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Evaluating Water Quality of Dhaka's Urban Rivers: Buriganga and Turag

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Abstract

The Buriganga and Turag rivers are two of the major water bodies surrounding Dhaka City, the capital of Bangladesh. The rivers have been suffering from various hazardous discharges from various points and non-point sources such as industrial effluents, municipal and solid waste. The physicochemical water quality parameters are a major concern for these rivers. In this study, water quality parameters such as pH, turbidity, dissolved oxygen (DO), alkalinity, total solids (TS), total dissolved solids (TDS), total suspended solids (TSS) and chloride was compared with the standard permissible limits by conducting a series of laboratory tests. Samples collected from several points of the both rivers, Specifically, Amin Bazar, Diabari Ghat and Sadar Ghat were the location of this current study. It was observed from the findings that the Turbidity (16.99–38.7 NTU), TSS (20–100 mg/L) and chloride levels in the sample water exceeded recommended standards. The DO levels (3.0–3.7 mg/L) were considerably below the acceptable range according the standards. The overall findings showed substantial degradation of pH and TDS levels although their values were found within the permissible limits. There are a varied number of aquatic life communities on these water bodies who are heavily dependent on it and the findings indicate there are significant risks due to pollution. The study recommends the application of effluent treatment plants (ETPs) to enhance wastewater management to mitigate these issues. Furthermore, the potential of surface water from rivers and ponds as a practical replacement for groundwater warrants further investigation.

Keywords: *Buriganga river, turag river, physicochemical parameter, water quality.*

1. Introduction

One of the most significant general public health issues of the twenty-first century is ensuring that every person has access to clean and safe drinking water. According to a current estimates, more than two billion people lack access to regularly safe water sources [1]. Thus, a large population is vulnerable to waterborne diseases and reduced quality of life in addition to heightened mortality. This problem is particularly complicated in developing countries. Groundwater is highly polluted by different materials such as naturally occurring toxins, most notably arsenic (As), iron (Fe), and manganese (Mn) in Bangladesh where it serves as the main source of drinking water [2]. Groundwater becomes unsuitable for drinking without specialized and often costly treatment methods due to these pollutants. There is scientific and policy interest in examining surface water for these reasons. River water could be an alternate source of water, provided its microbial and organic pollutants can be properly managed. The overall health of aquatic ecosystems, including the organisms they support, is directly influenced by physicochemical and biological water quality [3]. In the context of Dhaka, Bangladesh, both the Turag and Buriganga Rivers, despite their potential as alternative water sources, are significantly impacted by untreated household and industrial waste [4].

Thus, the objective of this study is to assess the potential of using Buriganga and Turag river water as safe drinking water by comparing the major quality parameters to the national standards and in favor of SDG 6 on clean water and sanitation.

2. Materials and Methods

To obtain the representative variations in pollution load and hydrodynamic conditions, three sampling points were chosen for both rivers Buriganga and Turag on 23rd March 2024. For the Turag River, samples were taken near Amin Bazar Bridge and Diabari Ghat. Sadar Ghat was the sample collecting location for the Buriganga River. The samples were labelled as Sample-1 (Amin Bazar), Sample-2 (Diabari Ghat), and Sample-3 (Sadar Ghat) for laboratory water quality parameter analysis.

Climatic and hydrodynamic characteristics of the study area were considered when evaluating sample quality. Observed climatic conditions such as rising temperatures and siltation were noted due to their influence on riverine water quality. Hydrodynamic observations indicated dark, odorous water with visible floating materials in both rivers. Pollution sources contained untreated industrial effluents, agricultural runoff, and municipal wastewater discharges[5].

Each water sample was subjected to a series of physicochemical tests following standard laboratory procedures. The parameters measured included are provided below with their corresponding units:

- pH (hydrogen ion concentration)
- Turbidity (NTU)
- Dissolved Oxygen (DO) (mg/L)
- Carbon Dioxide (CO_2) (mg/L)
- Alkalinity (mg/L)
- Chloride (Cl^-) (mg/L)
- Total Solids (TS) (mg/L)
- Total Dissolved Solids (TDS) (mg/L)
- Total Suspended Solids (TSS) (mg/L)

Water Quality Standards according to Bangladesh standard and WHO standard are presented in Table-1.

