WATER QUALITY PARAMETERS: A CASE STUDY OF TURAG RIVER, TONGI, DHAKA, BANGLADESH.

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Bachelor of Science in Civil Engineering

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DECLARATION

We hereby declare that this thesis has not been published elsewhere **“Water Quality Parameters: A Case Study of Turag River Tongi, Dhaka, Bangladesh.”**

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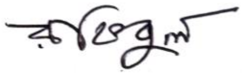

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DEDICATION

"I would like to dedicated this work to my parents and beloved teachers, who raised and guided me in every single moment of my life"

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious, the Most Merciful,

I begin by expressing my deepest gratitude to Allah, the Most Compassionate, and the Most Merciful, for granting me the wisdom, strength, and perseverance to embark on this journey of knowledge and discovery. His boundless blessings and guidance have been my constant source of inspiration and fortitude throughout this endeavor

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ABSTRACT

This thesis examines the water quality of the Turag River in Tongi, Dhaka, Bangladesh, through a detailed analysis of physicochemical and bacteriological parameters, based on field data collected in 2025 and compared with 2018 measurements. Key parameters, including pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), total dissolved solids (TDS), total suspended solids (TSS), electrical conductivity (EC), turbidity, were evaluated to assess the river's ecological health and suitability for use. Results indicate severe contamination, characterized by critically low DO levels (0.23–1.30 mg/L) signaling hypoxic conditions, elevated BOD (up to 8.39 mg/L), and high turbidity (up to 69.1 NTU), primarily driven by untreated industrial effluents, municipal sewage, and agricultural runoff from the Tongi industrial zone. These conditions render the river water unfit for drinking, irrigation, or aquaculture without comprehensive treatment, posing significant risks of waterborne diseases and through eutrophication and habitat degradation. The study highlights the urgent need for advanced wastewater treatment systems, stringent regulatory enforcement, real-time water quality monitoring, and community-led conservation initiatives to mitigate pollution and restore the ecological integrity of the Turag River, providing a model for sustainable urban river management in Bangladesh.

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INTRODUCTION

1.1 General

Rivers and other surface water bodies are extremely important in the support of human life, agriculture, industry and aquatic life. With the rapid urbanization, overpopulation, and uncontrolled waste management, rivers like the Turag in the city of Dhaka are more and more put under pressure by numerous types of pollution (Islam et al., 2015). The analysis of the physio-chemical parameters of surface water, including the measures of pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), turbidity, and electrical conductivity, to know the state of water quality and its appropriateness to further usage is obligatory (Rahman et al., 2019).

Besides the physio-chemical parameters, the bacteriological quality of the river water, in general, and the occurrence of the coliform bacteria in water, in particular, is a significant predictor of the presence of fecal contamination in water, and it poses a threat to human health (Ahmed et al., 2020). Most of the urban rivers in Bangladesh such as the Turag river are severely polluted with raw domestic water effluents, raw industrial discharge as well as waste and this reduces the quality of water to a huge extent (Alam et al., 2006).

The need to pinpoint on the main sources of pollution, i.e., industrial discharge, municipal waste, and agricultural run-off of airport pollution is an essential determiner of specific management approaches. Tongi and surrounding industrial areas have been considered to contribute partly to an enormous load of pollutants in the Turag River (Matin et al., 2018). Such pollutants are not only of health hazard to the members of the society - leading to water related diseases like diarrhoea, cholera and skin infections - but also to aquatic life and stability of the ecological network (Kamal et al., 1999).

Other environmental implications of surface water contamination also become hazardous due to eutrophication effects, damage to aquatic life, ecological imbalances, and a decline in water purity to be utilized in irrigation or recreation (Dey et al., 2020). Thus, it is necessary to assess these effects and make progressive suggestions as to how the pollution should be mitigated and leave the river with its ecological health and, consequently, safe drinking water.

1.2 Study Area

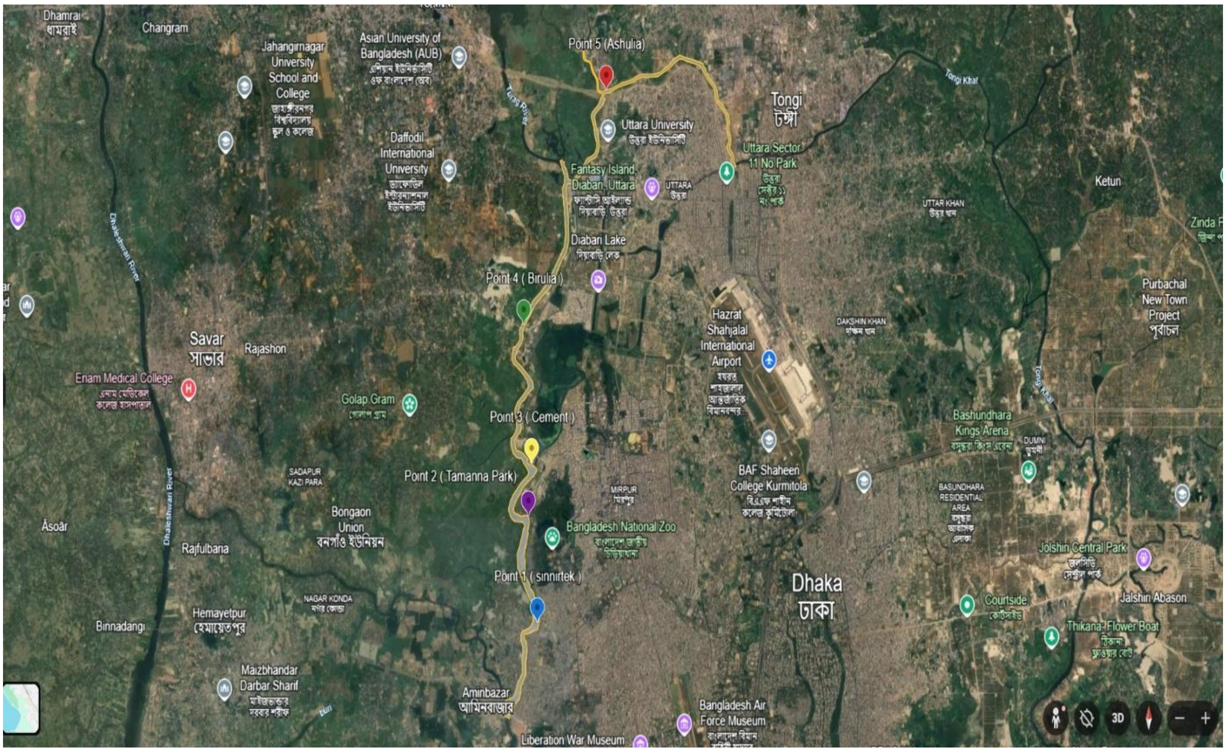

Figure 1.1: Study Area

1.3 Project Objectives

This thesis will therefore seek to assess and analyze the physio-chemical properties of surface water of the Turag River, Bangladesh and Dhaka. Essentially, the paper aims at finding the level of pollution and the cause of the problem as well as determining the consequences of the pollution regarding the health of the population and impact on the environment. Specifically, this thesis will:

1. Assess the physio-chemical parameters of surface water in the Turag River.

Chapter 2
LITERATURE REVIEW

2.1 Overview

The Turag River is a tributary of Buriganga, which is one of the geographically important river basins that pass through northwestern borders of Dhaka. It used to be famous as clean water and be utilized during navigation, irrigation, and cultural activities, but today, its condition was horribly degraded because of uncontrolled urbanization and industrialization (Islam et al., 2015).

2.2 Background

Traditionally, the Turag served rural and urban communities being a source of support to farmers and fisheries as well as to transportation. It was also a spiritual and cultural place as it annually hosted Bishwa Ijtema. The river, however, has been enduring catastrophic environmental degradation in the recent decades because of encroachment and solid waste disposal along with effluent discharges by factories (Khan& Hossain, 2013).

2.3 Parameters of Concern

Chemical, physical, and biological characteristics are present in the water quality parameters. It may be analyzed or even tracked based on the parameters of water that are of interest.

Under the Environment Conservation Rules 1997 (Standard, 1997), environmental standards are produced to control the amount and the levels of pollution released to the environment (Uddin et al., 2021). The document that has been used as a guide in water quality parameters and standards is the Bangladesh Environment Conservation Act, 1995 (GoB, 1995) (Act 1 of 1995). Important parameters for drinking, fisheries, agricultural/irrigation, and industrial water use are given below:

Here will describe the importance of the parameters we measure to find the water quality of a river.

