International Journal of Multidisciplinary Informative Research and Review
2021; 1(6) : 244 - 251
Published online February 28, 2021 (https://agribusinessedu.com/ijmirr-journal/)
DOI: 10.5281/zenodo.5655206
ISSN: 2709 - 6289 (Online)

Impact of Urban Wastes on Water Quality of Turag River

Hamamah Sadiqa[1, *], Md. Al-Amin[2], Md. Motaleb Hossain Sarker[3]

[1]Department of Civil Engineering, Sonargaon University, Dhaka, Bangladesh
[2]Local Government Engineering Department, Bangladesh
[3]Water Resources Management Division, Center for Environmental and Geographic Information Services, Dhaka, Bangladesh

Email address:

[*]Corresponding author: hamamah.sadiqa@gmail.com (H. Sadiqa)
66alamin@gmail.com (Md. A. Amin), motalebsarker@gmail.com (Md. M. H. Sarker)

To cite this article:

Hamamah Sadiqa, Md. Al-Amin, Md. Motaleb Hossain. Impact of Urban Wastes on Water Quality of Turag River. *International Journal of Multidisciplinary Informative Research and Review.* Vol. 1, No. 6, 2021, pp. 244 - 251.

Abstract: Department of Environment, Government of Bangladesh has declared the River Turag, running by the side of Dhaka city and one of the most polluted rivers in Bangladesh, as one of the ecologically critical areas (ECA). Due to continuous disposal of untreated industrial effluents and dumping of municipal sewerage and drainage water the Turag River is approaching its danger level rapidly, degrading its ecological status, which is very alarming to the lives of this river. A lot of works were done to report such a deterioration of the river. To assess all such works and to suggest a consolidated recommendation, some important research results and standards declared by WHO, FAO, DoE and Bangladesh standards were reviewed. The color of the river turned to pitch-black with a foul odor. DO was 3 ppm with a contrasting standard level of 5 ppm.An extreme elevation of COD up to 1020 ppm against 4 ppm for drinking water and TDS, up to 6000 ppm against 1000 ppm were alarming. Regarding the concentration of heavy metals, the chromium level was raised up to 0.65 ppm against its standard level of 0.05 ppm and the level of nickel, 0.62 ppm against 0.1 ppm. It is recommended that the Government of Bangladesh may take necessary steps to mitigate the existing aquatic environmental problems of the Turag River water in such a way that it may be declared as a safe ecological area.

Keywords: Turag River, Industrial Effluents, Municipal Wastes, Physicochemical Parameters of Water, Heavy Metals, ECA, Mitigation.

1. Introduction

Almost 71% of the earth's surface is covered with water. Out of it, 1% is freshwater from rainfall, snow-melts and ground water that people need every day to live(*How Much Water Is There on, in and above the Earth*, n.d.). A major part of this water is available in streams, rivers, lakes and other inland water bodies. Only this freshwater is used randomly in domestic (drinking, food preparing, bathing, washing, gardening) industrial, agricultural and aquaculture purposes. Thus, freshwater is one of the most generous gift's of the nature (Afrin et al., 2014b; *How Much Water Is There on, in and above the Earth*, n.d.; Mobin et al., 2014; Nawshin, Sultana, et al., 2016). But, among all the natural resources, this water is the most poorly managed one in developing countries(Islam et al., 2012). Even a lion's share of it is exploited by industrial work such as fabrication, processing, washing, dilution, cooling and even for transportation. Because, maximum solid wastes, waste waters from domestic works, untreated industrial effluents and toxic precipitates from agricultural fields often find their end result in the surface waters. Also, the oil spill from water vehicles is continuously polluting the river waters (Nawshin, Sadab, et al., 2016).

Bangladesh is a low lying flat country with vast inland water bodies, including some of the biggest rivers in the world (Matin, M. A., n.d.; Mobin et al., 2014). The capital of Bangladesh, Dhaka, is one of the densely populated cities in the world. Though, now-a-days, this city has become a member of the megacity family, rapid and unplanned urbanization, commercial development and population pressure have made it a severe environmentally polluted city in the world (Ahmed et al., 2016; Banu et al., 2013; DoE, n.d.). Almost no scientific activity is practiced to collect and dump municipal solid wastes of this mega city. Rather, mixed wastes are disposed of on open waste-land or low lying areas, even near rivers, ponds and other ecological sensitive regions, resulting in massive water pollution (Dhote & Dixit, 2009; Islam et al., 2012).

