WATER QUALITY ASSESSMENT OF HALDA RIVER AT VARIOUS DEPTHS

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ABSTRACT

Halda River is South Asia's sole natural fish spawning center. Which is located in the Chittagong Hill Tracts of Bangladesh at latitude 22°38'00" N and longitude 92°10'00" E[1]. Where carp fish release fertile eggs at high and low tide during the full moon from mid-April to June of every year for time immemorial. In 2020, 25000kg of eggs were collected from the Halda, and in 2021, it decreased to 8500kg. Which is a concern. Optimum fish production is dependent on the physical, chemical, and biological qualities of water. However, anthropogenic activities, including industrial discharge and agricultural runoff have raised concerns regarding the water quality of the river. This study presents a comprehensive assessment of the water quality in the Halda River at various depths. The study involved the collection of water samples from multiple depths (2m,4m & 6m) using a Van Dorn Bottle. The study was conducted to assess the water quality parameters of the Halda River from Anondo Bazar to Poran Bohaddar Bari in May 2022. Samples were collected from 30 locations of 10 stations during the pre-monsoon seasons and the parameters including pH, EC, TDS, DO, COD, Color, Turbidity, and Salinity were investigated from samples. In pre-monsoon season, pH (6.57-6.91), EC (170-297 us/cm), TDS (85-103 mg/L), DO (3.75-8.51 mg/L), COD (6.1- 7.9 mg/L), Color (66-195 PCU), Turbidity (0.7-406 NTU), Salinity (81-99 ppm) concentrations in water samples have been found. The investigated concentrations of these parameters were compared with the Bangladesh water quality standards set by the Bangladesh Environmental Conservation Rule: 2023 (BECR, 2023). The study underscores the importance of a multi-depth assessment approach to understand the water quality of the Halda River and provides valuable information for policymakers and environmental stakeholders to support the aquatic ecosystems of the Halda River.

Keywords: *Halda River, Water quality, Various depths, Van Dorn Bottle, Fish production*

1. INTRODUCTION

Bangladesh, basically known as the land of rivers, is filled with 907 rivers. Halda River, being the only tidal river in Bangladesh, serves as a natural source of fertilized carp[2]. In southeastern Bangladesh, the Halda River is well known as a spawning ground and for the collection of naturally produced eggs of Indian major carp. More than eighty species of finfish and 10 species of shellfish are inhabitants of this river[3]. Halda is one of the major rivers of the Chattogram district and has become the effecters of development providing fresh water supply, fish production, transportation, and waste assimilation provision along with a wide array of recreation and tourism options. Its water from extreme downstream is supplied to the Chattogram city dwellers for drinking after treatment. The river water is also used for irrigation and local people's transportation, bathing, discharging poultry litter, and household wastes of local Upazila towns such as Fatikchari, Nazirhat, and Hathazari. Water quality assessment is one of the most important aspects of water studies. Determination of the physicochemical characteristics of water is essential for assessing the suitability of water for various purposes like drinking, domestic, industrial, irrigation, and fish culture. That's why, good water quality is essential for the survival and growth of fish. Due to the increase in human population and the development of townships at large, these freshwater bodies are under tremendous pressure owing to their overuse on one hand and enrichment due to nutrients and organic matter on the other, leading to cultural eutrophication. At the present time, Bangladesh is facing serious problems with water contamination from different industries, domestic wastes, and agrochemicals. All the Previous studies of the Halda River were conducted with only surface water not depths-wise. That's why previous studies did not fulfill the accurate water quality of the Halda River. Therefore, the present study aimed to assess the suitability of the physicochemical characteristics of Halda river water at various depths for fish culture, agriculture & drinking purposes.

