Observation of Water Quality of Buriganga River and Different Lakes in Dhaka City

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A Thesis Submitted to the Department of Civil Engineering,
Daffodil International University in Partial Fulfillment of the Requirements for the Degree of

Bachelor of Science in Civil Engineering

Department of Civil Engineering

Daffodil International University

12th February 2024

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DECLARATION

The dissertation entitled "**OBSERVATION OF WATER QUALITY OF BURIGANGA RIVER AND DIFFERENT LAKES IN DHAKA CITY**" has been performed under the supervision of **Md. Masud Alom** (Assistant Professor) Department of Civil Engineering, Daffodil International University, Dhaka, Bangladesh, and got permission in partial completion of the requirement for the Bachelor of Science in Civil Engineering. To the best of our knowledge, the thesis contains no materials previously published or written by another individual except where due reference is prepared in the capstone itself.

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ABSTRACT

The Buriganga River is a vital source of water for the city, supplying water for residential, commercial, and agricultural uses. Even while they might not be direct sources of municipal water supplies, lakes like Uttara, Hatirjheel, and Dhanmondi can however help with local water availability and irrigation for surrounding communities. The river and other lakes in Dhaka city's water quality were evaluated and compared through a thorough investigation that is presented in this paper. The river and other nearby lakes become contaminated for a variety of causes; the primary cause of the pollution is industrial chemical waste. Here, we collected the water from these locations and examined a wide range of parameters, such as pH, BOD, COD, DO, and Turbidity. Seasonal changes are noted once a thorough investigation of these factors is conducted. This study was conducted to differentiate the water quality of three different lakes in Dhaka City and Buriganga River in two different seasons. Additionally, we compared the water quality of the Buriganga River and selected lakes. In this study, we have checked the water quality by the standard of WQI and determined the effect size of every parameter by using Cohen's d. According to the study, the summer and winter seasons' pH values are restricted to 7.2 to 7.6. However, BOD, COD, Turbidity, and DO values vary greatly. During the summer, the minimum BOD value in the river is 7.5 mg/l, and during the winter, it is 14.3 mg/l. In rivers, the DO value drops to zero throughout the winter, whereas there are no appreciable variations in lakes. The values of COD, BOD, pH, DO, and turbidity decrease in the winter compared to the summer. When the three lakes are compared, Hatirjheel Lake has the highest pH value (9.94), while Dhanmondi Lake has the lowest pH value (6.8). During the winter, Dhanmondi Lake had 120 NTU the highest value of Turbidity. This study does a thorough evaluation of many water quality indicators, including pH, Turbidity, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD), in Buriganga River, Dhanmondi Lake, Hatirjheel Lake, and Uttara Lake. The Water Quality Index (WQI) is computed to assess the overall water quality of these areas. Turbidity is identified as a critical element, with the highest Quality Index, indicating a potentially large influence on water quality. The impacts of pH and dissolved oxygen (DO) are relatively minimal, but biochemical oxygen demand (BOD) and chemical oxygen demand (COD) have a moderate influence. The study places these findings within the framework of existing water quality standards, emphasizing the ever-changing nature of water quality and underscoring the importance of specific management measures to protect and improve environmental health in the areas under investigation. Continual surveillance is crucial for monitoring shifts and evaluating the efficacy of applied solutions.

ACKNOWLEDGEMENT

First and foremost, we would like to thank the Almighty Allah for his blessings, protection, mental fortitude, and knowledge in every area of our lives. We also thank Allah for helping us finish this thesis. The true spirit of goal achievement is in the pursuit of excellence and strict discipline; without the support, encouragement, and collaboration of numerous individuals, we could never have finished our assignment.

Without the assistance and direction of Md. Masud Alom (Assistant Professor), Department of Civil Engineering, Daffodil International University, Dhaka—who also happens to be our research supervisor—this study would not have been feasible. We are grateful for his unwavering patience, scholarly guidance, and constant encouragement. The completion of this research has been made possible by active and continuous supervision, helpful critique, insightful counsel, and the reading and correction of subpar versions at every level. And we decided on this subject and created the search. Our supervisor's deep knowledge and continued interest in the engineering profession encouraged us to do this research.

We would like to thank the staff of Daffodil International University's CE department as well as all of our faculty members in the Department of Civil Engineering for their invaluable assistance in helping us complete our thesis. We must sincerely and respectfully thank our family, friends, and other loved ones for their unwavering support and patience in helping us finish our program.

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CHAPTER I

INTRODUCTION

1.1 Background

A vital waterway for trade and transportation, the Buriganga River is historically significant and is frequently referred to as Dhaka's lifeline. It continues to be an essential source of water for many uses, despite pollution concerns. Near the river, several companies have been built, including cement factories, vehicle repair shops, battery manufacturing facilities, hardware stores, as well as workshops for aluminum, steel, and iron. Furthermore, lakes like Uttara, Hatirjheel, and Dhanmondi are vital for stormwater management, biodiversity, recreational space, and improving Dhaka's overall urban environment. The cultural fabric, business ventures, and urban development plans of the city are all shaped by these waterbodies, which together define the character and operation of Bangladesh's capital.

The Buriganga River and the nearby lakes in Dhaka are severely contaminated by many types of human waste. Untreated effluents from industrial discharges are released into water bodies, where they contaminate them with dangerous substances. Solid garbage also builds up in and around these water sources as a result of improper waste management and home waste disposal. Water quality is further deteriorated by the inappropriate dumping of plastic, domestic waste, and other contaminants, which presents risks to the environment and human health. The ecological health of the Buriganga River and the lakes in Dhaka is seriously threatened by the combined effects of home and industrial pollution.

The increasing contamination of the Buriganga River and Dhaka's lakes—Dhanmondi, Uttara, and Hatirjheel has detrimental effects on the ecology, public health, and general quality of life in the city. Aquatic habitats are threatened by pollution from industrial discharges and inappropriate waste disposal, which lowers biodiversity and degrades water quality. Waterborne infections are propagated by contaminated water sources, directly endangering public health. Furthermore, these bodies of water lose some of their aesthetic and recreational value, which lowers locals' quality of life. To combat pollution and guarantee the sustainable management of these essential water resources in Dhaka, comprehensive and immediate action is needed.

In here we studied the water quality of Dhanmondi Lake, Uttara Lake, Hatirjheel Lake and Buriganga River in two different seasons. Also, we made a comparative study of river’s water quality and lake’s water quality.

1.2 Study Area

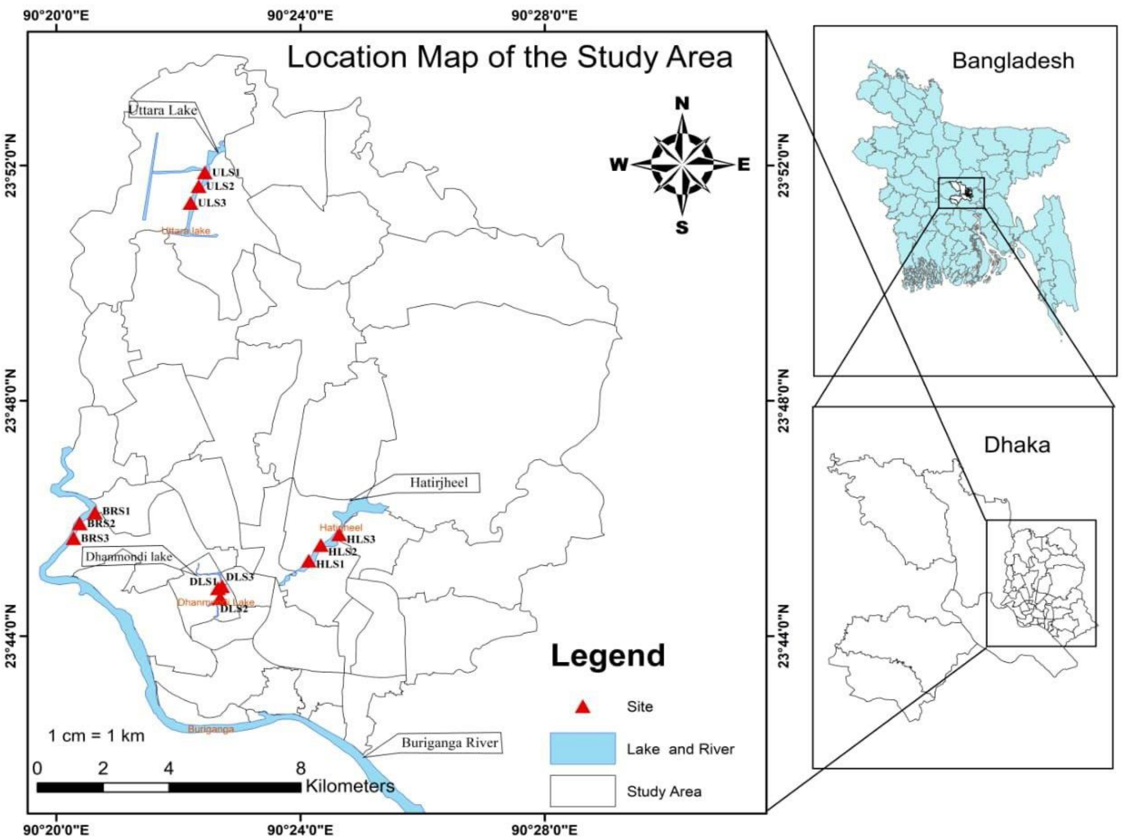


Figure 1.1: Location Map of the study area

1.3 Objective

The major objectives of the present thesis are as follows:

i. To observe the temporal variation of the water quality parameter of the selected lakes and river.

ii. To compare the water parameter quality between lakes and Buriganga River

CHAPTER II

LITERATURE REVIEW

2.1 General

The Buriganga River is vital to Dhaka, the capital city of Bangladesh. The river, which has long been an important part of the city's culture and economy, has recently suffered from severe pollution and degradation brought on by industrial chemical waste. In Dhaka, Bangladesh, there are three well-known urban lakes: Uttara Lake, Hatirjheel Lake, and Dhanmondi Lake. In addition to providing green space and a center for recreational activities, these lakes also serve as a catchment area for rainfall and a source of water for the city. The lake gives the neighborhood a calm environment and is essential to preserving ecological balance.

A wide range of topics, including water quality, sources of pollution, and the impact of human activities on the river's ecology, have been covered in the extensive body of literature on the Buriganga River and these three lakes. One of the main sources of pollution in the Buriganga River is untreated industrial wastewater. Studies show that the river is heavily contaminated with heavy metals and hazardous chemicals from textile and leather factories along its banks that release their waste through untreated sewage pipes. Because of this, the river's high pollution levels are detrimental to both human health and the health of the fish and other aquatic life in the river. Urban development has resulted in uneven water quality in Dhanmondi Lake, one of the most significant water bodies in Dhaka. It's a serene area to have fun, however there are concerns about pollution from nearby urban development and drainage issues. Pollutants affect the environment and endanger the aquatic life in the lake. Pollution poses a threat to Uttara Lake's aquatic life, underscoring the importance of conservation initiatives. A man-made reservoir known Hatirjheel Lake helps the city regulate flooding. On the other hand, problems with urban runoff and drainage pose a threat to water quality. Sustainable solutions are needed to manage water quality and maintain natural balance.

To determine the effectiveness of these treatments and to create innovative approaches for enhancing lake and river water quality while preserving the ecosystem, additional study is required.

2.2 Parameters of Concern

The importance of a few crucial water quality metrics that are crucial for assessing the general condition of water bodies is discussed in this section.

2.2.1 pH

Since pH reveals the water's acidity or alkalinity, it is an essential metric in the evaluation of water quality. The concentration of hydrogen ions in a solution is measured by pH, which indicates whether the solution is acidic (pH < 7), neutral (pH = 7), or alkaline (pH > 7). The pH range is important for water quality; levels in the range of 6.5 to 8.5 are usually thought to be appropriate for aquatic life. Deviations from this range may be harmful; low pH indicates acidity, which can be harmful to fish and other aquatic life, while high pH indicates alkalinity, which can also be harmful to biodiversity. Upholding the recommended pH levels strictly is necessary to keep the aquatic ecosystem healthy.

