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ASSESSMENT OF SELECTED WATER QUALITY PARAMETERS OF TURAG RIVER IN DHAKA, BANGLADESH

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ABSTRACT

The Turag is a very important river of Dhaka city that is under considerable stress from anthropogenic activities. There is a dearth of reliable and up to date studies conducted on the water quality of Turag that have utilized standard methods for assessment of water quality parameters. This study looks at selected water quality parameters from samples collected from nine points along the length of Turag River during the monsoon season. Water quality parameters included in the study are pH, conductivity (µS), temperature (°C), and dissolved oxygen (mg/L), total dissolved solids (mg/L), chemical oxygen demand (mg/L), Cd (ppb), Cr (ppm) and Pb (ppb). All the samples tested contained Pb with highest concentration of 110.93 ppb at the National Zoo and the lowest value of 7.93 ppb at the Tongi area. Cr was found in two sites: the Tongi Ijtema Moydan and Tongi Bazar Bridge, while Cd was not detected in any of the samples. Tongi Ijtema Moydan also had the highest chemical oxygen demand (COD) value of 210 mg/L.

KEY WORDS : Water quality, Turag River, Dhaka, Lead, Chromium, Cadmium

INTRODUCTION

Dhaka is a city with one of the highest population densities in the world and its residents suffer due to many environmental issues (Rahman and Rabbani, 2007; Phillis *et al.,* 2017). The Turag River, in the northern part of Dhaka, is important as it serves as the primary waterway of the north-eastern part of the city - transporting people, commodities and agricultural produce (Fig. 1). Turag originates from the Bangshi River and joins the Buriganga river towards the south of Dhaka (Islam *et al.,* 2015). The banks of Turag consist of many unplanned and illegal establishments ranging from commercial buildings to industries of varying sizes and scales. There are extensive agricultural lands along sections of Turag's banks and the Bangladesh National Zoo is located along the river as well. The second largest annual international gathering of Muslims (Biswa Ijtema Pilgrimage) takes place on the banks of the Turag which also is a source of pollution at certain times of the year. What is of immediate concern from a pollution perspective is that along the length of the river, especially as it enters Dhaka from the north, there is residential, commercial and industrial effluent discharge into Turag (Rahman *et al.,* 2012). According to researchers, there are many industries along the bank of the river which includes garment industries, chemical industries, plastic recycling centers, etc. (Aktar and Moonajilin, 2017). An assortment of illegal and semi-legal minor industries and businesses are dotted along the banks of Turag River, many of which are innocuously housed

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within the residential, semi residential and temporary buildings and can contribute significantly to deterioration of river's water quality. There is also significant wastewater or sewage from residential complexes around these industrial areas which are released regularly into the river. Turag was declared as an ecologically critical area (ECA) on September 2009 by the Department of Environment, Government of Bangladesh (Hafizur *et al.*, 2017). Regular evaluation of water quality parameters of rivers is necessary to identify the source of pollution and determine the health of a river. There is no regular monitoring of water quality of Turag River, certainly not along the whole river. There are some studies in the literature on the water quality parameters of this river but most do not use standard methods of sampling and analysis or specify which location the measurements are taken. This makes it difficult to compare water quality parameters with other studies. More importantly, the studies frequently do not clarify in which season the measurements are taken. This is important because in a country like Bangladesh, where there is a lot of rain in the monsoon season, the concentrations of pollutants will naturally be diluted compared to the drier winter season. This study looked at the water quality of several significant and specific points along the Turag in the monsoon season to investigate the overall quality of river water and identify the pollution sources.

MATERIALS AND METHODS

Field measurements of water quality parameters were conducted in nine locations along the Turag river (Site 1 to Site 9), in a single day on July 2018 during the monsoon season. The GPS coordinates of each location was determined with the aid of a handheld GPS (GPS60, Garmin, USA). The pH, conductivity (µS), temperature (°C), dissolved oxygen (mg/L) and total dissolved solids (mg/L), were measured on location using a pre-calibrated hand-held multimeter analyzer (HQ40d Multimeter, Hach, USA), as per standard methods (Federation and Association, 2005). For laboratory testing, 1 liter of surface water samples were collected from each site, in polypropylene bottles, prewashed with distilled water and dried beforehand. Three drops of concentrated nitric acid (HNO_3; 70%) was added to bottle and they were labeled with pertinent information like date and sampling location. The samples were taken to the laboratory and preserved in refrigerator. In total, nine samples were collected and analyzed. Each parameter was measured three times and the mean value of the readings was taken. Chemical oxygen demand (COD) was measured via a Closed Reflux, Titrimetric Method (Federation and Association, 2005) and Pb, Cd and Cr were measured using Electrothermal Atomic Absorption Spectrometric Method (Federation and Association, 2005).

