

Assessment of Water Quality of Hatirjheel and Gulshan Lakes

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ABSTRACT: The main objective of the study is to assess the water quality of Hatirjheel Lake and Gulshan lake. Research work has been carried out to determine some vital water quality parameters. The assessment included whether the water quality meets the criteria for drinking water quality set by the Environment Conservation Rules, 1997. The results showed that the pH of all samples of both lakes maintain the standard (ECR'97). Color of all samples of both lakes varied from 97 to 418 Pt-Co show huge deviations from standard (15 Pt-Co). Turbidity varied from 7.5 to 30.4 NTU show deviation from the standard (10 NTU). Gulshan lake water has more color and total dissolved solids than Hatirjheel lake. Turbidity test result shows that water of Gulshan Lake is more turbid than Hatirjheel lake. Carbon dioxide (CO₂) in water of Hatirjheel lake, varied from 28 to 30 mg/L and of Gulshan lake varied from 31 to 65 mg/L exceed the ECR'97 permissible limit (4 mg/L) and show that Gulshan lake water is more acidic than Hatirjheel lake water. Alkalinity of all samples of both lakes water varied from 102 to 113 mg/L as CaCO₃ are below the standard value (600 mg/L as CaCO₃). Hardness of all samples of both lakes water varied from 122 to 286 mg/L as CaCO₃ have shown lower value than the ECR'97 standard (500 mg/L as CaCO₃). Chloride of all samples of both lakes water varied from 42 to 52 mg/L is below than the ECR '97 standard (150 mg/L as CaCO₃). The BOD₅ value of Hatirjheel lake varying from 1 to 10 mg/L and Gulshan lake varying from 1 to 20 mg/L show huge deviation from ECR'97 standard (0.2 mg/L). The average COD value of Hatirjheel lake is 45 mg/L and Gulshan lake is 64 mg/L show huge deviation from ECR'97 standard (4 mg/L). Comparing the water quality of both Hatirjheel and Gulshan Lakes and we found that water of Hatirjheel Lake is of better quality than Gulshan lake and can be reused if proper treatment plant is established and prevention of contamination source surrounding the water body can be ensured.

KEYWORDS: Water quality assessment, Environment Conservation Rules, pH, Color, Turbidity, Alkalinity, Hardness, Chloride, Carbon dioxide (CO₂), Biochemical Oxygen demand (BOD) and Chemical Oxygen demand (COD).

I. INTRODUCTION

Water that constantly cycles between the land and the atmosphere is a unique resource because of its necessity for all life. The same water is also used for crop and animal production beside it can be shared with the public and the aquatic and terrestrial ecosystems mentioned by Cooper et al. [1]. Water resources are of great environmental issues and studied by a wide range of specialists including hydrologists, engineers, ecologists, geologists and geo morphologists revealed by Kumar and Dua, [2]. Environmental statistics reveals that water bodies should constitute about 10 percent of a city for it to function properly, as the presence of water bodies to ensure reduction of sound and air pollution presented by Razzak et al. [3].

A lake (from Latin *lacus*) is a terrain feature, a body of liquid on the surface of the world that is localized to the bottom of basin and moves slowly if it moves at all. They act as water retention basins during the Monsoon. Besides being the sources of biodiversity of the area, they are an important part of the scenic beauty. The Hatirjheel and Gulshan Lakes are the part of long demand of the urban dwellers for their physical as well as mental nourishment. Rapid urbanization together with encroachment, leading to the loss of catchments of surface water bodies and problems of siltation, pollution, which includes domestic, industrial and agricultural waste including eutrophication are the major problems of