2.2.2 Dissolved Oxygen (DO)

The amount of oxygen dissolved in water, which is necessary for aquatic creatures to survive, is represented as dissolved oxygen (DO), a critical water quality indicator. Pollution and temperature are two factors that affect DO levels. Optimal DO, usually ranging from 5 to 9 mg/L, is necessary for the maintenance of robust aquatic ecosystems. Lower than 5 mg/L DO levels can be dangerous, causing hypoxia and having an adverse effect on fish and other aquatic life. Although they are rare, extremely high DO levels may be a sign of excessive algal development. To ensure the general health of water bodies and to preserve aquatic biodiversity, it is imperative to monitor and maintain ideal DO levels.

2.2.3 Turbidity

Turbidity, which measures the haziness or cloudiness brought on by suspended particles in water, is an essential metric for assessing the quality of water. It has an immediate effect on water transparency and can also have an impact on photosynthesis, light penetration, and the general well-being of aquatic ecosystems. Higher values of nephelometric turbidity units (NTU), which are used to measure turbidity, indicate greater cloudiness. Although turbidity is normal to some extent, high levels can harm aquatic life by obstructing light penetration and upsetting eating habits. Aquatic life normally has standard turbidity levels between 5 and 25 NTU; values outside of this range indicate possible stress to the environment and call for additional study and control actions.

2.2.4 Biochemical Oxygen Demand (BOD)

A crucial metric for evaluating the quality of water is biochemical oxygen demand, or BOD. It is the amount of dissolved oxygen that microorganisms in water use to break down organic matter. A larger concentration of organic contaminants is indicated by elevated BOD levels, which can stress the aquatic ecology and perhaps cause oxygen depletion. The unit of measurement for BOD is mg/L, or milligrams of oxygen consumed per liter of water. Healthy aquatic life typically has BOD levels between 1 to 6 mg/L, while values above this range may indicate pollution and be dangerous to aquatic life. Understanding the effects of organic pollution on water bodies and maintaining the sustainability of aquatic ecosystems depend on BOD monitoring. Similar to low dissolved oxygen levels, high BOD levels cause stress, suffocation, and death in aquatic creatures.

2.2.5 Chemical Oxygen Demand (COD)

Since it quantifies the quantity of oxygen needed to chemically oxidize contaminants in water, Chemical Oxygen Demand (COD) is an essential metric for evaluating the quality of water. Excessive COD levels are a sign of the presence of both organic and inorganic materials that can damage aquatic life and reduce dissolved oxygen. Milligrams per liter, or mg/L, are used to measure COD. In healthy aquatic ecosystems, standard COD concentrations typically fall between 5 and 20 mg/L. Over this range, elevated COD values indicate growing pollution, which stresses the water body and may eventually cause oxygen depletion, endangering aquatic life. In order to detect and lessen the effects of chemical pollutants on water quality and to protect aquatic ecosystems, it is imperative to monitor COD. On the contrary BOD solely measures organic stuff that has undergone biological decomposition; COD analyzes all organic matter.

CHAPTER III

METHODOLOGY

3.1 General

This paper is studied for determining the water quality of Buriganga river and other three selected lakes adjacent to Dhaka city. And the samples were collected from same site in two different seasons.

In the comprehensive assessment of water quality in the Buriganga River and three adjacent lakes of Dhaka city, sample collection in winter and summer involves a meticulous approach. During winter, parameters such as dissolved oxygen, pH, and chemical oxygen demand are crucial, reflecting the impact of reduced temperatures on water quality and potential pollution sources. In summer, emphasis is placed on turbidity, chemical oxygen demand, and biological oxygen demand, considering the heightened biological activity and potential for algal blooms. These seasonal variations in sample collection enable a thorough understanding of the dynamic environmental conditions, guiding effective management strategies to preserve the health of the Buriganga River and surrounding lakes in both seasons.

The discussion that follows will address each of the seasons and their impact on the water quality of the Buriganga River and the lake. In addition, we will thoroughly distinguish between the lake and river water quality as well as our operational procedures.

3.2.1 Selection of sampling points

Samples were taken at different locations across the Buriganga River area, Dhanmondi Lake area, Uttara Lake area and Hatirjheel Lake area. We choosen total twelve different locations where the samples were taken in winter and summer season. Samples were carefully gathered to ensure that there were no air bubbles in the sample vials.

A single sample taken from a particular location cannot adequately represent the variability in water quality over time and space.

(a)

(b)

(c) (d)

Figure 3.1: (a) Buriganga River (b) Dhanmondi Lake (c) Hatirjheel Lake (d) Uttara Lake

This might affect the interpretation of trends in water quality. The choice of sampling sites, their geographic locations, sample collection schedules, sample collection techniques, sample processing methods, analytical techniques, and sample collecting length are other factors that affect water quality trend monitoring.

Here, we'll talk about the various times of year and geographical zones as well as how the sewage lines are influencing the water in the Buriganga River. We'll also try to go into depth about the water quality of the lines, their effects, and how we operate.

3.2.2 Flow Chart

To streamline our analysis, a distinctive flow chart has been made so that we can quickly see the steps we took during the processing.

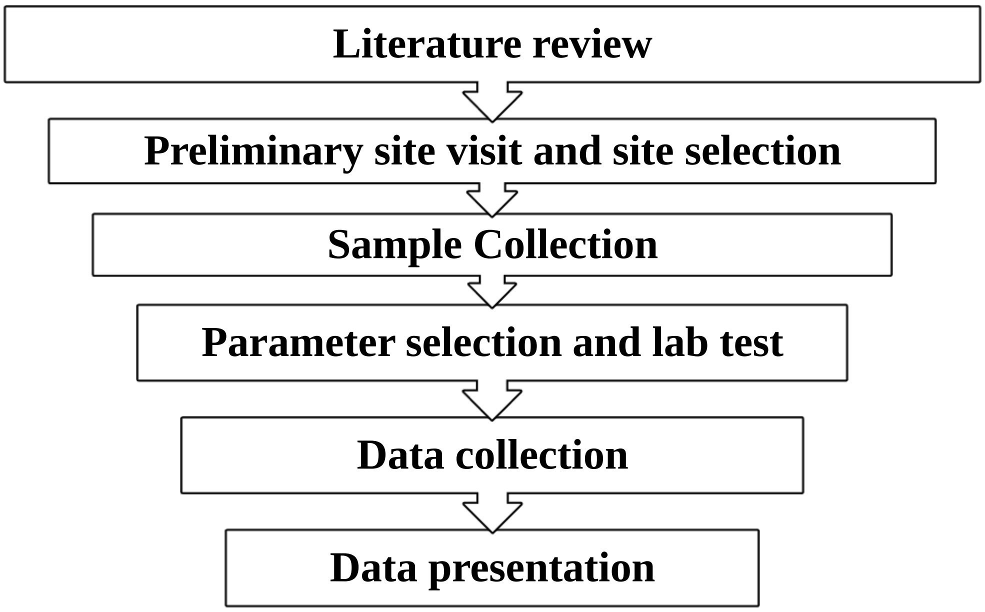


Figure 3.2: Flow chart of working procedure

3.2.3 Preliminary Site Investigation and Site Selection

First, while choosing a place, we decided on the Buriganga River. Since Dhaka city has several lakes, we also picked Uttara Lake, Hatirjheel Lake, and Dhanmondi Lake since they were the furthest apart.

A thorough site investigation was conducted before a variety of factors were used to choose the sample locations. In order to ensure a comprehensive portrayal, a range of point sources were employed, encompassing both residential and commercial spaces. Second, places that could be immersed in the winter and subsequently cleaned up in the summer were given preference over others, with water availability being prioritized throughout the year. The locations chosen for the collecting of samples must also be easily accessible and safe. To identify sites that accurately reflected the total body of water, the selection process examined the physical, chemical, and biological characteristics of the river. Sample sites were chosen carefully to record seasonal variations in water flow and quality. Lastly, samples were taken from each selected location using 2-liter pre-labeled plastic bottles. One important factor to take into account was how easy it would be to do ongoing maintenance and observation at each site.

3.2.4 Collection of Sample

We took samples from locations where it was simple for us to collect water and where effluent was being dumped into the river after coming from various sources. Afterwards, utilizing the samples, a laboratory determines the existence and concentration of different contaminants, such as heavy metals, organic materials, and nutrients. Several considerations, such as possible spatial variation in pollutants, the capacity to identify pollution peaks, and the frequency of sample collection, influence how many sampling locations are chosen for a given study in a given body of water. Throughout the Buriganga region, samples were collected at several sites. Five separate sewage lines that dropped into the river were chosen for water sample collection. The procedures of bucket sampling were employed to gather the samples. Make use of the appropriate tools and techniques for sampling to ensure that the samples accurately reflect the quality of the water and were not tainted during collection.

Table 3.1: Locations of the water sampling points of Lakes and Buriganga River

Locations	Stations	Coordinates	
		Latitude	Longitude
Premier Cement Ghat	BRS1	23°46’09” N	90°20’39” E
Dhaka Uddhan	BRS2	23°45’54” N	90°20’23” E
Fulmela School	BRS3	23°45’40” N	90°20’17” E
Bachelor point, Road 12A	DLS1	23°44’49” N	90°22’39” E
Baitul Aman Jame Mosque, Road 7	DLS2	23°44’39” N	90°22’41” E

Kolabagan, Road 10	DLS3	23°44’51” N	90°22’43” E
Hatirjheel RAJUK Apartments	HLS1	23°45’17” N	90°24’8” E
Uttor Begun Bari Moshjid Road	HLS2	23°45’33” N	90°24’20” E
Samarai Cattle Farm	HLS3	23°45’44” N	90°24’38” E
Premium Motors & LPG Conversion, Diyabari	ULS1	23°51’53” N	90°22’30” E
Diyabari Bridge 5	ULS2	23°51’35” N	90°22’17” E
Sangita, Diyabari	ULS3	23°51’03” N	90°22’12” E

At each sampling station, water is collected from the river and lakes so that it can be easily examined for water quality. We carefully gather samples because our objective is to assess the amount of pollution and harmful parameters in the river and in the lakes. The sample bottle was thoroughly cleansed with water three times before the sample was taken. Water samples were collected at each location and placed in 2-liter plastic bottles that already had labels on them. Samples were meticulously gathered to ensure there were no air bubbles in the sample bottles.


(a)


(b)


(c)


(d)


(e)


(f)

(g) (h) (i)

(j) (k) (l)

Figure 3.3: Sample Collection Point (a) BRS1 (b) BRS2 (c) BRS3 (d) DLS1 (e) DLS2 (f) DLS3 (g) HLS1 (h) HLS2 (i) HLS3 (j) ULS1 (k) ULS2 (l) ULS3

After sampling, the sample bottles were kept in storage until they were needed for analysis. During collecting, surface debris was avoided, and substantial sources of contamination were sufficiently distanced.

3.4 Parameter selection and Test

The process of assessing and analyzing water quality is known as water analysis. Numerous analytical techniques are employed to ascertain the physical, chemical, and biological properties of water samples. The research is necessary for a number of reasons, including monitoring the health of aquatic ecosystems, guaranteeing the security of drinking water, and assessing the efficiency of industrial and agricultural water use. 3 hours after sampling, samples were we transferred from the field to the lab of Dhaka University.

The water samples that were gathered were tested for pH, turbidity, chemical oxygen demand (COD), biochemical oxygen demand (BOD), and dissolved oxygen (DO).

CHAPTER IV

RESULT AND DISCUSSION

4.1 General

A paper's conclusion and discussion part are essential since it discusses the overall result of the study. It is discussed what has been tried, what testing have revealed, what the treatments are, why it occurred, and so on. Many frequently asked questions are addressed here. As a result, we must use caution when addressing this matter to avoid disseminating false information.

Discoveries and discussions regarding wastewater sewage systems High amounts of contaminants, including organic compounds and heavy metals, were found in the wastewater sewers, as the study indicated. Our results demonstrate the need for better wastewater treatment and management techniques in order to save the environment and the general public's health. To try and make sense of the results in this study, we will perform some analysis.

4.2 Cohen's d

Cohen's d is the standardized difference between two means and is used to quantify effect magnitude. It is frequently employed in hypothesis testing to assess how much two groups differ from one another.

The interpretation of Cohen's d

Cohen's d is a standardized effect size measure used in statistical analysis to quantify the magnitude of the difference between two groups. It is particularly valuable in interpreting the practical significance of observed differences beyond mere statistical significance. The formula, $d = \frac{M1-M2}{s}$ considers the difference in means (M_1 and M_2 and the pooled standard deviation (s).

