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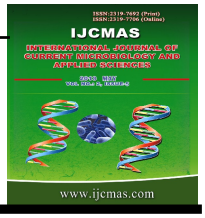

Original Research Article

Assessment of Physicochemical Properties of Water from the Turag River in Dhaka City, Bangladesh

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Keywords

Turag River; Water quality; Nutrients; Pollution; physico-chemical parameters

A B S T R A C T

The study was conducted to get an idea about the water quality of the Turag River in Dhaka and its temporal changes over post-monsoon, pre-monsoon and monsoon seasons due to change of physico-chemical parameters during the period from October 2011 to September 2012. The investigation demonstrated the present condition of the water quality of the Turag River that is highly polluted due to direct dumping of untreated city corporation and industrial wastewater. The contents of total nitrogen (N), phosphorus (P), alkalinity and hardness in the river water abnormally exceeded the permissible limit of the standard values (EQS, 1997) in all seasons where as the levels of pH, electric conductivity (EC), total dissolved solid (TDS) and cadmium (Cd) were highly exceeded the standard level in both post and pre monsoon season but in monsoon they were under the permissible limit in the Turag River. The lowest concentration of dissolved oxygen (DO) and higher concentration of biological oxygen demand (BOD) were observed that severely harmed the aquatic organisms and destroyed their habitat in the river. Temperature, the contents of potassium (K), sodium (Na) and copper (Cu) were within the standard level in all seasons. The comparative study showed that the water quality of the Turag River was highly degraded due to the presence of significant amount of pollutants discharged from Dhaka city. This deterioration not only affects the aquatic organisms but also worsely affects the entire ecosystem as well as the local people who depend on river water for their daily activities. To maintain the sound environment and healthy ecosystem of the river and the surrounding areas, need proper management and monitoring of water quality of the river.

Introduction

A river is a system comprising both the main course and the tributaries, carrying the one-way flow of a sediment load of matter in dissolved and particulate phases from both natural and anthropogenic sources (Shrestha and Kazama, 2007). The

river present a continuously renewable physical resource used for domestic, industrial, and agricultural purposes, as means foe waste disposal, transportation, getting food resources, and recreational activities (Rani *et al*., 2011). Bangladesh depends on its river system for such purposes as agriculture, navigation, sanitation, drainage, forestry, fishery and control of salinity. The ecosystem of the country is highly dependent on the river system and any upset in the supply of water in the system is sure to bring about changes in the living systems including people, flora and fauna (Alam, 2003). In Bangladesh, surface water fluctuations are very common in the rivers, as they vary on seasonal precipitation and remain dependant on the inflow from upland sources (Haque, 2008).

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 (Rabbani and Sharif, 2005). The increasing urbanization and industrialization of Bangladesh have negative implications for water quality where the industrial effluents directly dispose into the rivers without any consideration of the environment (BCAS, 2004). There has been a growing concern over the possible contamination of soils, sediments and water systems around many of the industrial areas of the countries (Chowdhury *et al*., 2007). Huge quantities of industrial effluents, solid waste from river-side settlements, petroleum products from ships, launches, cargoes, boats, untreated sewage etc. regularly get dumped into the Buriganga, Balu, Turag and Shitalakshya rivers, which are already severely polluted (Khan *et al*., 2007). The surface water along these peripheral rivers of Dhaka city is known to be highly polluted due to municipal and industrial untreated wastewaters that are discharged into these rivers (Kamal *et al*., 1999; Karn and Harada, 2001).

The Turag River is the upper tributary of the Buriganga, a major river in Bangladesh. Both organic and inorganic waste effluents that are discharged into the Turag River water adversely interacting with the river system and thus deteriorate the water quality of the river. For this reason, water causes the adverse effect of surrounding land and aquatic ecosystem as well as subsequent impact on the livelihood of the local community. The Turag River has been declared as ecologically critical areas (ECA) by the Department of Environment on September 2009 (DoE, 2009). As the fluvial environment of Bangladesh is mainly controlled by seasonal fluctuations, it is important to characterize the seasonal change for evaluating the temporal variations of water pollution (Bhuyan *et al*., 2010). In the study, the water quality parameters were investigated from the Turag River and compared with relevant standard levels to know the present status of the water quality of the river. The water quality parameters were compared among three seasons of the river to understand the temporal variations and their impacts throughout the year.