The Turag River, running by the side of Dhaka city, is one of the most polluted rivers in Bangladesh(Rahman, A. K. M. L.; Islam, M.; Hossain, M. Z. and Ahsan, 2012). The entire regime of this river is almost a semi-funnel shaped basin (Mobin et al., 2014). The basin boundary is 197.79 km and the total area of the river basin is 1160.48 sq-km (Sci, Resources, Salam, et al., 2014). Many industries have grown up in its bank (Ahmed et al., 2016). Most of the industries are discharging their effluents directly or indirectly into the Turag without any treatment continuously causing pollution of its water. Moreover, the river is being used as the dumping ground of municipal sewerage and drainage systems and thus all kinds of solids, liquids and chemical wastes are continuously causing its pollution. Such heavy pollutions have become the mother of emitting noxious smells from its water (Islam et al., 2012).

Lots of works were done to assess the Turag river water and its sediment parameters at different spots. The studies assessed color, odor, DO, BOD, COD, TDS, EC, pH, salinity and heavy metals as chromium (Cr), cadmium (Cd), copper (Cu), nickel (Ni), zinc (Zn), lead (Pb) etc. The study results apparently proved that the critical level of the above physicochemical parameters, suitable for living organisms, has been exceeded by the above mentioned pollutants (Afrin et al., 2014b; Ahmed et al., 2016; DoE, n.d.; Islam et al., 2012; Mobin et al., 2014; Nawshin, Sadab, et al., 2016; Nawshin, Sultana, et al., 2016; Sci, Resources, Salam, et al., 2014). Different studies on Turag River water quality were carried out in different times by the Department of Environment (DoE), Government of Bangladesh (GoB) and the river has been declared as one of the ecologically critical areas (ECA) (DoE, n.d.; Mobin et al., 2014). In the circumstances, the present study was conducted to review some of the precious works with a view to consolidate the recommendations by those authors and to pursue a strong recommendation to the Government of Bangladesh to save our daughter "Turag" in such a way that it may be declared as a safe ecological area.

2. Materials and methods

Some important works were reviewed, after a systematic search, related to the water quality of the river Turag (Fig. 1). Original research papers were collected by on-line search. Data of those results were cited, compiled and compared with the standard value of water parameters. For this purpose, standards declared by WHO, FAO, DoE and Bangladesh standards were reviewed. Relevant references cited in the reviewed papers were also collected in original to study them in detail. The findings, suggestions and recommendations of the papers were evaluated to stop the systematic destruction of this river leading to its death warrant. Lastly, a strong and humble recommendation was placed to attract the view of the Government of Bangladesh to save the river "Turag" in such a way that it may be declared as a safe ecological area.

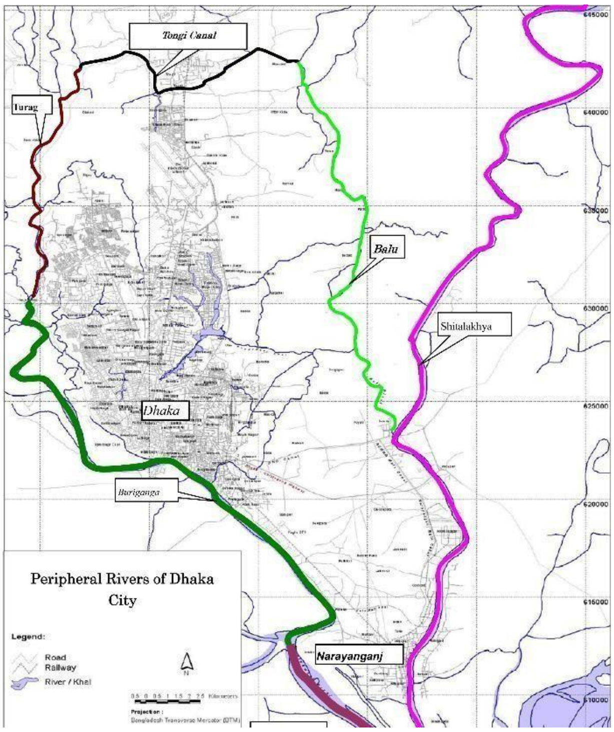

Figure 1. Inland water body around the Dhaka city(Banu et al., 2013)

3. Results and Discussions

A crucial analysis of physicochemical parameters and concentrations of heavy metals in the river Turag is described below.