Table 1: Water Quality Standards according to Bangladesh standard and WHO standard

Parameters	Unit	Bangladesh standards	WHO standards
pH		6.5-8.5	6.5-8.5
Turbidity	NTU	5	1
DO	mg/L	6	--
Alkalinity	mg/L	100	--
Chloride	mg/L	150-600	250
TDS	mg/L	1000	600
TSS	mg/L	10	--

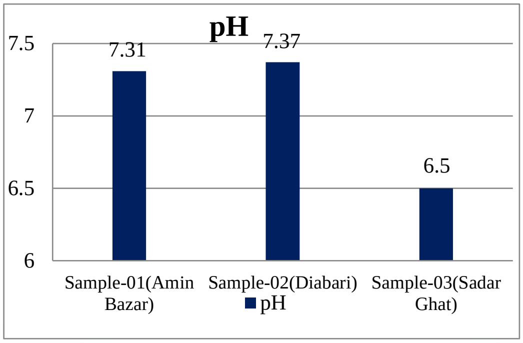
3. Results and Discussion

It is evident from the findings that the physicochemical water quality parameters analysis in the laboratory standard tests such as pH, turbidity, dissolved oxygen (DO), carbon dioxide (CO_2), alkalinity, chloride, total solids (TS), total dissolved solids (TDS), and total suspended solids (TSS) of the both Buriganga and

Turag rivers provides a comprehensive scenario of the present water quality conditions. It was further found that there are considerable variations in these indicators where the samples were taken from multiple locations along both rivers. Furthermore, it shows the effects of the pollution sources surrounding the river systems. Contamination from industrial discharges, municipal wastewater, and urban runoff, and other various point and non-point sources poses heavy risks to aquatic ecosystems and human use as there is found an increase in turbidity, reduced DO, increased CO_2 concentrations, and higher levels of solids and chloride.

In Figure 1 the pH values measured at the three sampling locations varied across the Turag and Buriganga rivers as shown graphically. The Turag River samples recorded pH levels of 7.31 at Amin Bazar and 7.37 at Diabari. This shows a slightly alkaline condition. In contrast, the result from Buriganga River indicates slightly acidic water at Sadar Ghat where a pH of 6.50 was found.

All values fall within the general surface water guideline range of 6.5–8.5, suggesting no extreme deviation in acidity or alkalinity. Although the Buriganga sample exhibited a lower pH, the overall variation among the sites is small and unlikely to affect the major physicochemical



properties of the river water.

Figure 1: Comparison of pH Values

Figure 2 represents the Turbidity levels across the three sampling sites. The graphical representation shows that the Turag River recorded values of 20.8 NTU at Amin Bazar and 16.99 NTU at Diabari. Comparison shows that these results exceed the surface water standard of 10 NTU [6]. The Buriganga River sample at Sadar Ghat exhibited a significantly higher turbidity of 38.7 NTU. This value is the highest in the Turbidity results. It is concerning that all values surpass the acceptable limit and this further suggests notable contamination from suspended solids.

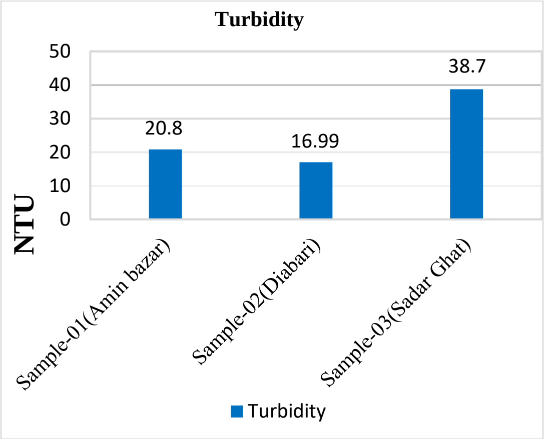


Figure 2: Turbidity value in three situations.

DO levels were found to be significantly below the recommended 6 mg/L [7] across all sampling points which is illustrated in Figure 3 in the manuscript. The results show limited oxygen availability as in the Turag River as the concentrations were 3.7 mg/L at Amin Bazar and 3.0 mg/L at Diabari. The Buriganga River sample at Sadar Ghat showed a similarly low value of 3.4 mg/L. Overall, these reduced DO levels represent organic pollution and poor water quality.