Materials and Methods

Study area

The study was conducted for a period of one year from October 2011 to September 2012 at the Turag River in Dhaka, Bangladesh. The Turag River is the upper tributary of the Buriganga River. The river originates from the Bangshi River, the latter an important tributary of the

Dhaleshwari River, flows through Gazipur and joins the Buriganga at Mirpur and the Tongi Khal links the Turag with the Balu River (Choudhury and Choudhury, 2004). The entire regime of the Turag River is almost a semi-funnel shaped basin and its catchment is located on the central and southern part of Madhupur tract and flows from north to south within the basin and its length is 40 miles and 15 miles in wide to the maximum. It has a total area of 386 square miles (Uddin, 2005).

Sample collection

At the Turag River, the water samples were collected from 5 sites of the river such as T-1 (Faydabad), T-2 (Tongi bridge), T-3 (Ashulia), T-4 (Berulia) and T-5 (Sunnirtake) during post-monsoon (October 2011 to January 2012), pre-monsoon (February to May, 2012) and monsoon (June to September, 2012) seasons, respectively. It was mentioned that each sampling sites were divided into three stations. To analyze the water quality, a 1000 ml of water was collected by plastic bottles with double stoppers from each sampling station. Samples were collected season wise between 9:30 and 11:30 am from the surface of the river. Before sampling, the bottles were cleaned and washed with detergent solution and treated with 5% nitric acid (HNO_3) over night. The bottles were finally rinsed with deionized water and dried. After sampling, the bottles were screwed carefully and marked with the respective identification number. Before analysis, the 50 ml and 250 ml water of each sample were preserved immediately with 0.1N hydrochloric acid (HCl) for Cd and Cu analysis, and alkaline potassium iodide (KOH+KI) for BOD analysis respectively.

Sample analysis

The water quality parameters such as temperature and pH were determined by the thermometer and digital pH meter (model-pH Scan WP 1, 2, Malaysia), respectively. Buffer solution containing pH 7.0 was used to calibrate the digital pH meter. Transparency was ascertained by Secchi disc method (Trivedy and Goel, 1984). Electric conductivity (EC) and total dissolved solids (TDS) were determined by digital EC meter and digital TDS meter (model-HM digital, Germany), respectively. Dissolve oxygen (DO) was determined by digital DO meter (model-D. 46974, Taiwan) where sodium thiosulphate (0.025N) was used as a reagent. Alkalinity was measured by titration method and the EDTA method was used to determine the hardness of water. The biological oxygen demand (BOD) was measured by two steps where initial BOD (BOD_1) was measured immediately after collection and after 5 days BOD (BOD_5) was measured by incubation in the dark condition at 20^0C for 5 days.

Then the total BOD (BOD_1 - BOD_5) was measured according to Trivedy and Goel (1984), and Huq and Alam (2005). The total nitrogen (N), phosphorus (P) and sulfur (S) were measured according to semimicro-kjeldahl method (a wet oxidation process), Olsen method/ sodium bicarbonate method and calcium chloride extraction method, respectively followed by Sattar and Rahman (1987). The sodium (Na) and potassium (K) concentration were measured according to ammonium acetate extraction method (Sattar and Rahman, 1987). Heavy metals such as cadmium (Cd) and copper (Cu) were measured by atomic absorption spectrophotometer (model-UNICAM 969, England).

Statistical analysis

The collected data were analyzed by using the software MS Excel, where the mean, standard deviation, significance of variance, standard error, etc. were calculated by MSTAT software.