3.1. Physicochemical parameters

3.1.1. Color and odor

Phytoplankton-enriched dark greenish-blue, red or brown colored water is good for fisheries(Islam et al., 2012). But the water of Turag River was observed to be pitch-black in color (Fig. 2) and with a foul odor(Mobin et al., 2014). It indicated the presence of a high concentration of TSS and TDS in the water that might attribute to the polluted environment of the river(Sci, Resources, Munnaf, et al., 2014). This might be due to the contamination by untreated industrial effluents and municipal sewage (Mobin et al., 2014).

Figure 2. Pitch-black water of Turag River

3.1.2. Temperature

The temperature of river water contributes a major influence on its biological activities and growth. It is accounted for determining metabolic rates, photosynthesis, the toxicity of toxic compounds, dissolved oxygen, other dissolved gas concentrations, conductivity, salinity, pH, water density, etc.(*Water Temperature*, n.d.). Fish, insects, zooplankton, phytoplankton and other aquatic species - all have a preferred temperature range (*Water Properties: Temperature*, n.d.). A 10°C increase in water temperature will approximately double the rate of the physiological function of most of the fishes. Furthermore, temperatures above 35°C may initiate denaturing or breaking down of enzymes and reduce metabolic functions. Plants are also affected by water temperature. While some aquatic plants tolerate cooler waters, most of them prefer warmer temperatures. Tropical plants in particular will show restricted growth and dormancy in water temperatures below 21°C(*Water Temperature*, n.d.). The solubility of oxygen and other gases decreases as temperature increases. The fluctuation in river water temperature usually depends on the season, geographic location, diurnal period, circulation of air, cloudiness of sky, depth of water and its flow rate, testing time and temperature of effluents entering the stream (Ahipathi MV and Puttaiah ET, 2006; Ahmed et al., 2016; Mobin et al., 2014)

The DoE standard of river water temperature for sustaining aquatic life is 20 to 30˚C both in dry and wet season(Bhaumika, U.; Das, P. and Paria, 2006; Mobin et al., 2014)

The temperature of Turag river water observed during the month of April to July at Abdullapur, Ashulia and near BiswaIjtema field was in the range of 23 to 30˚C which was within the standard range 2. The effluent temperatures, discharged directly without any treatment from industries were found to be 30 to 45˚C and 40 to 47˚C during summer and winter respectively (Sci, Resources, Munnaf, et al., 2014).However, the allowable temperature is 40˚C during summer and 45˚C during winter as per the Environment Convention Rule (ECR), 1997(DoE, 1997). This high effluent temperature may lead to the rise of river water temperature.

3.1.3. pH

The range of pH found in various sites of the Turag river was 6.2 to 8.5 (Afrin et al., 2014b; Ahmed et al., 2016; Islam et al., 2012; Mobin et al., 2014; Mohiuddin et al., 2016; Nawshin, Sadab, et al., 2016; Nawshin, Sultana, et al., 2016; Rahman, A. K. M. L.; Islam, M.; Hossain, M. Z. and Ahsan, 2012). The standard range of pH for inland surface water, drinking water and irrigation water is 6.5 to 8.5 according to Bangladesh standards, FAO standards and Bangladesh Environment Conservation Rule (ADB (Asian Development Bank)., 1994; Mobin et al., 2014). For fish culture, this range is 6.5 to 8.0 (Islam et al., 2012; Mobin et al., 2014). Though the above pH range of the river Turag was within the standard range of domestic water, fish culture and irrigation standard, reflecting its suitability for aquatic life and for all types of water uses, it would be threatened by the untreated industrial effluents and project wastes. The standard range of pH for industrial wastes or project wastes is 6 to 9 (DoE, 1997).The pH of water discharged from industries ranged from 8.9-10.5 and 9.2-10.7 during the rainy and winter seasons, respectively (Sci, Resources, Munnaf, et al., 2014)which exceeded the standard range to a large extent.

