IUBAT Review
A Multidisciplinary Academic Journal

Md Monirul Islam, Selina Nargis, Mahfuzur Rahman & Md Rayhan Ahamed. 2021. **"Determination of Pollutant of River Turag Coming from Surrounding Industries"** *IUBAT Review* 4 (1): 1-9. iubat.net/journal/

Determination of Pollutant of River Turag Coming from Surrounding Industries

Md Monirul Islam[1]*, Selina Nargis[2], Mahfuzur Rahman[1], Md Rayhan Ahamed[1],

[1]Department of Civil Engineering, International University of Business Agriculture and Technology (IUBAT), Dhaka 1230, Bangladesh
[2]Department of Psychology, International University of Business Agriculture and Technology (IUBAT). Dhaka 1230, Bangladesh.

*Corresponding author, E-mail: mmislam@iubat.edu

ABSTRACT: *The study deals with assessing water quality parameters including pH, total dissolved solids (TDS), dissolved oxygen (DO), biological oxygen demand (BOD), temperature, transparency, hardness, and turbidity of the Turag River in Tongi, Gazipur, Bangladesh based on the standards of the Department of Environment (DoE) in Bangladesh, the Department of Public Health Engineering (DPHE), and the World Health Organization (WHO). The physicochemical parameters of water were investigated for nine stations (S1 to S9) in the Turag River through laboratory experiments considering three different sources, i.e., discharge point (DP), contamination point (CP), and midpoint (MP). The average pH values ranged between 6.44 and 7.76, indicating that all values were within the standard limits (pH=6.5 to 8.5) for aquatic creatures for all stations except S7 (pHCP=6.44). The average values of TDS were 0.31~0.90 ppm, which reveals a low TDS condition. The average values of DO were 3.79 to 6.49 ppm, indicating a low DO value from the standard level (4.0 to 6.0 ppm for domestic and 5.0 ppm for fish culture) for all stations excluding S1 (CP). The values of BOD were between 18.98 and 50.81 ppm, indicating a higher condition than the expected value of BOD (6.0 ppm for fish culture and 10.0 ppm for irrigation). The temperatures of water varied from 26.28 to 32.19ºC, indicating standard temperatures (20 to 30ºC) for aquatic creatures except for S2 (DP, CP, and MP), S3, S7 (DP and CP), S5 (DP), and S6 (DP). The average transparency values maintained the standard limits (≤15.75 inches) for aquatic organisms. The hardness values were 26.0~214.04 ppm, indicating without S1, S2, S3 (DP and CP), S7 (DP) under the acceptable limits. Finally, the turbidity values indicate a higher condition than the standard limit (10 NTU, Nephelometric turbidity units). According to the investigation, the water quality of the Turag River mostly exceeds acceptable limits. It is, therefore, urging water managers to do constant monitoring to reduce the level of pollution of the Turag River.*

KEYWORDS: *Water Quality; physicochemical parameters; aquatic; pollution; Turag River*

1. Introduction

Water quality is inextricably linked to public health, ecological sustainability, and regional societal benchmarks. It is believed that poor drinking water quality causes eighty% of all illnesses worldwide (Mukherjee and Singh, 2022). Clean water shortage is and will continue to be a major worldwide concern in the years ahead. According to United Nations, approximately 7.7 billion people are currently experiencing water scarcity which is expected to increase ~34% by 2050 (Mukherjee and Singh, 2022). In addition, water quality worsens daily due to various natural and anthropogenic reasons, i.e., hydrogeochemical phenomena, uncontrolled discharge of industrial effluent, agricultural wastes, etc. It is vital to employ proper river water management strategies, including extensive monitoring and quality assessment procedures, in order to sustainably preserve water quality.

Numerous industrial facilities in Bangladesh are built next to rivers or other waterways. Industrial wastewater is dumped into rivers directly or indirectly, contaminating surface water (Rahman et al., 2021). Over the last several decades, both urban solid waste and industrial effluents have significantly harmed Bangladesh's river water quality (Uddin and Jeong, 2021).