Results and Discussion

Water temperature was found lower in the post-monsoon than that of monsoon and pre-monsoon season in the river and in most cases, it was just above 30˚C which was within the standard limit for uses of all purposes (Table 1). Rahman (1992) stated that the transparency of productive water bodies should be in 40 cm or less. Turag River water was within the standard limit and suitable for the fisheries in case of transparency (Table 1). The EC was ranged from 691-822, 618-1334 and 155-276 µs/cm in post-monsoon, pre-monsoon and monsoon season, respectively in the Turag River (Table 1) that showed their higher ionic conductance during post-monsoon and pre-monsoon due to discharge of huge quantities of electrolytes from industries and other sources. During monsoon EC showed sharp declination in the Turag River. This was due to huge dilution of the river water by the monsoon rainfall and upstream flow of water. The TDS is an important chemical parameter of water (Kabir *et al*., 2002).

The alarming condition of the Turag River water in case of TDS (Table 1) was observed which is detrimental for aquatic organisms. During pre-monsoon, the sampling sites T-1, T-2 and T-3 showed much higher TDS than T-4 and T-5 and during post-monsoon all the sites showed relatively similar value that exceeded the standard level (165 ppm). A positive relation was found between EC and TDS where the EC value increased with increasing the TDS concentration.

The investigated pH in Turag River among three seasons reflected its non-suitability for aquatic life and for all types of water uses especially in post-monsoon and pre-monsoon season (Table 2). Results of the study indicated that the water had a tendency to become acidic in post-monsoon and pre-monsoon, and again become alkaline in nature in monsoon season. This seasonal variation was due to dumping of waste effluents into the less water body in post-monsoon and pre-monsoon whereas the pollutants were diluted during monsoon because of heavy rainfall and upstream runoff of water. Adequate DO is necessary for good water quality, survival of aquatic organism and decomposition of waste by microorganism (Islam *et al*., 2010). The DO below 2 mg/l may lead to the death of most fishes in fresh water (EGIS II, 2002). From the investigation, it was observed that the DO content was much lower than the desired limit in Turag River (Table 2).

The mean concentration of DO along the river was 1.12, 0.87 and 5.75 mg/l during post-monsoon, pre-monsoon and monsoon, respectively which were detrimental for fisheries. When BOD level is high, DO level decrease because the oxygen available in the water is being consumed by the bacteria (Sawyer *et al*., 2003). The river Turag showed higher BOD concentration in all seasons due to the presence of comparatively more organic waste in the river water (Figure. 1). The investigation reflects that all the time throughout the year the Turag River water was polluted. Highly alkaline water contains high value of pH. The alkalinity of Turag River exceeded the standard level (>100 mg/l) in all seasons (Table 2).

Table.1 Physical parameters of water quality of the Turag River during post-monsoon, pre-monsoon and monsoon seasons

Para-meters	Sampling sites	Post-monsoon (Oct. - Jan.)		Pre-monsoon (Feb. - May)		Monsoon (Jun. - Sep.)		Standard
		Avg. (N=3)	R	Avg. (N=3)	R	Avg. (N=3)	R	
Temperature (°C)	T-1	17.4	16.8 - 18.4	30.67	29.2 - 33.0	32.87	30.5 - 35.7	20-30 (EQS, 1997)
	T-2	17.13		30.00		34.93		
	T-3	17.93		31.67		30.40		
	T-4	18.00		30.33		30.73		
	T-5	18.27		32.07		32.87		
	Mean±SD	17.75±0.46		30.95±1.20		32.36±1.77		
	SE	0.12		0.31		0.46		
	Sig.	**		**		*		
Transparency (cm)	T-1	18.27	15.5 - 23.0	12.08	10 - 24	17.25	15.5 - 20.0	40 or less (Rahma, 1992)
	T-2	21.67		11		16.17		
	T-3	16.00		T		16.67		
	T-4	17.50		23.50		18.00		
	T-5	17.67		10.62		19.75		
	Mean±SD	16.09±6.84		9.17±7.90		13.90±7.33		
	SE	1.76		2.04		1.89		
	Sig.	**		**		NS		
EC (µs/cm)	T-1	805	691 - 822	1206	618 - 1334	217	155 - 276	700 (EQS, 1997)
	T-2	752		1318		242		
	T-3	706		1052		156		
	T-4	699		843		159		
	T-5	718		794		185		
	Mean±SD	736.3±41.52		1056.1±238.99		193.1±36.16		
	SE	10.72		61.71		9.34		
	Sig.	**		**		**		
TDS (ppm)	T-1	441	370 - 457	670	449 - 763	94	83 - 116	165 (Huq and Alam, 2005)
	T-2	406		751		100		
	T-3	380		549		83		
	T-4	376		464		85		
	T-5	389		490		102		
	Mean±SD	398.9±25.63		584.9±125.98		93.1±10.01		
	SE	6.62		32.53		2.58		
	Sig.	**		**		NS		