3.1.4. EC

The standard value of electric conductivity declared by ECR is 1200 µS/cm for inland surface water (DoE, 1997). The acceptable range of EC for recreational water is 500 µS/cm, irrigation is 750 µS/cm and aquaculture is 800 to 1000 µS/cm (ADB (Asian Development Bank)., 1994). Maximum works reported that, the EC of Turag river, though remained within the safe limit (30 to 500 µS/cm) (Ahmed et al., 2016; Islam et al., 2012; Mobin et al., 2014; Mohiuddin et al., 2016; Nawshin, Sultana, et al., 2016; Rahman, A. K. M. L.; Islam, M.; Hossain, M. Z. and Ahsan, 2012) in monsoon, it strikingly went beyond the limit of all kind of use by crossing 1000 µS/cm in the dry season(Ahmed et al., 2016; Banu et al., 2013; Islam et al., 2012; Rahman, A. K. M. L.; Islam, M.; Hossain, M. Z. and Ahsan, 2012). The more the industrial effluent and municipal waste are disposed of in this river, the more intensely EC value rises beyond the acceptable range and the more salinity, COD (chemical oxygen demand) and TDS (total dissolved solid) increase in water.

3.1.5. Salinity

Salinity in river water may vary according to the season and confluence of industrial discharges with river water. Chiefly tanneries, dying industries, leather factories, glass industries and textile industries have the use of salt. Discharges of these industries in the river Turag might have a great effect on the salinity of the river. The salinity of Turag river water ranged from 300 to 600 ppm and 50 to 250 ppm in dry and wet season respectively (Ahmed et al., 2016) categorizing it as having low to moderate salinity (Nawshin, Sadab, et al., 2016). During the winter season (January to April) the salinity dominates at and downstream of the discharging point of industries creating a threat to freshwater biota (Ahmed et al., 2016).

3.1.6. Total Dissolved Solid (TDS)

The presence of various kinds of minerals like ammonia, nitrite, nitrate, phosphate, alkalis, some acids, sulfates and metallic ions in water comprises both colloidal and dissolved solids and is indicated by total dissolved solids (TDS) (Ahmed et al., 2016; Rahman, A. K. M. L.; Islam, M.; Hossain, M. Z. and Ahsan, 2012).

A high TDS value indicates the presence of an appreciable quantity of bicarbonates, sulfates and chlorides of Ca, Mg and Na (Mobin et al., 2014). The acceptable concentration of TDS for drinking water is 1000 ppm, irrigation is 2000 ppm, industrial water is 1500 ppm and livestock is 5000 ppm (ADB (Asian Development Bank)., 1994). The present review could draw an outline that, unless in monsoon, the TDS of Turag river exceeded 1000 ppm at Konabari industrial area (Islam et al., 2012), Ashulia[1], Kacharighat(Ahmed et al., 2016), Abdullapur (dense industrial area) (Sci, Resources, Munnaf, et al., 2014) and Biswa Ijtema field (Ahmed et al., 2016; Mobin et al., 2014). Even it reached to 6000 ppm at the outlet of untreated effluents of industries. However, the usual range of TDS value was 400 to 800 ppm (Ahmed et al., 2016; Banu et al., 2013; Mobin et al., 2014; Nawshin, Sultana, et al., 2016) during the wet season and rarely 100 ppm (Ahmed et al., 2016).

3.1.7. Dissolved oxygen (DO)

Dissolved oxygen is necessary for many forms of life including fish, invertebrates, bacteria and plants for their respiration, similar to terrestrial organisms. The amount of DO needed varies from creature to creature. In freshwater systems such as lakes, rivers and streams, DO varies by season, location and water depth. DO concentrations are constantly affected by diffusion, aeration, photosynthesis, respiration and decomposition. It also fluctuates with salinity, temperature and pressure of water (*Fundamentals of Environmental Measurements*, n.d.). The standard DO level for sustaining aquatic life is 5 ppm and for drinking water, it is 6 ppm (Matin, M. A., n.d.). Its range for domestic water supplies is 4.0 to 6.0 ppm as declared by the United States Public Health (USPH) standard and 3.0 ppm by ISI standard (*Fundamentals of Environmental Measurements*, n.d.). The standard range of DO for fish culture is 5 ppm (Meade, 1998). The optimum DO in natural water is 4.0 to 6.0 ppm (De, 2005). According to the Environmental Quality Standard (EQS), the requirements for DO for various purposes are: 6.0 ppm for drinking, 4.0 to 5.0 ppm for recreation, 4.0 to 6.0 ppm for fish and livestock and 5.0 ppm for industrial application (Rahman, A. K. M. L.; Islam, M.; Hossain, M. Z. and Ahsan, 2012). But, usually, the observed DO level of the Turag river by various studies did not exceed 3 ppm (Ahmed et al., 2016; Islam et al., 2012; Mobin et al., 2014; Sci, Resources, Munnaf, et al., 2014) and seldom reached 4.8 ppm (Rahman, A. K. M. L.; Islam, M.; Hossain, M. Z. and Ahsan, 2012). In such a low DO level, fish and other aquatic organisms might not survive (Rahman, A. K. M. L.; Islam, M.; Hossain, M. Z. and Ahsan, 2012).