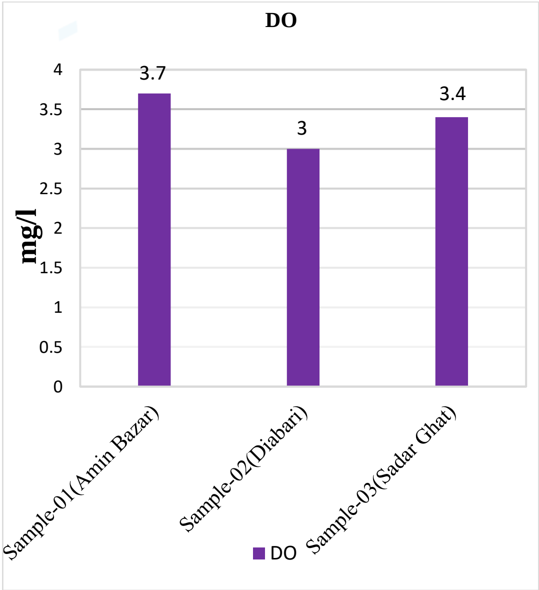


Figure 3: Comparison of DO Values

Figure 4 presents the laboratory finding for Carbon dioxide (CO_2) along with all sampling points. Higher levels of this parameter in water can increase water acidity. This condition can affect aquatic life, and indicate high organic decomposition. Surface waters typically contain less than 10 mg/L of free CO_2 [8] . In this study, all sampling points exceeded the recommended range of 0–8 mg/L. In the Turag River, CO_2 concentrations were 13.3 mg/L at Amin Bazar and 15.4 mg/L at Diabari, indicating noticeable enrichment of dissolved carbon dioxide. The Buriganga River sample at Sadar Ghat showed a high value of 24.2 mg/L,which means significant organic pollution and high microbial respiration. These higher CO_2 levels reflect poor water quality conditions in the Buriganga River.

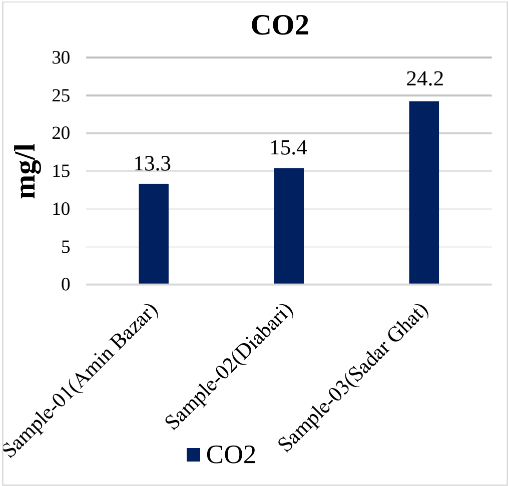


Figure 4: Comparison of CO_2 Values

Figure 5 showed the value for Alkalinity. For assessing the buffering capacity of water this parameter is needed. This helps resisting changes in pH and maintains a stable environment in the water. Bicarbonates, carbonates and hydroxides present in water are the primary sources of this parameter. A level of Alkalinity is 50 mg/L at Amin Bazar and 345 mg/L at Diabari for the Turag River. The water samples of Buriganga River at Sadar Ghat showed 360 mg/L. This river shows a high buffering capacity. All the values fall within the general surface water guideline of 30–400 mg/L [10]. However, the higher levels at Diabari and Sadar Ghat could affect water quality and aquatic ecosystems.

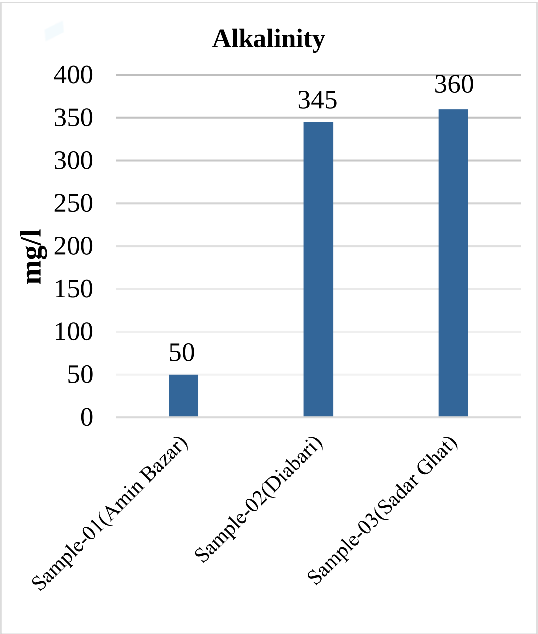


Figure 5: Comparison of Alkalinity Values

A comparison among Total Solids (TS), Total Dissolved Solids (TDS), and Total Suspended Solids (TSS) is demonstrated in Figure 6**.** The presence of dissolved and suspended materials that can affect aquatic life can be detected by these parameters. In this study, TS levels were 820 mg/L at Amin Bazar, 810 mg/L at Diabari, and 530 mg/L at Sadar Ghat. All the values exceeded the typical surface water reference of 300 mg/L [11]. Similarly, TDS concentrations were also high, 720 mg/L at Amin Bazar, 790 mg/L at Diabari, and 450 mg/L at Sadar Ghat. Additionally, some values were also found above the 500 mg/L standard for surface water. TSS values were tested 100 mg/L at Amin Bazar, 20 mg/L at Diabari, and 80 mg/L at Sadar Ghat. These values are exceeding the standard limit of 10 mg/L [11] in several locations. The result is the direct indication of the significant contamination from urban runoff.