2.3.1 pH

Ph is a scientific label that shows whether or not a solution is acidic or alkaline. The level of pH should be at 6.5 to 8.5 on a scale in water sources. A pH-level of 7 is a neutral level and any parameter with a level less than 7 is regarded as acidic whereas any parameter with a level greater than 7 is regarded as alkaline (Gorde et al., 2013). Water pH significantly determines the sustainability of the species in the water, the solubility and the toxicity of chemicals and heavy metals present in the water. The pH level is vital to the existence of aquatic life and the health of a water body in general.

2.3.2 Dissolved Oxygen (DO)

DO represents the amount of oxygen contained in water. Bodies of water absorb the contents of the air and submerged plants, which contain oxygen. Fish and other aquatic organisms require adequate levels that would generally be above 5 mg/l (Fikresilassie et al., 2011). Hypoxia may cause low DO, and is destructive to the aquatic organisms and reflects a low-quality of water. The temperature of the water, salinity and the air pressure all determine the content of dissolved oxygen in the water.

2.3.3 Biochemical Oxygen Demand (BOD)

BOD 5 is the measure of the quantity of oxygen that is used regarding the presence of microorganisms in water to decompose organic materials. An excess of 5 mg/l of BOD5 demonstrates pollution and the danger to the survival of aquatic lifeforms (Fikresilassie et al., 2011). The more the BOD5, the more quickly oxygen is used up in the stream. Low dissolved oxygen and high BOD5 share similar effects such as leading to the stressing, suffocation and death of organisms in the water.

2.3.4 Electrical Conductivity (EC)

EC measures the conductivity of water that is linked to TDS. Normal values in EC are highly dependent on the exact type of EC, however in freshwater there is a range of 50 to 800 0μS / cm (Fikkresilase et al., 2011). High EC implies high TDS and water quality problem.

2.3.5 Total Dissolved Solids (TDS)

The estimation of the increased amount of dissolved things in the water is TDS. Although there are no universally safe limits to TDS that can be proposed due to their dependence on a source, average TDS limits in fresh water are between 50 and 500 mg/l (Gorde et al., 2013). TDS may lead to undesired taste in water and even indicate potential pollution. Large levels of TDS, especially as exhibited by dissolved salts, may have a wide range of effects on aquatic forms of life.

2.3.6 Temperature

The temperature of water factors in biological and chemical reactions. The safe levels also depend on the species; however, in the case of the freshwater ecosystem, the temperature of 10 to 25 o C is considered optimal. Harsh climatical conditions may put aquatic life under strain and modify the dynamics of ecosystem.

2.4 Relevant studies

Tahmina (Tahmina et al., 2018) conducted an extensive research on water quality of the Turag River and highlighted the importance of regular monitoring which would be able to measure the changes of the parameters used in water such as Temperature, pH, Salinity, TDS, TA, EC, TH, Chloride content, Free CO-, DO, Nitrate and Sulfate. They noted that in both seasons, water quality of the river got to threshold of being poisoned. Thus, there is long overdue to be proactive in ensuring that the river is saved any further pollution.

The previous study (Hafizur et al., 2017) discussed the seasonal changes of Water Quality Parameters of Turag River, which showed considerable differences between the dry and the wet season. These changes were explained by changes in precipitation, land use and anthropogenic activities in the catchments of the area.

The study of the water quality parameters using comparative method plays a vital role in understanding regional changes as well as establishing the possible sources of pollutants. Comparisons were done in this research to a study by (Uddin et al., 2021) on a neighboring river system, wherein some similarities and differences in the trend of water quality were noted, and the need to contextualize the results mentioned.

2.5 Surface water in the Turag River

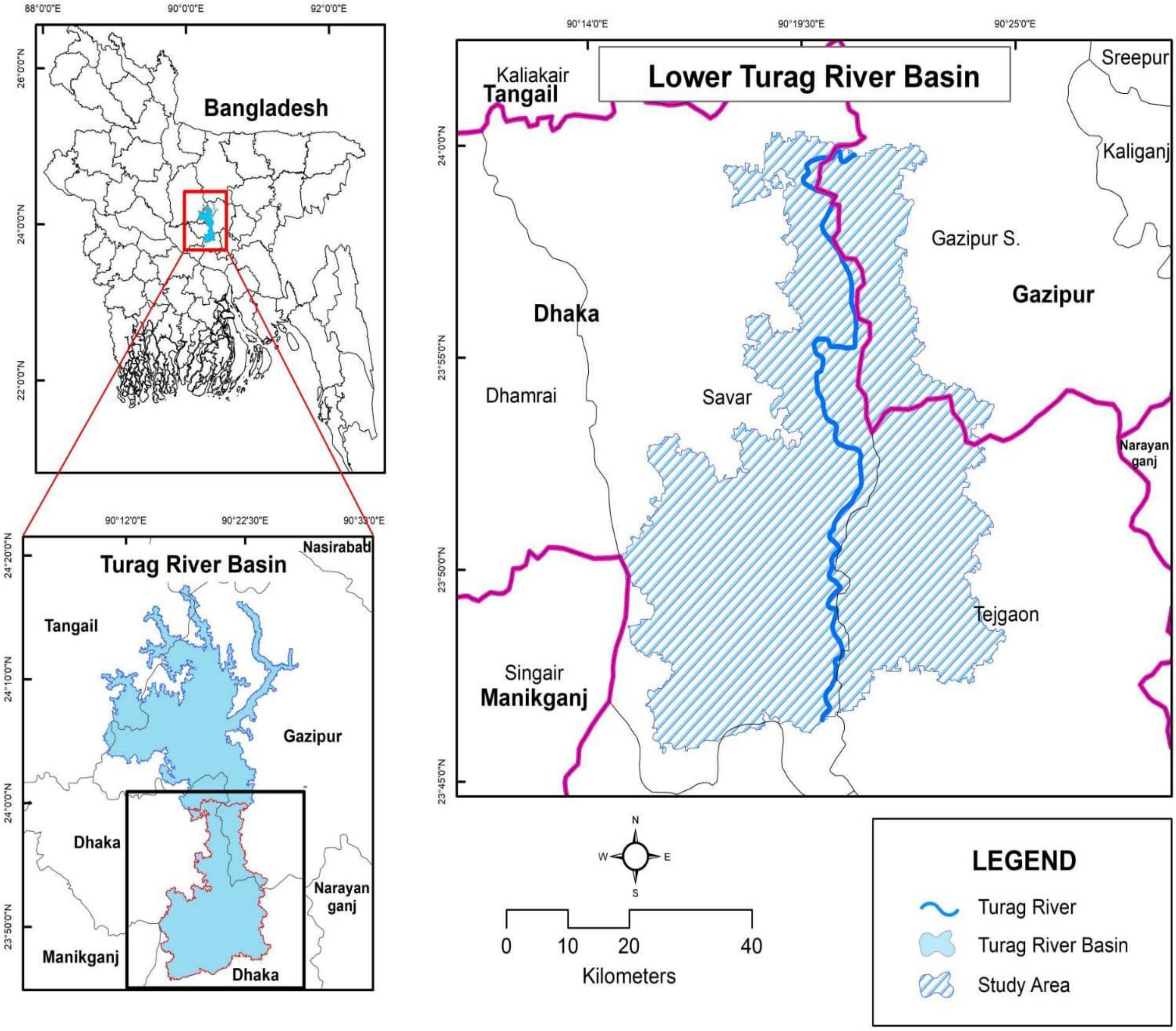

Figure 2.1: Location of Turag River

2.6 Turag River Surface water Situation

1. **Severe Water Quality Degradation**

Recent assessments indicate that the Turag River's water quality ranges from "poor" to "unfit for consumption," primarily due to intensified human activities.

2. **Industrial and Urban Pollution**

The river receives substantial amounts of untreated industrial effluents and municipal waste from Dhaka city, leading to elevated levels of pollutants such as Total Dissolved Solids (TDS) and heavy metals.

3. **Ecological Imbalance**

Low dissolved oxygen (DO) levels and high concentrations of free CO_2 have been observed across all seasons, severely harming aquatic organisms and disrupting the river's ecological balance.

4. **Seasonal Variations**

Water transparency exceeds standard levels during pre-monsoon and monsoon seasons but falls below permissible limits post-monsoon. Bangladesh Journals Online

5. **Reduced Water Flow**

Over the past two decades, the Turag River has experienced a significant decrease in water flow, with the lowest flow reducing by approximately 65.8%, exacerbating pollution concentration.

6. **Lack of Effective Governance**

Despite initiatives like declaring rivers as "living entities" and establishing monitoring bodies, there has been a lack of effective governance and community involvement in river conservation efforts.