3.1.8. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

Higher BOD and COD levels mean greater oxidation of organic materials in the water, which reduces the dissolved oxygen (DO) level (*RealTechInc.*, n.d.). The permissible concentration of BOD is 0.2 ppm for drinking water, 3 ppm for recreation, 6 ppm for fish and 10 ppm for irrigation (DoE, n.d., 1997). Generally most natural rivers will have BOD_5 below 1 ppm (Nawshin, Sultana, et al., 2016). BOD_5 ranging from 2 to 8 ppm indicates moderate pollution and exceeding 8 ppm indicates severe pollution (*Biochemical Oxygen Demand: Wikipedia*, n.d.). The observed values of BOD in the Turag river were 0.4 to 1.2 ppm in dry and wet seasons (Islam et al., 2012; Mobin et al., 2014; Rahman, A. K. M. L.; Islam, M.; Hossain, M. Z. and Ahsan, 2012) sometimes reaching nearly 3 ppm (Banu et al., 2013). Banu *et al.* (2013) reported that the BOD of the Turag river increased from 2.8 ppm to 22 ppm by 4 years (2006 to 2010) (Banu et al., 2013). The observed range of COD of Turag river was 200 to 1020 ppm and the discharged effluents contained almost 1600 ppm COD. But the Bangladesh Standard of COD for drinking water is 4 ppm (DoE, 1997). It is allowed for industries to discharge effluents in inland water having COD

---

[1] The milligrams of oxygen needed to break down the organic matter contained in a litre of water over 5 days.

of a maximum 250 ppm (Limit & Limit, n.d.). Such excessive values of BOD and extremely high range of COD gave evidence of localized pollution by heavy toxic chemicals in the river Turag.

3.2. Heavy Metals

3.2.1. Cadmium (Cd)

The standard values of Cd for drinking, irrigation and livestock water are 0.005, 0.01 and 0.5 ppm respectively (ADB (Asian Development Bank)., 1994; Afrin et al., 2014b). The usual value of Cd found in the river was in the range of 0.001 to 0.002 ppm (Afrin et al., 2014a; Ahmed et al., 2016; Islam et al., 2013; Mandal & Ahmed, 2014; Nawshin, Sultana, et al., 2016)', which was within the safe range.

3.2.2. Chromium (Cr)

The standard value of Cr for surface water is 0.05 ppm (EPA, 2001) (Afrin et al., 2014a). WHO and FAO declared values are 0.06 and 0.1 ppm respectively(Nawshin, Sultana, et al., 2016). However, Bangladesh's standardized value is 0.05 ppm (Nawshin, Sadab, et al., 2016). The value of Cr in Turag river water ranged from 0.002 to 0.65 ppm (Afrin et al., 2014a; Ahmed et al., 2016; Islam et al., 2013; Mandal & Ahmed, 2014; Nawshin, Sadab, et al., 2016), presenting an elevated level of Cr.

3.2.3. Nickel (Ni)

WHO and FAO declared values of Ni are 0.01 (Nawshin, Sadab, et al., 2016) (0.02 ppm [8]) and 0.2 ppm (Nawshin, Sadab, et al., 2016)respectively. Bangladesh's standardized value is 0.1 ppm (Nawshin, Sadab, et al., 2016). The range of Ni level in the river Turag was between 0.011 and0.62 ppm crossing the standard level dangerously (Afrin et al., 2014a; Ahmed et al., 2016; Banu et al., 2013; Islam et al., 2013; Nawshin, Sadab, et al., 2016).

3.2.4. Copper (Cu)

The standardized level of Cu for drinking water in Bangladesh is 1 ppm (DoE, 1997). WHO standard is 0.02 ppm (Ahmed et al., 2016). The level of Cu in the Turag river was found to be 0.006 to 0.12 ppm which was within thesafety level(Afrin et al., 2014a; Ahmed et al., 2016; Banu et al., 2013; Islam et al., 2013; Mandal & Ahmed, 2014; Nawshin, Sadab, et al., 2016).