Interpretation of Cohen's d involves assessing the effect size magnitude. A small effect is typically considered when (d = 0.2), a medium effect at (d = 0.5), and a large effect at (d = 0.8). The sign of (d) indicates the direction of the effect, with positive values suggesting that the first group has a higher mean than the second, and negative values indicating the opposite.

Researchers often consider the practical significance of Cohen's d in addition to statistical significance. The measure helps gauge the real-world importance of observed differences and is influenced by factors like the overlap of distributions and the variability within each group. Confidence intervals for Cohen's d are also commonly calculated to provide a range within which the true effect size is likely to fall. In summary, Cohen's d is a valuable tool for researchers, offering a standardized means to convey the substantive impact of differences between groups in various fields of study.

Table 4.1 Cohen's d test values for two seasons of Buriganga River

Parameters	Seasons	Mean	SD	Count (n)	Mean difference	Polled SD	Effect Size(d)
pH	Summer	7.417	0.180	3.000	0.063	0.212	0.298
	Winter	7.353	0.240	3.000			
BOD	Summer	14.317	3.675	3.000	2.140	4.450	0.481
	Winter	12.177	5.109	3.000			
COD	Summer	56.073	4.934	3.000	25.657	7.335	3.498
	Winter	30.417	9.125	3.000			
Turbidity	Summer	52.333	3.055	3.000	19.000	4.830	3.933
	Winter	33.333	6.110	3.000			
DO	Summer	1.980	0.423	3.000	1.980	0.299	6.615
	Winter	0.000	0.000	3.000			

Table 4.2 Cohen's d test values for two seasons of Dhanmondi Lake

Parameters	Seasons	Mean	SD	Count (n)	Mean difference	Polled SD	Effect Size(d)
pH	Summer	7.110	0.180	3.000	0.223	0.212	1.052
	Winter	7.333	0.240	3.000			
BOD	Summer	25.117	3.675	3.000	7.617	4.450	1.711
	Winter	17.500	5.109	3.000			
COD	Summer	33.777	4.934	3.000	8.643	7.335	1.178
	Winter	25.133	9.125	3.000			
Turbidity	Summer	107.667	3.055	3.000	16.333	4.830	3.381
	Winter	91.333	6.110	3.000			
DO	Summer	10.360	0.423	3.000	5.693	0.299	1.902
	Winter	4.667	0.000	3.000			

Table 4.3 Cohen's d test values for two seasons of Hatirjheel Lake

Parameters	Seasons	Mean	SD	Count (n)	Mean difference	Polled SD	Effect Size(d)
pH	Summer	8.123	0.180	3.000	0.290	0.212	1.367

	Winter	7.833	0.240	3.000			
BOD	Summer	21.000	3.675	3.000	5.043	4.450	1.133
	Winter	15.957	5.109	3.000			
COD	Summer	37.487	4.934	3.000	8.197	7.335	1.117
	Winter	29.290	9.125	3.000			
Turbidity	Summer	62.333	3.055	3.000	13.667	4.830	2.829
	Winter	76.000	6.110	3.000			
DO	Summer	7.737	0.423	3.000	1.170	0.299	3.909

Table 4.4 Cohen's d test values for two seasons of Uttara Lake

Parameters	**Seasons**	**Mean**	**SD**	**Count (n)**	**Mean difference**	**Polled SD**	**Effect Size(d)**
pH	Summer	7.677	0.180	3.000	0.657	0.212	3.094
	Winter	8.333	0.240	3.000			
BOD	Summer	23.440	3.675	3.000	4.773	4.450	1.073
	Winter	18.667	5.109	3.000			
COD	Summer	35.877	4.934	3.000	8.187	7.335	1.116
	Winter	27.690	9.125	3.000			
Turbidity	Summer	118.000	3.055	3.000	20.667	4.830	4.278
	Winter	97.333	6.110	3.000			
DO	Summer	9.960	0.423	3.000	2.867	0.299	9.577
	Winter	7.093	0.000	3.000			

Table 4.5 Cohen's d-test results effect size table (Sawilowsky, S. S. 2009, Cohen, J. 1988).

Lebel	**Effect size (d)**
Very small	0.01 < 0.2
Small	0.20 < 0.50
Medium	0.50 < 0.80
Large	0.80 < 1.20
Very large	1.20 < 2.0
Huge	>2.0

Table 4.6 Overall Cohen's d test values effect size of our selected area

		Parameters				
		pH	**BOD**	**COD**	**Turbidity**	**DO**
Locations	**Buriganga River**	0.298	0.481	3.498	3.933	6.615
	Dhanmondi Lake	1.052	1.711	1.178	3.381	1.902
	Hatirjheel Lake	1.367	1.133	1.117	2.829	3.909
	Uttara Lake	3.094	1.073	1.116	4.278	9.577

The water quality indicators, including pH, BOD, COD, Turbidity, and DO, were analyzed at four different locations—Buriganga River, Dhanmondi Lake, Hatirjheel Lake, and Uttara Lake—using Cohen's d impact size categories. These categories provide a detailed comprehension of the extent of variations between consecutive sites for each metric. The transitions from Buriganga River to Dhanmondi Lake and from Dhanmondi Lake to Hatirjheel Lake have minimal impact on pH levels. However, the shift from Hatirjheel Lake to Uttara Lake has a significant influence on pH. The changes in BOD exhibit a combination of minimal and moderate impacts among the specified regions. Furthermore, fluctuations in COD and turbidity exhibit a wide range of impact magnitudes, spanning from minuscule to substantial. Dissolved Oxygen (DO) exhibits variable magnitudes of impact, ranging from minimal to enormous, across sequential places. These interpretations of effect size provide valuable insights into the practical importance of observed variances in water quality measures. They help guide potential environmental management methods that are specifically adapted to the unique characteristics of each place, based on the magnitude of these variations.

4.3 Water Quality Index (WQI)

A Water Quality Index (WQI) assesses many physical, chemical, and biological characteristics to provide a comprehensive picture of a water body's general health. It makes information about water quality easier to communicate by combining variables like temperature, pH, dissolved oxygen, turbidity, and nutrient levels into a single numerical value. Based on the importance of each characteristic, a weight is assigned, and the resulting index is frequently scaled for ease of reading. Ranging from 0 to 100, a greater WQI signifies better water quality. The index facilitates educated decision-making and environmental management by assisting authorities, researchers, and the general public in understanding and addressing issues related to water quality. There may be regional variances, allowing the index to be in line with regional water quality requirements and regulations.

Table 4.7: Water Quality Index based on WQI value (Khudair et al. 2018)

WQI Value	**Wastewater Quality**
<50	Excellent
50 - 100	Good
100 - 200	Poor

200 - 300	Very Poor
300 - 400	Polluted
>400	Very Polluted

Table 4.8: Water Quality Index test values in both summer and winter

WQI of Buriganga River of summer season										
Parameter	**Standard (Sn)**	**1/Sn**	**Σ1/Sn**	**K=1/(Σ1/Sn)**	**Wi=K/Sn**	**Ideal Value (Vo)**	**Mean Conc. value (Vn)**	**Vn/Sn**	**Vn/Sn* 100=Qn**	**WnQn**
pH	8.5	0.118	0.718	1.393	0.164	7	7.417	0.873	87.255	21.035
BOD	5	0.2	0.718	1.393	0.279	0	9.850	1.970	197.000	80.738
COD	10	0.1	0.718	1.393	0.139	0	30.417	3.042	304.167	62.329
Turbidity	10	0.1	0.718	1.393	0.139	0	52.333	5.233	523.333	107.240
DO	5	0.2	0.718	1.393	0.279	14	1.980	1.315	131.458	53.876
		0.718								325.219

WQI of Dhanmondi Lake of summer season										
Parameter	**Standard (Sn)**	**1/Sn**	**Σ1/Sn**	**K=1/(Σ1/Sn)**	**Wi=K/Sn**	**IDEAL VALUE (Vo)**	**Mean Conc. value (Vn)**	**Vn/Sn**	**Vn/Sn*100=Qn**	**WnQn**
pH	8.5	0.118	0.718	1.393	0.164	7	7.110	0.073	7.333	1.202
BOD	5	0.2	0.718	1.393	0.279	0	17.500	3.500	350.000	97.541
COD	10	0.1	0.718	1.393	0.139	0	25.133	2.513	251.333	35.022
Turbidity	10	0.1	0.718	1.393	0.139	0	107.667	10.767	1076.667	150.027
DO	5	0.2	0.718	1.393	0.279	14	7.737	0.715	71.493	19.924
		0.718								303.717

WQI of Hatirjheel of summer season										
Parameter	**Standard (Sn)**	**1/Sn**	**Σ1/Sn**	**K=1/(Σ1/Sn)**	**Wi=K/Sn**	**Ideal value (Vo)**	**Mean Conc. value (Vn)**	**Vn/Sn**	**Vn/Sn* 100=Qn**	**WnQn**
pH	8.5	0.118	0.718	1.393	0.164	7	8.123	0.749	74.889	12.277
BOD	5	0.2	0.718	1.393	0.279	0	15.957	3.191	319.133	88.939
COD	10	0.1	0.718	1.393	0.139	0	29.290	2.929	292.900	40.814
Turbidity	10	0.1	0.718	1.393	0.139	0	62.333	6.233	623.333	86.858
DO	5	0.2	0.718	1.393	0.279	14	7.737	0.715	71.493	19.924
		0.718								248.812

WQI of Uttara Lake of summer season										
Parameter	**Standard (Sn)**	**1/Sn**	**Σ1/Sn**	**K=1/(Σ1/Sn)**	**Wi=K/Sn**	**Ideal value (Vo)**	**Mean Conc. value (Vn)**	**Vn/Sn**	**Vn/Sn*100=Qn**	**WnQn**
pH	8.5	0.118	0.718	1.393	0.164	7	7.677	0.451	45.111	7.395
BOD	5	0.2	0.718	1.393	0.279	0	18.667	3.688	368.800	102.780
COD	10	0.1	0.718	1.393	0.139	0	27.690	2.769	276.900	38.584
Turbidity	10	0.1	0.718	1.393	0.139	0	62.333	6.233	623.333	86.858
DO	5	0.2	0.718	1.393	0.279	14	9.960	0.483	48.333	13.470
		0.718								249.088

Summary of WQI for Summer		
Locations	WQI Value	Comments
Buriganga	325.219	Polluted
Dhanmondi	303.717	Polluted
Hatirjheel	248.812	Very Poor
Uttara	249.088	Very Poor

WQI of Buriganga River of winter season										
Parameter	**Standard (Sn)**	**1/Sn**	**Σ1/Sn**	**K=1/(Σ1/Sn)**	**Wi=K/Sn**	**Ideal value (Vo)**	**Mean Conc. value (Vn)**	**Vn/Sn**	**Vn/Sn*100=Qn**	**WnQn**
pH	8.5	0.118	0.718	1.393	0.164	7	7.353	0.865	86.510	20.856
BOD	5	0.2	0.718	1.393	0.279	0	16.643	3.329	332.867	136.421
COD	10	0.1	0.718	1.393	0.139	0	56.073	5.607	560.733	114.904
Turbidity	10	0.1	0.718	1.393	0.139	0	33.333	3.333	333.333	68.306
DO	5	0.2	0.718	1.393	0.279	14	0.000	1.521	152.083	62.329
		0.718								402.816

WQI of Dhanmondi Lake of winter season										
Parameter	**Standard (Sn)**	**1/Sn**	**Σ1/Sn**	**K=1/(Σ1/Sn)**	**Wi=K/Sn**	**Ideal value (Vo)**	**Mean Conc. value (Vn)**	**Vn/Sn**	**Vn/Sn*100=Qn**	**WnQn**
pH	8.5	0.118	0.718	1.393	0.164	7	7.333	0.222	22.222	3.643
BOD	5	0.2	0.718	1.393	0.279	0	25.117	5.023	502.333	139.995
COD	10	0.1	0.718	1.393	0.139	0	33.777	3.378	337.767	47.066
Turbidity	10	0.1	0.718	1.393	0.139	0	91.333	9.133	913.333	127.268
DO	5	0.2	0.718	1.393	0.279	14	6.567	0.837	83.681	23.321
		0.718								341.292