2.7 Turag River Surface Water Recycling Potential

The Turag River in Bangladesh is a major tributary of the Buriganga River which has been under severe degradation because of unhindered urbanization, industrial effluents, and discharge of urban waste. Although it is already in its present state of pollution, the river can be of great value as a source of surface water recycling especially when used in non-potable projects like irrigation, industrial cooling and even in the drinking of water after it has undergone advanced treatment. The use of water recycling technology has the potential to reduce the effects of groundwater depletion, which are only increasing in Dhaka and nearby regions (Islam et al., 2015).

Constructed wetlands, membrane filtration, and bio filtration technologies have proven to be effective in the removal of pollution in form of heavy metals, nutrient and pathogens in the polluted water in the river. Such technologies are particularly feasible in rivers such as Turag because the major pollutants are organic waste, heavy metal pollutants, and industrial chemicals (Rahman et al., 2020). Additionally, one can think of decentralized treatment systems sited on the riverbanks to provide recycling facilities at the community levels that would not necessitate any large-scale elements in the infrastructural changes.

Recycling of the Turag surface water is also in line with sustainable water resource management, recyclability of water in the city ecosystem. As the current water supply system faces increasing water demand and water shortage, recycled river water can be added in the long-term to bring resilience into the whole system (Kabir & Hasan, 2019). Nevertheless, the strongest regulation, pollution control, and the partnership between the government and private kindergartens would be needed to implement such a solution successfully and satisfy the health and safety standards of the treated water (Ahmed & Rahman, 2021).

2.8 Water Quality Standards and Monitoring:

The quality standards of water are maintained on the basis of guidelines provided by the WHO and the Department of Environment (DoE) and the Bangladesh standards and Testing Institution (BSTI), which maintain quality regulations in Bangladesh. The parameters of acceptability as outlined in the standards relate to the variables like pH, dissolved oxygen (DO), biochemical oxygen dm, and total dissolved solids (TDS) along with heavy metals and microbial contamination. Government agencies like DoE and Bangladesh Water Development Board (BWDB) do surface water monitoring although coverages are limited in most cases and not updated in real-time. Formal discharge, sewage, and runoff agriculture continue to threaten the quality of water, especially in the urban rivers such as the Turag River.

2.9 Historical Role of the Turag River

Spiritual and Cultural Influence: The Turag River has had religious significance particularly to the Muslim society being used as a venue of huge Islamic congregation called the Bishwa ijtema, the second largest Islamic gathering after Hajj. Trade and Transportation: The Turag has been an important inland waterway in the past that helped the transportation as well as trade in the surrounding areas of Tongi and Dhaka. Agricultural Expertise: Associated agricultural farms were provided with water by the River which was a substantial source of food supplies in the region and provided revenue to the country life. Fishing, Livelihoods: The Turag provided local fisheries that provided income and food supply to the living population along rivers. Depending on Dhaka as an Urban Development Catalyst: It is due to its geographical location near Dhaka that has facilitated urban settlement growth especially on places such as Tongi and Mirpur. Industrialization: With the industrialization of Dhaka, Turag had become a base of industries and factories, which later on resulted in intense pollution.

2.10 Polluted River Water with Waste: Current Practice

One such problem is the Turag River that runs on the periphery of Dhaka bearing serious pollution issues to deal with because of different waste management procedures. This contamination is of industrial as well as domestic origin causing major ecological and health implications on the population.

2.10.1 Major Sources of Pollution

Industrial Effluents: Various industries such as the tanneries, garments factories, dyeing factories, metal works, pharmaceuticals industries, and the chemical industries, release their untreated/partially treated effluent into Turag River directly. Such effluents have toxic elements like heavy metals and dyes that harm aquatic life and the health of human beings.

Municipal and Domestic Waste: Large spillages of untreated sewage into the river include illegal sewage outfalls of individual households, hospitals, markets and other commercial objectives.This comprises of solid waste such as plastics, paper and organic matter and liquid waste which degrade the river.

Solid Waste Dumping: Riversides have been turned into so-called inofficial dumps where all kinds of solid waste are disposed. The monsoon season contributes to the pollution levels as the wastes are washed into the river posing even more problems to the environment.

2.10.2 Environmental and Health Impacts

Degradation of Water Quality: Research has indicated that the Turag River has an excessive amount of pollutants, where there is high BOD contents of the pollutants, which poses a significant organic pollution problem. The concentration of Dissolved oxygen is dangerously low and in dry seasons habitats it is not liveable to the aquatic creatures. Health risks: People living around river have reported high numbers of skin sickness, respiratory diseases, gastric problems and other health related complications that have been attributed to raw water.

2.10.3 Current Mitigation Efforts

Regulatory Measures: The Department of Environment has designated the Turag River as an Ecologically Critical Area (ECA), aiming to implement stricter regulations to curb pollution.

Clean-up Initiatives: Organizations and community groups have undertaken river clean-up projects and awareness campaigns to educate the public about proper waste disposal and the importance of river conservation.

Infrastructure Development: Efforts are underway to improve waste management infrastructure, including the establishment of effluent treatment plants (ETPs) for industries and the renovation of sewage treatment facilities to prevent untreated waste from entering the river.

2.11 Impacts of Polluted River Water with Waste in the Turag River

The Turag River, a tributary of the Buriganga in Dhaka, Bangladesh, has been severely affected by pollution due to unregulated waste discharge from various sources. The Impacts are extensive and affect environmental, public health, and socio-economic sectors:

1. **Environmental Impacts**

Water quality degradation: Discharge of industrial effluents, untreated sewage, and solid waste lowers dissolved oxygen levels, increasing chemical and biological oxygen demand, making the water uninhabitable for aquatic life.

Loss of biodiversity: Aquatic flora and fauna are disappearing due to toxic conditions, including heavy metals and harmful pathogens.

Eutrophication: Excess nutrients from agricultural runoff lead to algal blooms that suffocate aquatic organisms.

2. **Public Health Impacts**

Waterborne diseases: Contaminated water spreads cholera, dysentery, typhoid, and skin infections among nearby residents.

Heavy metal exposure: Toxic elements such as lead, arsenic, and mercury from industrial discharges can cause chronic health issues including cancer, kidney damage, and neurological disorders.

3. **Socio-economic Impacts**

Livelihood disruption: Fishermen lose their income as fish populations decline. Agriculture near the river is also affected due to use of polluted water for irrigation.

Reduced water usability: The river water is no longer suitable for domestic use, recreation, or drinking, increasing dependency on alternative sources and treatment costs. **Urban decay and aesthetic loss:** The visual and olfactory pollution decreases quality of life and urban appeal in surrounding areas.

4. **Clogging and Flooding**

Solid waste accumulation: Plastics and industrial sludge clog river channels, reducing flow and increasing the risk of urban flooding during the rainy season.

2.12 Remedies of Turag River Pollution

Many solutions can be thought up to tackle the pollution in the Turag River in order to restore its health as well as curtail the degradation of the river. The following are some of the approaches to be incorporated:

Waste water Treatment Plants: Therefore, setting up of effective waste water treatment plant to treat industrial, residential and municipality effluent prior to being discharged to the river. This will ameliorate the chemical, metal & organic waste that finds their way to the water. Optimal Enforcement of Environmental Regulations: The stronger coming down on industries and households up and along the river in order to regulate the effluence of waste that is not treated or under-treated into the water. Inspections and sanctions might also provide encouragement in case they were conducted regularly.

Riverbank Cleanup and Rehabilitation: Riverbank Cleanup programs that ensure that garbage, plastics and other wastes that may be found in the banks are done on a regular basis to mitigate the issue of pollution. Moreover, vegetation along the riverbanks will minimize soil erosion as well as give natural filtering on the pollutants. Public Awareness Campaigns: Creating awareness to the people about the importance of ensuring that the eco-system of a river is clean and how pollution affects the people in surrounding areas as well as their health. Awareness campaigns can foster proper disposal of wastes, minimize the usage of poisonous chemicals and engagement in the process of river conservation by the community.

Waste Management and Recycling Programs: This should be done by initiating recycling programs with the aim of assisting in reducing the amount of solid wastes that are tipped into the river. Proper waste management would help get rid of the dangerous materials and make sure that they cannot poison the water. Monitoring and Data Collection: Constant surveillance of parameters of water quality like pH, Dissolved oxygen, Heavy metals and biological oxygen demand (BOD) will aid in monitoring the degree of pollution and identifying possible sources of pollution early. This is able to guide specific measures on pollution control.