The Turag River is a river that flows through Dhaka, the capital city of Bangladesh. Current environmental and water pollution concerns along this river have resulted in a biological and hydrological impasse, which has caused it to become a significant source of pollution. A wide variety of industries have sprung up along the banks of this river, including petrochemical plants, tanneries, textile mills, and rubber and cotton mills. In addition, the Turag River's physiochemical characteristics and heavy metal content exceed the acceptable value, causing skin, diarrhea, dysentery, respiratory ailments, anemia, and birth difficulties. Besides, public health is harmed by odor pollution and respiratory diseases. Necessary steps should be taken to reduce pollution. Numerous prior researches have used statistical approaches to determine seasonal fluctuation in surface water quality over time in water quality metrics and physicochemical rates (Islam et al., 2019;

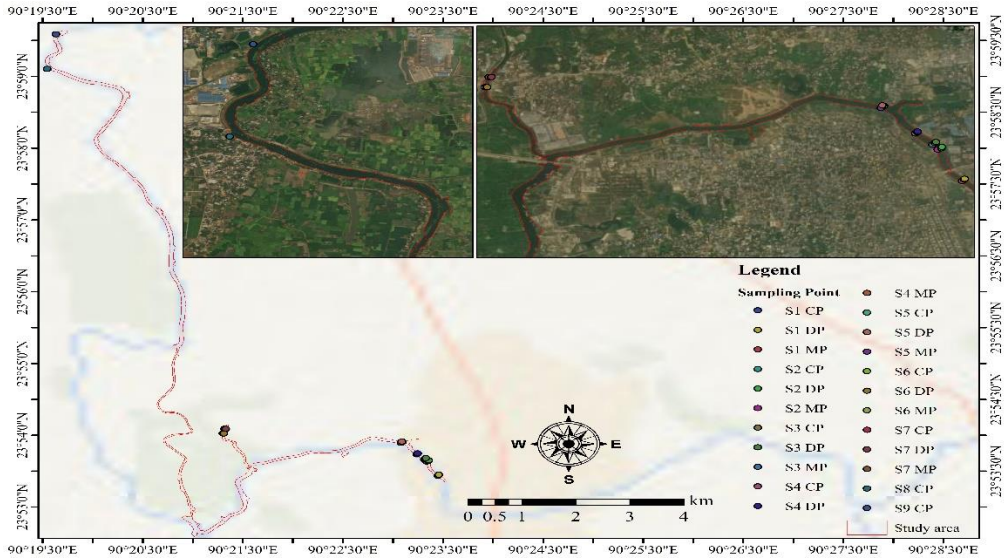

Figure 1. Sampling point (point source) adjacent to the IUBAT Boundary

Rahman et al., 2021; Tahmina et al., 2018). Water quality data must be updated often due to continual fluctuation in water quality. Therefore, the research aimed to determine the water quality state of the Turag River as a result of industrial effluent discharge.

Figure 2. Field scenario and sample collection.

2. Materials and methods

2.1 Study area

The study areas were situated at various points along the Turag River (Fig. 1). In Turag, samples were collected on Ijtema Road, Tongi (23.89º N and 90.39º E); Nishatnagar, Gazipur, Tongi Bypass Road (23.89º N and 90.38º E); Abdullahpur Highway (23.90º N and 90.39º E); 120/5 Squibb Road (23.90º N and 90.38º E); Bakrail Bridge, Bhadam Road (23.90º N and 90.36º E); ZiraniKashimpur Road, Kashimpur (23.98º N and 90.33º E); and Jarun, Konabari (23.99º N and 90.33º E).

2.2 Sample collection and data analysis

A comprehensive range of physicochemical parameters like temperature, dissolved oxygen (DO), and pH, turbidity, total dissolved solids (TDS), biochemical oxygen demand (BOD), transparency, and hardness was measured to assess the inland surface water quality in the Turag River.

Three water samples were collected from each of the stations of the Turag River. Sampling was done in 500ml plastic bottles (Fig. 2). The bottles were cleaned with distilled water before they were used to sample collection. All of the samples were collected via grab sampling. Immediately

after sampling, the bottles were sealed and carefully labelled to ensure that they could be identified. The pH parameters were measured using a pocket-type pH meter; TDS was measured using a TDS meter; DO and BOD values were checked by titration; temperatures were measured by thermometer; transparency was checked by Secchi disk; total hardness value measured by EDTA titration; turbidity was measured by turbidity meter.

During sample collection, it was observed that all forms of trash, including solid, liquid, and chemical, are dumped into the Turag River by the surrounding residents (Fig. 2). Pollute the Turag River with a complex combination of toxic organic and inorganic substances from industries and domestic garbage. The water level drops, and the water quality deteriorates throughout the dry season with minimal flows.