WQI of Hatirjheel of winter season										
Parameter	**Standard (Sn)**	**1/Sn**	**Σ1/Sn**	**K=1/(Σ1/Sn)**	**Wi=K/Sn**	**Ideal value (Vo)**	**Mean Conc. value (Vn)**	**Vn/Sn**	**Vn/Sn*100=Qn**	**WnQn**
pH	8.5	0.118	0.718	1.393	0.164	7	7.833	0.556	55.556	9.107
BOD	5	0.2	0.718	1.393	0.279	0	21.000	4.200	420.000	117.049
COD	10	0.1	0.718	1.393	0.139	0	37.487	3.749	374.867	52.236
Turbidity	10	0.1	0.718	1.393	0.139	0	76.000	7.600	760.000	105.902
DO	5	0.2	0.718	1.393	0.279	14	6.567	0.837	83.681	23.321
		0.718								307.615

WQI of Uttara Lake of winter season										
Parameter	**Standard (Sn)**	**1/Sn**	**Σ1/Sn**	**K=1/(Σ1/Sn)**	**Wi=K/Sn**	**Ideal value (Vo)**	**Mean Conc. value (Vn)**	**Vn/Sn**	**Vn/Sn*100=Qn**	**WnQn**
pH	8.5	0.118	0.718	1.393	0.164	7	8.333	0.889	88.889	14.572
BOD	5	0.2	0.718	1.393	0.279	0	23.440	3.688	368.800	102.780
COD	10	0.1	0.718	1.393	0.139	0	35.877	3.588	358.767	49.992
Turbidity	10	0.1	0.718	1.393	0.139	0	76.000	7.600	760.000	105.902
DO	5	0.2	0.718	1.393	0.279	14	7.093	0.782	78.194	21.792
		0.718								295.038

Summary of WQI for winter season		
Locations	WQI Value	Comments
Buriganga	402.816	Very Polluted
Dhanmondi	341.292	Polluted
Hatirjheel	307.615	Polluted
Uttara	295.038	Very Poor

It is crucial to remember that various nations or areas may have various wastewater discharge rules or laws, which may have an impact on how WQI scores are interpreted. Furthermore, the WQI score's weighting criteria could change based on the objectives and particular setting of the wastewater treatment facility or regulatory body. Consequently, it is crucial to refer to the appropriate regulatory body or association for detailed instructions and standards pertaining to the interpretation of WQI scores.

The analysis of the summer and winter datasets, indicated by the Water Quality Index (WQI) values and accompanying comments, provides interesting observations about the seasonal variations in water quality across Buriganga, Dhanmondi, Hatirjheel, and Uttara. Throughout the summer, the WQI ratings demonstrate a spectrum ranging from "Very Poor" to "Polluted," effectively emphasizing the environmental issues present in each specific area. Nevertheless, the dataset for winter consistently displays elevated WQI values, indicating a possible worsening of water quality problems during this time of year. Dhanmondi and Uttara routinely obtain a "Polluted" categorization in both seasons, underscoring the ongoing difficulties that require urgent remedial measures.

The differences seen between the summer and winter datasets can be related to seasonal oscillations in temperature, patterns of precipitation, and human activities that affect water quality indicators. It is crucial to take into account and tackle the fluctuations in water quality during different seasons when developing management methods. Consistently monitoring and employing adaptive management strategies are crucial for fully understanding the intricate problems presented by seasonal variations. These findings emphasize the importance of focused interventions and emphasize the ever-changing nature of water quality, requiring a comprehensive approach to protect and improve environmental health in the examined regions throughout several seasons.

4.4 Correlation Matrix

A table that displays the correlation coefficients between variables is called a correlation matrix. The correlation between two variables is displayed in each table cell. The correlation matrix aids in forecasting how the relationships between the variables will evolve in the future. A broad overview of the more or less significant relationship between various variables is given by the correlation matrix.

The correlation matrix displays the correlation values, which indicate the degree to which each pair of variables is associated linearly. The range of the correlation coefficients runs from -1 to +1. A positive correlation score indicates that there is a propensity for the two variables to rise and fall together. The correlation value is negative when one variable rises while the other falls.

Table 4.9: Correlation between the parameters in summer

	pH	*BOD (mg/L)*	*COD (mg/L)*	*Turbidity (ntu)*	*DO (mg/L)*
pH	**1**				
BOD	**-0.33834**	**1**			
COD	**0.018832**	**-0.7246**	**1**		
Turbidity	**-0.22186**	**-0.709633**	**0.72449**	**1**	
DO	**-0.33834**	**0.668529**	**0.91974**	**0.751381**	**1**

Table 4.10: Correlation between the parameters in winter

	pH	*BOD (mg/L)*	*COD (mg/L)*	*Turbidity (ntu)*	*DO (mg/L)*
pH	**1**				
BOD	**0.248871**	**1**			
COD	**-0.10199**	**-0.62465**	**1**		
Turbidity	**0.441979**	**0.717038**	**-0.43675**	**1**	
DO	**0.415735**	**0.646661**	**-0.22755**	**0.807087**	**1**

The matrix in Table 4.9 and 4.10 shows that there is a substantial positive association between the pH and turbidity (ntu) values. This suggests that turbidity tends to increase along with pH.

To be clear, the relationship between pH, COD (Chemical Oxygen Demand), and BOD (Biochemical Oxygen Demand) might change depending on the environmental factors and pollution sources. Broadly speaking, pH indicates the water's acidity or alkalinity, whereas BOD and COD indicate the number of organic pollutants in the water.

The phrase implies a negative association, meaning that BOD and COD levels fall with increasing pH. Although the rates of chemical reactions and microbiological activity can be affected by pH, there are other variables that can affect the link between pH and BOD/COD.

Each pair of variables' linear relationship is measured by the correlation values, which are shown in the correlation matrix. The range of the correlation coefficients is from -1 to +1. If the two variables have a tendency to increase and fall together, the correlation value is positive. When one variable increase while the other decreases, the correlation value is negative.

The relationship between DO and turbidity is somewhat good. This may suggest that turbidity tends to grow somewhat along with the amount of dissolved oxygen. Understanding this link in its entirety would require knowledge of the particular environmental situation.

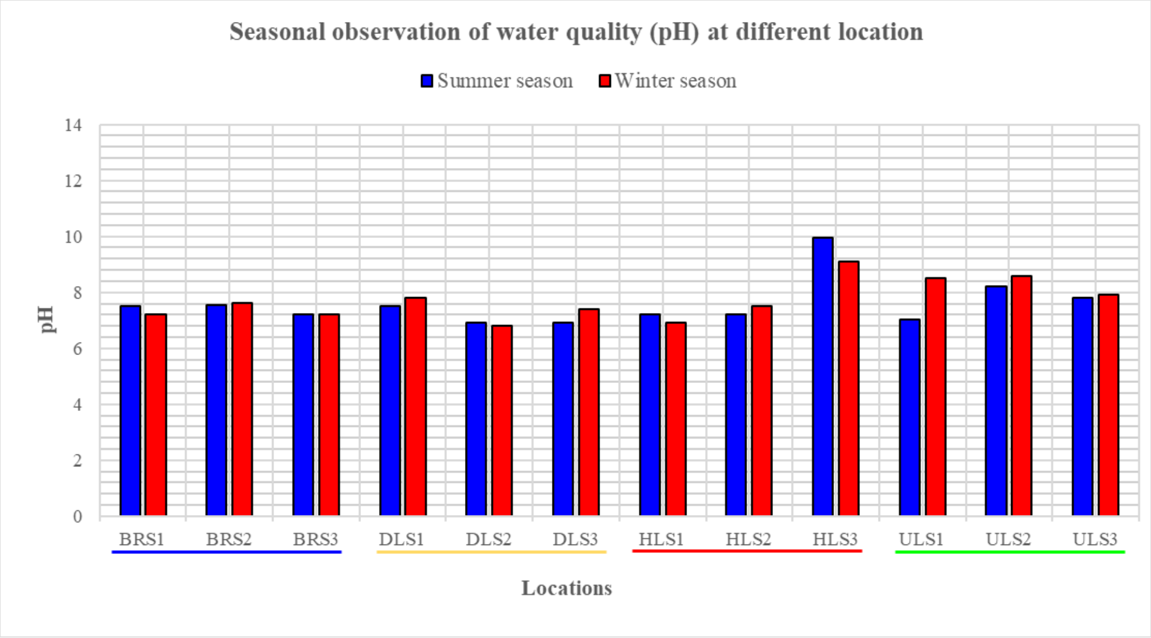
Contradictory data show a high negative association between BOD and COD. Since BOD and COD quantify organic pollutants, a positive correlation should be expected between them. An inverse association might be suggested by a high negative correlation, which could need more research and confirmation.

4.5 Seasonal and spatial variation of different parameters

4.5.1 Seasonal observation of water quality (pH) at different location

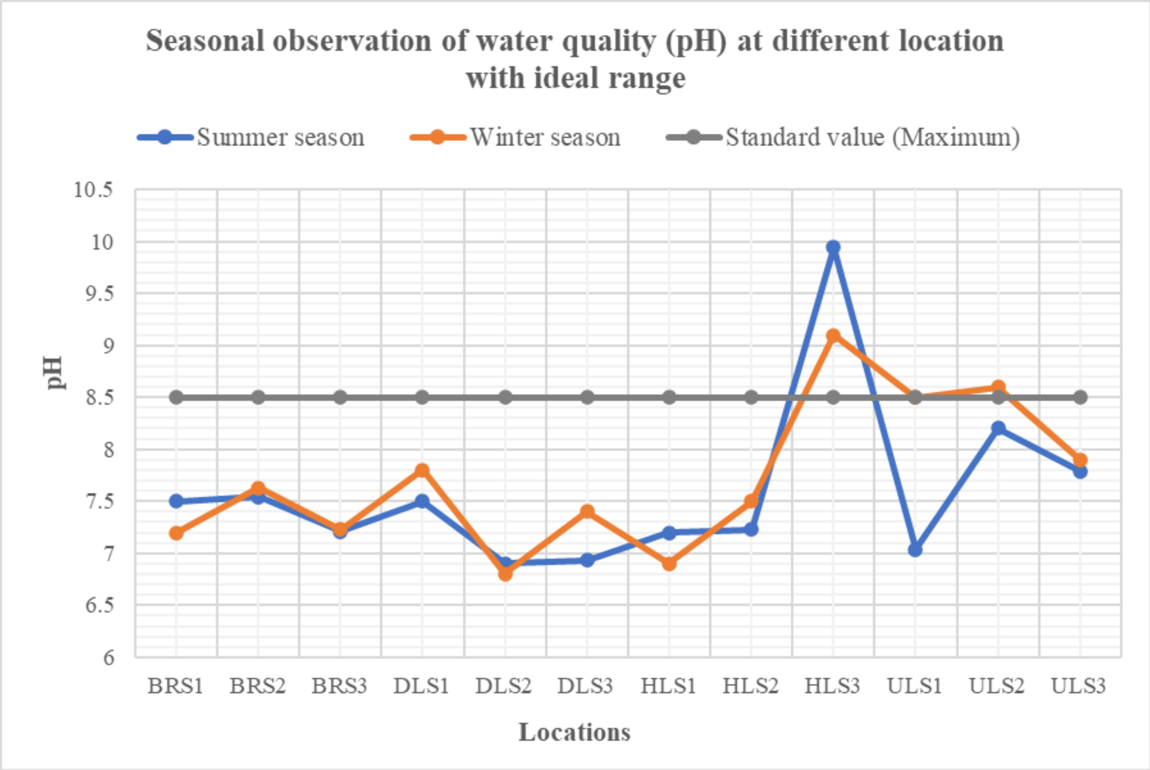
The chart illustrates how the summer and winter seasons affect the quality of the water, with a particular emphasis on pH levels. The purpose of the study is to determine how these different seasons affect the acidity and alkalinity of water. According to preliminary research, there may be a tendency toward higher acidity throughout the summer, which could be related to things like rising temperatures and more people being around. On the other hand, wintertime pH values show a move towards neutral or alkaline levels due to a combination of lower temperatures and decreased biological activity. Comprehending these seasonal fluctuations is essential for proficient management of water quality and developing environmental policies that are customized to address the distinct obstacles posed by the summer and winter seasons.