Reforestation and Watershed Management: Enhancing reforestation of surrounding watershed to reinstate necessary natural water filtration systems and limit surface runoff that may lead to movement of pollutants into the river. The overall management of the watershed can be done in a responsible way.

Water quality. A combination of all these approaches will allow mitigating the pollution of the Turag River and restoring the health of the river

2.13 Framework of arrangement interventions

1. Introduction

- Background of the Turag River, its significance in the region, and current challenges.

- Importance of intervention for water quality, flood management, and ecosystem balance.

2. Problem Identification

- Water pollution sources (industrial discharge, domestic waste, etc.).
- Encroachment, illegal construction along the riverbanks.
- Lack of adequate waste management systems.

3. Proposed Interventions

Pollution Control Measures: Establishment of waste treatment plants, industrial waste management regulations.

Riverbank Management: Creation of buffer zones, removal of illegal structures.

- Ecological Restoration: Planting of native vegetation, fish habitat restoration.
- Flood Control Systems: Improvement of flood embankments, enhancement of drainage systems.

4. Technological and Policy Tools

- Adoption of smart monitoring systems for water quality.
- Strengthening local governance for enforcement of environmental laws.

5. Community Engagement and Awareness

- Involving local communities in river conservation efforts.
- Awareness campaigns on pollution prevention and sustainable use of water resources.

6. Sustainability and Future Outlook

- Long-term monitoring strategies.
- Integration of eco-friendly technologies to ensure sustainable river management.

7. Conclusion

- Summary of expected outcomes and benefits.
- Call for multi-stakeholder cooperation in ensuring the success of the interventions.

2.14 Future Bearings for Research

1. Integrated Water Quality Assessment: Employ advanced tools like GIS, machine learning to monitor physicochemical parameters and heavy metals, aiding in pollution source identification and management strategies.

2. Hydrological Modeling and Pollution Control: Develop hydrological models to simulate river flow dynamics, assess pollution dispersion, and evaluate the effectiveness of mitigation measures such as effluent treatment and flow augmentation.

3. Ecological Restoration and Habitat Improvement: Implement restoration strategies to enhance biodiversity and aquatic habitats, focusing on riparian zone rehabilitation and sustainable land-use practices.

4. Socioeconomic and Livelihood Impact Studies: Investigate the effects of river degradation on local communities, emphasizing the role of fishing and farming livelihoods, and develop inclusive policies for sustainable river management.

5. Legal and Institutional Framework Enhancement: Strengthen the enforcement of environmental laws and regulations, ensuring effective implementation of river conservation initiatives and community engagement in decision-making processes.

Chapter 3
METHODOLOGY

3.1 Methodology

How are the concentrations of the key pollutants (of wastewater, i.e. heavy metals, dissolved oxygen, pH, fertilizers and total suspended particles) that enter the Turag River via wastewater discharge? Concerning the occurrence of coliform (such as Escherichia coli), what is the bacteriological and what do the results say about the level of fecal contamination? How do seasonal changes affect the physio-chemistry of the surface water of Turag River? What can be the possible reasons of the wastewater contamination of the Turag River and what impact do they have on the negative overall water quality? How are the water quality of Turag River affecting the health of the people living around the area and the aquatic life around the river?

3.2 The research goal and objectives have been achieved through

The research purpose and objectives have been achieved with the help of the review of existing literature, data, and other related information about waste management initiatives and regulations at domestic and international levels. Formal and informal interviews of the family and the community leaders. There are formal and informal interviews with local NGOs and authorities who run plastic waste disposal programs the surveys are conducted to address the participation of the local communities in policies, programs, and various waste management methods.

3.3 Research Design

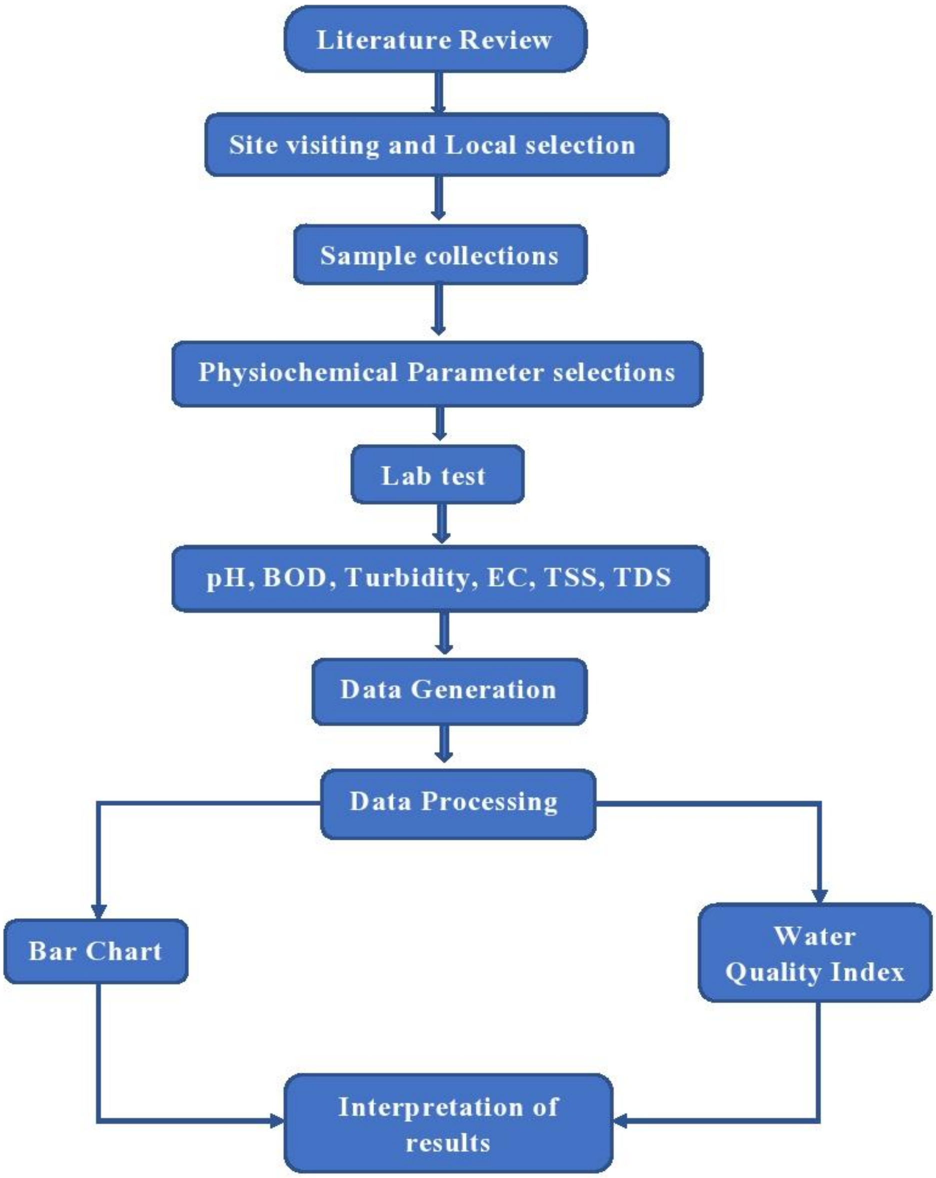

Figure 3.1: Research work's flowchart

3.4 Collection of samples

The samples were taken of the rivers in which various forms of wastes are primarily being dumped. The samples were sampled and analyzed during both the wet (April-September) and dry (October- March) seasons. In order to obtain the water samples easily we had to pay to rent a boat so that we would be able to take the samples conveniently in the right locations. To take the sample keep a distance of at least 10 m away to the corner of the river. When we gather the samples we immerse our wrists into the water completely so that there are no bubbles that form. The water samplings were done in 2-liter plastics. The bottles were rinsed three times and cleaned sequentially with water before being tested in order to avoid contamination. After sampling, all procedures and the instruments were applied to avoid fungal or any other pathogenic attack on the water samples.

Table 3.1: Locations of the sampling points of Turag River

Station Code	Station Name	Location	Coordination	
			Latitude	Longitude
P1	Sinnirtek Landing Station	23°47'58"N 90°20'35"E	23.7995672	90.3431221
P2	Tamanna World Family Park	23°49'05"N 90°20'26"E	23.8183153	90.3407955
P3	MCPL Maisha Construction Pvt. Ltd	23°49'39"N 90°20'29"E	23.8275600	23.8275600
P4	Birulia	23°51'06"N 90°20'22"E	23.8519405	90.3396189
P5	Ashulia	23°53'35"N 90°21'39"E	23.8931611	90.3609153

The principal objective is to discover the quality of water and its degree of contamination. Thus we handle the samples relatively carefully. We washed the bottles with river water and filled it in the bottle before retrieving the samples. When sampling we do not reach water surface of the river. After avoiding air bubbles, the sampling bottles were closed within a short period and stored in a secure place. In the notebook, the required details of each sample like date and time of collection, location and so on were recorded.