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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the world to protect and control water resources mentioned by Jagdish Singh [4]. In [5], studies from the Great Lakes in the U.S. and other important lakes show that while the release of these toxic pollutants had decreased their levels in fish and other aquatic organisms have actually increased because they stay in the environment and accumulate in fish over long periods of time. Fortunately Bangladesh, because of its geographical location holds adequate reserves of freshwater. But due to excessive population pressure, unawareness lack of enforcement of legal matters, very few of her water bodies retain good water quality and biodiversity mentioned by Shahrir Alam [6]. A number of investigations have been carried out in some lakes situated in and around Dhaka area to evaluate their water quality. The Hatirjheel and Gulshan lakes are no longer attractive to the eye and reduced to almost a drain. Both lakes often contain high pollution levels relative to the surrounding landscapes and environment. There is need to assess the water quality of Hatirjheel and Gulshan lakes to find out the solution of pollution of water.

II. STUDY AREA

Hatirjheel Lake

Hatirjheel Lake is located in the center of Dhaka and is a crucial element in the city's drainage system. Hatirjheel Lake is located at 23°48' N & 90°25' E of Dhaka city and length of the lake is 4.1 km which covers an area of 0.79 km². It has an average depth of 2.6 m. The widest part of the lake is approximately 0.46 km. The peripheral sides are, northern at Gulshan-Banani, southern at Banglamotor, eastern at Rampura and western at Tejgaon industrial area mentioned by Tariqzaman et al. [7].

Gulshan Lake

Gulshan Lake is the northern most lake in a chain of water bodies (Gulshan Lake, Hatirjheel, Begunbari Khal, Balu River and Shitalakhya River) in Dhaka, suffering from highly significant pollution. Gulshan lake is located 23°48' N and 90°25' E of Dhaka city. The length of the lake is 3.8 km which covers an area of 0.0160 km². It has an average depth 2.5 m and volume 12 × 105m³ presented by Nishat A. [8]. The lake is a channel-like elongated water body. The peripheral sides are, northern at Baridhara, southern at Tejgaon-Hatirjheel, western at Gulsan-Banani and eastern at Badda area mentioned by Razzak et al [9]. Previous study showed that only heavy metal Pb concentration during the monsoon and concentrations of all other four heavy metals (Cd, Cr, Cu and Ni) during summer exceeded the standard level of drinking, fishing and surface water as setup by WHO [10], ECR'97 [11] and USEPA [12].

III. METHODOLOGY

Sampling Locations

With a view to finding out the water quality parameters, water samples were collected from three different suitable locations as listed in tables 3.1 which were selected by exploring the entire lake areas such that the samples represent the characteristics of whole lake. Water samples were collected in plastic containers which were first cleaned with tap water and detergent, then with distilled water sampling points. Plastic containers of capacity greater than 2 liters were used for sampling, and 2 liters of each sample in each location was collected for the study.

Table 3.1: Sample Point Location

Sample Point	Hatirjheel Lake	Gulshan Lake
1	Near Rampura Bridge	Hatirjheel Entry Point
2	Near BFDC	Gulshan 1
3	Near the Modhubagh Bridge	Badda Gudara Ghat

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Laboratory Testing of the Samples

All the samples were directly carried to the laboratory with care and the standard lab test procedures have been followed to analyze the physicochemical parameters of the collected water samples. All collected samples were analyzed for pH, Color, Turbidity, Total Dissolved Solids (TDS) and Total Suspended Solids (TSS), CO₂ determination, Total Alkalinity, Hardness, Chloride determination, Biochemical Oxygen Demand (BOD₅), Chemical Oxygen Demand (COD) and compared with standard values.

IV. RESULTS AND DISCUSSION

Laboratory test results of pH, Color, Turbidity and TDS of the collected water samples of Hatirjheel lake and Gulshan lake are given in Table 4.1 and 4.2.

