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An Investigation into the Impact of the Relocation of Tannery Industry on Water Quality Parameters of Urban River Buriganga

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***Abstract*—**The study deals with an investigation into the impact of the relocation of tannery industry on water quality parameters of Buriganga. For this purpose, previous records have been collected from authentic data resources and for the attainment of present values, several samples were collected from three major locations of the Buriganga River during summer and winter seasons in 2018 to determine the distribution and variation of water quality parameters. Samples were collected six ft below the river water surface. Analysis indicates slightly acidic to slightly alkaline (6.8-7.49) in nature. Bio-Chemical Oxygen Demand, Total Dissolved Solids, Total Solids (TS) & Total Suspended Solids (TSS) have been found greater in summer. On the other hand, Dissolved Oxygen is found greater in rainy seasons. Relocation shows improvement in water quality parameters. Though the improvement related to relocation of tannery industry is not adequate to turn the water body to be an inhabitable place for aquatic lives.

***Keywords*—**Buriganga river, river pollution, tannery industry, water quality parameters.

I. Introduction

ALMOST 71 percent of whole earth surface is covered by water and considering our health issues, almost 60% of an adult human body is made up of water. According to the analysis of H.H. Mitchell in the Journal of Biological Chemistry 158, the brain of an adult body consists 73% water, the heart does the same [9]. For lung, the percentage is 83%. Even the bones are consisting of 31% water [9]. An individual cannot go more than seven days without consuming water [9]. But, the consequences of consuming polluted water are more hazardous. Naturally, absolute pure water can never be found in natural condition. Actually, it is not even palatable to consume because of its tasteless condition. So, the purity of water is highly dependent on the usage criteria. Before the usage of water, the sources, uses, quality and overall treatment processes are to be considered. Buriganga is one of the major rivers in Bangladesh regarding its trade and connective potential towards the country capital Dhaka city. It has played a vital role on the establishment of Dhaka, but till then the river has been severally polluted by the city itself. Dhaka is one of the mostly populated countries in the world, a megacity with a population of over eighteen million [1], [2].

Buriganga River, itself being part of the Ganges, flows through west and south of Dhaka [3]. The degradation of water quality parameters of Buriganga has aggravated as a result of increasing industrialization, urbanization and development activities [10]. Buriganga River receives huge quantity of sewage, domestic, industrial and agricultural effluents. There are thousands of industrial units and sewerage lines that dump a large volume of toxic wastes into Buriganga River daily deteriorating the quality parameters of the water. A few days back, the worst reason was Hazaribagh Tannery Industry previously located near the bank of Buriganga River, that was the largest tannery industry of the country, dumping thousands liters of untreated effluent daily. In 2001, the High Court had directed the government to shift the factories from Hazaribagh to Savar, considering the critical situation of the Buriganga due to the discharge of highly toxic untreated chemical waste from tanneries [4], [6], [11], [16]-[21]. High Court stated that by 2003, untreated waste from more than 200 tanneries had virtually turned the Buriganga into a noxious pool [4], [6], [11], [16]-[21]. At the end of the year 2017, government managed to relocate the tannery industry from Hazaribagh to Savar, a faraway point from Buriganga River. Keeping in mind the aims of the present experiment was to investigate the impact of the relocation of Hazaribagh Tannery Industry on some water quality parameters of the Buriganga River and judgment of parameter values regarding the possibility of being an inhabitable place for aquatic lives.

II. Materials and Methods

A. Previous Data Collection

According to the experiment process, values regarding various water quality parameters of Buriganga River have been measured and then compared with previous data so that the impact of tannery relocation may easily be observed. For such reasons, previous data were collected from renowned literatures and published authentic news articles sources.

B. Sampling Sites

The water sample was collected from three different points of Buriganga River. The sampling sites were Point 1: Loharbridge, Point 2: Wise Ghat, and Point 3: Dholaikhal Ghat. These sites were chosen because these sites are situated near the discharge points and there are past records of the locations. The locations are still heavily polluted by different

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kinds of waste discharged from tannery industry, commercial sectors and households.

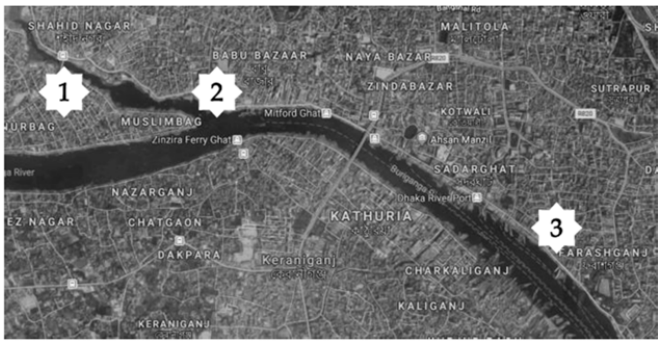


Fig. 1 Map of Buriganga River with the study areas indicated as [5]

C. Sample Collection

Water samples were collected in winter season (January, 2018) and summer season (April, 2018). Each time three water samples of approx. 2.5L were collected in 2.5L plastic bottles from 6ft depth from the middle of river reaching via boat. After sampling, the bottles were screwed and marked with the respective identification number as HR-1, HR-2 and HR-3.