2. METHODOLOGY

2.1 Study area

This investigation was carried out to evaluate the status of the Halda River water, which is located in the Chittagong Hill Tracts of Bangladesh at latitude 22°38'00" N and longitude 92°10'00" E[4]. Water samples were collected from 10 stations of **Anondo Bazar** (22° 35' 44.88"N, 91° 49' 6.672"E) to **Poran Bohaddar Bari** (22° 23' 47.6"N, 91° 50' 21.22"E) along the Halda river. The water of Halda River is used for drinking, fish culture, agriculture and partially domestic activities. The present study was conducted to analyze the parameters of water in May 2022.
Our 10 sampling stations are:

Station 1: Anondo bazar (22° 35' 44.88"N, 91° 49' 6.672"E)
Station 2: Nazirhat (22° 37′ 57.72″ N, 91° 47′ 39.48″ E)
Station 3: South sobali (22° 35′ 57.60″ N, 91° 49′ 39.30″ E)
Station 4: Noyahat (22° 30' 0.3744"N, 91° 51' 55.6884"E)
Station 5: West Gohira (22° 30' 33.012"N, 91° 51' 25.056"E)
Station 6: Sattarghat (22° 30' 47.592"N, 91° 50' 49.164"E)
Station 7: Mohora (22° 24' 46.8"N, 91° 53' 9.06"E)
Station 8: Ramdashat (22° 27' 54.0714"N, 91° 51' 23.0754"E)
Station 9: Modunaghat (22° 26' 2.76"N, 91° 52' 21.18"E)
Station 10: Poran Bohaddar Bari (22° 23' 47.6"N, 91° 50' 21.22"E)