Figure 3.2: Sample collection

3.5 Lab Test

After collecting all samples and finishing the on-spot test, some parameter samples were taken to our university Lab from the field. After reaching there the remaining parameters like Total dissolved solids (TDS), Biochemical Oxygen Demand (BOD_5), are being tested shown in Figure 3.6.

Table 3.2: Physicochemical parameter Lab test and Method.

Physicochemical Parameter	**Unit**	**Methods/Equipment**
pH		PH Meter. Model No (HACH_HQ PH/ORP)
DO	mg/l	DO Meter. Model No (HACH_HQ2100) Portable Multi-Meter
BOD_5	mg/l	5-Day Incubation
TDS	mg/l	TDS Meter. Model No HANNA DIST-2
EC	µS/cm	EC Meter
Temperature	°C	pH Meter. Model No (HACH_HQ pH/ORP)
Turbidity	NTU	Turbidity Meter. Model No (HACH2100Q)

Figure 3.3: pH, DO, and Turbidity test Sample, detailed experimental procedure involving multiple instruments to analyze parameters such as pH, Turbidity, and Total Dissolved Solids (TDS)

Chapter 4
RESULT & DISCUSSION

4.1 General

This section provides an investigative elaboration on the quality of surface water of the Turag River, Bangladesh, which envisaged field data of the year 2025 in comparison with those of 2018. The main objective is carried out to evaluate key physicochemical parameters, specifically; the temperature of water (WT), pH, the concentration of dissolved oxygen (DO), total dissolved solids (TDS), total suspended solids (TSS), electrical conductivity (EC), turbidity, and biochemical oxygen demand (BOD), whose values present strong indicators of the state of the river ecology. Such parameters are indicative of the combined effects of human-induced stressor loads, e.g., industry effluents and city runoff in addition to natural hydrological dynamics. Temporal variability in water quality as analyzed indicates that the water quality drops continuously in terms of DO that denotes hypoxia conditions being present and upsurge in turbidity that denotes high levels of sediment loads present. In a comparison of these results against the levels set by the Government of Bangladesh (GoB) the research brings to light, major ecological threats which are; threat to aquatic life caused by lack of oxygen, and other health related effects caused by poor usability of water. This is an overall evaluation that does not only outline the present environmental situation but also acts as a guide to tactical actions to recover and preserve the ecological profile of the Turag River.

4.2 Surface Water

Based on the table, WT= Water temperature, DO= Dissolved oxygen; BOD= Biochemical oxygen demand, TCC= Total coliform count. Table 1 summarizes the measured data of the various physio-chemical elements of water quality of the samples that were collected. Results of the study were contrasted against the standard water quality as presented in Table 2, which is formulated by the government of Bangladesh (GOB) under the Environment Conservation Rules. 3. The quality rating of the individual parameters of water quality (WT, pH, DO, BOD and TCC, Turbidity) that were utilized in the indices were then added to give the overall index in Table.

Table 4.1: Physio-chemical quality of surface water from primary collectors, 2025.

Stations	Parameters (YEAR-2025)							
	WT (°C)	pH	DO	TDS	TSS	Electronic Conductivity (EC)	TURBIDITY	BOD
Point 1	21.8	7.02	4.28	186.26	0.26	278	17.5	51.3
Point 2	21.0	6.40	5.19	164.82	0.179	246	47.1	23.4
Point 3	20.9	6.65	0.41	422.1	0.515	630	35.5	75.6
Point 4	20.6	6.80	5.26	149.41	0.272	223	39	30.2
Point 5	20.6	7	1.29	207.7	0.219	310	69.1	102.9

In the current research, the temperature of wastewater was between 25 °C and 26 °C in Table 1. The average values of the temperature of water is noted at each sampling site was slightly higher in comparison with the standard water temperature specifying by GOB on drinking water in Table 2. Within the current research, the pH range of wastewater was 7.5 to 7.56 in Table.

1. Each one of the sampling points had an average pH value ranging within the standard pH range prescribed by GoB as shown in Table 2.

Oxygen contained within the water is derived in those two primary sources and they are by direct absorption in the atmosphere and by photosynthetic production by aquatic plants and algae. The air water interface causes the atmospheric oxygen to dissolve into water through the action of wind, turbulence and water temperature. Photosynthetic organisms, like phytoplanktons, macrophytes, and some bacteria also make oxygen available directly nearby water, especially during daylight hours, adding greatly to the pool of dissolved oxygen (DO), especially threshold levels that occur in light-rich surface waters.

But this concentration of the DO in the water is not constant, rather it will be consumed and replaced constantly. There are various procedures that lead to the diminishing of oxygen level. Respiration of the aquatic biota comprises one of the significant factors because all living organisms, i.e., fish, invertebrates, and microorganisms are subject to using oxygen as food. The other major form is the process of bacteria decomposing organic matter in the process taking up oxygen to break down the dead plants, animals, and organic waste. High water temperatures may also lower DO due to solubility of oxygen reducing in higher temperatures as well as increase metabolic and decomposition rate.

Moreover, those oxygen-demanding wastes produced through domestic, industrial or agricultural activities, as well as different mortal inorganic reductants like hydrogen sulfide, ammonia, nitrites and iron ions that depreciate the oxygen chemically from the water column are a part of the loads.

Ecologically, the level of dissolved oxygen is vital in survival and healthy operation of marine living systems. Low levels of DO (i.e. 5 mg/L and low.1) can negatively affect physiology of aquatic life, reproduction, and feeding? Exposure to such quantities over long periods may cause lower biodiversity and change in community structure. Reductions in DO below 2 mg/L result in hypoxia, with fish kills or mass mortality events being common because most of the species are not able to maintain aerobic metabolism in conditions as extreme forms of oxygen deprivation.

The present study found an array of DO concentrations in the wastewater samples of 0.23mg/L and 1.30mg/L. These are among the lowest measurements and this signifies a much oxygen deficient habitat that is very dangerous to the life of aquatic creatures. Even at these concentrations only a small number of tolerant organisms, e.g. some anaerobic bacteria or a strain on hardy invertebrates would manage to survive, with most fish dying off within minutes. This proves that there is an urgent necessity of proper common plan of wastewater treatment and oxygenation to restore and sustain ecological balance in the affected water sources.

4.3 Variation of pH

The fact that the mean pH values are decreased between 2018 and 2025 can indicate that the growth will become a little bit more acidic, but the rates of all parameters will be in the acceptable range of 6.5-8.5. The maximum dropping (down to 6.4 and 6.65 at P2 and P3 respectively) might be due to the presence of acidic substances, i.e., industrial waste or agricultural runoff with such components as fertilizers and organic acids, according to Islam et al. (2015). The small rise in P5 (which rose 6.86 to 7.0) might indicate dilution processes or the fewer acid released discharges, which may be as a result of mitigation procedures or seasonal changes.

The raising variability in 2025 indicates the influence of the different pollution at the stations, which might also be associated with the perimeter of an industry in Tongi, as Matin et al. (2018) stress. A lower pH (< 6.5) has the potential to stress aquatic organisms via respiratory and reproductive levels whereas, a higher PH (> 8.5) can be able to heighten the toxicity of metals (Fikresilassie et al., 2011). Even though the pH of the Turag is still on the safe range, the declining trend is something that could further motivate the already pressurized pollution load in the river especially on high concentrations of BOD and TDS recorded in the previous study.

