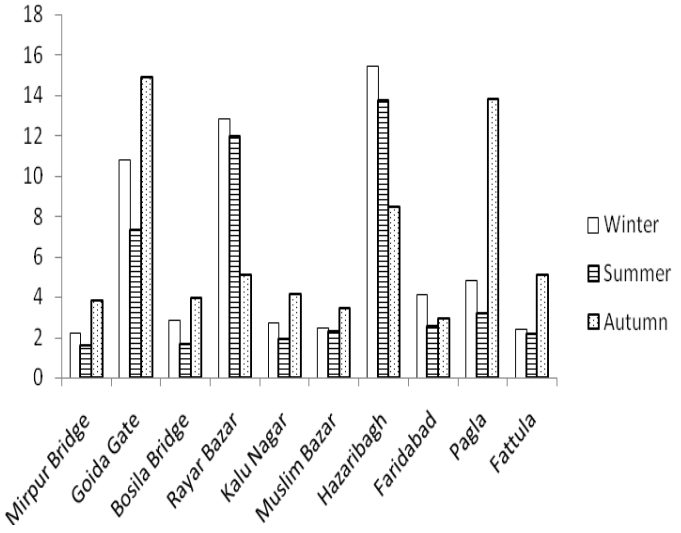

Fig: 5. *Phosphate values at different seasons and points of Buriganga river*

It is interesting to note that there is no noticeable difference between the nitrate and phosphate levels in the various locations of the river (Fig 5 and Fig 6). Nitrate and phosphate levels are usually indicative of sewage pollution in a river [8]. The standard value of nitrate in drinking water is less than 2.5 mg/L [6]. The average value of nitrate and phosphate in Buriganga River is approximately 5.92 mg/L and 5.83 mg/L respectively and this may cause the death of fish and also impair the immune system and increase stress in some aquatic species. The nitrate pollution along the river does not change significantly between the 10 sampling points which indicates that the source of nitrate pollution is not a specific point source but is probably due to fertilizer being added upstream which would indicate a non-point source of pollution. The lack of change in nitrate levels along the river indicate that even if the industries are relocated, the nitrate and phosphate levels in the river will not improve.

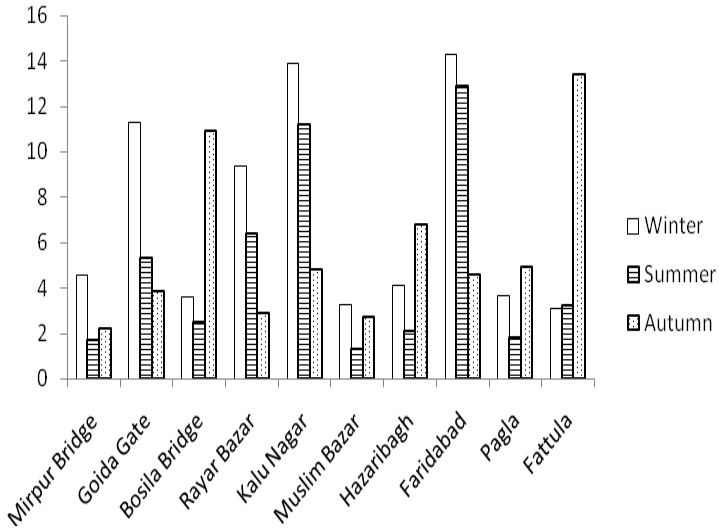

Fig: 4. *Nitrate values at different seasons and points of Buriganga river*

TABLE 1: *Results of different water quality parameters of Buriganga River in winter*

Sampling date: January 04, 2015 (Winter)										
Site name	DO mg/L	BOD mg/L	COD mg/L	pH	Temperature ºC	Conductivity µs/cm	Turbidity NTU	TDS mg/L	Nitrate mg/L	Phosphate mg/L
Mirpur bridge	1.04	76.60	104.80[b]	7.49	28.00	121.60[b]	10.90	124.00[b]	4.60	2.23[b]
Goida sluice gate	0.85	107.16	150.10	7.67	27.00	625.00	39.70	396.00[a]	11.30	10.81
Bosila bridge	1.57	84.00	137.80	6.11	27.00	602.00	16.20	395.00	3.60	2.88
Rayar bazaar sluice gate	0.90	128.00[a]	405.00[a]	6.73	28.00	94.95[b]	93.30[a]	300.00[b]	9.40	12.84[a]
Kalunagar	0.50	69.80[b]	146.80	6.45	28.00	619.00	10.00[b]	375.00	13.90[a]	2.75
Muslim bazaar	0.41[b]	97.20	142.70	6.30	29.00	601.00	9.66[b]	358.00	3.30[b]	2.48
Hazaribagh	0.21[b]	134.79[a]	282.10[a]	6.16	27.00	1362.00[a]	139.00[a]	824.00[a]	4.10	15.45[a]
Faridabad	1.37	91.36	176.70	6.04	35.00	631.00[a]	21.80	380.00	14.30[a]	4.14
Pagla	2.13[a]	87.37	136.30	6.23	27.00	584.00	49.30	372.00	3.70	4.81
Fattula	2.29[a]	53.00[b]	81.70[b]	6.21	28.00	556.00	16.10	352.00	3.10[b]	2.40[b]