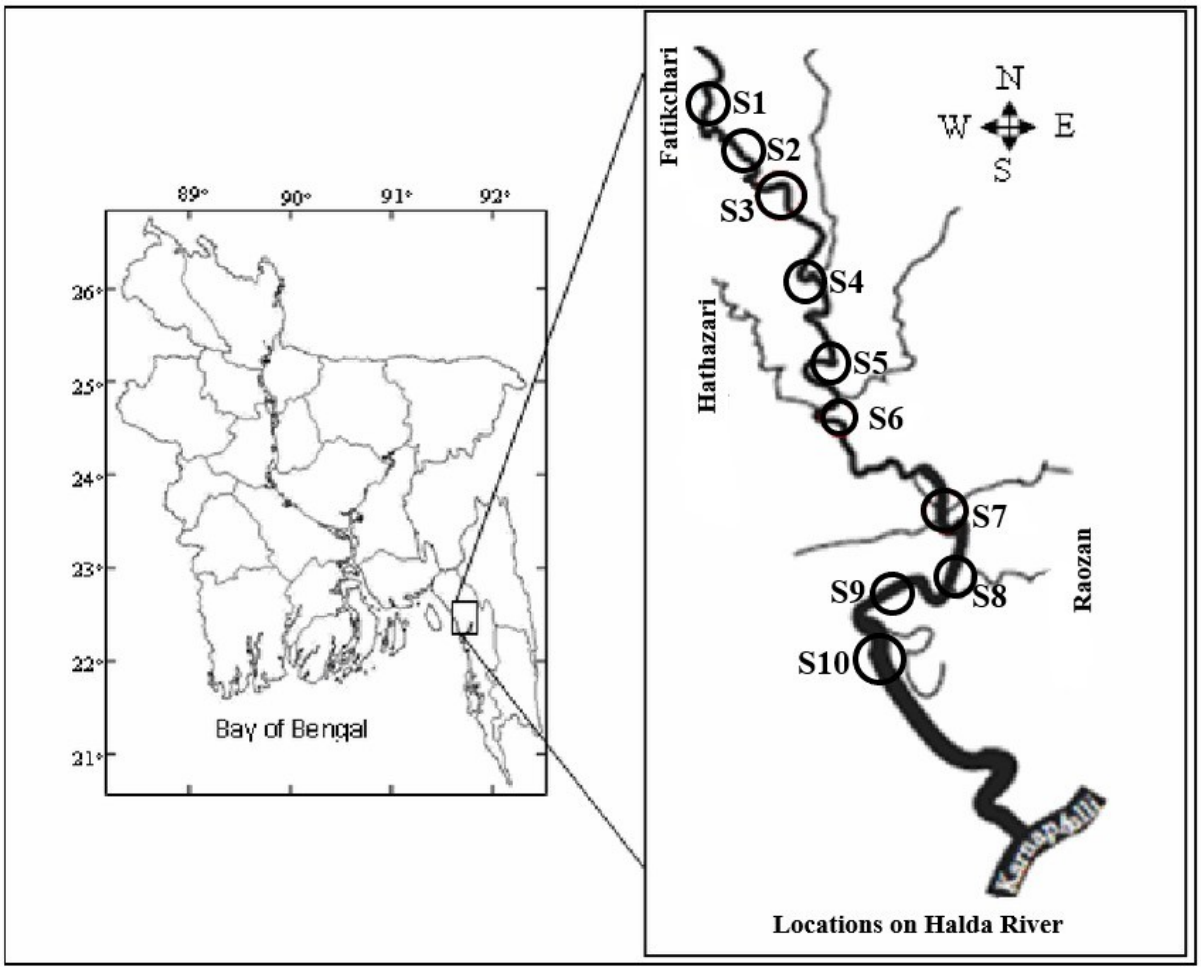

Figure 1: Map showing the 10 sampling stations (St.1: Anondo Bazar, St.2: Nazir Hat, St.3: South sobali, St.4: Noya Hat, St.5: West Gohira, St.6: Sattar Hat, St.7: Mohora, St.8: Ramdas Hat, St.9: Modunagat, and St.10: Poran Bohaddar Bari)

2.2 Sample collection

The water samples were collected from 30 locations of 10 stations of the Halda River from Anondo Bazar to Poran Bohaddar Bari from multiple depths (2m,4m & 6m) using a Van Dorn Bottle.Water samples stored in fresh unsullied plastic bottles.

2.3 Water quality analysis

Eight parameters were analyzed to find out the quality of the Halda River. three parameters [electric conductivity (EC), pH, and total dissolved solids (TDS)] were tested in the sampling stations immediately after the collection of samples. After necessary preservation, the rest five parameters [dissolved oxygen (DO), chemical oxygen demand (COD), colure, turbidity, salt] were analyzed in the Laboratory.
Water parameters were analyzed by

1. pH: By using Digital pH meter.
2. Electric Conductivity: By using Conductivity meter.
3. TDS: By using TDS meter.
4. DO: By using titration method.
5. COD: By using titration method.

6. Color: By using Spectrophotometer.
7. Turbidity: By using Nephello Turbid Meter.
8. Salinity: By using Hydrometer.

2.4 Standard parameters

In this paper we compare the resultant values of water parameters with the standard valus of water according to Bangladesh Environmental Conservation Rule:2023 ,FAO,WHO in terms of agriculture, fisheries and drinking water.

Table 1: STANDARD PARAMETERS FOR AGRICULTURE:

Standards / Parameters	BECR (2023)	FAO
pH	6.5-8.5	6-8.5
EC (uS/cm)	2250	1200
TDS (mg/L)	1000	2000
DO (mg/L)	-	4-6
COD (mg/L)	100	10
Colour (PCU)	-	-
Turbidity (NTU)	-	5
Salt (ppm)	≥26%	-

Table 2: STANDARD PARAMETERS FOR FISHERIES:

Standards / Parameters	BECR (2023)
pH	6-9
EC (uS/cm)	-
TDS (mg/L)	1000
DO (mg/L)	≥5
COD (mg/L)	50
Colour (PCU)	-
Turbidity (NTU)	-
Salt (ppm)	-

Table 3: ***STANDARD PARAMETERS FOR DRINKING WATER:***

Standards / Parameters	BECR (2023)	WHO
pH	6.5-8.5	6.5-8.5
EC (uS/cm)	600-1200	1200
TDS (mg/L)	1000	500
DO (mg/L)	≥6	4-6
COD (mg/L)	10	10
Colour (PCU)	15	-
Turbidity (NTU)	5	5
Salt (ppm)	-	-

3. RESULTS AND DISCUSSION

3.1. pH

pH is the negative logarithm of hydrogen ion concentration. It indicates the level of acidity or alkalinity of a solution[5]. It's a very important factor in fish culture and agriculture. It is considered that the value of pH between 6 and 9 is congruous for fish production. In this study, we recorded the pH value between 6.57 to 6.91. We recorded the maximum values of pH in Anondo Bazar station at 2m depth and the minimum values of pH found in Sattarhat station at 4m depth. The present result of the pH of the ten stations is within the permissible limit according to the Bangladesh Environmental Conservation Rule:2023, WHO, and FAO based on use for drinking water purposes, agriculture, and fish culture. so the water of Halda River could be considered as safe for fish production, agriculture, and drinking.