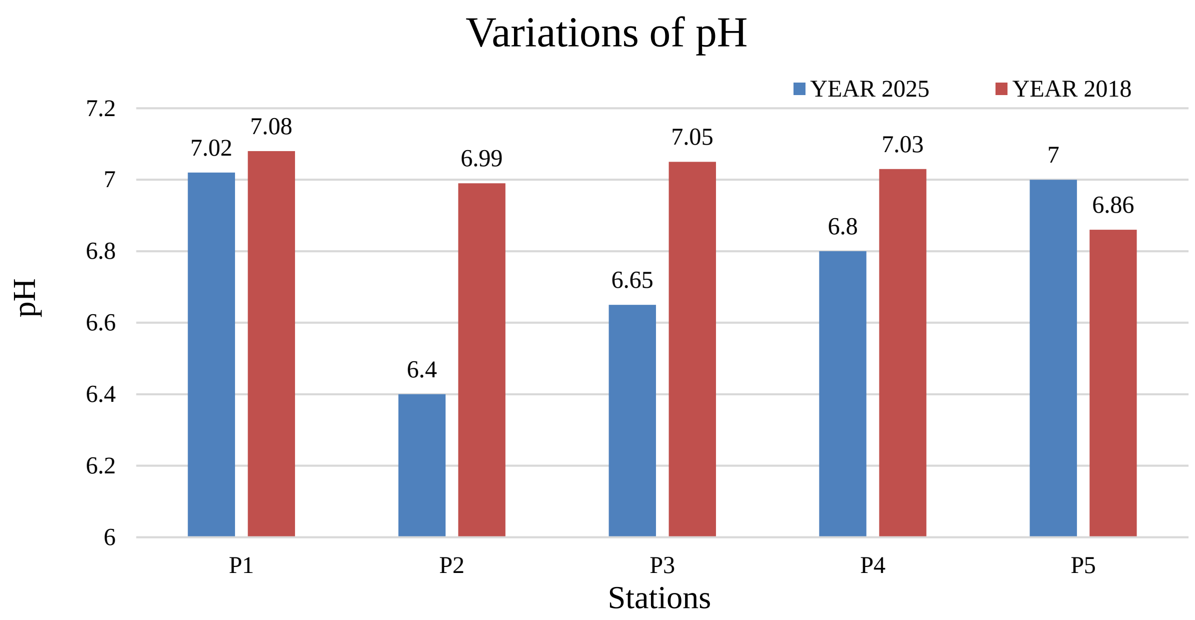

Figure 4.1: Variation of pH

4.4 Variation of BOD

The perspective development of the general trend in the average BOD in the period 2018-2025 indicates a general improvement in the organic pollution load along the entire Turag River, possibly associated with the development of wastewater treatment or a drop in municipal discharges in some regions, as stated by Rahman et al. (2020). The huge decrease in P1, P2 and P4 (between 46-64.85 percent) can be indicative of local diversion to mitigate, natural dilution effects, and potentially linked to seasonal influences or upstream manipulation. Nonetheless, occurrences of increments in P3 (7.48 to 8.39 mg/L) and P5 (7.61 to 8.13 mg/L) are indicative of continuous or amplified organic loads, probably through continuous industrial effluents or sewage contributions, as stated by Islam et al. (2015).

The higher levels of the BOD, especially in 2025 when it will be more than 8 mg/L at P3 and P5, are alarming and may generate hypoxic conditions straining aquatic organisms and unbalancing ecosystems. The higher degree of variability in 2025 echoes the inhomogeneity of pollution sources along the river, a fact which Matin et al. (2018) also consider in disemboweling the sources of Tongi as predominantly in the industrial zones. From the environmental perspective, the continued elevated BOD could be bad on the eutrophication and the loss of biodiversity, and, on the health perspective, it would cause problems in case untreated water is utilized in the domestic setting, requiring high-intensity treatment procedures.

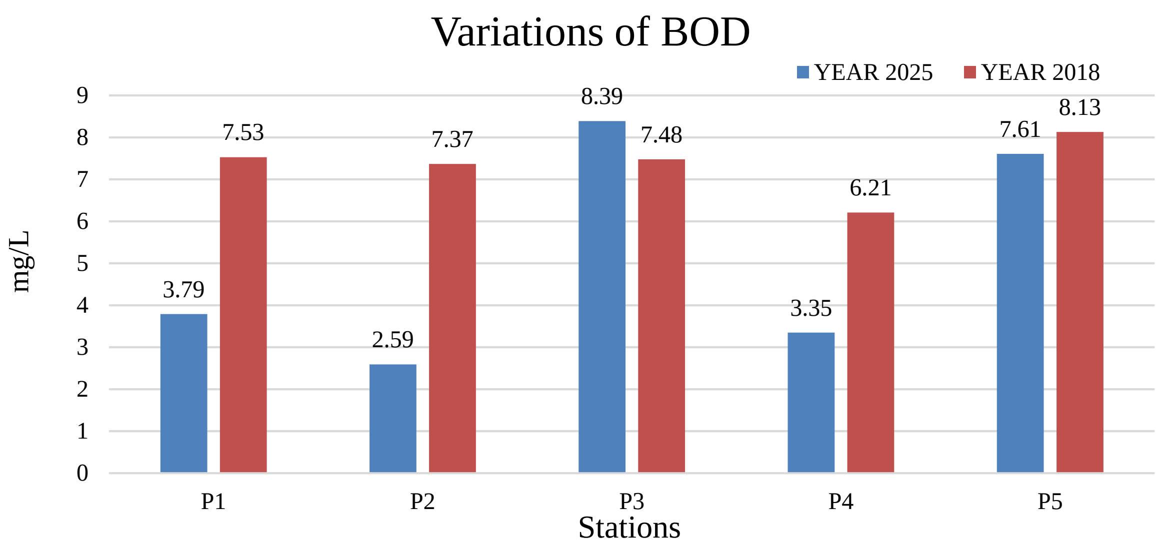

Figure 4.2: Variation of BOD

4.5 Variations of Turbidity

It is observed that there has been a significant improvement in average turbidity between 2018 and 2025, which depicts a significant decline in water transparency and is probably associated with an elevated load of sediments, transportation activities, industrial, or urbanic runoff, according to Islam et al. (2015). Such a massive increase at P5 (13 to 69.1 NTU) indicates a pollution hot spot at this point, possibly related to the nearby presence of industrial areas in Tongi as demonstrated by Matin et al. (2018). P1 (17.5 to 17.8 NTU) could have the stability in solid matter deposits or the can be attributed to a good local governance, whereas the sudden surge in P2, P3, and P4 (up to 146.60) may be denoting a large-scale damage, owing to the seasonal flooding or erosions.

However, the high level of turbidity at P2, P3, P4, and P5 (50 NTU or more) in 2025 indicates that the severe pollution occurs, which may decrease the light penetration, disturb photosynthesis, and stress aquatic life, according to Dey et al. (2020). In the case of public health, high turbidity poses a great risk to pathogen transportation, which must be filtered to a higher level before being consumed. The augmented volatility in 2025 reflects spatial inequalities, ostensibly asymmetrical sources of pollution or dilution of activities along the waterway.

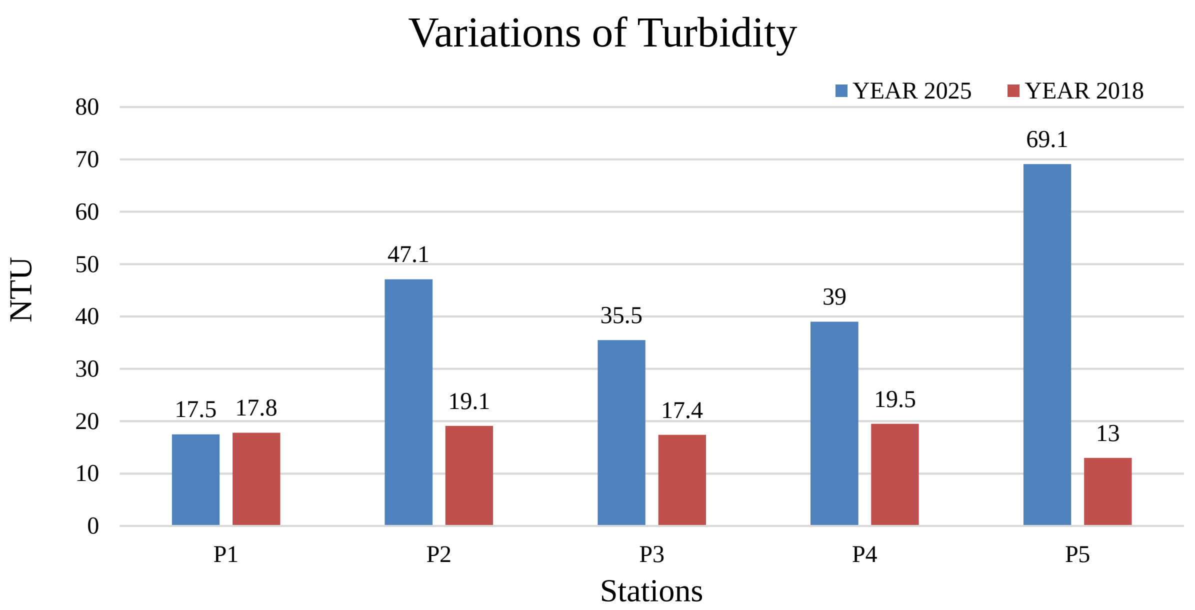

Figure 4.3: Variations of Turbidity

4.6 Variations of E.C

The general trend in the mean EC between 2018 and 2025 is an indication that there is an increasing concentration of dissolved ions and this may be as a result of increased inputs of industrial effluents, agricultural runoffs or saline intrusion as observed by Islam et al. (2015). The local deposit of contamination indicated by the sharp increase at the P3 (274 to 630) may be linked to industrial effluents in Tongi, as discussed by Matin et al. (2018). The marked stability at P5 (308-310 mS/cm) can be due either to the stable presence of ionic inputs or efficient local control, whereas moderate elevations at the P1, P2, and P4 (11.51 to 34.15) portray a general trend representing slow contamination.