D. Sample Analyses

Different methods and specimens were used for the determination of different quality parameters of water samples.

TABLE I
METHODS OR INSTRUMENTS USED FOR DETERMINATION OF VALUES OF PROPERTIES [10]

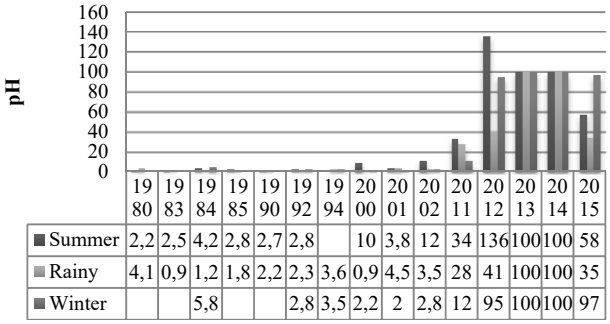
Properties	Methods / Instruments
pH	pH Meter
DO (mg/L)	DO Meter
TS (mg/L)	Digital TDS Meter
TDS (mg/L)	Digital TDS Meter
TSS (mg/L)	Digital TDS Meter
NH_3 (mg/L)	Titrimatric Method
COD (mg/L)	Colorimetric Method of COD
BOD_5 (mg/L)	Titrimatric Method

III. RESULTS AND DISCUSSION

A. pH

It can be noted that the pH of all sampling sites was higher in dry season (winter and summer) than the rainy season, whereas the highest value has been found in summer season rather than in winter. During summer season, there was a little difference in average pH ranging from 6.8 at Loharbridge Ghat, 7.1 at WiseGhat and 7.1 in Dholaikhal Ghat. During winter season, there was also a little difference in average pH ranging from 7.1 at Loharbridge Ghat, 7.49 at WiseGhat and 7.39 in Dholaikhal Ghat. The highest value of pH has always been found at WiseGhat point. The pH ranging from 6-9 is suitable for the existence of most biological life [8], [10].

Considering Wise Ghat (and ChadniGhat) point, the year wise variation of pH is less to be considerable, even if after the relocation of Hazaribagh Tannery industry. The value of pH varies in between 6.1-7.6 at summer season, 6-7.2 at rainy season and 6.9-7.5 at winter. There was an exception in 2012, due to industrial usage and less precipitation rate, in this year the value went beyond 8.

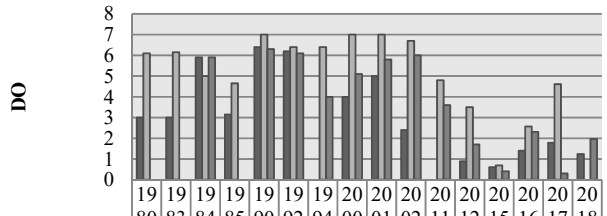


	1980	1983	1984	1985	1990	1992	1994	2000	2001	2002	2011	2012	2013	2014	2015
Summer	2,2	2,5	4,2	2,8	2,7	2,8		10	3,8	12	34	136	100	100	58
Rainy	4,1	0,9	1,2	1,8	2,2	2,3	3,6	0,9	4,5	3,5	28	41	100	100	35
Winter			5,8			2,8	3,5	2,2	2	2,8	12	95	100	100	97

Fig. 2 Variation of pH value overtime

B. Dissolved Oxygen (DO)

Regarding dissolved oxygen, highest values have been found in wet season compared dry season [10]. And the value is considerably lowest at summer. During winter season, the lowest average DO value was found at Loharbridge Ghat (1.3 mg/L), whereas the highest average value was found at Dholaikhal Ghat (3.5 mg/L). The value was 1.96 mg/L at Wise Ghat. On the other hand, during summer the lowest average DO value was also found at Dholaikhal Ghat (1.16 mg/L) and similar highest at other two points (1.24 mg/L). Considering Wise Ghat (Considering as Chadni Ghat also) point, the year wise variation of DO is showing considerable amount of improvement just after the relocation of Hazaribagh Tannery industry.



	1980	1983	1984	1985	1990	1992	1994	2000	2001	2002	2011	2012	2015	2016	2017	2018
Summer	3	3	5,9	3,2	6,4	6,2		4	5	2,4		0,9	0,6	1,4	1,8	1,2
Rainy	6,1	6,2	5	4,7	7	6,4	6,4	7	7	6,7	4,8	3,5	0,7	2,6	4,6	
Winter			5,9		6,3	6,1	4	5,1	5,8	6	3,6	1,7	0,4	2,3	0,3	2

Fig. 3 Variation of DO value over period of time

C. Total Solids (TS)

Except the Loharbridge Ghat point, the TS values were found to be highest in summer season compared to winter season. In summer season, average value of TS ranged from 599 mg/L (Dholaikhal Ghat) to 625 mg/L (Wise Ghat) and 617 mg/L at Loharbridge Ghat. In winter season, the highest average TDS value was found at Loharbridge Ghat (636 mg/L) lowest at Wise Ghat (473 mg/L) and 493 mg/L at Dholaikhal Ghat. The high TS value of the water is indicator to high volume of pollution.