RESULTS AND DISCUSSIONS

The data obtained during the study is summarized in the Table below:

The standard value of DO for sustaining aquatic life in the river is 5 mg/L (Alam *et al.*, 2007). 5mg/

Table 1. Results of water quality parameters of Turag River

Site No.	Site name	pH	Temperature (^{0}C)	Conductivity (µs/cm)	TDS (mg/L)	DO (mg/L)	COD (mg/L)	Cd (ppb)	Cr (ppm)	Pb (ppb)
1	Amin Bazar	5.43	30.3	1110	710	3.75	40	< dl	< dl	14.49
2	Palpara Ghat	5.37	29.7	1096	701	3.77	160	< dl	< dl	80.96
3	Kaundia Ghat	5.24	29.8	1097	702	2.64	120	< dl	< dl	65.35
4	National Zoo	6.29	30.2	1109	710	4.11	120	< dl	< dl	110.93
5	Beruliya launch Ghat	6.74	30.1	1106	708	5.24	40	< dl	< dl	14.05
6	Rustompur Gudara Ghat	6.49	30.1	1105	707	5.43	40	< dl	< dl	8.51
7	Tongi	6.61	31	1124	719	4.31	40	< dl	< dl	7.93
8	Tongi Ijtema Moydan	6.94	30.1	1105	707	4.06	210	< dl	0.1	15.83
9	Tongi Bazar Bridge	7.03	29.9	1102	705	3.98	40	< dl	0.12	21.84
	Industrial effluent discharge values*	6-9	40	1200	-	4.5-8	200	500	0.1	100
	Drinking water#	6.5-8.5	20-30	-	1000	6	4	5	0.05	50

*ECR,1997 Schedule 10: Standards for discharge into inland surface water , (units reconciled)#ECR,1997 Schedule 3A&B: Standards for inland surface water and drinking water, (units reconciled)

L is also the standard value assigned for fish by the Environment Conservation Rules (ECR, 1997) of Bangladesh in case of usable water for fisheries. The average value of DO in this study was below the minimum requirement for aquatic life (4.14 mg/L), with Kaundia Ghat (Site 2) having lowest DO value of 2.64 mg/L which is unsuitable for most aquatic life. Industrial effluents from Tongi industrial area beside the Turag River and dumping of solid wastes into the Turag river water are the main reasons for lower DO value (Mobin *et al.,* 2014). COD values represent the contamination load in surface water (Rao *et al.,* 2001) and the obtained COD values in the Turag river indicates a high content of oxidizable organic and inorganic contaminants. COD for all location points exceeded Bangladesh standard for drinking water which is 4 mg/L (Rahman *et al.,* 2012). However, in eight location points the COD values are within the Environmental Quality Standard (EQS), set in the ECR (1997) that specifies wastewater from industrial units after treatment must have COD < 200 mg/L to be permissible for discharging into inland rivers. The exception is in Site 8: (Tongi Ijtema Moydan) where COD was 210 mg/L. The reason behind this high pollution is probably due to industrial effluents (dyeing, metal, pharmaceutical, etc. industries) and municipal wastes located around this point. Site 2 (Palpara Ghat) had the second highest COD (160 mg/L). The two major sources of pollution near this site are effluent from the sewers and discharge from a rice mills located nearby. The densely populated settlements near Palpara Ghat discharge both solid and liquid waste into the river, which might have contributed to the high COD value. Also, it is well known that wastewater from rice mill contains mainly dissolved carbohydrates and minerals that can cause a significant increase in COD values of the receiving waters. pH, temperature, conductivity and TDS of the samples collected are within or very close to the acceptable standards. This can be attributed to the fact that the samples were collected during the monsoon season, when large volumes of fresh rainwater fed into the river and significantly improved the water quality by diluting potential pollutants.

This study showed no cadmium (Cd) and very little chromium (Cr) in the samples. Cd is a common pollutant from industrial emissions and Cr is a common pollutant from the tannery industry. The absence of these metals may point to the notion that there are not a lot of emissions into this river from industry. Lead (Pb), however, was found in all the samples tested and it was unusually high in Site 4 (National Zoo). Sources of Pb in the environment include Pb in paint, fossil fuels like diesel or gasoline, car batteries and industrial waste. Until recently, automobile exhaust emissions were also a major source of Pb. We can speculate that the absence of Cd and Cr in Turag river points to either lack of significant industrial emission into the river or it could be due to the sample being collected during the rainy season - where all the metals were washed out with the rainwater. A previous study found that the in the high flow season (June to October) the heavy metal concentrations in water tend to be within the national standards, while in low flow season (January to May), the concentrations can exceed the standard limit by up to a thousand times (Rahman *et al.,* 2017). The presence of Pb in all the samples along the Turag River, could be due to leaching from the fossil fuels used by the small boats plying along the river. Legally, diesel oil, which is extensively used by these boats, can have a Pb content of up to 13 mg/L. More alarmingly, Pb could come from illegal manufacture or dumping of Pb acid batteries into the river by the numerous illegal establishments along the riverbanks. The abnormally high amount of Pb at the National Zoo is probably from the vehicle fuels as many vehicles in Bangladesh use Pb as anti-knocking agent in the fuels (Dhar and Rahman, 2003).

CONCLUSION

Some water quality parameters were measured in the Turag River and the COD levels were all found to be above the acceptable potable limit. The ubiquitous presence of significant Pb concentrations was found all throughout the Turag River which suggests the need for further study to pinpoint its contributory sources. It is reasonable to assume that the concentrations of pollutants in the river is diluted in the rainy season when sampling was done, compared to the drier, cooler winter season. This study showed that the pollution levels of several points along the Turag are alarmingly high even in the rainy season. The pollution levels will be even higher during the drier winter season and further studies need to be conducted then for comparative analysis.

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