Note: Avg. = Average, NI = Not Investigated, SD = Standard Deviation, SE = Standard Error, Sig. = Significance, ** = Significant at 1% level of probability (T-test), * = Significant at 5% level of probability (T-test), NS = Not Significant.

Table.2 Chemical parameters of water quality of the Turag River during post-monsoon, Pre-monsoon and monsoon seasons

Para-meters	Sampling Site	Post-monsoon (Oct. - Jan.)		Pre-monsoon (Feb. - May)		Monsoon (Jun. - Sep.)		Standard
		Avg. (N=3)	R	Avg. (N=3)	R	Avg. (N=3)	R	
pH	T-1	5.50	5.20 - 6.60	5.39	5.28 - 6.60	6.97	6.88 - 6.98	6.5-8.5 (Das, 1997)
	T-2	5.80		5.64		6.93		
	T-3	6.06		5.93		6.95		
	T-4	5.55		6.40		6.96		
	T-5	5.53		6.37		6.91		
	Mean±SD	5.69±0.33		5.95±0.42		6.94±0.03		
	SE	0.09		0.11		0.01		
	Sig.	NS		**		**		
DO (mg/l)	T-1	1.49	0.82 - 2.45	0.00	0.00 - 2.45	4.59	4.08 - 8.16	5.0 (EQS, 1997)
	T-2	0.82		0.00		5.98		
	T-3	0.82		2.45		5.57		
	T-4	1.09		1.63		6.53		
	T-5	1.36		1.09		5.51		
	Mean±SD	1.12±0.50		0.87±0.95		5.75±0.95		
	SE	0.13		0.25		0.24		
	Sig,	**		*		*		
Alkalinity (mg/l)	T-1	373.33	350 - 440	826.67	315 - 860	153.33	130 - 170	>100 (Rahman, 1992)
	T-2	373.33		643.33		156.67		
	T-3	420.00		670.00		133.33		
	T-4	416.67		338.33		143.33		
	T-5	436.67		426.67		163.33		
	Mean±SD	404.0±30.19		581.0±188.57		150.0±12.54		
	SE	7.79		48.69		3.24		
	Sig.	NS		**		NS		
Hardness (mg/l)	T-1	155.33	116 - 156	175.33	130 - 176	70.00	42 - 70	123 (Huq and Alam, 2005)
	T-2	136.67		168.67		65.33		
	T-3	128.67		158.00		59.33		
	T-4	118.67		140.67		140.67		
	T-5	122.67		132.00		44.33		
	Mean±SD	132.4±13.53		154.9±17.17		57.2±10.49		
	SE	3.49		4.43		2.71		
	Sig.	**		**		NS		

Note: Avg. = Average, NI = Not Investigated, SD = Standard Deviation, SE = Standard Error, Sig. = Significance, ** = Significant at 1% level of probability (T-test), * = Significant at 5% level of probability (T-test), NS = Not Significant.

During the pre-monsoon T-1, T-2 and T-3 showed more alkaline water in comparison of post-monsoon as well as all the sites during above both seasons showed about 3 fold higher alkaline water compared to monsoon. The hardness of Turag River exceeded the standard level (123 mg/l) in all sites during pre-monsoon and in some sites in post-monsoon and was not suitable for aquatic organisms as well as fisheries. All the sites during above both seasons showed about 2 fold higher hard water compared to monsoon. It could be due to dumping of municipal wastes, illegal drainage of industrial effluents, oil spillage from boats etc. with less flow of river water.