3.2. Electric Conductivity (EC)

Electrical conductivity (EC) is a helpful parameter for assessing water purity. High conductivity values are a sign of pollution. In this study, we recorded the values of Electrical conductivity between 170 uS/cm to 297 uS/cm. The maximum value of EC was found in Mohara at 4m depth and the minimum value of EC was found in Poran Bohaddar Bari at 4m depth. The present result of the EC of the ten stations is within the permissible limit according to the Bangladesh Environmental Conservation Rule:2023, WHO, and FAO based on use for drinking water purposes and agriculture but no standard value reported in the Bangladesh Environmental Conservation Rule:2023 for fish culture.

3.3. Total dissolved solids (TDS)

The total amount of minerals, metals, organic matter, and salts that are dissolved in a certain amount of water is known as total dissolved solids(TDS)[6]. The quality of water has a direct correlation with TDS. In this study, we recorded the values of TDS between 85 mg/L to 103 mg/L. The Maximum value of TDS was found in Poran Bohaddar Bari at 4m depth and Mohara at 6m. The Minimum value of TDS was found in Anondo Bazar at 2m depth and West Gohira at 6m depth. The present result of the TDS values of ten stations within the permissible limit according to the Bangladesh Environmental Conservation Rule:2023, WHO, and FAO based on use as drinking water purpose, agriculture, and fish culture.

3.4. DO

DO is the measurement of the amount of dissolved oxygen in an aqueous solution. Values of DO vary daily and seasonally and depend on the species of phytoplankton present, light penetration, nutrient availability, temperature, salinity, water movement, and pressure of atmospheric oxygen in contact with the water[7]. In this study, we recorded the values of DO between 3.75 mg/L to 8.5 mg/L. The maximum value of DO was found in Ramdas Hat at 2m depth and the minimum value of DO was found in West Gohira at 4m depth. There is no standard DO value reported in Bangladesh Environmental Conservation Rule:2023 for agriculture. The maximum sample result of DO values within the permissible limit according to the Bangladesh Environmental Conservation Rule:2023 and WHO ($\geq$5), except 8 samples (sample no:2, sample no:6, sample no:7, sample no:12, sample no:14, sample no:15, sample no:16, sample no:17) for fisheries and drinking. The reason behind the problem was agricultural runoff and hot weather.

3.5. COD

COD is the amount of oxygen needed for both organic and inorganic matter to oxidize chemically. The higher values of COD indicate the pollutants were present in the water[8]. During the study, we recorded the values of COD ranging between 6.1 mg/L to 7.9 mg/L. The maximum COD was found in Poran Bohaddar Bari at 6m depth and the minimum COD was found in Anondo Bazar at 2m. The present values of COD of the ten stations within the permissible limit according to the Bangladesh

Environmental Conservation Rule:2023, WHO, and FAO based on use as drinking water purpose, agriculture, and fish culture.

3.6. Colour

Colour is one of the most important parameters for any aquatic water body and indicates the purity of the water. pale colour, light greenish waters are suitable for fish culture[9]. During the analysis, we recorded the values of Colour ranging between 66 PCU to 195 PCU. The maximum value of Colour was found in Poran Bohaddar Bari at 4m depth and the minimum value of Colour was found in West Gohira at 2m depth. There is no standard value reported in the Bangladesh Environmental Conservation Rule:2023 and FAO for agriculture and fish culture. However, this study does not satisfy the color standard value of the Bangladesh Environmental Conservation Rule:2023 for drinking water. All of our sample colour values cross the standard value (15 PCU). The reason behind the problem was rainwater runoff.

3.7. Turbidity

Turbidity is the measure of the ability of water to transmit the light that restricts light penetration and limits photosynthesis. It is an observation of the light scattered by suspended particles[10]. During the study, we recorded the values of turbidity ranging between 0.7 NTU to 406 NTU. The maximum Turbidity was found in West Gohira at 2m depth and the minimum Turbidity was found in SouthSobali at 2m depth. There is no standard turbidity value reported in Bangladesh Environmental Conservation Rule:2023 for agriculture and fish culture. However, except 5 samples (sample no:1, sample no:2, sample no:3, sample no:7, sample no:29) most of the sample's turbidity value does not satisfy the turbidity standard value of the Bangladesh Environmental Conservation Rule:2023 and WHO (5NTU) for drinking water. The reason behind the problem was rainwater and agriculture runoff.

