A Study on Water Quality Monitoring and Seasonal Variation of Turag River

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Abstract

The escalating industrialization and urbanization in the northern part of Dhaka city have led to significant environmental degradation of the Turag River, manifesting through various forms of pollution. This study aims to delineate the adverse impacts of land use on the river's water quality, emphasizing the necessity of a comprehensive assessment to identify the pollution sources accurately. This study's primary goal is to evaluate the Water Quality Parameters and their potential influence on the Turag River's water's quality in terms of WQI. Ten parameters such as pH, TDS, TS, TSS, DO, BOD_5, COD, Iron, Alkalinity and Arsenic were analyzed. The analyzed parameters values are pH 7.40 to 8.61: Total Dissolve Solids 121.5 mg/l to 201.3 mg/l; Total Solids 249.5 mg/l to 400.9 mg/l; Total Suspended Solids 105.8 mg/l to 213.5 mg/l; DO 0.55 mg/l to 0.87 mg/l; BOD_5 1.41 mg/l to 1.51 mg/l; COD 25.4 mg/l to 78.7 mg/; Iron 0.10 mg/l; Alkalinity 84.4 mg/l to 150.7 mg/l and Arsenic 0 mg/l. The results of nearly each of the water quality parameters were higher above the ECR'23 standard limits and WHO but TDS, Iron and arsenic were within standards. Seasonal analysis indicated an alarming increase in pollutants from the wet to the dry season, underscoring the river's deteriorating condition. Consequently, the Water Quality Index (WQI) categorizes the river's water as unsafe for consumption, pointing towards an urgent need for targeted environmental management strategies.

Keywords: Water quality index, Assessment, Turag River, Season.

1. Introduction

Rivers are vital for the survival of all species and fulfill a diverse range of human needs, including hydropower generation, agricultural irrigation, industrial usage, drinking water supply, and recreation. The water quality of rivers can be significantly impacted, both immediately and over time, by discharges from stormwater, industrial wastewater, domestic sewage, and agricultural runoff. Routine monitoring of water bodies with an adequate number of water quality criteria is essential for preventing disease outbreaks and the emergence of hazards [1]. Furthermore, regular assessment of water quality parameters is crucial for maintaining the health of freshwater ecosystems [2].

The Turag passes through Dhaka and Gazipur city, especially to its northern inhabitants providing significantly to the local population's water needs. It rises from the Bangshi River, which is a significant tributary of the Dhaleshwari River. It passes through Gazipur and merges with the Buriganga near Mirpur in the Dhaka District [3]. The river itself has multiple canals that branches off of it in order to provide water to people living nearby and irrigable land. River water is utilized for bathing, washing, fisheries, poultry farms, feedstock and other activities. In rural Bangladesh, there is no entity in charge of managing solid garbage [4]. Management of solid waste in Turag River totally concur with that assertion. This River is the water body receiving most of the agricultural, urban and industrial discharges directly without any treatment. Therefore, it is still necessary for evaluating the river's water quality to see if it is suitable for various uses, such as irrigation, industries, leisure activities, etc., and whether or not the frequent consumption of this river's water is degrading its quality.

There were three distinct goals for this study: 1) to determine the values of the water quality parameters; 2) for comparison of the standards with ECR'23, WHO and represented in graphical form 3) using Water Quality Index to find out the overall level of water quality.

2. Methodology

2.1. Sample collection

For the execution of the objectives, ten potential locations were selected extends from Beribadh to Ashulia, Dhaka. The sites are given in the Table 1 below with their corresponding latitudes and longitudes. The methods that were used for water quality sampling and the parameters that were examined in Table 2. Water sample collection was done using bottles from each location. Before collecting the sample, the bottles were washed three times with local water. The next day, collected samples were sent to Uttara University's Environmental Engineering Laboratory, where several parameters were evaluated.

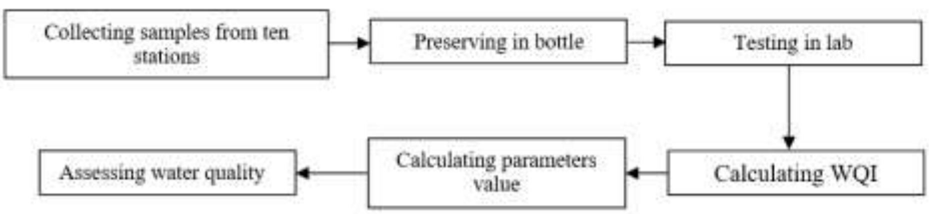
Table 1: Selected ten locations in Turag River