The excessive nitrogen can cause over-production of planktons and as they die and decompose they use the oxygen and therefore the DO content of water goes down and the oxygen dependent organisms finally died (EGIS II, 2002; Momtaz *et al*., 2010). The observed ranges of N were 8.4-16.8, 5.6-16.8, and 5.6-14 ppm during post-monsoon, pre-monsoon and monsoon, respectively in Turag River which were exceeded the standard limit of 1.0 ppm (ECR, 1997) and all the sites in all seasons showed 5-16 times higher concentration than the standard level. It could be due to municipal and industrial waste effluents, and agricultural practices along the river bank. The observed concentration of P was ranged from 0.10-0.64, 0.07-0.39, and 0.09-0.22 ppm during post-monsoon, pre-monsoon and monsoon, respectively in Turag River (Table 3) which was exceeded the standard limit of 0 ppm (ECR, 1997). The Na and K concentration were below the permissible limit in all seasons (Table 3). The concentration of S of the Turag River water at all sites were within the range of 1.69-3.73, 2.04-55.92, and 6.30-7.24 ppm during post-monsoon, pre-monsoon and monsoon, respectively. The sulphur concentration was much higher in monsoon than post-monsoon and pre-monsoon season where T-5 showed abnormality in pre-monsoon (Table 3).

The variations of heavy metal concentrations such as Cd in the Turag River water were mainly due to different collection spots and seasons (Figure 2). The mean concentration of Cd in the river water was ranges from 0.09-0.13, 0.15-0.20 and -0.04 to -0.10 mg/l during post-monsoon, pre-monsoon and monsoon season, respectively which exceeded the standard limit of 0.005 mg/l (ECR, 1997) in both post-monsoon and pre-monsoon but monsoon showed the satisfactory level. It could be due to the less flow of water with direct dumping of wastes. Monsoon received flash flow of rain water so that the concentration of Cd was lower in that season. Phosphoric fertilizers are widely regarded as being the most ubiquitous source of Cd contamination of agricultural soils. Paints and dyes are used for cloth manufacturing along the river (Islam *et al*., 2012). Ahmed *et al*. (2010) found the concentration of Cd in water of the Shitalakhya River that ranged from 7.12-10.11 µg/l, which was less similar with the present study. The collected surface water samples from the Turag River contained significant amount of Cu and ranged from 0.01-0.02, 0.02-0.03 and -0.27 to -0.21 mg/l during post-monsoon, pre-monsoon and monsoon season, respectively (Figure 3).All the sites during pre-monsoon showed relatively higher concentration than post-monsoon and the concentration of Cu in monsoon was negligible which were within the standard limit of 1.0 mg/l (ECR, 1997).

Table.3 The nutrients concentrations of the Turag River water during post-monsoon, pre-monsoon and monsoon seasons