3.2.5. Zinc (Zn)

WHO standardized value of Zn for drinking water is 5 ppm(Ahmed et al., 2016). In Turag river water, it was found in the range of 0.029 to 3.1 ppm which was within the safe range.

3.2.6. Lead (Pb)

The WHO established the standard level of Pb for drinking water, irrigation and fishery as 0.05, 0.1 and 0.05 ppm respectively (Afrin et al., 2014a; DoE, 1997). The Pb concentration of Turag river water was found to be within 0.001 and 0.08 ppm expressing its exceeding level in drinking water and fishery (Ahmed et al., 2016; Banu et al., 2013; Islam et al., 2012; Limit & Limit, n.d.; Nawshin, Sadab, et al., 2016).

4. Conclusion and Recommendations

The physicochemical parameters of the river Turag, which isbeing polluted continuously, were understood to be attributed to the untreated chemical effluents disposed from industries directly to the river. The COD of the river Turag increased vigorously and consequently reduced the DO level of water below the required one, which was the chief element for aquatic life, irrigation, drinking and domestic purposes.

To save the river from its steady deterioration, the following steps are recommended to be taken to reduce the level of pollution and thereby to declare it again as a safe ecological area.

1. Mitigating the existing aquatic environmental problems of the Turag River water.
2. Industries must run effluent treatment plants (ETP).

3. Low-cost water treatment process should be developed at each outlet of the river.
4. Social awareness about the consequences of environmental degradation should be developed by the government through mass media such as TV, radio, newspapers and other media sponsored by the Ministry of Science & Information and Communication Technology.
5. All the implementation steps should be initiated, regulated and successfully completed by the Government.

References

ADB (Asian Development Bank). (1994). *Training Manual for Environmental Monitoring. Engineering Science Incorporation*. *2*, 26.

Afrin, R., Mia, M. Y., & Akter, S. (2014a). Investigation of Heavy Metals (Pb, Cd, Cr, Cu, Hg and Fe) of the Turag River in Bangladesh. *Journal of Environmental Science & Natural Resources*, *7*(2), 133–136.

Afrin, R., Mia, M. Y., & Akter, S. (2014b). *ISSN 1999-7361 Investigation of Heavy Metals (Pb , Cd , Cr , Cu , Hg and Fe) of the Turag River in Bangladesh*. *7*(2), 133–136.

Ahipathi MV and Puttaiah ET. (2006). Ecological Characteristics of Vrishabhavathi River in Bangalore (India). *Environmental Geology,49*, 1217–1222.

Ahmed, K. S., Rahman, A. K. M. L., Sarkar, M., Islam, J. B., Jahan, I. A., Moniruzzaman, M., Saha, B., & Bhoumik, N. C. (2016). *OF SCIENTIFIC AND Assessment on the level of contamination of Turag river at Tongi area in Dhaka*. *51*(3), 193–202.

Banu, Z., Chowdhury, M. S. A., Hossain, M. D., & Nakagami, K. (2013). Contamination and Ecological Risk Assessment of Heavy Metal in the Sediment of Turag River, Bangladesh: An Index Analysis Approach. *Journal of Water Resource and Protection*, *05*(02), 239–248. https://doi.org/10.4236/jwarp.2013.52024

Bhaumika, U.; Das, P. and Paria, T. (2006). Impact of Plankton Structure on Primary Production in Two Beels of West, India. *Bangladesh Journal of Fisheries Research,10*, 1–11.

Biochemical oxygen demand: Wikipedia. (n.d.). https://en.wikipedia.org/wiki/Biochemical_oxygen_demand

De, A. K. (2005). Environmental Chemistry. 5th ed. *New Age International (P) Ltd., Daryagang, New Delhi, India, 187.*

Dhote, S., & Dixit, S. (2009). Water quality improvement through macrophytes - A review. *Environmental Monitoring and Assessment*, *152*(1–4), 149–153. https://doi.org/10.1007/s10661-008-0303-9

DoE. (n.d.). *"Water Quality Data of Rivers Buriganga, Meghna, Balu, Shitalakhya, Jamuna (1991-2000)," Department of Environment, Dhaka, 1997.*

DoE. (1997). The Environment Conservation Rules, 1997. *Bangladesh Department of Environment, Ministry of Environment and Forest, Government of the People's Republic of Bangladesh*, 179–227.