3. Result and Discussion:

We have collected data from April 2019 to March 2020. At first, we collected samples from station 1, station 2, and station 3. After October 2019, we increased our number of stations (4,5,6,7,8, and 9). In station 1, from June 2019 to October 2019, we could not collect samples because there was a rainy season. In rainy season outlet of the disposal from industry goes to under the river water. So, we could not collect the disposal sample for station 1. According to our experiment, the results are described as follows:

pH value without station 3 MP (November 2019), station 4 CP (December 2019 and January 2020), station 5 DP (December 2019), station 7 DP (December 2019), CP (January 2020 to March 2020), station 8 CP (December 2019, February 2020 and March 2020) all station were accepted level (Table 1). Surface water systems often exhibit the pH range of 6.5 to 8.5, that is ideal for irrigation and fish farming (DoE, 1997a, b). TDS values are under the standard level; that is why all values are suitable for aquatic lives. However, the TDS values are not appropriate for drinking purposes because they exceeded the standard. According to Rahman et al. (2021) and Aktar and Moonajilin (2017), TDS values in the Turag River range between 519 to 783 mg/L. DO values were comparatively higher than the standard level, which was also in the accepted level. But station 1 in CP (November 2019, February 2020, and March 2020) and station 3 in DP (May 2019) are comparatively less than the standard level, which is not accepted. BOD value for all stations were very high, which are fallen unacceptable level. Aktar and Moonajilin (2017) and Ahmed et al. (2016) refer to BOD values between 13 to 73 mg/L, while in this study, the mean maximum value is 48.1 mg/L. The BOD level shows the presence of an excessive number of bacteria/microorganisms in the water, which might be the result of industrial and household wastewater that depleted the DO in the river water, resulting in an increased the BOD (Hasan et al., 2019). The mean temperature of the water samples taken from the three points fell within a reasonable range (26.28 to 32.19ºC). Temperature value for station 1 MP (November 2019), station 2 DP (April 2019 to June 2019, August 2019 to November 2019 and February 2020), CP (April 2019 to June 2019, August 2019 to October 2019, and February 2020), and MP (May 2019, July 2019, August 2019 and February 2020), station 3 DP (May 2019 to October 2019), CP (April 2019 to October 2019) and MP (July 2019, Auguest 2019, October 2019 and November 2019), station 4 DP (November 2019), MP (December 2019), station 5 DP (December 2019 and February 2020), CP (December 2019) and MP (November 2019), station 6 DP (December 2019 and March 2020) and MP (November 2019), station 7 DP (December

Table 1. Comparison of water quality parameters with standards based on different source points and stations (DoE, 1997a, b; Huq and Alam, 2005; Rahman, 1992).

Parameter	Standard guideline	DP							CP									MP						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7
Temp. (ºC)	20 to 30	√	×	√	√	√	×	×	√	×	×	√	√	√	×	√	√	√	√	√	√	√	√	√
pH	6.5 to 8.5	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
DO (mg/L)	4 to 6	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	×	√	√	√	√	√	√
BOD (mg/L)	6.0	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
TDS (ppt)	1.00	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
TT (NTU)	10.0	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
TH (mg/L)	123	×	×	×	√	√	√	×	×	×	×	√	√	√	√	√	√	√	√	√	√	√	√	√
TS (in.)	40								√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

2019 and February 2020), CP (January 2020 to March 2020) and station 9 CP (December 2019) are not accepted because this value is more than the standard value, but others are accepted. Transparency value for all stations was accepted. Total hardness value for station 1 MP (April 2019 to May 2019 and January 2020 to March 2020), station 2 DP (September 2019), CP (June 2019 to December 2019), MP, station 3 CP (May 2019 to December 2019), MP, station 4 DP, CP (November 2019 and January 2020 to March 2020), MP, station 5 DP (November 2019 and January 2020), CP, MP, station 6, station 7, CP, MP, station 8 and station 9 are under the standard value. But the value of the others of hardness was comparatively higher than the standard value. Turbidity value for station 2 DP (January 2020), and station 3 DP (April 2019 to May 2019 and January 2020 to March 2020), CP (January 2020 to March 2020) are under the standard value. But the value of the other turbidity was comparatively higher than the standard value. pH values were not acceptable to limit during the Estima without station 1 and station 2 DP (before Estima 2020 and after 1st Estima 2020, Table 2). During the Estima, all TDS values were accepted level. During the Estima without station 1 and station, 2 DP all DO values were not accepted. During the Estima BOD value for all points of our selected 3 stations were very high, which is unacceptable. During the Estima, temperature value without station 2 CP (before Estima 2020 and after 1st Estima 2020), station 3 DP (after 2nd Estima 2020) and CP all were accepted. During the Estima, transparency value for all stations were accepted (Table 2). During, the Estima, total hardness value without station 1 MP (after 1st Estima 2020 and after 2nd Estima 2020) and station 3 MP (after 1st Estima 2020 and after 2nd Estima 2020) are comparatively higher than the standard value. During the Estima, all Turbidity values were relatively higher than the