Parameters	Sampling Site	Post-monsoon (Oct. - Jan.)		Pre-monsoon (Feb. - May)		Monsoon (Jun. - Sep.)		Standard
		Avg. (N=3)	R	Avg. (N=3)	R	Avg. (N=3)	R	
N (ppm)	T-1	11.2	8.4 - 16.8	16.8	5.6 - 16.8	11.2	5.6 - 14	1.0 (ECR, 1997)
	T-2	12.6		11.2		7.0		
	T-3	11.2		8.4		8.3		
	T-4	11.2		9.8		14.0		
	T-5	8.4		9.8		11.4		
	Mean±SD	10.92±2.78		11.20±3.73		10.37±2.72		
	SE	0.88		1.18		0.86		
	Sig.	NS		**		NS		
P (ppm)	T-1	0.43	0.10 - 0.64	0.22	0.07 - 0.39	0.15	0.09 - 0.22	0 (ECR, 1997)
	T-2	0.18		0.21		0.10		
	T-3	0.17		0.21		0.11		
	T-4	0.21		0.09		0.10		
	T-5	0.17		0.28		0.17		
	Mean±SD	0.231±0.15		0.202±0.09		0.126±0.04		
	SE	0.048		0.027		0.012		
	Sig.	NS		**		NS		
Na (ppm)	T-1	15.39	12.86 - 15.58	14.80	14.80 - 72.46	11.30	8.18 - 14.80	200 (ECR, 1997)
	T-2	15.39		16.56		11.10		
	T-3	14.02		15.97		8.76		
	T-4	13.44		16.75		9.15		
	T-5	14.41		72.26		13.83		
	Mean±SD	14.53±0.90		27.27±23.73		10.83±2.07		
	SE	0.28		7.50		0.65		
	Sig.	NS		*		**		
K (ppm)	T-1	3.72	3.22 - 3.83	3.02	2.01 - 12.08	3.39	3.08 - 4.11	12 (ECR, 1997)
	T-2	3.62		4.03		3.60		
	T-3	3.32		3.72		3.39		
	T-4	3.42		4.03		3.19		
	T-5	3.42		11.88		4.01		
	Mean±SD	3.50±0.17		5.33±3.50		3.52±0.31		
	SE	0.05		1.11		0.10		
	Sig.	NS		*		NS		
S (ppm)	T-1	2.36	1.69 - 3.73	2.67	2.04 - 55.92	6.57	6.30 - 7.24	-
	T-2	2.36		2.29		7.24		
	T-3	1.76		2.40		6.53		
	T-4	2.32		6.06		6.53		
	T-5	3.13		54.64		6.89		
	Mean±SD	2.39±0.54		13.61±21.69		6.76±0.35		
	SE	0.17		6.86		0.11		
	Sig.	NS		NS		**		

Note: Avg. = Average, NI = Not Investigated, SD = Standard Deviation, SE = Standard Error, Sig. = Significance, ** = Significant at 1% level of probability (T-test), * = Significant at 5% level of probability (T-test), NS = Not Significant.

Table.4 Comparison of water quality parameters between the Turag and the Dhaleshwari River with mean±standard deviation.

Para-meters	Turag River (Present study)			Dhaleshwari River (Islam *et al.*, 2012)		
	Post-monsoon	Pre-monsoon	Monsoon	Post-monsoon	Pre-monsoon	Monsoon
pH	5.69 ± 0.33	5.95 ± 0.42	6.94 ± 0.03	5.60 ± 0.14	5.33 ± 0.47	7.52 ± 0.07
EC (µs/cm)	736.3 ± 41.52	1056.1 ± 238.99	193.1 ± 36.16	437.6 ± 136.33	365.5 ± 10.6	155.2±22.83
TDS (ppm)	398.9 ± 25.63	584.9 ± 125.98	93.1 ± 10.01	236.4 ± 75.44	204.5±13.43	78.4 ± 9.71
DO (mg/l)	1.12 ± 0.50	0.87 ± 0.95	5.75 ± 0.95	6.4 ± 1.83	6.4 ± 0.19	6.6 ± 1.21
BOD (mg/l)	4.38 ± 3.57	7.49 ± 6.70	2.65 ± 2.46	-1.56 ± 2.56	-4.1 ± 0.38	-1.47 ± 1.78
Alkalinity (mg/l)	404.0 ± 30.19	581.0 ± 188.57	150.0 ± 12.54	404.6 ± 150.85	497 ± 131.52	151.6±20.71
Hardness (mg/l)	132.4 ± 13.53	154.9 ± 17.17	57.2 ± 10.49	32.0 ± 7.53	41.6 ± 3.39	50.1 ± 13.04
Cd (mg/l)	0.11 ± 0.02	0.18 ± 0.02	-0.03 ± 0.02	0.08 ± 0.02	0.11 ± 0.02	0.07 ± 0.01
Cu (mg/l)	0.02 ± 0.01	0.02 ± 0.01	-0.24 ± 0.02	0.01 ± 0.02	0.02 ± 0.06	0.01 ± 0.02
N (ppm)	10.92 ± 2.78	11.20 ± 3.73	10.37 ± 2.72	10.9 ± 1.53	9.1 ± 0.99	14.6 ± 5.29
P (ppm)	0.231 ± 0.15	0.202 ± 0.09	0.126 ± 0.04	0.15 ± 0.10	0.09 ± 0.01	0.12 ± 0.04
Na (ppm)	14.53 ± 0.90	27.27 ± 23.73	10.83 ± 2.07	14.59 ± 8.03	17.04 ± 0.68	5.69 ± 0.93
K (ppm)	3.50 ± 0.17	5.33 ± 3.50	3.52 ± 0.31	3.96 ± 0.78	4.73 ± 0.00	2.92 ± 0.74

Figure.1 The concentrations of BOD in the Turag River water among three seasons.