Figure: 4.1 Seasonal observation of water quality (pH) at different location



Here, we can observe that the pH is higher in the winter than it is in the summer. In the winter, the values of every point we chose are greater than 7. However, in the summer, some values are below 7 and some are above 7.

Figure: 4.2 Seasonal observation of water quality (pH) at different location with ideal range



In this instance, it's feasible that warmer summertime temperatures could result in a drop in the water's dissolved oxygen content, which might raise pH levels. Moreover, agricultural methods and other human endeavors involving the application of chemicals or fertilizers may raise the pH values in water. Conversely, the fall season's higher precipitation and colder temperatures may lessen the concentration of contaminants in the water, potentially lowering the pH levels.

4.5.2 Seasonal observation of water quality BOD_5 (mg/l) at different location

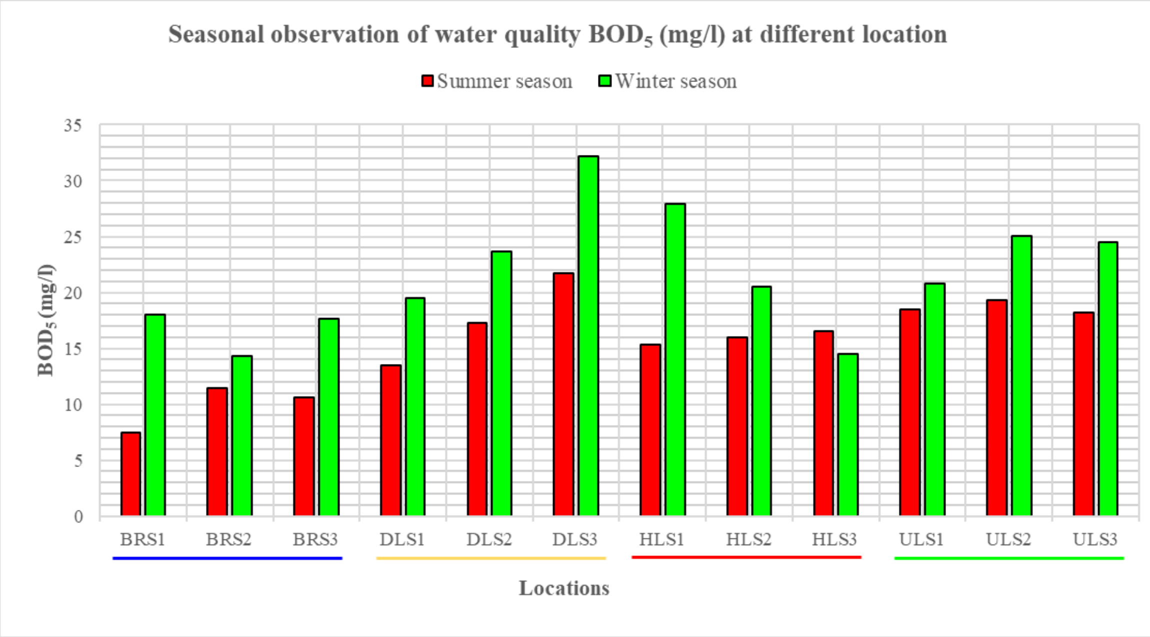
This provides a comprehensive analysis of the seasonal fluctuations in water quality, with a particular emphasis on the levels of Biochemical Oxygen Demand (BOD_5) at several sites in the summer and winter. Because it represents the need for oxygen in aquatic habitats, BOD_5 is an important indication of organic pollution.

The study finds that BOD_5 concentrations significantly rise over the summer in all of the studied areas. Summertime temperatures are higher, which increases microbial activity and speeds up the breakdown of organic materials. Because of the increase in biological processes, there is a greater need for oxygen, which raises BOD_5 levels and may signal an impending increase in pollution.

On the other hand, there is a noticeable pattern during the winter months when BOD_5 concentrations decrease. Wintertime temperatures that lower tend to slow down the breakdown of organic materials and microbial metabolism. As a result, there is less of a demand for oxygen, which lowers BOD_5 levels in comparison to summertime. This suggests that there is less organic pollution during the winter.

The results of this study provide important new understandings of the seasonally dynamic character of water quality, especially in relation to organic pollutants. This knowledge is essential for creating environmental management plans that can effectively handle the numerous problems that summer and winter weather in various places provide, thereby enhancing the sustainability and well-being of aquatic ecosystems.

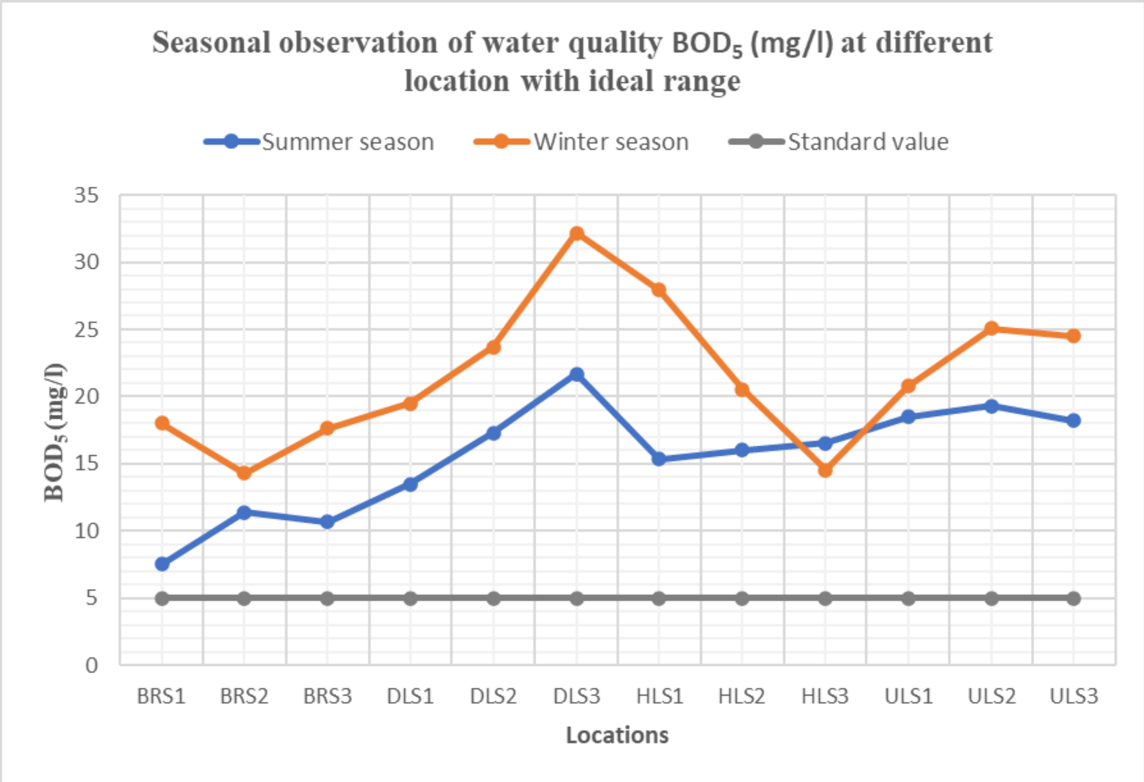
Figure:4.3 Seasonal observation of water quality BOD_5 (mg/l) at different location



Summertime brings with it an increase in the BOD level of water due to the concentration of chemicals and organic waste in the water. Although warmer temperatures and water should contain less oxygen, warmer summertime weather can also raise BOD levels.

However, because the water is colder and has more oxygen in it than in the winter, the BOD levels of water may be lower in the winter. Additionally, because the organic and inorganic composition of water decreases in the winter, BOD levels may be lower during this time.

Figure:4.4 Seasonal observation of water quality BOD_5 (mg/l) at different location with ideal range

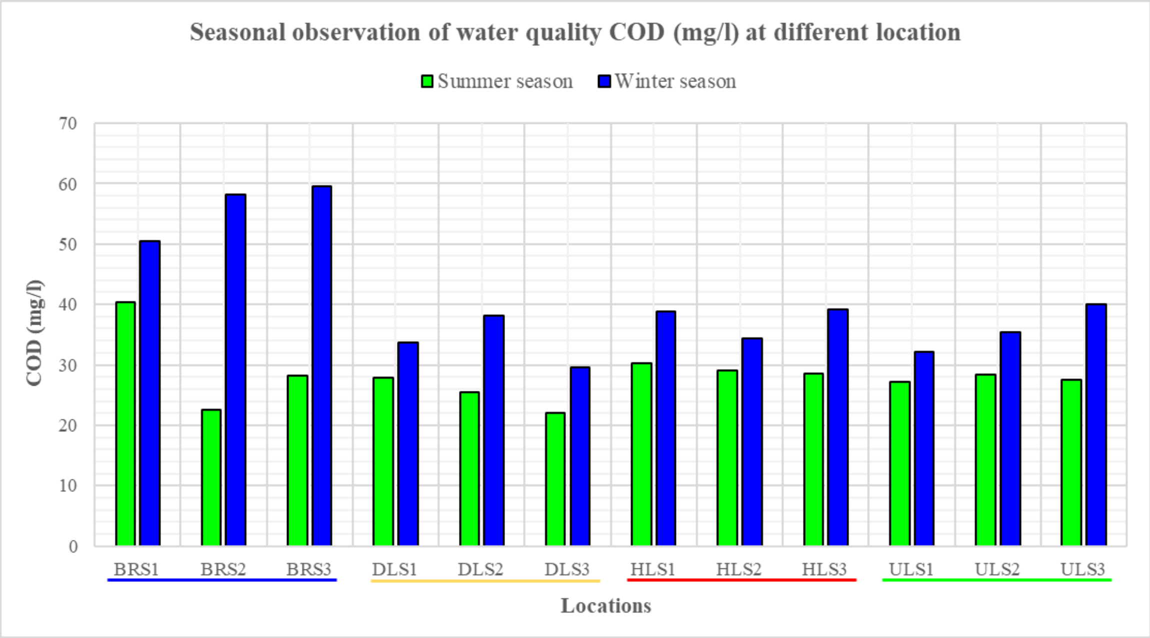


Low BOD levels in water can occasionally occur in the winter due to variations in water temperature, warmth, and oxygen content. A number of variables, including discharge, pollution from industrial or agricultural sources, and natural disasters like droughts and floods, might cause the BOD levels to be greater or lower than anticipated.

4.5.3 Seasonal observation of water quality COD (mg/l) at different location

When water quality is compared seasonally in different places using Chemical Oxygen Demand (COD), a dynamic story about environmental health is revealed. Premier Cement Ghat reports that COD levels change from summer to winter, suggesting that levels of organic pollutants may change as well. On the other hand, Dhaka Uddhan (BRS2) has a significant decrease in the winter, indicating a complex interaction between seasonal factors influencing water composition. Kolabagan (DLS3) exhibits lower COD levels in the winter than in the summer, continuing this tendency. It's interesting to note that places with very stable COD levels across the seasons include Bachelor Point (DLS1), Kolabagan (DLS3), and Premium Motors & LPG Conversion (ULS1), Diabari (ULS2), suggesting continuous environmental dynamics.