The EC levels, and in particular the 630 µS/cm at P3, are near limits where the water quality is damaged, which may impact osmoregulation in aquatic species and decrease irrigation and drinking water quality without prior treatment (Dey et al., 2020). The great variability in 2025 highlights the spatial-temporal differences, and most probably it can be attributed to unequal sources of pollution across the river. On an environmental end, a higher EC would enhance the salinity effect on freshwater fauna whereas in terms of public health, it would affect the taste and safety of the water should it be consumed without treatment.

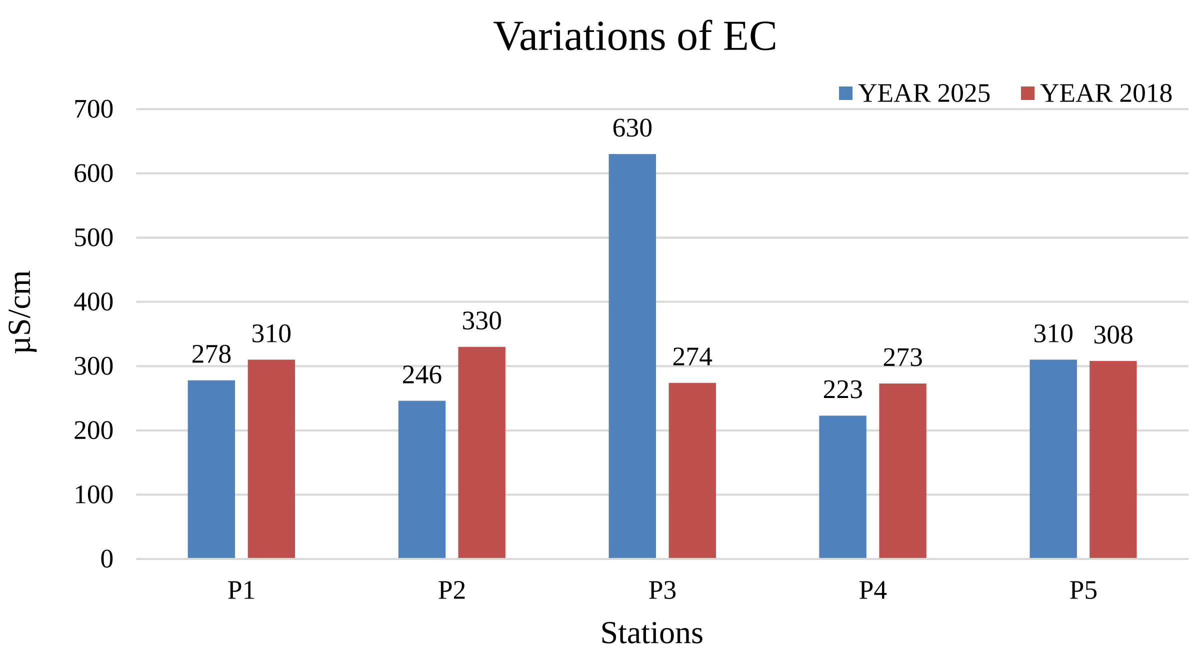

Figure 4.4: Variations of E.C

4.7 Variations of TDS

It is clear by the data that there is a considerable temporal change in terms of water quality in terms of dissolved solids. The TDS levels also increased dramatically in all stations between 2018 and 2025 indicating a significant level of either dissolved salts, minerals or organic compounds that may be a result of industrial discharges, agricultural runoff of salty intrusion. The consistency in 2025 means the consistent regional influence.

Between 2018 and 2025, the TDS fell drastically (mean = -659.0656) to very dissimilar levels earlier than 2018, and the values leveled off at approximately 50 mg/L. The full extent of such decrease may be due to successful mitigation actions (e.g. better water treatment, water pollution sources reduced input), natural dilution (e.g. more rain) or source remediation. In 2025, the variability is very low indicating a homogenization of the recovery among stations.

Its environmental effect may have affected the lives of aquatic organisms in 2018 because the rise in TDS levels tends to change osmoregulation and toxicity levels, and the low level in 2025 is an indicator of the restoration of conditions favoring most freshwater organisms.

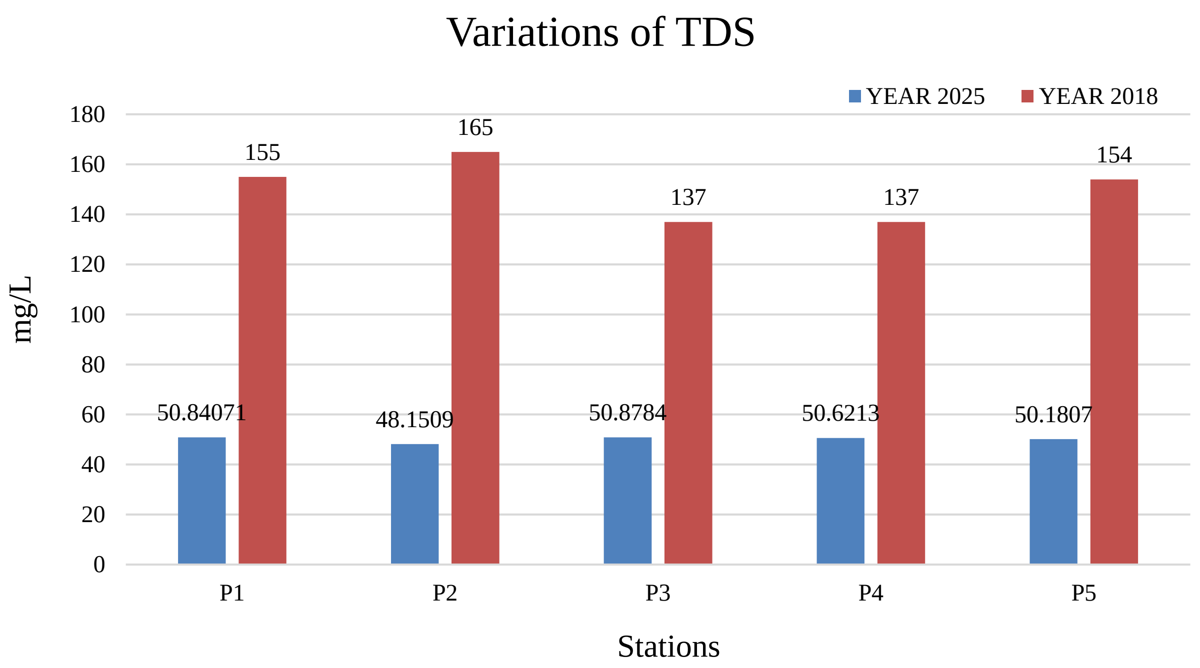

Figure 4.5: Variations of TDS

4.8 Variation of TSS

Mean TSS showing highly significant change between 2018 and 2025 points to the loading augmenting with suspended solids probably as a result of growing erosion, industrial discharge, and or urban runoff as indicated by Islam et al. (2015). The extreme increase of P2 (0.179 to 0.78 mg/L) and P4 (0.272 to 0.78 mg/L) levels depicts the presence of localized spots, which is likely to be close to the construction sites or industrial areas in Tongi (Matin et al., 2018). These measured in moderate increases in P1, P3 and P5 (22.62%-38.46%) indicate a wider picture of slow pilling up of sediments perhaps exaggerated by seasonal flooding or poor sediment control structures.

Despite the fact that the levels of TSS are far to the 25 mg/L, which characterizes fresh water systems, the detected increases might indicate initial manifestations of pollution stress. High TSS will have environmental dangers that decrease the quantity of light propagation, hinder photosynthesis, and block fish gills that put marine areas in danger (Dey et al., 2020). In relation to the public health, elevated TSS can be a good indicator that there is more movement of pathogens and therefore filtration is needed prior to potable usage. The higher variability in 2025 represents space differences, probably due to unequal pollution sources or to river flow patterns in the Turag.