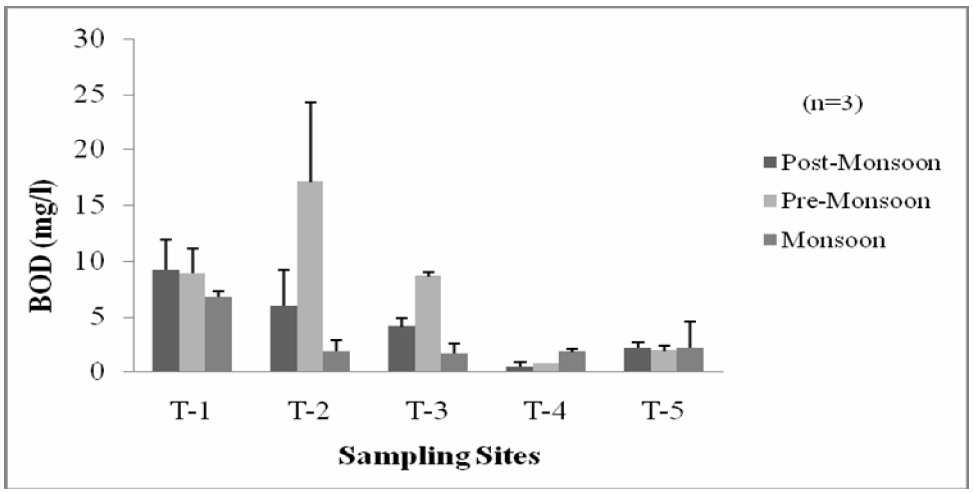


Figure.2 The concentrations of Cd in the Turag River water among three seasons.

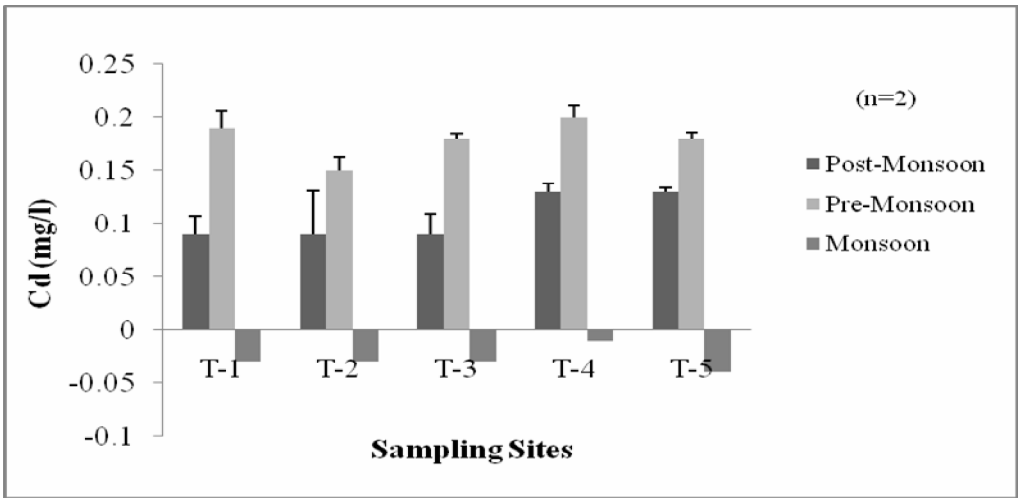
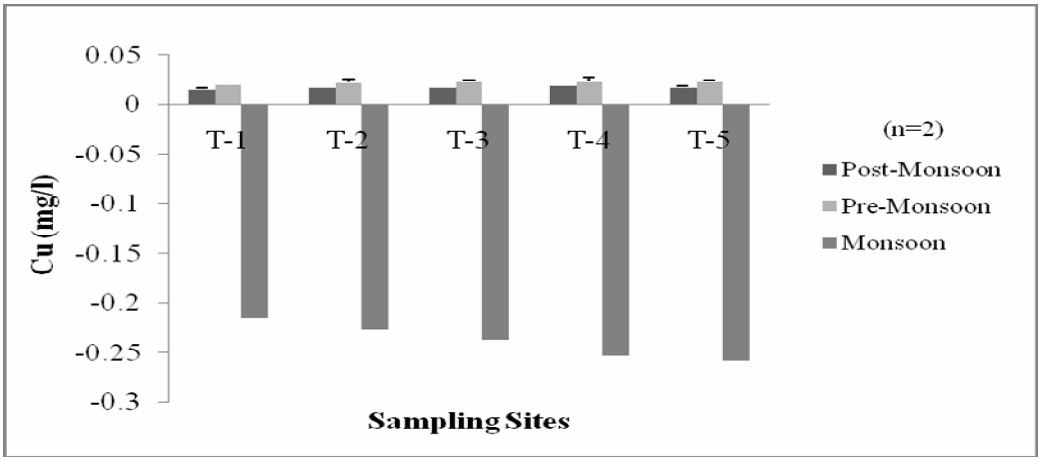