Location No.	Longitude	Latitude	Area
L1	23.917112	90.467734	Isthema field
L2	23.882053	90.404182	IUBAT
L3	23.897993	90.385506	Beribadh
L4	23.878545	90.352000	Slum area
L5	23.868578	90.312133	H. S. Jalal Hotel
L6	23.897479	90.318473	Fokir Bazar
L7	23.450598	90.328749	Cargo Center Ltd
L8	23.868585	90.348594	Cambrian University
L9	23.823488	90.335938	Ultra Washing Ltd
L10	23.898587	90.318474	Kathaldia Ghat

Table 2: Measurement methods of water parameters

Serial No.	Parameter	Unit	Measuring methods
1	pH	--	pH meter
2	TDS	mg/l	TDS meter
3	TS	mg/l	Gravimetric
4	TSS	mg/l	Gravimetric
5	DO	mg/l	DO meter
6	BOD_5	mg/l	Winkler and incubation
7	COD	mg/l	Winkler and incubation
8	Iron	mg/l	Reagents
9	Alkalinity	mg/l	Titration
10	Arsenic	mg/l	AAS

2.2. Methodology approach



2.3. Weighted arithmetic water quality index

The Weighted Arithmetic Water Quality Index Method is widely used to assess whether water is fit for human consumption. This approach is highly helpful for interacting with the general public and decision-makers.

2.3.1 WQI calculation

The overall WQI is calculated from the equation 1 is as follows:

$$WQI = \frac{Q_i W_i}{W_i} \tag{1}$$

Where, Q_i is calculated from the equation 2.

$$Q_i = 100 * \left(\frac{V_i - V_o}{S_i - V_o} \right) \tag{2}$$

Here: Q_i = ith parameter of quality rating scale, V_i = Estimated value of ith parameter in the sample, S_i = Standard value for ith parameter, V_o = Ideal value of the ith parameter in the pure water. Here, ideal value, V_o is taken for all as zero except for pH = 7.0 and DO = 14.6 mg/L.

The unit weight (W_i) is calculated from the equation 3.

$$W_i = \frac{K}{S_i} \tag{3}$$

Here, W_i = Unit weight for ith parameter, K = proportionality constant = $\sum \frac{1}{S_i}$

Table 3: Water quality is classified by WQI index according to weighted arithmetic method [5], [6]

WQI	Quality	Grading	Possible usage
0-25	Excellent Water Quality	A	Drinking, irrigation and industrial usage
26-50	Good Water Quality	B	Drinking, irrigation and industrial usage
51-75	Poor Water Quality	C	Irrigation and industrial usage
76-100	Very poor Water Quality	D	Irrigation
Above 100	Unsuitable for drinking purpose and fish culture	E	Proper treatment is necessary before any usage

3. Result and Discussion

3.1 Seasonal Variation of Different Parameters

Sessional variation of temperature, pH, TS, TDS, TSS, DO, BOD_5, COD, Iron, Alkalinity, Arsenic respectively has been shown in Table 4. September to October has been taken as wet season and November to December as dry season.

Table 4: The value of different parameters of Turag River

Parameter	Unit	ECR'23 standard	WHO'2006 standard	Wet season		Dry season	
				Sep 22	Oct 22	Nov 22	Dec 22
pH	--	6.5-8.5	6.5-8.5	7.40	7.90	8.13	8.61
TDS	mg/l	1000	1000	121.5	145.1	215.8	201.3
TS	mg/l	-	-	249.5	284.5	309.5	400.9
TSS	mg/l	10	10	128.1	138.4	105.8	213.5
DO	mg/l	≥6	5	0.55	0.73	0.80	0.87
BOD_5	mg/l	≤2	5	1.42	1.41	1.51	1.42
COD	mg/l	10	-	25.4	70.0	73.9	78.7
Iron	mg/l	0.3-1	0.1-1	0.10	0.10	0.10	0.10
Alkalinity	mg/l	-	120	84.4	95.5	150.7	87.8
Arsenic	mg/l	0.05	0.01	0	0	0	0

The average value of pH is increased from 7.40 to 8.61 in September to December is shown in fig.1. In the month of December (dry season) the pH value crossed the ECR'23 standard limit (6.5-8.5).