3.8. Salinity

The amount of dissolved salt in a body of water is its salinity. According to the United States Geological Survey, the water containing less than 1000 ppm is fresh[11]. Salt obtained from this study had ranged between 81 ppm to 99 ppm. The maximum salinity was found in West Gohira at 6m depth and the minimum salinity was found in Poran Bohaddar Bari at 6m depth. There are no standard values of salinity reported in Bangladesh Environmental Conservation Rule:2023 for fisheries and drinking water. But this study's results satisfy the United States geological survey’s freshwater defination. So the water would be regarded as fresh water.

Table 4: Water quality parameter analysis of Halda River

Location	Depth (m)	Sample no.	pH	EC (uS/cm)	TDS (mg/L)	Do (mg/L)	COD (mg/L)	Colour (PCU)	Turbidity (NTU)	Salt (ppm)
Anondo Bazar	2	1	6.91	206	103	5.43	6.1	80	1.94	98
Anondo Bazar	4	2	6.84	194	97	4.85	7.2	85	1.78	93
Anondo Bazar	6	3	6.85	196	97	6.15	7	85	4.24	94
Nazir Hat	2	4	6.81	188	94	5.17	6.6	95	75.8	91
Nazir Hat	4	5	6.78	184	92	5.15	6.6	100	105	88
Nazir Hat	6	6	6.75	195	95	4.74	6.2	105	24.5	92
South sobali	2	7	6.81	192	96	4.72	6.3	75	0.7	93
South sobali	4	8	6.82	184	91	5.78	6.3	85	31.6	84
South sobali	6	9	6.79	183	91	5.76	6.3	91	25.6	85
Noya Hat	2	10	6.69	182	91	5	6.3	70	40.6	84
Noya Hat	4	11	6.76	189	94	5.07	7	72	115	86
Noya Hat	6	12	6.69	191	102	4.88	7.9	80	303	89
West Gohira	2	13	6.71	194	95	5.28	7	66	406	93
West Gohira	4	14	6.66	195	97	3.75	6.9	77	51.8	94
West Gohira	6	15	6.69	207	103	4.78	6.6	92	9.4	99
Sattar Hat	2	16	6.64	190	93	4.78	7	67	21.1	89
Sattar Hat	4	17	6.57	189	93	4.68	6.2	82	91.1	90
Sattar Hat	6	18	6.65	204	102	5.46	6.7	88	77	98
Mohora	2	19	6.59	202	100	5.52	7.8	105	10.2	97
Mohora	4	20	6.89	297	98	5.01	7.8	145	124	96
Mohora	6	21	6.77	191	85	5.62	7.7	100	121	82
Ramdas Hat	2	22	6.72	188	93	8.51	6.3	85	80.6	87
Ramdas Hat	4	23	6.66	186	92	5.15	6.6	95	123	89
Ramdas Hat	6	24	6.66	187	93	5.98	6.5	80	170	90
Modunagat	2	25	6.61	189	93	5.53	6.5	100	122	89
Modunagat	4	26	6.63	190	94	5.01	6.9	90	117	91
Modunagat	6	27	6.64	190	94	5.56	6.4	95	147	92
Poran Bohaddar Bari	2	28	6.66	187	93	5.63	6.8	75	49.8	89
Poran Bohaddar Bari	4	29	6.67	170	85	5.28	7.3	195	4.18	81
Poran Bohaddar	6	30	6.61	187	93	5.21	7.9	175	101	90