Table 4.1: pH, Color, Turbidity and TDS test results

Location	Sample Point	pH	Color (Pt-Co)	Turbidity (NTU)	Total Solids (TS) mg/L	Total Dissolved Solids (TDS) mg/L	Total Suspended Solids (TSS) mg/L
Hatirjheel Lake	1	7.3	207	13.2	403	345	58
	2	7.1	136	21.9	444	405	39
	3	7.1	197	22.1	468	440	28
Gulshan Lake	1	5.8	418	30.4	396	366	30
	2	7.2	259	15.7	500	445	55
	3	7.1	97	7.50	504	432	72

Figure 4.1 shows that by testing existing water of Hatirjheel lake and Gulshan lake, we have pH value from 5.8 to 7.3 whereas the standard range as ECR'97 is 6.5 to 8.5. So, the pH value is 100% satisfied.

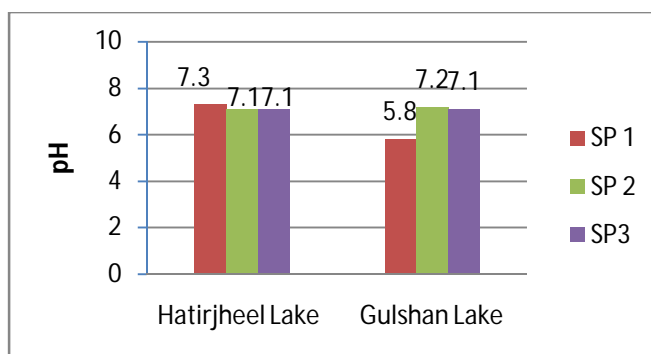


Figure 4.1: pH Test results of Hatirjheel and Gulshan lakes

Figure 4.2 shows that the value of color of the existing water of Hatirjheel lake ranges from 197 to 207 Pt-Co units and the water of Gulshan lake ranges from 97 to 418 Pt-Co whereas ECR.97 standard range is 15 Pt-Co units, so the color is very much higher than the permissible limit for both lakes.

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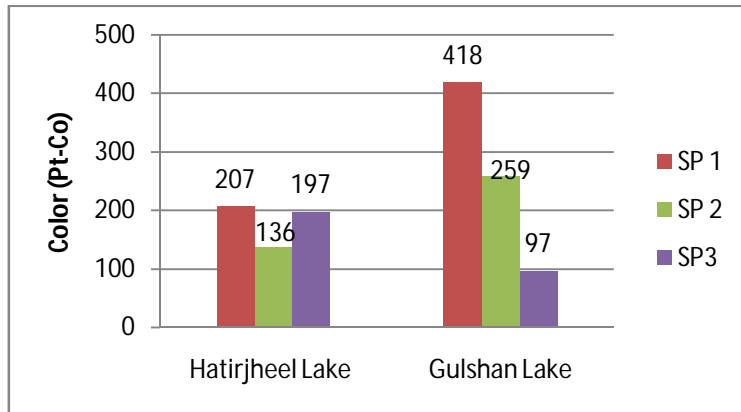


Figure 4.2: Color Test results of Hatirjheel and Gulshan lakes

Figure 4.3 shows that the average value of the turbidity of Hatirjheel lake is 19.1 NTU which exceeds the permissible limit according to ECR'97(10 NTU). The average value of the turbidity of Gulshan lake is 17.9 NTU which also exceeds the limit. This means there is huge amount of suspended particles or colloids in the water of the lakes.