Table 2. Parameter's value during the Estima time (TDS, total dissolved solids; DO, dissolved oxygen; BOD, biological oxygen demand; Tem., temperature; TS, transparency; TH, total hardness; and TT, turbidity).

Station	Point	Time	pH	TDS (ppt)	DO (mg/L)	BOD (mg/L)	Tem. (^{0}C)	TS (in.)	TH (mg/L)	TT (NTU)
1 (Lat.: 23.8906; Long.:90.3908)	DP	Before Estema,2020	7.30	0.49	4.20	28.72	27.00		187.00	30.12
		After 1st Estema,2020	7.50	0.40	4.40	31.41	26.00		181.00	36.52
		After 2nd Estema,2020	7.60	0.38	4.90	32.00	27.00		170.00	42.14
	CP	Before Estema,2020	7.70	0.45	4.90	35.00	23.00	2.80	191.00	30.00
		After 1st Estema,2020	7.90	0.41	5.20	38.50	21.00	2.50	163.00	39.70
		After 2nd Estema,2020	8.00	0.34	5.60	42.00	20.00	1.50	132.00	53.11
	MP	Before Estema,2020	7.00	0.43	4.21	28.21	27.00	3.70	144.00	30.48
		After 1st Estema,2020	7.40	0.40	4.80	31.30	26.00	2.90	118.00	38.39
		After 2nd Estema,2020	7.20	0.37	5.10	33.00	25.00	2.00	96.00	40.35
2 (Lat.: 23.8941; Long.: 90.3892)	DP	Before Estema,2020	7.40	0.61	4.90	77.51	29.00		195.00	22.87
		After 1st Estema,2020	7.60	0.57	5.20	80.05	28.00		178.00	26.32
		After 2nd Estema,2020	6.67	0.64	4.50	79.60	30.00		191.00	22.26
	CP	Before Estema,2020	5.30	0.68	3.60	54.41	32.00	5.00	197.00	34.38
		After 1st Estema,2020	5.20	0.61	3.20	53.12	33.00	4.40	173.00	38.57
		After 2nd Estema,2020	5.78	0.74	3.80	57.00	28.00	4.60	224.00	28.08
	MP	Before Estema,2020	5.10	0.52	3.10	40.40	29.00	5.90	195.00	34.12
		After 1st Estema,2020	5.30	0.50	3.80	42.10	28.00	4.70	131.00	45.66
		After 2nd Estema,2020	5.19	0.72	3.60	41.60	30.00	5.20	178.00	34.75
3 (Lat.: 23.8947; Long.: 90.3888)	DP	Before Estema,2020	6.30	0.79	4.12	44.13	27.00		287.00	11.25
		After 1st Estema,2020	5.50	0.63	3.91	41.57	30.00		250.00	16.12
		After 2nd Estema,2020	5.30	0.66	3.70	39.50	31.00		265.00	13.34
	CP	Before Estema,2020	6.10	0.38	4.20	31.68	31.00	3.10	193.00	39.07
		After 1st Estema,2020	5.30	0.32	3.80	28.94	32.00	2.70	148.00	45.38
		After 2nd Estema,2020	5.40	0.55	3.50	26.50	31.00	2.70	220.00	42.66
	MP	Before Estema,2020	6.21	0.36	3.97	47.19	28.00	4.10	152.00	31.24
		After 1st Estema,2020	5.40	0.29	3.60	46.97	30.00	3.60	87.00	38.48
		After 2nd Estema,2020	5.52	0.32	3.90	53.00	27.00	3.70	108.00	31.40
	Average		6.38	0.50	4.21	43.90	28.00	3.62	176.07	33.21

Table 3. Mean values of multiple parameters based on latitude and longitude in all stations (Long., longitude; Lat., latitude; TDS, total dissolved solids; DO, dissolved oxygen; BOD, biological oxygen demand; Tem., temperature; TS, transparency; TH, hardness; and TT, turbidity).