Bari

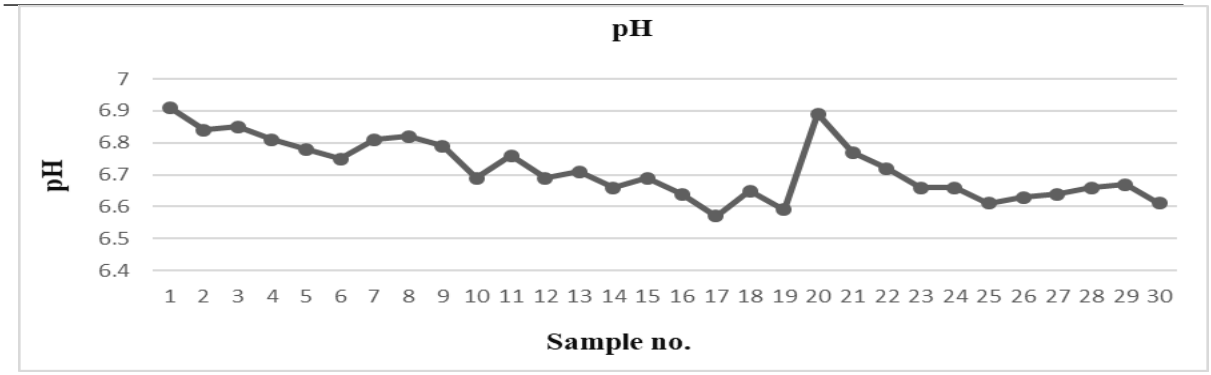

Figure 2: Variation of pH

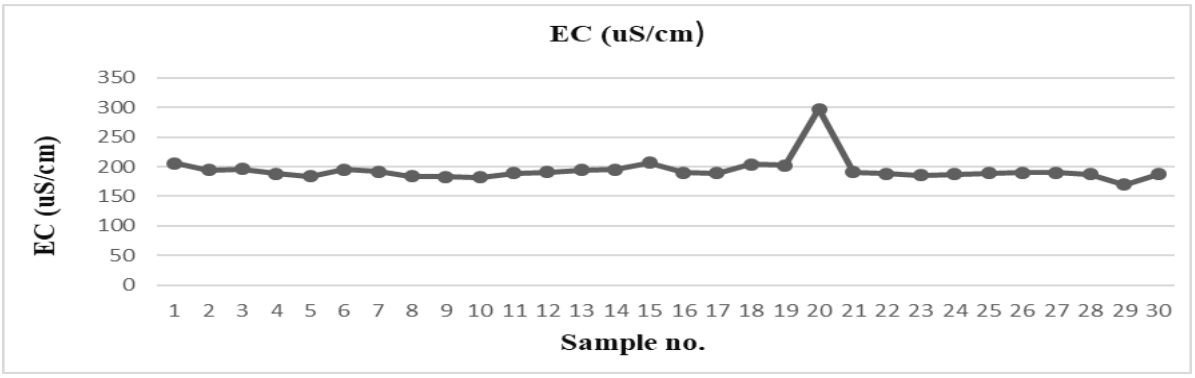

Figure 3: Variation of EC

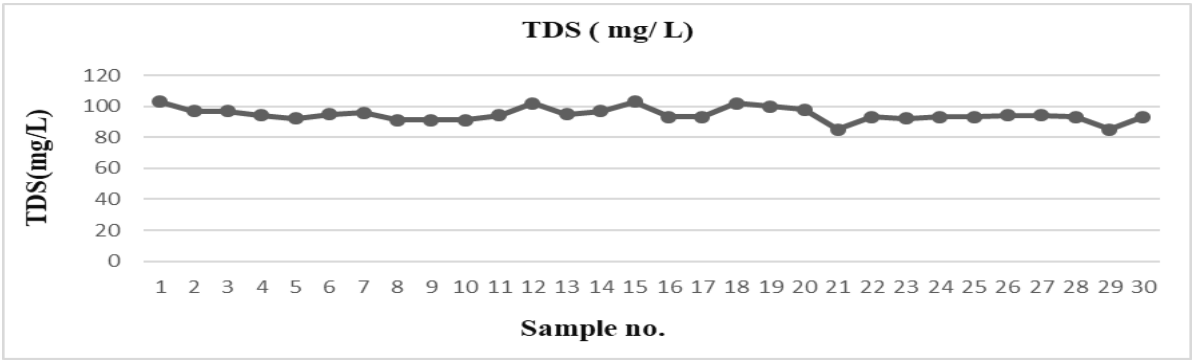

Figure 4: Variation of TDS

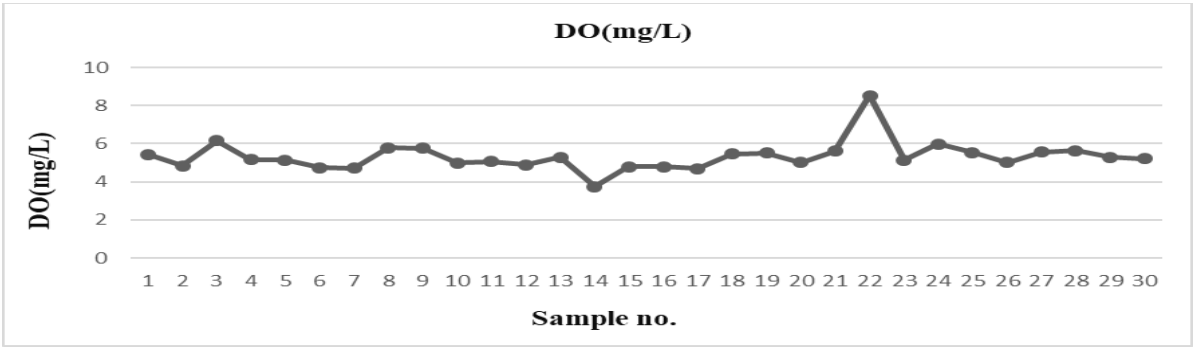

Figure 5: Variation of DO

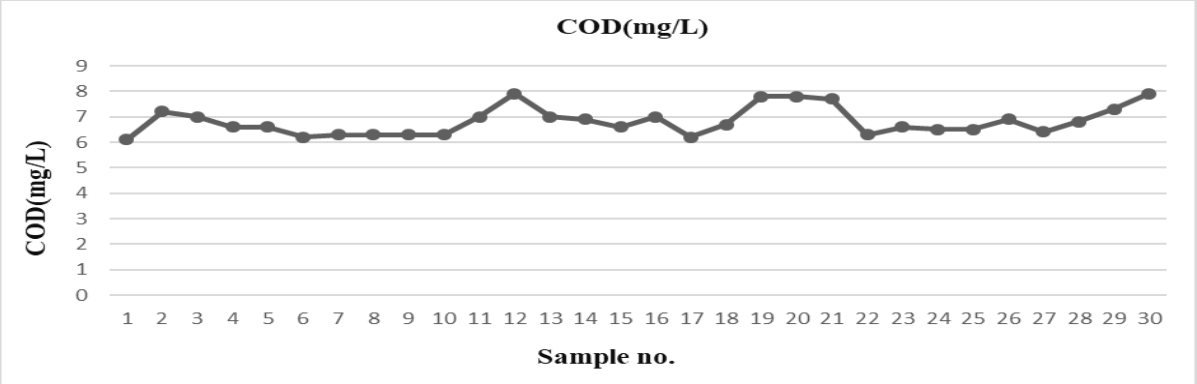

Figure 6: Variation of COD

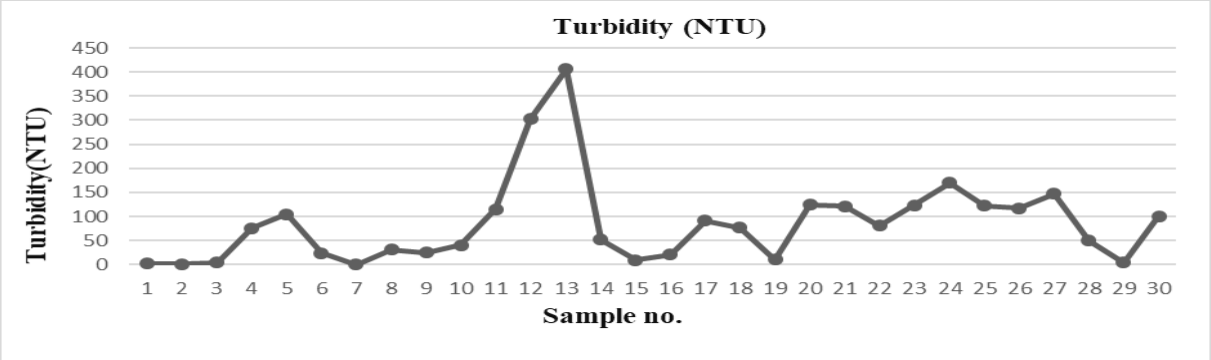

Figure 7: Variation of Turbidity

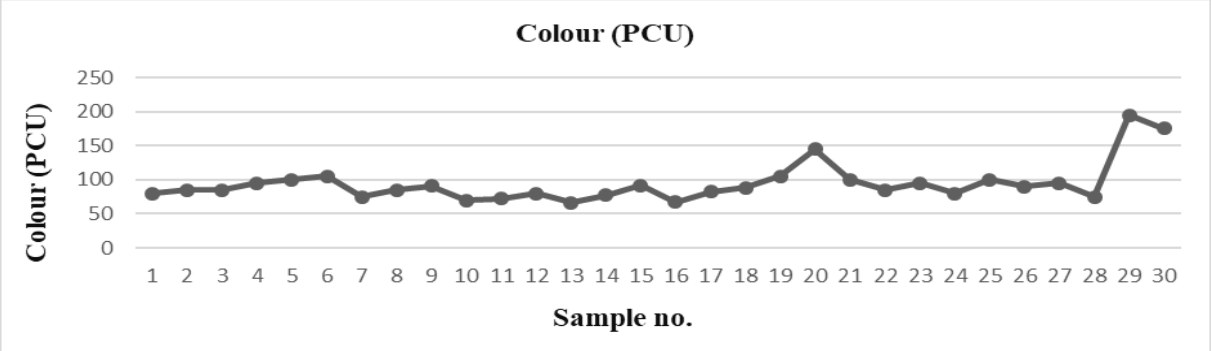

Figure 8: Variation of Colour

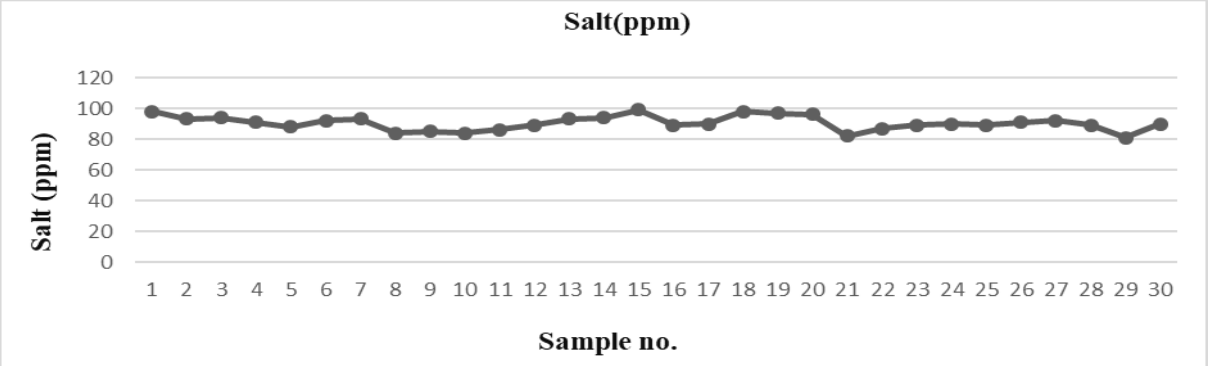

Figure 9: Variation of salt

4. CONCLUSIONS

Water quality assessment at various depths is an important part of water monitoring. When water quality becomes poor, it affects the whole ecosystem and the aquatic life. Which this study conducted. In this study, we analyzed the water in various depths(2m, 4m, 6m). Which gives a clear picture of the water quality of the Halda River. In this study, we found that maximum tested water parameters satisfy the standard values mentioned in the Bangladesh Environmental Conservation Rule:2023, FAO, and WHO. In few water samples did not satisfy the DO, Colour, and turbidity standard values. The reason behind the problem was hot weather, agriculture runoff, and rainwater runoff. The main causes of the decrease in the spawning rate of species like Rui, Katla, Mrigel, and Kaliboush are the unregulated hunting of brood fish, cutting bends, removing soil from the banks, extracting sand, and dredging. In this study, we strongly conclude that the water quality of the ten stations of the Halda River is not suitable for directly drink but this water is safe for agriculture and fisheries.

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