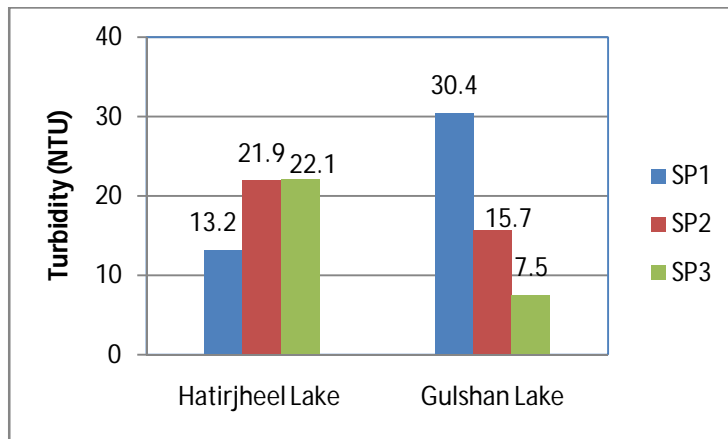


Figure 4.3: Turbidity Test results of Hatirjheel and Gulshan lakes

Figure 4.4 shows that the average value of the Total Dissolved Solids of Hatirjheel lake is 396.67 mg/L and of Gulshan lake is 414.33 mg/L. Both are within the permissible limit of ECR'97 (100mg/L).

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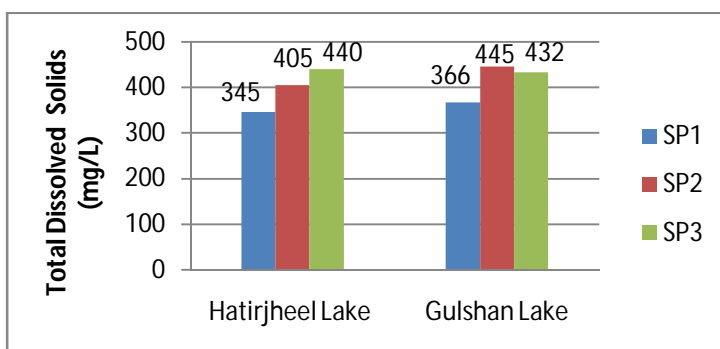


Figure 4.4: TDS Test results of Hatirjheel and Gulshan lakes

Table 4.2: CO₂ Total Alkalinity, Hardness, Chloride, BOD and COD test results

Location	Sample Point	CO ₂ in Water (mg/L)	Total Alkalinity (mg/L as CaCO ₃)	Hardness (mg/L as CaCO ₃)	Chloride in water (mg/L)	BOD (mg/L)	COD (mg/L)
Hatirjheel Lake	1	29	121	122	52	2	27
	2	28	102	148	46	10	44
	3	28	103	148	42	8	63
Gulshan Lake	1	65	103	286	51	20	94
	2	26	113	168	42	1	36
	3	31	113	212	44	9.6	60

Figure 4.5 shows that by testing existing water we have carbon oxide value 28 to 30 mg/L for Hatirjheel Lake and 31 to 65 mg/L for Gulshan lake whereas ECR.97 standard range is 4 mg/l .So the carbon dioxide value is very high in the lakes water which makes the lakes water acidic.

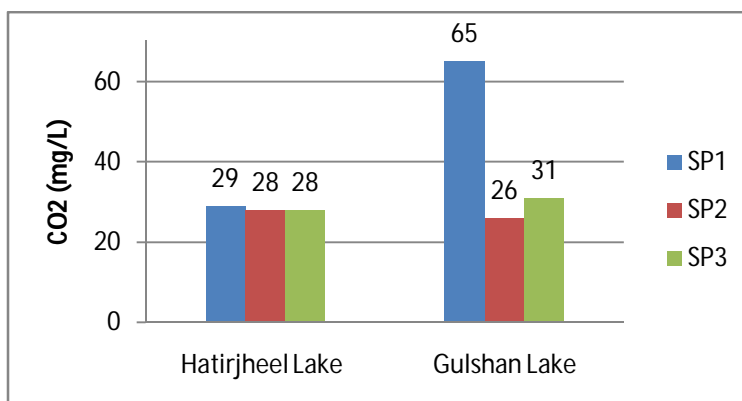


Figure 4.5: CO₂ in water of Hatirjheel and Gulshan lakes

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Figure 4.6 shows that the value of Total Alkalinity of Hatirjheel lake is 103 to 121 mg/L as CaCO₃ and of Gulshan lake is 103 to 113 mg/L as CaCO₃. Both are quite below than standard value of 600 mg/L as CaCO₃. So the alkalinity value is very low in both lakes water.