Long. (º)	90.3908	90.3892	90.3888	90.3872	90.3847	90.355	90.3553	90.3909	90.3892	90.3888	90.3874
Lat. (º)	23.8906	23.8941	23.8947	23.8956	23.8983	23.9004	23.9015	23.8908	23.8940	23.8946	23.8957
Tem. (ºC)	28.25	29.21	28.68	28.36	27.19	27.38	26.45	27.23	30.15	30.15	27.02
pH	7.05	7.48	7.30	7.09	7.15	7.17	7.07	7.00	7.46	7.40	6.54
DO (mg/L)	3.61	5.09	4.32	4.68	5.99	5.89	4.95	4.00	5.49	5.04	4.09
BOD (mg/L	25.88	32.35	35.68	39.81	39.06	33.28	38.97	27.57	44.92	29.2	48.1
TDS (ppt)	0.45	0.44	0.39	0.46	0.43	0.57	0.67	0.46	0.49	0.42	0.43
TT (NTU)	31.01	43.19	37	35.01	24.57	29.54	31.26	30.03	43.52	19.05	50.38
TH (mg/L)	100.25	34.21	68.65	72.94	61.63	61.38	45.38	191.36	137.29	135.35	102.19
TS (in.)	4.93	6.93	6.10	6.34	6.63	5.40	5.29	4.03	6.81	5.10	3.78

Note: Green shaded cells indicate the water quality parameters are an acceptable limit and red cells show parameters did not meet the standard

standard value. Further Table 3 presents the average parameter value for all stations.

Fig. 3 shows the Pearson's correlation coefficients of all water quality parameters. The temperature had a negative correlation with turbidity (TT) and transparency (TS) (-0.07 and -0.17). The temperature does not seem to have any significant association with the other water quality parameters. pH negatively correlated with TDS and TT (-0.17 and -0.17). Except for turbidity and total hardness, DO had a positive relationship with all other parameters. For instance, DO showed a statistically significant positive relationship with pH (0.41) and transparency (0.32). BOD and TS showed a negative correlation (-0.14) and a weak positive correlation with other parameters (0.10~0.26). TDS was negatively correlated with pH (-0.17), TH (-0.15), and TS (-0.34), and positive relation was observed with TT (0.55). TT positively associated with BOD (0.10), TDS (0.55), and TS (0.05) and negatively correlated with other parameters. TH showed a negative correlation with DO (-0.04), TDS (-0.15), TT (-0.41), and TS (-0.41) and a weakly positive relation with temperature (0.27), pH (0.12), and BOD (0.23). There was no significant positive or negative correlation observed between TS and other water quality parameters. According to the findings in this study, none of the parameters was highly correlated.

4. Conclusion

Turag River is an upper tributary river of the Buriganga river flowing beside Dhaka city.

This study was aimed to conduct assessing the physicochemical parameters of the Turag River water. According to the results, the physicochemical parameters indicate that river water quality is not suitable for aquatic life. Effective measures should be taken to reduce the level of pollution of the Turag River water. An effluent treatment plant (ETP) and a low-cost water treatment process should be developed, and the local authority must take appropriate measures to protect river water. In addition, it is necessary to manage residential and industrial wastes properly to reduce the buildup of pollutants in the Turag River and limit the destruction of the ecosystem.