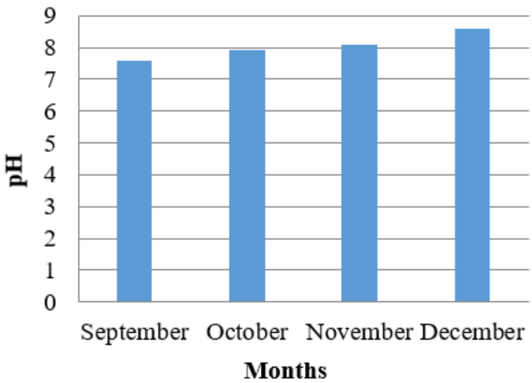


Fig. 1: Variations of pH

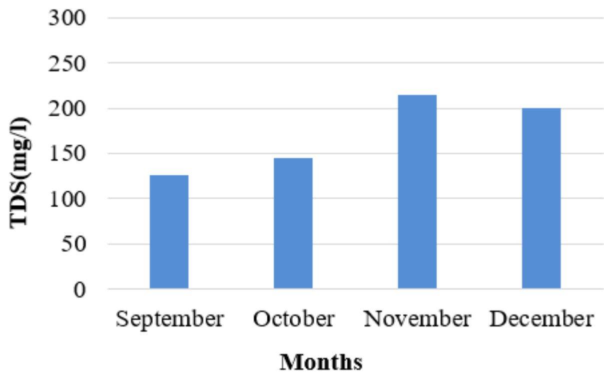


Fig. 2: Variations of TDS

The value of the Total Dissolved Solids during the entire study period ranges from 121.5 mg/l to 215.8 mg/l is shown in fig.2. All the values of TDS for each month are within ECR'23 (1000 mg/l) standard limit of drinking water. TDS value is increased from September (wet season) to November but is little decreased in December (dry season).

The value of the Total Solids during is increased from 249.5 mg/l to 400.9 mg/l is shown in fig.3. From September to December, TS values are increased because water level is decreased. Highest value is found in December (dry season) in which water level is minimum level.

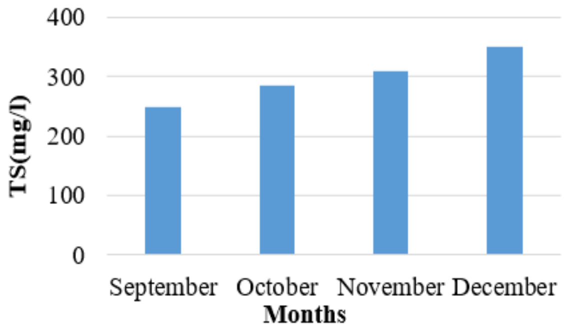


Fig. 3: Variations of TS

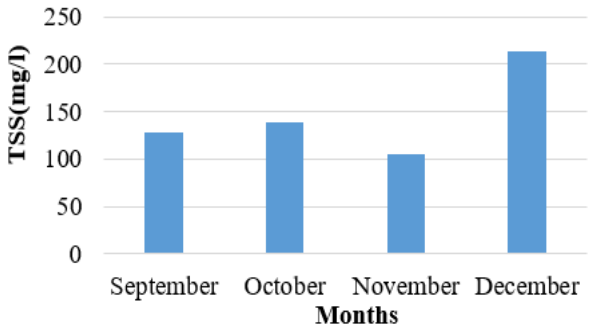


Fig. 4: Variations of TSS

The values of Total Suspended Solids for the river ranges from 105.8 mg/l to 213.5 mg/l is shown in fig.4. There are the increased of TSS values in December (dry season) compared to previous months which is crossed the ECR'23 standard limit (10mg/l).

The DO value ranges from 0.55 mg/l to 0.87 mg/l is shown in fig.5 which is very minimum value according to ECR'23 (≥6mg/l).

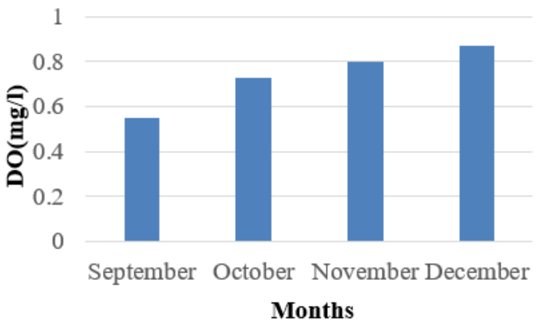


Fig. 5: Variations of DO

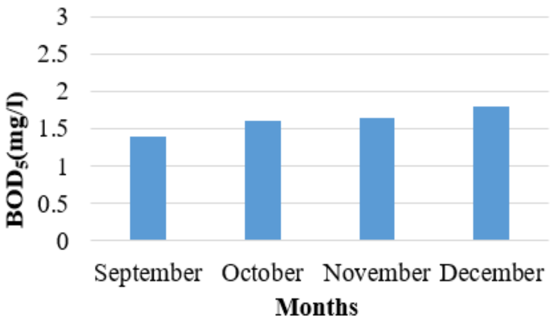


Fig. 6: Variations of BOD_5

The value of Biochemical Oxygen Demand of Turag River water was observed. The BOD_5 value ranges from 1.41 mg/l to 1.51 mg/L from September (wet season) to December (dry season) which are crossed the ECR'23 standard limit (2mg/l). The variation of BOD_5 is shown in fig.6.