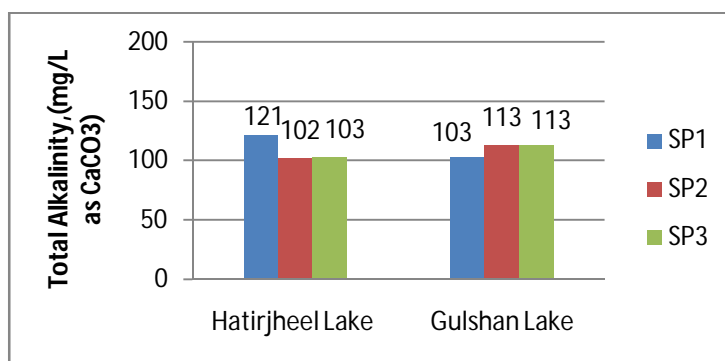


Figure 4.6: Total Alkalinity in water of Hatirjheel and Gulshan lakes

Figure 4.7 shows that the value of Hardness of Hatirjheel lake is 122 to 148 mg/L as CaCO₃ and of Gulshan lake is 168 to 286 mg/L as CaCO₃ whereas ECR.97 standard range is 500 mg/L as CaCO₃. So the hardness value is very low in both lakes water.

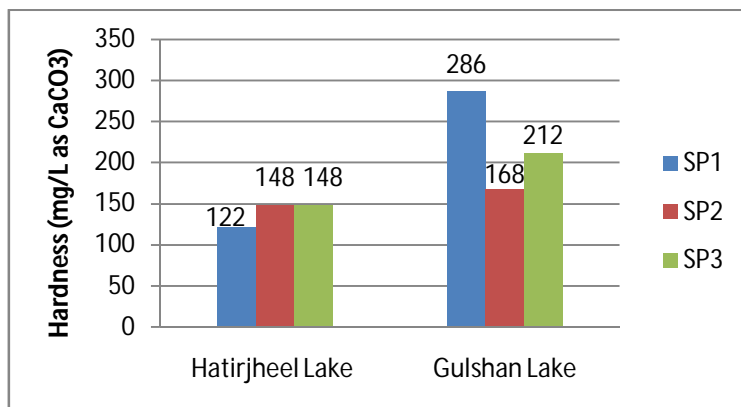


Figure 4.7: Hardness in water of Hatirjheel and Gulshan lakes

Figure 4.8 shows that the value of Chloride of Hatirjheel lake is 42 to 52 mg/L as CaCO₃ and of Gulshan lake is 44 to 51 mg/L as CaCO₃ whereas ECR.97 standard range is 150-600 mg/L as CaCO₃. So the Chloride value is very low in both lakes water. Figure 4.9 shows that by testing existing Hatirjheel lake water we have found that BOD₅ values varying from 1 to 10 mg/L whereas ECR.97 standard range is 0.2 mg/L. So, BOD₅ value is very high and not recommended for drinking purposes. The BOD value of Gulshan lake is 1 to 20 mg/L which also exceeds the permissible limit. Figure 4.10 shows that Average COD value of the Hatirjheel lake is 45mg/L which is much higher than the standard limit for drinking water (4.0 mg/L) according to ECR'97. Such a high value indicates presence of organic pollutant. Average COD value of the Gulshan lake is 64 mg/L which is also much higher than the standard limit. So, both lakes can be strictly prohibited as potable water source.