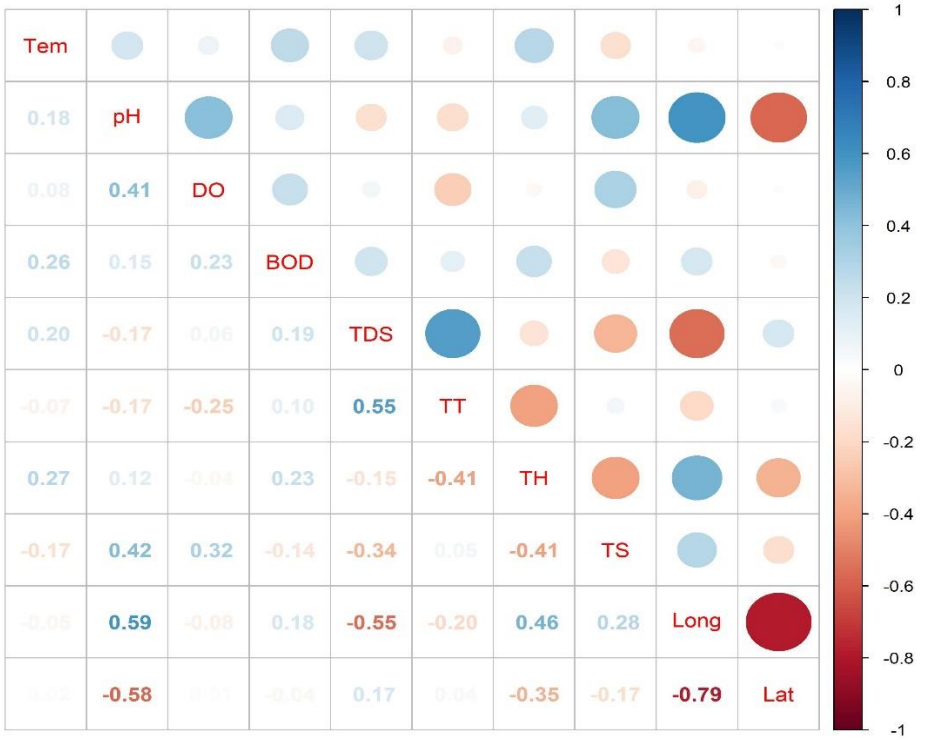

Fig. 3 Pearson's correlation matrix among various water quality parameters (Long., longitude; Lat., latitude; TDS, total dissolved solids; DO, dissolved oxygen; BOD, biological oxygen demand; Tem., temperature; TS, transparency; TH, hardness; and TT, turbidity).

References

Ahmed, K., Rahman, A., Sarkar, M., Islam, J., Jahan, I., Moniruzzaman, M., Saha, B., and Bhoumik, N., 2016, Assessment on the level of contamination of Turag river at Tongi area in Dhaka: Bangladesh Journal of Scientific and Industrial Research, 51(3), 193-202.

Aktar, P., and Moonajilin, M. S., 2017, Assessment of water quality status of Turag River due to industrial effluent: International Journal of Engineering and Information Systems (IJEAIS), 1(6), 105-118.

DoE, 1997a, Environmental Conservation Rules (ECR): Ministry of Environment and Forest, Government of the People's Republic of Bangladesh.

DoE, 1997b, Environmental Quality Standard (EQS): Ministry of Environment and Forest, Government of the People's Republic of Bangladesh.

Hasan, M. K., Shahriar, A., and Jim, K. U., 2019, Water pollution in Bangladesh and its impact on public health: Heliyon, 5(8), e02145.

Huq, S. I., and Alam, M. (2005). A handbook on analyses of soil, plant and water: BACER-DU, University of Dhaka, Bangladesh, 246.

Islam, M. S., Afroz, R., and Mia, M. B. (2019). Investigation of surface water quality of the Buriganga river in Bangladesh: laboratory and spatial analysis approaches: Dhaka University Journal of Biological Sciences, 28(2) 147-158.

Mukherjee, I., and Singh, U. K., (2022), Hydrogeochemical characterizations and quality evaluation of groundwater in the major river basins of a geologically and anthropogenically driven semi-arid tract of India: Science of The Total Environment, v. 805, p. 150323.

Rahman, A., Jahanara, I., and Jolly, Y. N., 2021, Assessment of physicochemical properties of water and their seasonal variation in an urban river in Bangladesh: Water Science and Engineering.

Rahman, M., 1992, Water quality management in Aquaculture BRAC prokashana: Dhaka, Bangladesh, 84.

Tahmina, B., Sujan, D., Karabi, R., Hena, M. K. A., Amin, K. R., and Sharmin, S., 2018, Assessment of surface water quality of the Turag River in Bangladesh: Res J Chem Environ, 22(2). 49-56.

Uddin, M. J., and Jeong, Y.-K., 2021, Urban River pollution in Bangladesh during last 40 years: potential public health and ecological risk, present policy, and future prospects toward smart water management: Heliyon, 7(2). e06107.

Tamanna Meghla, N., Sirajul Islam, M., Aslam Ali, M., & Sultana, N. (2013). Assessment of Physicochemical Properties of Water from the Turag River in Dhaka City, Bangladesh. In Int. J. Curr. Microbiol. App. Sci. 2(5).

Whitehead, P., Bussi, G., Hossain, M. A., Dolk, M., Das, P., Comber, S., Peters, R., Charles, K. J., Hope, R., & Hossain, S. (2018). Restoring water quality in the polluted Turag-Tongi-Balu River system, Dhaka: Modelling nutrient and total coliform intervention strategies. Science of the Total Environment, 631–632, https://doi.org/10.1016/j.scitotenv.2018.03.038