Figure.3 The concentrations of Cu in the Turag River water among three seasons.



In this respect, the river Turag was not polluted in terms of Cu concentrations. A study was conducted by Islam *et al*., (2012) to know the status of water quality in the Dhaleshwari River, and the results of the study showed that the concentrations of EC, DO, BOD, hardness, Na, K and Cu were within the standard limit as well as suitable for aquatic lives where as Turag River showed high pH, EC, TDS, BOD, hardness and Cd concentration, while it had low DO values which are threatened for aquatic organisms and their habitat (Table 4). The mean BOD values of Turag River water (post-monsoon 4.38 mg/l, pre-monsoon 7.49 mg/l and monsoon 2.65 mg/l) were higher than the Dhaleshwari River (post-monsoon -1.56 mg/l, pre-monsoon -4.1 mg/l and monsoon -1.47 mg/l). Alkalinity and Cd exceeded the standard level in all seasons as well as N and P also were exceeded the standard level in both Turag and Dhaleshwari River which made both of the river prone to eutrophication.

Water quality monitoring and assessment is the foundation of water quality

management; thus, there has been an increasing demand for monitoring water quality of the rivers by regular measurements of various water quality variables (Rani *et al*., 2011). In compliance to the objective of the study, water quality investigated from the Turag River which plays a vital role to facilitate the drainage of water from Dhaka city. The water quality of the river was affected by the industrial and agricultural activities in its vicinity and the water was characterized by high pH, EC, TDS, BOD, alkalinity, hardness and Cd concentration. The DO in the river was too low to endanger for aquatic lives during post-monsoon and pre-monsoon seasons. The excessive presence of N and P in Turag River could be due to dumping of municipal wastes and nutrients from induced fertilizers from agricultural lands along the river bank which ultimately made the river prone to eutrophication and resulted into degradation of water quality as well as the aquatic environment. It is alarming that the pollution concentration in the river is increasing sharply and can cause serious threat to the ecosystem. The investigation of COD, ammonium ion, nitrite, nitrate, phosphate, content of phytoplankton, zooplankton, microbiological parameters such as total coliforms and fecal coliforms were not possible due to insufficient laboratory facilities. In this regard, a similar study will be carried out in near future which will allow more precise assessment to get a clear idea about the aquatic environment of the rivers and for sustainable management of the river system. To recover the soundness of aquatic environment of the river, it is urgently needed regular monitoring of water quality to check and lessen the eutrophication and other problems, to ban to discharge the untreated industrial effluents and municipal wastes into the river, to ensure the control use of fertilizers and pesticides and to strictly practice the punishment system for land encroachers and polluters.

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