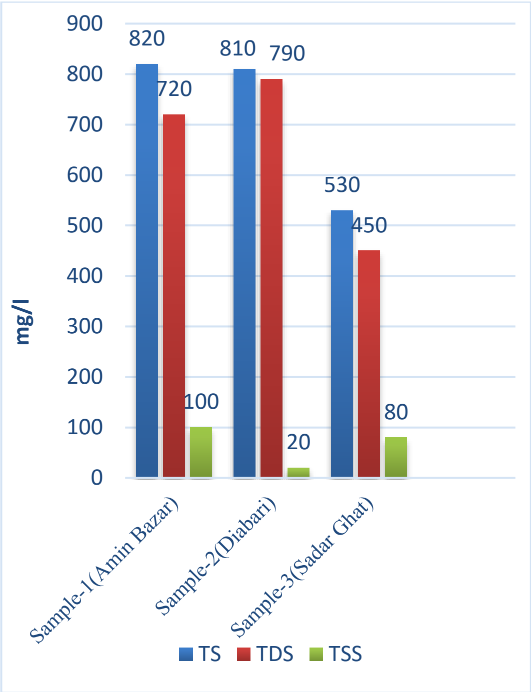


Figure 6: Comparison of TS, TDS, TSS

The evaluation of pollution levels in the study area, based on key physico-chemical parameters and conducted in the laboratory using standard testing methods, reveals significant deterioration in water quality. The findings reveal, the maximum, minimum, and average pH values were found to be 7.37, 6.50 and 7.06, respectively. Slight variations of acidity are evident. Turbidity levels varied between 16.99 and 38.7 NTU. The mean was found 25.49 NTU. Dissolved oxygen (DO) values were extremely low as the range was 3.0 to 3.7 mg/L (average 3.36 mg/L). It is an unfavorable condition for aquatic life that could be concludes based on these results. Substantial dissolved pollutants are present in the water as the average of the Total dissolved solids (TDS) was found 653.33 mg/L. It remained within standard limits. Total solids (TS) values (530 and 820 mg/L) also suggest the presence of significant solid contaminants.

Comparison with previous study: A study conducted by Khan et al. [12] in the Buriganga and Turag rivers collected water samples from five locations in each river. The researchers also collected samples from Diabari Ghat. In the present study, Diabari Ghat (Sample 2) was likewise selected as a sampling site. A comparison between the present and previous studies is presented in Table 2. The results indicate that the findings of the present study are consistent with those of the previous study.

Table 2: Comparison with previous study

Parameter	Present study findings (Sample -2)	Previous study [12]
pH	7.37	7.1
Turbidity (NTU)	16.99	16.2
DO	3	--
CO2	15.4	13.8
Alkalinity	345	250
TDS	790	734

Suitability of this study: The study is highly applicable to evaluating the status of the Buriganga and Turag rivers, as it measures important water-quality parameters that directly determine whether surface water is safe to use. The study, through the measurement of turbidity, DO, pH, TDS, solids, CO2, and others against national standards, gives a good scientific foundation of the evaluation of the potential of rivers to serve as alternative drinking water in particular locations where groundwater is polluted. SDG 6 (Clean Water and Sanitation) is related to this study because it helps to improve water safety, pollution control, and inform sustainable management of the water resource. This renders the study environmentally pertinent and crucial to the provision of national objectives on water security.

4. Conclusion

The evaluation indicated that the Buriganga and Turag rivers were highly contaminated with some of the significant parameters surpassing tolerable levels of safe usage. The water was highly polluted by particulate matter as the turbidity was found between 16.99 and 38.7 NTU which was way above the normal level of 10 NTU. The range of the dissolved oxygen was obtained between 3.0 and 3.7mg/L against the 6mg/L standard. It indicated excessive organic pollution. Total dissolved solids fell between 450 and 790 mg/L and total solids fell between 530-820 mg/L, which showed high concentrations of dissolved and suspended pollutants. There were also high carbon dioxide levels (13.3-24.2 mg/L) and high alkalinity up to 360 mg/L, which implied high buffering but considerable contamination inflows as well. In spite of the fact that the pH levels (6.50-7.37) were in the acceptable 6.5-8.5 range, other parameters showed significant degradation. Comprehensively, the results are valid to the fact that rivers have deteriorating water quality as a result of untreated industrial discharge, domestic wastewater and urban runoff. The enhancement of wastewater treatment, the establishment of effluents standards and better monitoring of rivers are the necessary measures to safeguard people and the sustainability of ecosystems, which is also in line with the SDG 6: Clean Water and Sanitation.

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Declaration of generative AI use

The authors used generative artificial intelligence (AI) solely for language editing and grammar improvement. The AI tool did not contribute to the analysis, interpretation or generation of scientific content. All intellectual content, conclusions and results were created by the authors.

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