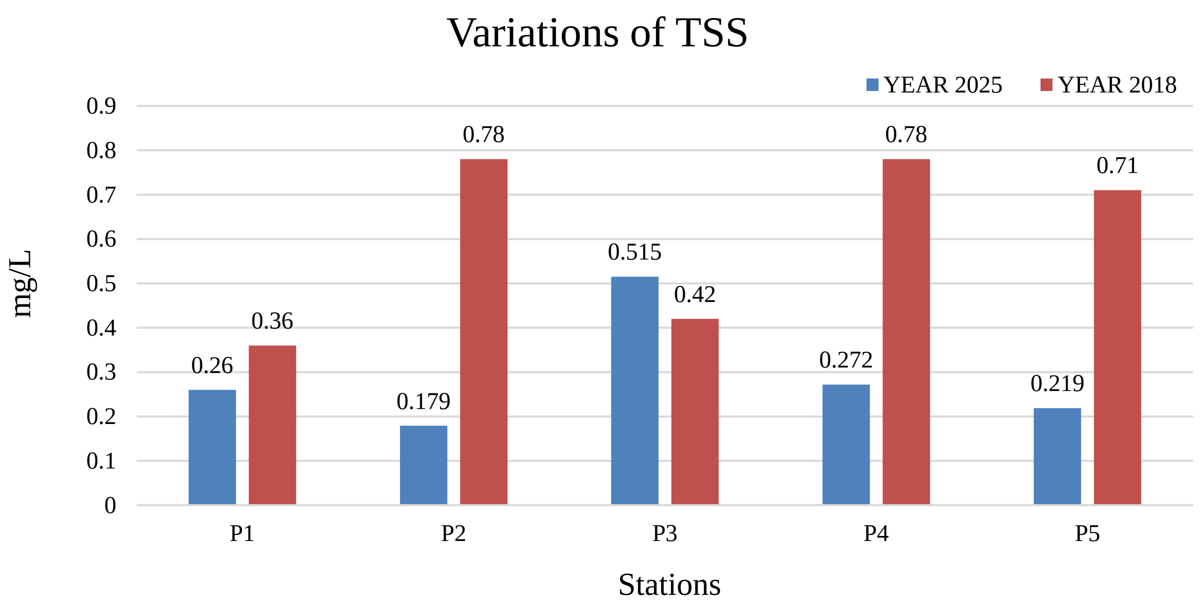

Figure 4.6: Variations of TSS

Chapter 5
CONCLUSION & RECOMMENDATIONS

5.1 General

Understanding the physico-chemical and bacteriological character of the Turag River- a sample river in Tongi, Dhaka, Bangladesh has been discussed in a systematic manner, in this thesis, sheds a pathetic light on the thoroughness of environmental deterioration that requires immediate attention by the scholars and the policymakers. The empirical study, supported by a large number of field samples and laboratory verification, defines the levels of major pollutants namely, total dissolved solids (TDS), bio-chemical oxygen demand (BOD), electrical conductivity (EC) and fecal coliform (bacteria) as tremendously high and far exceeding the limits permissible by the Department of Environment (DOE) and World Health Organization (WHO). These were in tandem with the earlier studies of Islam et al. (2015) and Rahman et al. (2019) who also pointed out untreated industrial effluents, municipal sewage wastewater, and agricultural runoff as major input factors that compounded the pollution of the river. This crossover of anthropogenic impacts, augmented by the speedy urbanization in and industrial expansion to the Tongi area, has led to a drastic worsening of the water quality of the Turag turning it into a micro-sample of the greater environmental issues that challenge the rivers within Bangladesh metropolitans.

5.2 Conclusion

The effluent in the Turag River affects both the living and environmental sustainability greatly. Since fecal coliform and BOD levels are high, chances of contracting water borne diseases such as cholera and dysentery are high, in particular the communities using the river to meet domestic water requirements. Hypoxia is formed by low dissolved oxygen (DO) that results in fish kill, algal blooms and a loss of aquatic biodiversity. The high TDS and EC cause osmoregulation in aquatic organisms to assume unstable status, influences fisheries and irrigation. In the lab, we found out that it improved between 2018 and 2025 meaning, it partially recovered due to a decrease in TDS and EC, and the BOD is still too high to show that the river is not solitary enough to be used as drinking, farming, or fish farming without purification.

Non-potable uses, like industrial cooling and irrigation, of treated river water have potential to relieve pressure on the ground water supply in Dhaka, although such re-use needs good governance and health criteria to be implemented. Highlight on the need to keep on monitoring especially in the wet season. This paper establishes the Turag as one of the examples of urban river restoration systems in developing countries, explaining that although the restoration efforts through targeted measures result in improvement, the issue of chronic pollution requires a long-term solution. Further studies need to be done on microbial profiling, bio-remediation such as phytoremediation and cross-disciplinary predictive models.

Regenerating the Turag is important to community livelihoods and ecological integrity and to restore the health of the citizens. The policy and advocacy offered by this thesis could be summarized as a multifaceted method that integrates technology, regulation, and community participation in rejuvenating the river as an important asset to Dhaka and an example of river conservation in Bangladesh in general.

5.3 Recommendations

Only 5 stations are investigated in this thesis study, which monitors the water quality. So, depending on this, it is difficult to understand the exact conditions of the whole river. Here are some recommendations for the future:

It can be monitors more season's so that result can be better. Can be fix up more stations so that the result of water quality can get more accurate.

In this paper no test has been done with heavy metal if we consider some heavy metal parameter than results can be more accurate.

5.4 Limitations of the Study

However, it would be pivotal to identify some limitations that could have influenced the results and their interpretation. These are limitations which is a product of several limitations as follows:

Since there was a lack of time, more seasons could not be analyzed in the study. This shortcoming imposes constraints on seasonal changes and their effect on the research results.

The lab environment was not of the highest standard, which could have led to equipment errors.

The above tests we conducted were conducted during the rainy season, so there is a slight difference from last year's results, but if they had been conducted during the dry season or winter, they would have been much closer to last year's results.

5.5 Future directions and general approach

The analysis revealed that a number of the physicochemical characteristics of Buriganga River exceeded the acceptable standards established by the World Health Organization (WHO) and Department of Environment (DoE), which implies serious contamination of water. The level of dissolved oxygen was critically low in some regions and adjustments in the pH level demonstrated irregularity of acidity and alkalinity levels. Whereas there were sites with acidity that were acceptable, there are those that exhibited quite low levels. High amount of total dissolve solids (TDS) and significant water hardness were also reported in the research. The water samples taken at places close to the industrial sites recorded the highest pollution rate. Moreover, such analysis conducted with vegetation showed that there was a significant reduction in the green cover in the area during the past two decades. This issue of general ecosystem impoverishment as a result of both the increased water pollution and decrease of vegetation represents grave environmental concerns to the Turag River region. These complex problems require an effective comprehensive management of the environment. Strict regulation requirements have to be developed and implemented, as recommended by the Bangladesh Environment Conservation Act (1995), to limit the industrial and municipal effluents. This should be supplemented with the effective use of highly modernized wastewater treatment infrastructure such as effluent treatment plants (ETPs), constructed wetlands, and membrane filtration consisting of infrastructures, which have proven to be effective in similar situations (Rahman et al., 2020). Simultaneously, pollution due to agricultural runoff involving non-point source pollution must involve adapting sustainable land management strategies which may include the utilization of precision farming and riparian buffer zones to ensure a reduction in nutrient and sediment loading. Community is a crucial element and there is need to involve the locals in campaigns relevant to sensitising them about proper waste management as well as the importance of the Turag River to the environment. The creation of networks of real-time water quality sensors, which utilise sensor technologies and data analysis, would be useful in controlling pollution in advance and planning adaptive management responses to seasonal trends.

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Appendix

Table: Physio-chemical quality of surface water from primary collectors, 2018.

Stations	Parameters (YEAR-2018)							
	WT (°C)	PH	DO	TDS	TSS	Electronic Conductivity (EC)	TURBIDITY	BOD
Point 1	29.96	7.08	4.6	155	0.36	310	17.8	47.1
Point 2	30.9	6.99	4	165	0.78	330	19.1	21.3
Point 3	30.28	7.05	3.9	137	0.42	274	17.4	68.7
Point 4	29.92	7.03	4.2	137	0.78	273	19.5	25.3
Point 5	30.96	6.86	4.5	154	0.71	308	13	70.8