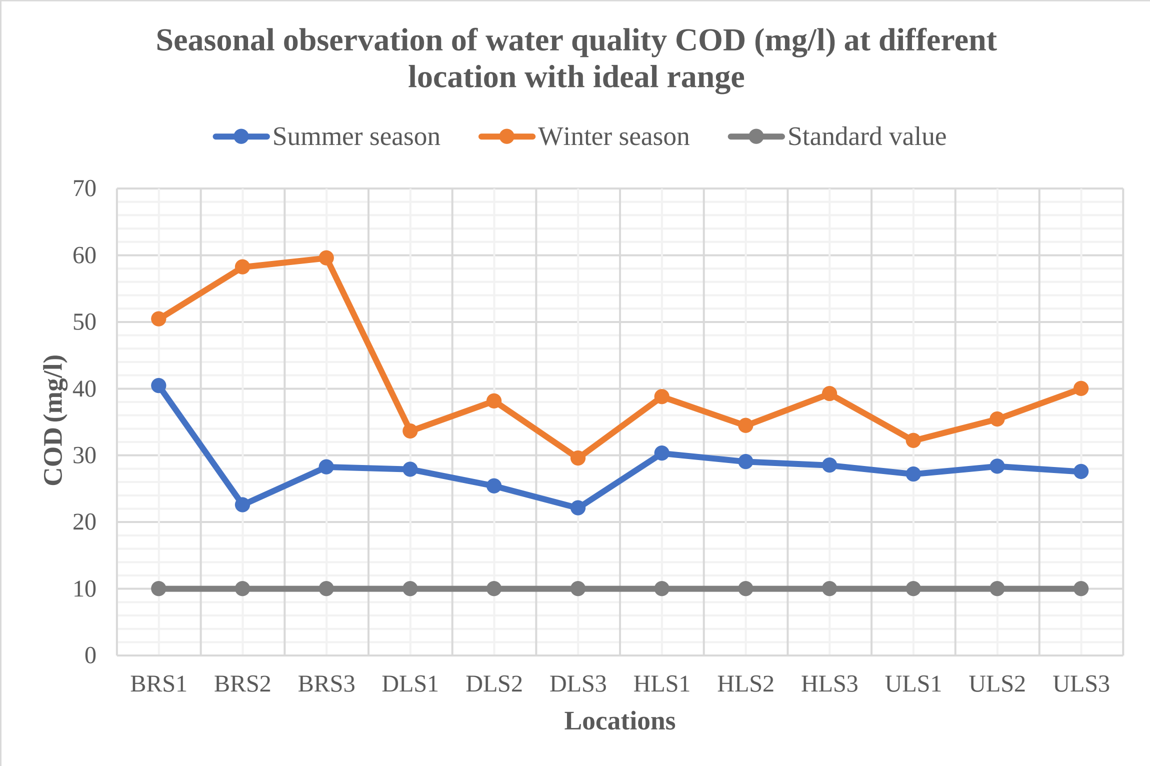
Figure:4.5 Seasonal observation of water quality COD (mg/l) at different location



Fulmela School (BRS3), is notable for having the highest COD level in the summer and the lowest level in the winter, demonstrating the intricate and site-specific effects on water quality. These differences highlight the complex interactions among geographic, anthropogenic, and climatic elements that shape the dynamics of water quality. In addition to illustrating the normal fluctuations of environmental variables, the results offer insightful information for the sustainable use of water resources.

The observed variations in COD levels highlight the necessity of ongoing observation and flexible management techniques in order to protect water resources. Temperature, precipitation, land use patterns, and human activity can all have an impact on seasonal variations in water quality. To effectively adopt conservation and management strategies, legislators, environmental agencies, and local communities must have a thorough understanding of these processes.

Figure:4.6 Seasonal observation of water quality COD (mg/l) at different location with ideal range

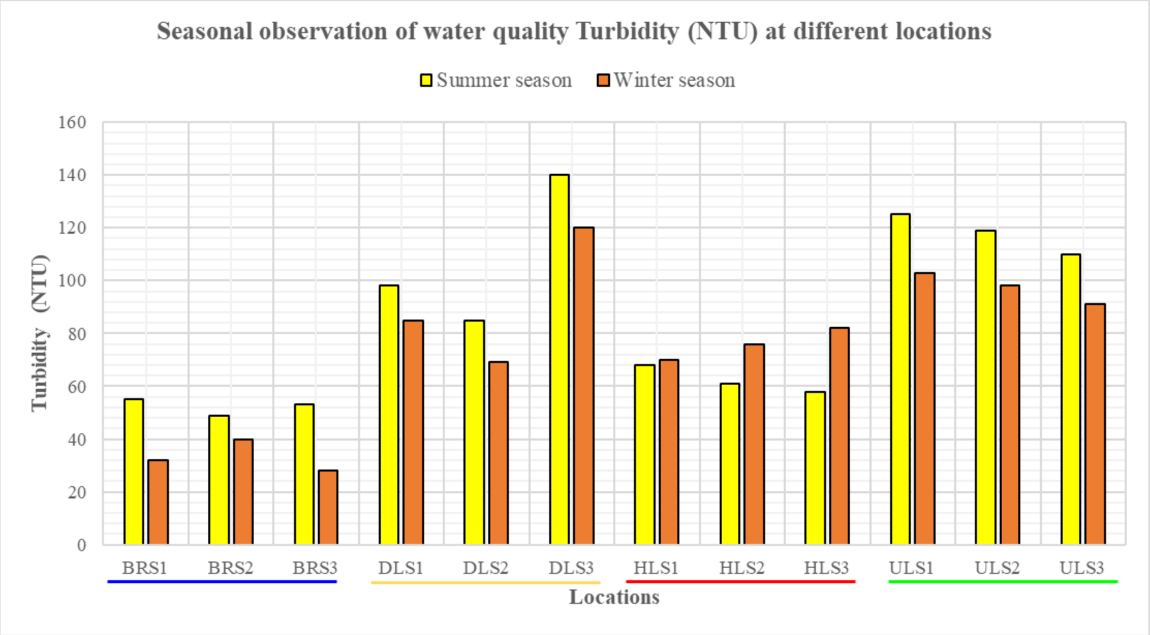


With climate patterns changing and human activities having an impact on ecosystems, the data from this COD analysis becomes essential for making well-informed decisions. Stakeholders can support sustainable practices, aquatic ecosystem preservation, and general environmental well-being in these varied areas by identifying and mitigating seasonal fluctuations in water quality.

4.5.4 Seasonal observation of water Turbidity (NTU) at different location

This bar chart shows the seasonal fluctuations in water quality, concentrating on the turbidity levels at various places measured in Nephelometric Turbidity Units (NTU). There is a noticeable rise in turbidity in all of the sampled areas during the summer. Elevated temperatures are linked to this trend, which in turn promotes algae blooms, sediment resuspension, and greater human activity—all of which raise the number of suspended particles in the water.

Figure 4.7 Seasonal observation of water quality Turbidity (NTU) at different locations

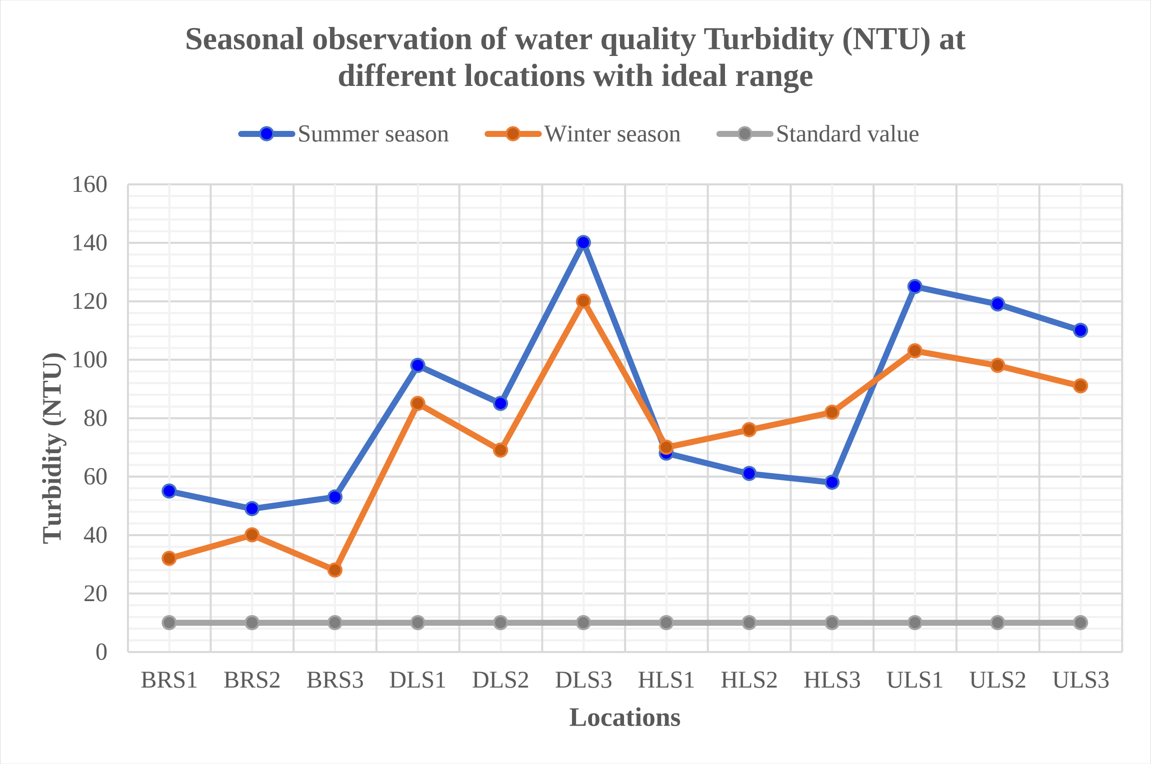


On the other hand, an opposing pattern with a noticeable drop in turbidity occurs during the winter. Wintertime temperatures that are lower than summertime cause less sediment resuspension and less algal activity, which in turn results in water that is clearer and has lower levels of turbidity.

In order to manage water quality effectively, it is essential to comprehend the seasonal dynamics of turbidity. These results offer important new information about how changing seasonal conditions affect the purity of the water in various places. With this knowledge, tactics connected to turbidity-associated problems can be specifically addressed throughout the year, preserving the resilience and well-being of aquatic ecosystems under a variety of environmental situations.

The summer months are comparatively less volatile than the winter months in this instance. Because of the accumulation of different contaminants through fog, increased muddy soil, foggy water, etc. during the winter. For this reason, the water is murkier in the winter than it is in the summer.

Figure 4.8 Seasonal observation of water quality Turbidity (NTU) at different locations with ideal range



The lone exception is Dhaka Uddan's (BRS2) extreme turbidity throughout the winter (BRS2). The cause is evident here: throughout the winter, rain and other debris from households find their way straight into the water system through the water pipe.

However, the winter months have lower temperatures due to the decreased light and increased precipitation, which raises the amount of water in the atmosphere and lowers the temperature. Furthermore, as a result of that period of time, different compounds are combined with the water, regulating its temperature.

As a result, the summertime brings high water temperatures, while the wintertime brings low temperatures.

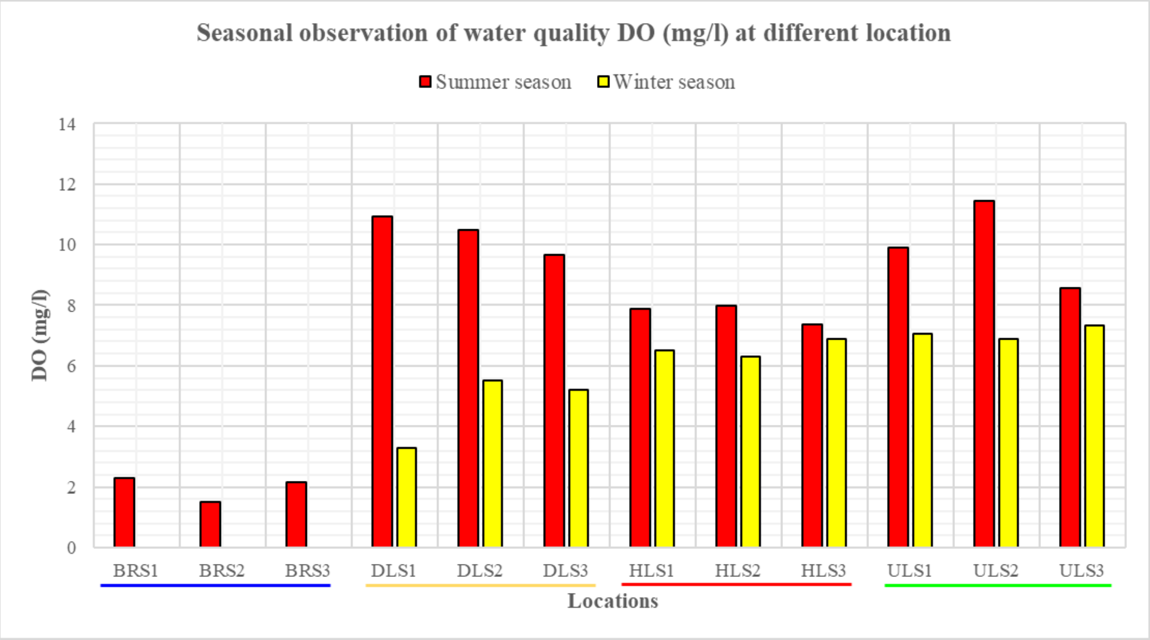
Since water contains dissolved salts, metals, and other ions, it generally has a higher electrical conductivity than clean water. However, the precise electrical conductivity value can change based on the water's unique properties as well as the surrounding environment.