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Vol. 7, Issue 7, July 2018

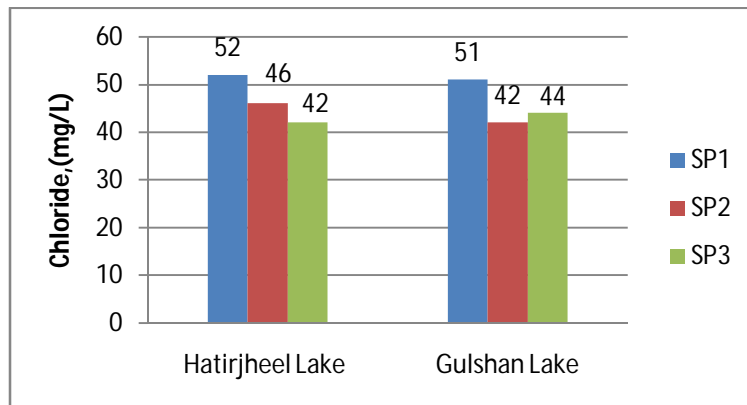


Figure 4.8: Chloride in water of Hatirjheel and Gulshan lakes

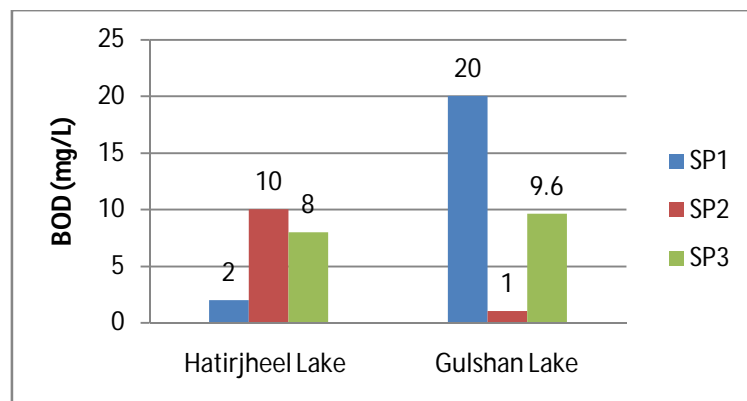


Figure 4.9: BOD₅ value in water of Hatirjheel and Gulshan lakes

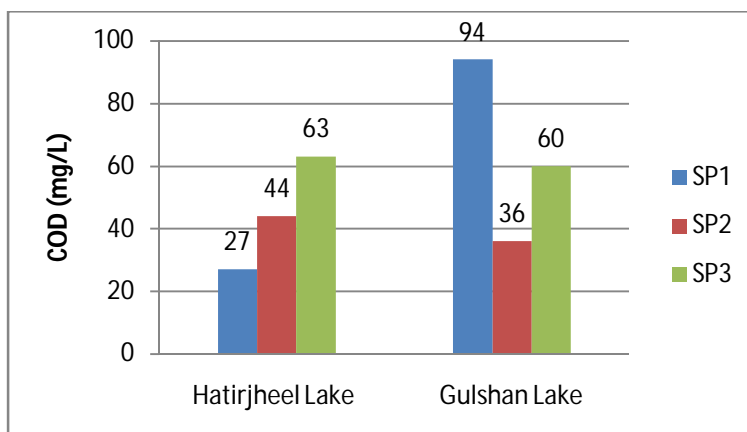


Figure 4.10: COD value in water of Hatirjheel and Gulshan lakes

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V. CONCLUSION

Hatirjheel and Gulshan Lakes both have great economic and environmental value with unique regional characteristics. But due to unplanned and excessive growth of urbanization and industrialization, the utilization and quality of lake water has been declined and contributed to serious environmental degradation. In this study period, sample size was limited for test due to time limitation and was not enough to make total environmental study of the lakes. From the quality assessment of Hatirjheel and Gulshan Lakes water, it can be clearly stated that the water of the Gulshan Lake is severely polluted compared to the Hatirjheel lake. We find that water of Hatirjheel Lake can be reused if proper treatment plant establish and prevent the contamination source surrounding the water body. Sewage from the Badda, Baridhara, Gulshan and Banani residential areas along with toxic discharges from the nearby industries have contaminated the water of Gulshan Lake. Awareness program and a coordinated plan for both lakes should be taken to stop unauthorized activities that seriously lead to pollution of the lakes and surrounding environment.

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