The values of COD ranges from 25.4 mg/l to 78.7 mg/l is shown in fig.7. The COD values are increased from September (wet season) to December (dry season) and crossed the ECR'23 standard limit (10mg/l).

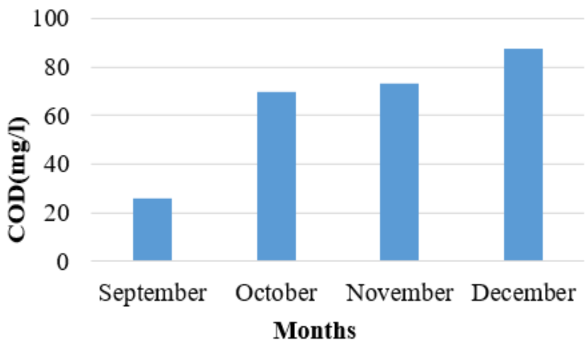


Fig. 7: Variations of COD

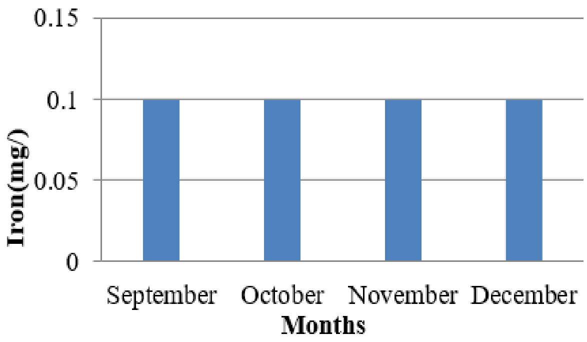


Fig. 8: Variations of Iron

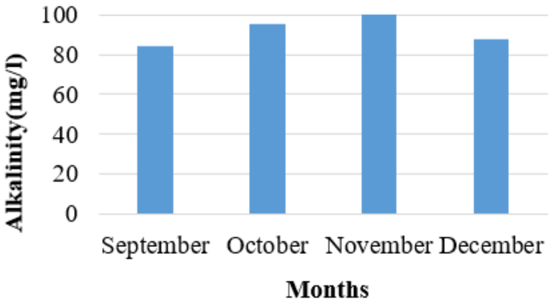


Fig. 9: Variations of Alkalinity

The value of iron of this river does not change throughout the four months which is 0.1mg/l and within standard limit shown in fig.8.

The value of alkalinity ranges from 84.4 mg/l to 150.7 mg/l to shown in fig.9. In November (dry season) the alkalinity value is crossed the WHO standard limit (120 mg/l).

This study shows Arsenic-free surface water

3.2 WQI by Arithmetic Method

Total nine parameters are used for figuring out water quality index. They are: pH, TDS, TSS, DO, BOD_5, COD, Iron, Alkalinity and arsenic [7] is shown in Table 5.

Table 5: WQI variation in different seasons.

Month	WQI	Grading	Category
September	145.57	E	Unsuitable for drinking purpose
October	156.25	E	Unsuitable for drinking purpose
November	165.33	E	Unsuitable for drinking purpose
December	162.05	E	Unsuitable for drinking purpose

The WQI values are found same throughout the two seasons. The WQI grading is E which unsuitable for drinking purpose shown in Fig.10.

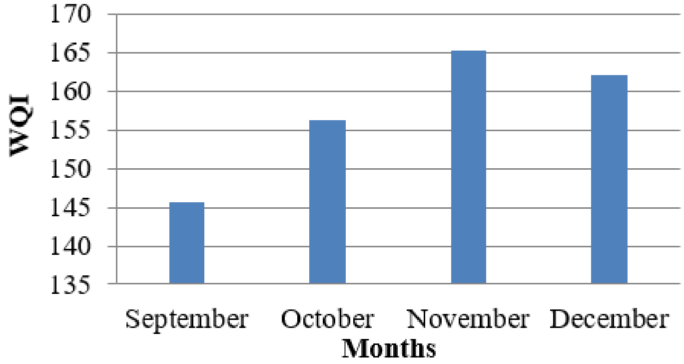


Fig. 10: Variations of WQI values

4. Conclusion

The major outcomes from this research are:

i. Nearly all WQI results were higher than the standards limit. DO levels were significantly lower and unhealthy for aquatic life.

ii. pH, TS, TSS, BOD_5, COD, and Alkalinity values were significantly greater than the typical ECR'23 and WHO'2006 Standards.

iii. TDS and Iron value were found within standard limit and the river was arsenic free water source.

iv. According to WQI values, this river's water is unfit for humans to drink. However, using it for industrial or irrigational purposes does not require any treatment.

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