In such instance, a number of things may contribute to the wintertime rise in electrical conductivity in water pipes. The breakdown of organic stuff in water leads to a rise in dissolved ions, which is one of the primary causes. Because of the falling of leaves and other plant waste, there is frequently an increase in the amount of organic matter in water throughout the winter. Ions like potassium, phosphorus, and nitrogen are released when organic matter breaks down, and these ions can make water more electrically conductive.

Furthermore, the presence of inorganic ions in the water may potentially be the reason of the rise in electrical conductivity. These salts can originate from a number of places, such as fertilizers applied to lawns and gardens, runoff from sidewalks and roadways, and industrial activities that discharge salts into the atmosphere. There might be a spike in the usage of pesticides and fertilizers over the winter, which could increase the number of salts in waste water and raise its electrical conductivity.

4.5.5 Seasonal observation of water quality DO (mg/l) at different location

Figure 4.9 Seasonal observation of water quality DO (mg/l) at different locations



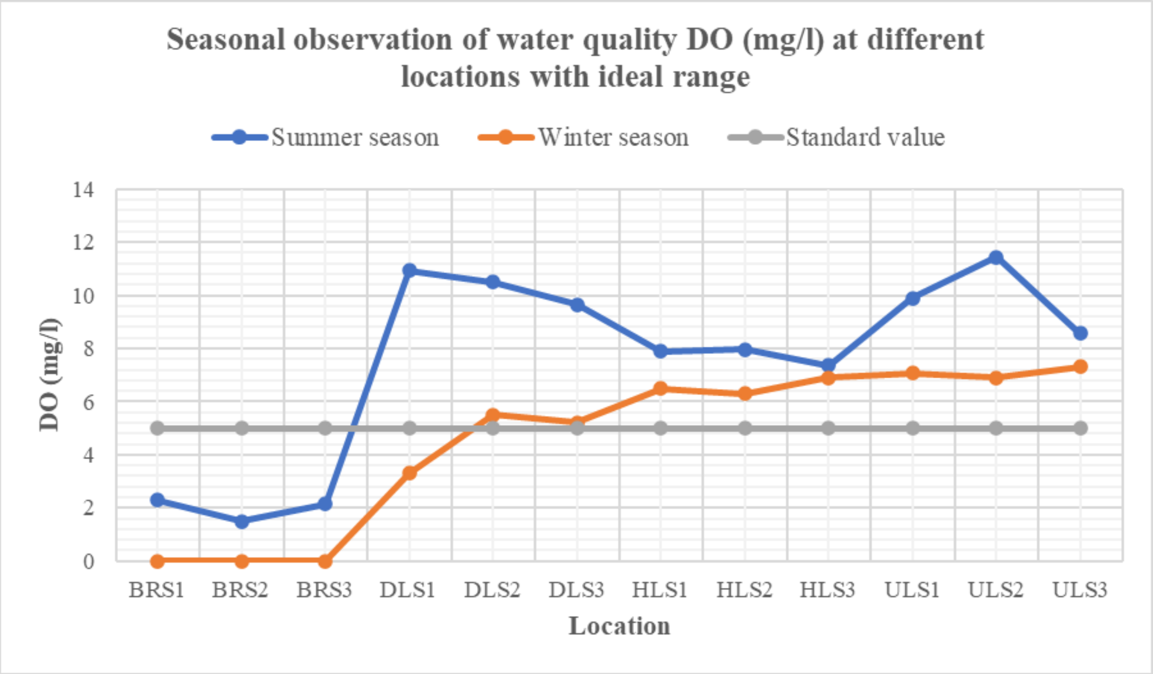
This chart does an extensive seasonal investigation of the quality of water, concentrating on the concentrations of dissolved oxygen (DO), in various places throughout the summer and winter. The vital indicator of oxygen availability in aquatic habitats, dissolved oxygen has a direct bearing on the well-being of aquatic life.

Preliminary findings show that throughout the summer months, DO levels in all of the investigated areas tend to drop. Higher temperatures, which lessen oxygen's solubility in water, and more biological activity are probably to blame for this phenomenon. Increased temperatures cause the oxygen consumption of aquatic organisms and microbial metabolism to increase, which lowers dissolved oxygen concentrations.

On the other hand, the study finds a different pattern with increased DO concentrations during the winter. Lower temperatures increase the amount of oxygen that is soluble in water, which raises DO levels. Elevated dissolved oxygen concentrations are further

supported by the fact that wintertime lower temperatures lead to a reduction in biological activity.
These results underline the need for a comprehensive understanding of dissolved oxygen dynamics by highlighting the dynamic interaction between seasonal fluctuations and water quality. The work offers insightful information for environmental management, indicating that seasonally adaptable techniques may be necessary to maintain optimal DO levels in various places. With consideration for the different effects of summer and winter circumstances on dissolved oxygen concentrations in various aquatic settings, this research lays the groundwork for well-informed decision-making in water resource management.

Figure 4.10 Seasonal observation of water quality DO (mg/l) at different locations with ideal range



Because of the increased water temperature in the summer, water may contain more dissolved oxygen in it. In addition to drawing dissolved oxygen from the water, low and high temperatures have the power to kill or limit an organism's life span. Furthermore, the water's level and temperature can change in a split second, and the issues mentioned above may get worse if there are more organisms in the area.

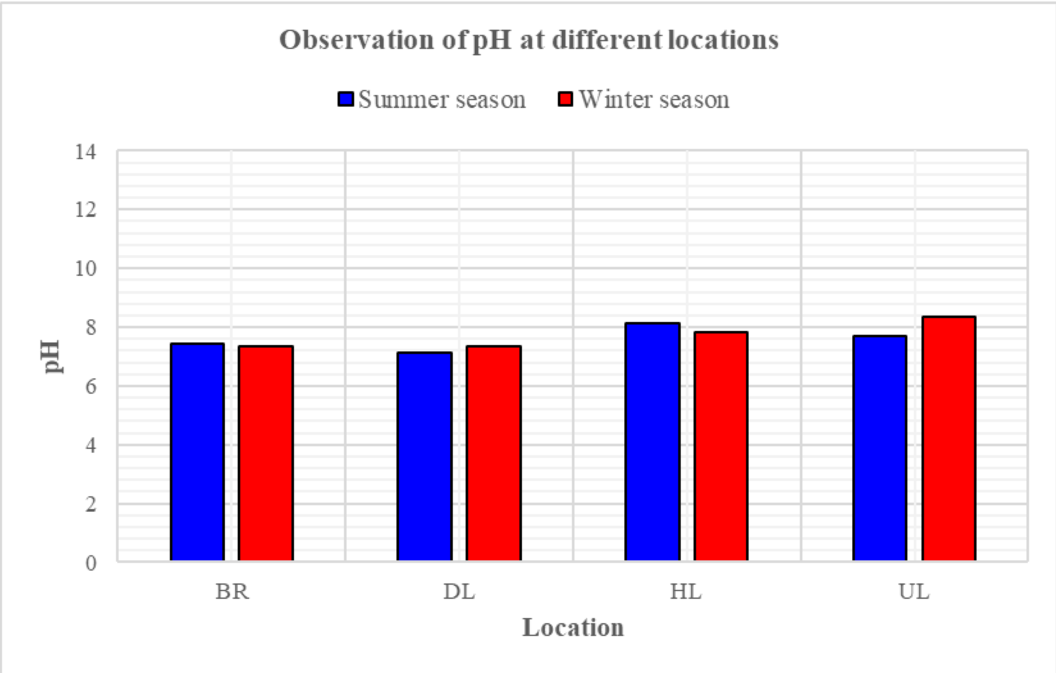
However, because the water is colder in the fall, there can be more dissolved oxygen in the water during that season. The water may have more dissolved oxygen than normal at this period, protecting the animals' lives.

4.6 Observation at different locations in summer and winter

4.6.1 pH

River Buriganga, Dhanmondi Lake, Hatirjheel Lake, and Uttara Lake all have different pH values in the summer and winter, which correspond to how acidic or alkaline these bodies of water are. The greatest pH in the summer is found in Hatirjheel Lake (8.1), followed by Uttara Lake (7.9), while somewhat lower pH values are found in River Buriganga and Dhanmondi Lake (7.6 and 7.4, respectively). Uttara Lake has the highest pH in the winter (8.3), which indicates that it is more alkaline than other lakes. Hatirjheel Lake and Dhanmondi Lake have steady pH values (7.9 and 7.6). River Buriganga shows a minor change in pH to 7.4. These pH changes are important markers of water quality because they affect the health of the aquatic ecosystem and highlight the necessity for context-specific environmental management techniques to maintain sustainable and balanced conditions in these bodies of water.

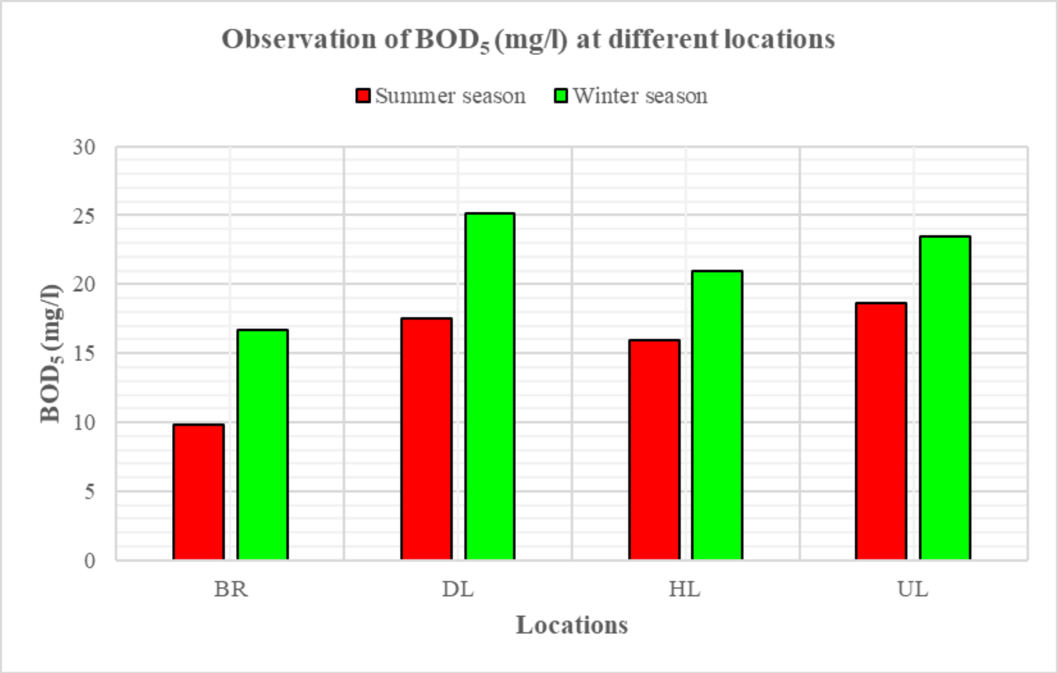
Figure 4.11 Observation of pH at different locations



4.6.2 BOD

Summer and winter time patterns of organic pollution are evident in the Biochemical Oxygen Demand (BOD) levels in the investigated water bodies. The greatest BOD concentrations are continuously seen in Dhanmondi Lake, which suggests a substantial organic load. The BOD level in the river Buriganga decreases from winter to summer, which may indicate a seasonal improvement in the water quality. Hatirjheel Lake exhibits steady organic loading throughout the year, as seen by its generally constant BOD levels. The BOD in Uttara Lake shows a slight drop from winter to summer. various variances highlight the fluid character of pollution in various bodies of water, highlighting the necessity of customized environmental management plans to deal with particular issues and maintain the ecological well-being of these aquatic ecosystems.