Fundamentals of Environmental Measurements. (n.d.). http://www.fondriest.com/environmental-measurements/parameters/water-quality/dissolved-oxygen/

How much water is there on, in and above the earth. (n.d.). www.water.usgs.gov

Islam, M. S., Tusher, T. R., Mustafa, M., & Mahmud, S. (2012). *Effects of Solid Waste and Industrial Effluents on Water Quality of Turag River at Konabari Industrial Area , Gazipur , Bangladesh*. *5*(2), 213–218.

Islam, M. S., Tusher, T. R., Mustafa, M., & Mahmud, S. (2013). Effects of Solid Waste and Industrial Effluents on Water Quality of Turag River at Konabari Industrial Area, Gazipur, Bangladesh. *Journal of Environmental Science and Natural Resources*, *5*(2), 213–218. https://doi.org/10.3329/jesnr.v5i2.14817

Limit, T., & Limit, T. O. F. (n.d.). *SCHEDULE I LIST I GENERAL STANDARDS AND CRITERIA FOR THE DISCHARGE OF INDUSTRIAL EFFLUENTS INTO INLAND SURFACE WATERS Radio Active Material : (a) Alpha emitters (b) Beta emitters micro curie / ml max max Note 1 : Note 2 : All efforts should be made to*. *1*.

Mandal, S., & Ahmed, A. T. A. (2014). Copper, Cadmium, Chromium and lead bioaccumulation in Stinging Catfish, Heteropneustes fossilis (Bloch) and freshwater mussel, Lamellidens corrianus Lia and to compare their concentration in sediments and water of Turag river. *Journal of the Asiatic Society of Bangladesh, Science*, *39*(2), 231–238. https://doi.org/10.3329/jasbs.v39i2.17862

Matin, M. A., and R. K. (n.d.) (2010). *"Impact of climate change on river system." Proceedings of the International Symposium on Environmental Degradation and Sustainable Development (IS SD 2010). 12t. 2010.*

Meade, J. W. (1998). *Aquaculture Management*. CBS Publishers & Distributors.

Mobin, M. N., Islam, M. S., Mia, M. Y., & Bakali, B. (2014). Analysis of Physicochemical Properties of the Turag River Water , Tongi , Gazipur in Bangladesh. *Journal of Environmental Science and Natural Resources*, *7*(1), 27–33. https://doi.org/http://dx.doi.org/10.3329/jesnr.v7i1.22140

Mohiuddin, K. M., Islam, M. S., Basak, S., Abdullah, H. M., & Ahmed, I. (2016). *Status of heavy metal in sediments of the Turag river in Bangladesh*. *27*(2), 78–85.

Nawshin, N., Sadab, F. R., Chowdhury, M. A. H., & Baten, M. A. (2016). *ISSN 1999-7361 Effects of Buriganga and Turag River Water on the Yield and Heavy Metal Contents of Indian Spinach ISSN 1999-7361*. *9*(2), 15–20.

Nawshin, N., Sultana, N., Chowdhury, M. A. H., & Baten, M. A. (2016). *Chemical Properties of Buriganga and Turag River Water ISSN 1999-7361*. *9*(2), 9–14.

Rahman, A. K. M. L.; Islam, M.; Hossain, M. Z. and Ahsan. (2012). Study of the seasonal variations in Turag river water quality parameters. *African Journal of Pure and Applied Chememistry*, *6*(10), 144–148.

RealTechInc. (n.d.). https://realtechwater.com/chemical-oxygen-demand/

Sci, J. E., Resources, N., Munnaf, A., Islam, M. S., Tusher, T. R., Kabir, M. H., & Molla, M. A. H. (2014). *Investigation of Water Quality Parameters Discharged from Textile Dyeing Industries*. *7*(1), 257–263.

Sci, J. E., Resources, N., Salam, M. A., & Alam, M. S. (2014). *Identification and Delineation of Turag River Basin Boundary Using Remote Sensing Techniques Results and Discussion There are 6 (six) segments of the basin area has been identified as below :7*(1), 169–175.

Water properties: Temperature. (n.d.). https://water.usgs.gov/edu/temperature.html

Water temperature. (n.d.). http://www.fondriest.com/environmental-measurements/parameters/water-quality/water-temperature/