[a]: Highest values of the parameter among all samples
[b]: Lowest values of the parameter among all samples

TABLE 2: *Results of different water quality parameters of Buriganga River in summer*

Sampling date: May 16, 2015 (Summer)										
Site name	DO mg/L	BOD mg/L	COD mg/L	pH	Temperature ºC	Conductivity µs/cm	Turbidity NTU	TDS mg/L	Nitrate mg/L	Phosphate mg/L
Mirpur bridge	0.00[b]	25.20[b]	64.00[b]	7.95	27.00	888.00	36.10[b]	497.00	1.70[b]	1.58[b]
Goida sluice gate	0.61	15.00[b]	112.00	7.28	27.00	738.00	42.00	437.00[b]	5.30	7.31
Bosila bridge	0.85	69.00	80.00	6.60	30.00	910.00	41.80	551.00	2.50	1.68[b]
Rayar bazaar sluice gate	2.10	213.90[a]	300.00[a]	7.79	39.00	264.00[b]	77.10	1634.00[a]	6.40	11.97[a]
Kalunagar	0.25	86.00[a]	164.40[a]	7.68	32.00	965.00[a]	50.10	531.00	11.20[a]	1.91
Muslim bazaar	0.60	30.00	135.50	7.45	31.00	918.00	51.30	523.00	1.30[b]	2.28
Hazaribagh	0.20[b]	57.90	65.00[b]	7.36	31.00	1144.00[a]	82.50[a]	651.00[a]	2.10	13.73[a]
Faridabad	0.21	51.00	74.40	7.37	32.00	776.00	39.10	488.00	12.90[a]	2.53
Pagla	3.47[a]	69.00	114.00	6.64	33.00	645.00	119.00[a]	416.00	1.80	3.19
Fattula	2.64[a]	77.10	139.00	7.63	29.00	528.00[b]	8.79[b]	327.00[b]	3.20	2.14

[a]: Highest values of the parameter among all samples
[b]: Lowest values of the parameter among all samples

TABLE 3: *Results of different water quality parameters of Buriganga River*

Sampling date: September 09, 2015 (Autumn)										
Site name	DO mg/L	BOD mg/L	COD mg/L	pH	Temperature ^{o}C	Conductivity µs/cm	Turbidity NTU	TDS mg/L	Nitrate mg/L	Phosphate mg/L
Mirpur bridge	1.84	78.00	130.24	6.48	32.00	712.00	98.70 [a]	531.00	2.19 [b]	3.79
Goida sluice gate	2.13[a]	85.20	154.32	7.18	30.00	620.00 [b]	14.97 [b]	402.00 [b]	3.87	14.87 [a]
Bosila bridge	0.29	94.00[a]	183.20 [a]	7.25	29.00	1031.00	58.70	631.00	10.90 [a]	3.92
Rayar bazaar sluice gate	1.90[a]	36.70	149.80	7.71	30.00	978.00	56.10	509.00	2.90	5.12
Kalunagar	0.50	69.80	79.40	7.34	32.00	1208.00 [a]	97.21 [a]	716.00 [a]	4.80	4.14
Muslim bazaar	0.14[b]	63.28	85.70 [b]	8.01	31.00	798.00	56.80	534.00	2.70 [b]	3.47 [b]
Hazaribagh	0.69	34.79[b]	79.10 [b]	6.93	29.00	907.00	49.57 [b]	593.00	6.80	8.49
Faridabad	1.14	21.36[b]	139.70	7.13	28.00	816.00	58.60	486.00 [b]	4.56	2.95[b]
Pagla	0.59[b]	87.37	96.30	7.38	31.00	1039.00 [a]	54.80	608.00	5.90	13.83 [a]
Fattula	1.87	275.00[a]	343.50[a]	8.02	38.00	312.00 [b]	89.76	1719.00 [a]	13.40 [a]	5.12

[a]*: Highest values of the parameter among all samples*
[b]*: Lowest values of the parameter among all samples*

4 CONCLUSION

A study was undertaken to determine the water quality of Buriganga River and the water quality parameters were sampled during different seasons (Summer, Winter and Autumn) and in 10 different sampling points along the river (Mirpur bridge, Goida sluice gate, Bosila bridge, Rayar bazaar sluice gate, Kalunagar, Muslim bazaar, Hazaribagh, Faridabad, Pagla, and Fattula) along the banks of the Buriganga River. All the water quality parameters indicate that the quality of water in Buriganga river is very poor and the average DO, BOD and COD was 1.11 mg/L, 82.30 mg/L and 148.45 mg/L respectively and the concentration of nitrate and phosphate was 5.92 mg/L and 5.83 mg/L respectively. Nitrate and phosphate values show very little change along the river indicating that this pollution is from a non-point source of pollution while the DO, BOD and COD show that these values are more indicative of point sources of pollution.

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