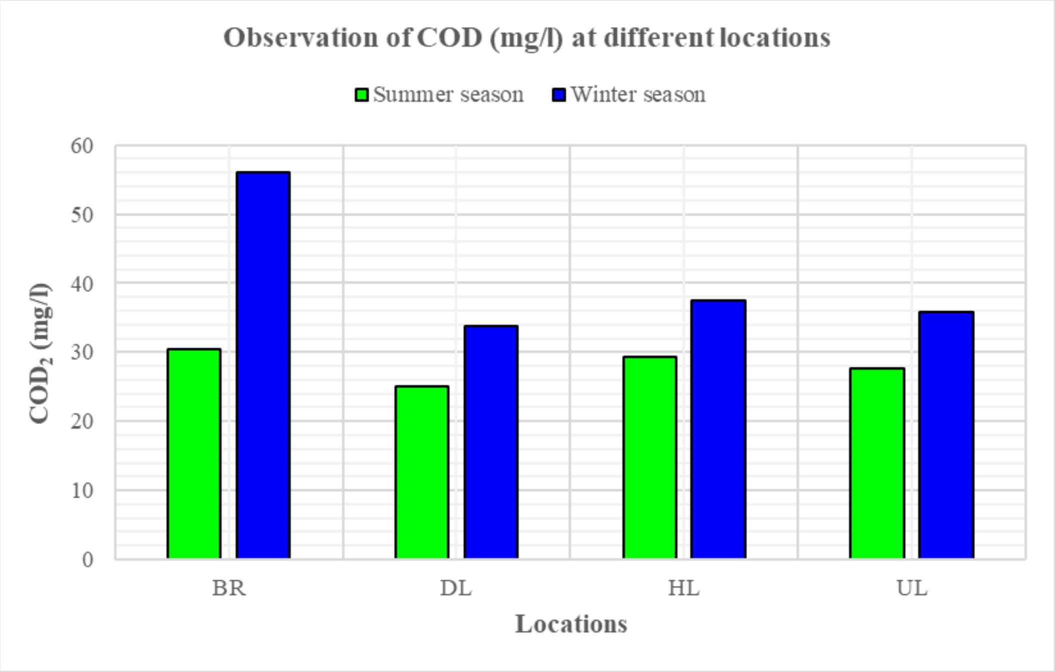
Figure 4.12 Observation of BOD_5 at different locations



4.6.3 COD

The study's four water bodies—the River Buriganga, Dhanmondi Lake, Hatirjheel Lake, and Uttara Lake—show different patterns of organic pollutants in the summer and winter based on their Chemical Oxygen Demand (COD) levels. The COD level in the river Buriganga significantly drops from 56 mg/L in the winter to 30 mg/L in the summer, suggesting that the water quality has improved during the colder months. Although Dhanmondi Lake shows a seasonal decline from 25 mg/L in winter to 34 mg/L in summer, its COD levels are consistently lower than those of other sites. Seasonal fluctuations have an impact on water quality, as seen by the decline in COD from summer to winter in both Uttara Lake and Hatirjheel Lake. The dynamic character of pollutant concentrations is highlighted by these findings, underscoring the necessity of focused environmental management techniques in these aquatic environments.

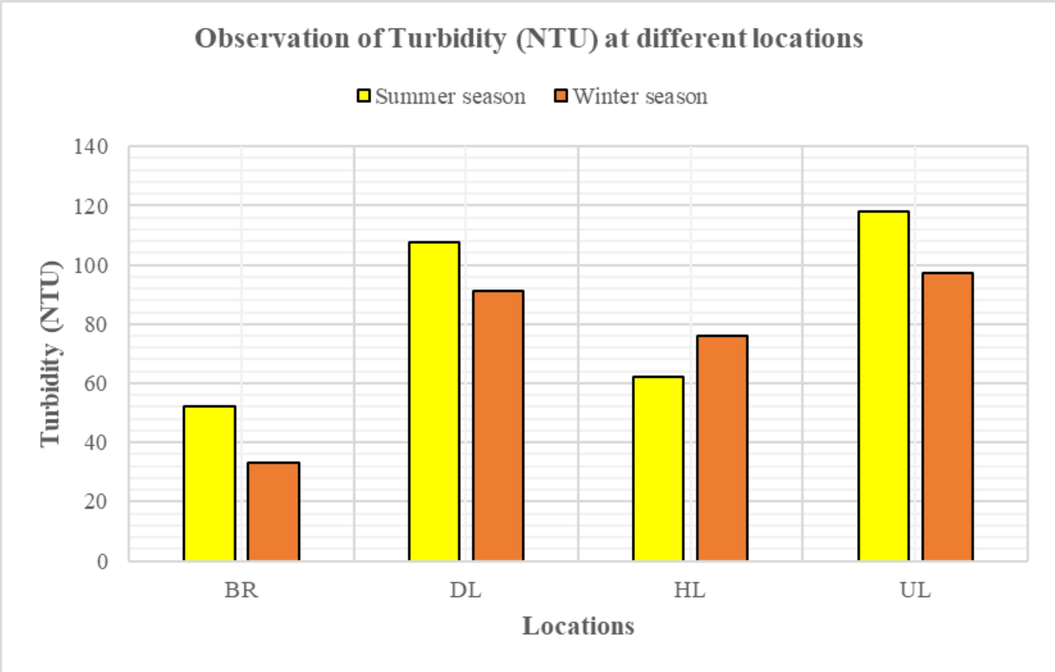
Figure 4.13 Observation of COD at different locations



4.6.4 Turbidity

Water clarity can be understood by comparing the summer and winter turbidity levels of River Buriganga, Dhanmondi Lake, Hatirjheel Lake, and Uttara Lake, which are measured in Nephelometric Turbidity Units (NTU). During the summer, the turbidity levels in Dhanmondi Lake are the greatest at 109 NTU, followed by Uttara Lake at 119 NTU. On the other hand, the turbidity levels in River Buriganga and Hatirjheel Lake are relatively lower, at 50 NTU and 65 NTU, respectively. Uttara Lake has the most turbidity in the winter (99 NTU), followed closely by Dhanmondi Lake (90 NTU). From summer to winter, Hatirjheel Lake's turbidity rises to 78 NTU, whereas River Buriganga's turbidity falls to 36 NTU. The dynamics of water quality are highlighted by these fluctuations in turbidity, highlighting the effects of seasonal variations and human activity on sedimentation and clarity in these varied aquatic settings.

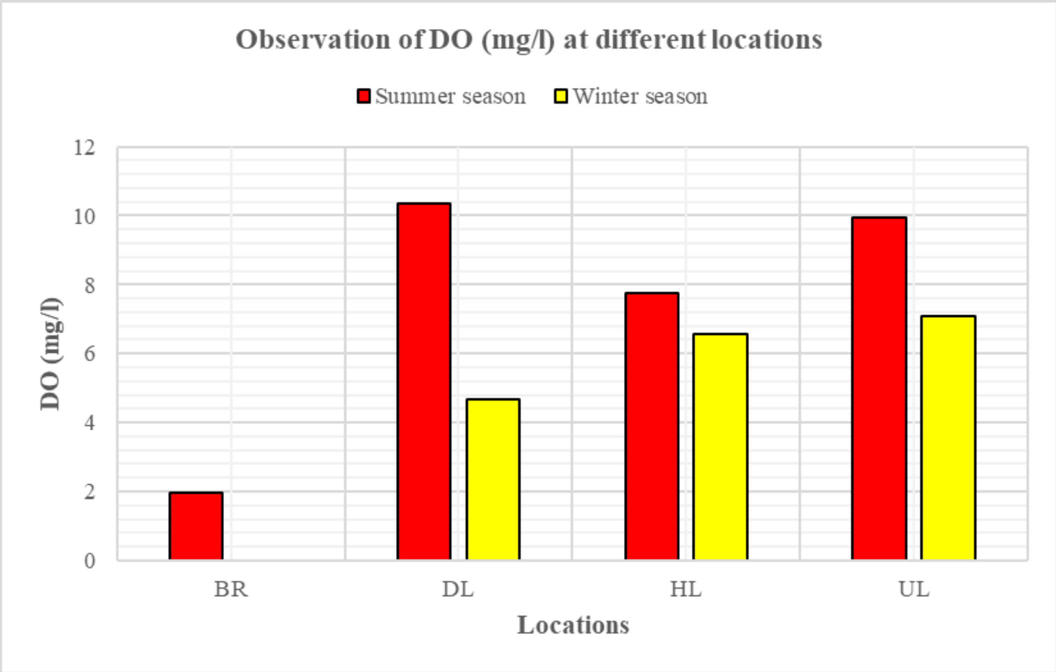
Figure 4.14 Observation of Turbidity at different locations



4.6.5 DO

Variations in summer and winter dissolved oxygen (DO) levels in River Buriganga, Dhanmondi Lake, Hatirjheel Lake, and Uttara Lake reveal details about the aquatic ecosystem. Dhanmondi Lake has the highest DO levels in the summer, at 10.2 mg/L, followed by Uttara Lake at 10 mg/L. Hatirjheel Lake and river Buriganga have the lowest levels, at 2 mg/L and 7.9 mg/L, respectively. However, Dhanmondi Lake, at 4.2 mg/L, and Uttara Lake, at 6.5 mg/L, sustain the greatest DO levels throughout the winter. From summer to winter, the DO in Hatirjheel Lake rises to 6.3 mg/L, whereas River Buriganga displays a sharp fall to 0 mg/L. In order to maintain the health of aquatic ecosystems, management measures that are tailored to the specific needs of each water body are necessary. These variances serve to emphasize the various oxygen dynamics found in these bodies of water.

Figure 4.15 Observation of DO at different locations



CHAPTER V

CONCLUSION AND RECOMMENDATION

5.1 General

Understanding the seasonal and regional fluctuations of many environmental parameters especially those that occur between winter and summer is crucial to understanding the dynamic character of ecosystems. The goal of the study was to comprehend how important variables, like temperature, pH, dissolved oxygen, turbidity, and contaminants, vary over time and in different places. Seasonal fluctuations showed clear patterns, with summer and winter showing different traits. Lower temperatures and possible effects on dissolved oxygen levels and microbial activity were observed during the winter. Summertime, on the other hand, brought with it higher temperatures, more biological activity, and possible changes in the dynamics of nutrients. The spatial differences brought to light a variety of situations in various locales, highlighting the impact of elements like land use and closeness to sources of pollution. Pollution hotspots were found, indicating the necessity for focused actions and management plans. These findings have ramifications for environmental management, where a grasp of seasonal and spatial variability is essential to putting recommendations into practice. Seasonal modifications to regulatory measures and customized interventions in particular spatial zones are among the recommendations. It is advised to monitor continuously in order to track changes over time and evaluate the success of adopted procedures. As a result, this work adds significantly to our understanding of environmental science and emphasizes the significance of taking seasonal and spatial factors into account when managing ecosystem health and water quality.

5.2 Conclusion

To summarize, the thorough evaluation of water quality factors, leading to the computation of the Water Quality Index (WQI), offers useful information on the overall ecological condition of the designated areas. Turbidity is identified as a crucial element, exhibiting the highest Quality Index and indicating a potentially substantial influence on water quality. The effects of pH and dissolved oxygen are rather minimal, although Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) have a modest impact. These findings highlight the variability in water quality among the examined parameters and locales. The computed WQI values are a crucial instrument for assessing the relative impact of each parameter on the overall water quality. To obtain relevant conclusions about the environmental sustainability and potential dangers of the water at the examined places, it is crucial to interpret these data within the framework of existing water quality standards or guidelines. Sustained monitoring and evaluation will be essential for implementing focused management strategies aimed at protecting and enhancing water quality in these regions in the long run.

Overall, the whole study outlines that, the average value of all the parameters is much higher in the winter season than summer season for both lakes and the river. If we consider the standard range of all the parameters between lakes and rivers neither of them gets close to the standard range. However, in the summer season water quality of the river is much better than the lakes, and in winter water lakes water quality is more acceptable. Regarding water quality, Hatirjheel Lake's water is favorable during the summer, and Uttara Lake's water is favorable during the winter. Conversely, the water quality of Dhanmondi Lake's water is unfavorable during both summer and winter.

5.3 Recommendations

1. Only two seasons were examined in this work; more data would be accessible if further seasons were examined in the future.

2. This article only looked into 4 places; however, more results will be available if more areas are investigated.

3. Five parameters have been examined in this thesis paper; however, further information will be discovered if other parameters are examined in the future.

4. Industries should be utilized modern wastewater treatment methods, such as membrane filtration, activated carbon filtration, or ozonation to eliminate hazardous chemicals from water.

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