D. Total Dissolved Solid (TDS)

Similar to TS, except the Loharbridge Ghat point, the TDS values were found to be highest in summer season compared to winter season. In summer season, average value of TDS ranged from 558 mg/L (Loharbridge Ghat) to 608 mg/L (Wise Ghat) and 568 mg/L at Loharbridge Ghat. In winter season, the highest average TDS value was found at Loharbridge Ghat (570 mg/L) lowest at Wise Ghat (456 mg/L) and 468 mg/L at Dholaikhal Ghat. The high TDS value of the water is due to different sewage, domestic, industrial and agricultural effluents.

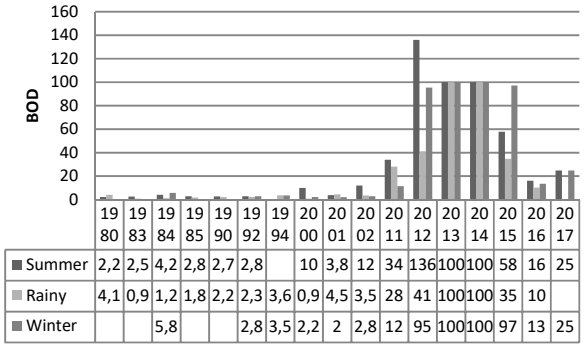
E. Total Suspended Solid (TSS)

Again, similar to TS and TDS, except the Loharbridge Ghat point, The TSS values were found to be highest in summer season compared to winter season. In dry season, average TDS values ranged from 17 mg/L (Wise Ghat) to 64 mg/L (Loharbridge Ghat) and 31 mg/L at Dholaikhal Ghat. In winter season, the highest average TDS value was found at Loharbridge Ghat (66 mg/L) lowest at Wise Ghat (17 mg/L) and 26 mg/L at Dholaikhal Ghat.

F. Biochemical Oxygen Demand (BOD)

Among the pollutants of water bodies, organic substances cause serious hazards regarding odor, color, etc. There are certain parameters for the measurement of bio-degradable organic substances. One of them is Biochemical Oxygen Demand or BOD in short.

BOD signifies the amount of oxygen required by micro-organisms to oxidize organic wastes aerobically. It is expressed in mg of oxygen required per liter of wastewater.



	1980	1983	1984	1985	1990	1992	1994	2000	2001	2002	2011	2012	2013	2014	2015	2016	2017
Summer	2,2	2,5	4,2	2,8	2,7	2,8		10	3,8	12	34	136	100	100	58	16	25
Rainy	4,1	0,9	1,2	1,8	2,2	2,3	3,6	0,9	4,5	3,5	28	41	100	100	35	10	
Winter			5,8			2,8	3,5	2,2	2	2,8	12	95	100	100	97	13	25

Fig. 4 Variation in the Value of BOD

The BOD of water samples of three locations were found higher in dry season compared to wet season. But regarding its probability of having higher value of BOD, is it in winter or in summer, it varies with the location. Among the three spots the highest average BOD in winter season was found at Loharbridge Ghat (256 mg/L), while the lowest value was found at Wise Ghat (40 mg/L). On the other hand, in summer, the highest value has been obtained similarly at the same point – Loharbridge Ghat (212 mg/L) and 98 mg/L at other two points.

Considering Wise Ghat point, the year wise variation of BOD shows highly positive impact of relocation of tannery industry. Reaching to the maximum value of pollution in years between 2010 and 2015, the reduction in the value of BOD signifies cognitive changes in the water quality.

IV. Comparison of Data with Standard Values for Aquatic Lives

The average values of all investigated water quality parameters were compared with standard values to determine the suitability of water for fisheries and other aquatic lives [10], [22].

TABLE II
STANDARD VALUES OF DIFFERENT WATER QUALITY PARAMETERS FOR AQUATIC LIVES

Properties	Fisheries Standard (EQS, 1997) [7], [12]	Obtained Value	
		Winter	Summer
pH	6.5 to 8.5	7.5	7.1
DO (mg/L)	4 to 6	1.96	1.24
TDS (mg/L)	500	456	608
BOD_5 (mg/L)	below 2	40	98

High BOD level and low DO level clearly indicate that the River Buriganga was polluted with the organic chemical and bacterial pollutants. The DO and BOD values clearly show that the water body was unsuitable for fisheries in wet and dry season. BOD value exceeded the standard limit that causes inappropriate conditions for aquatic lives. The pH was within the range of standard value [10].

V. Water Parameter Values of Collected Sample

TABLE III
OBTAINED VALUES OF DIFFERENT WATER QUALITY PARAMETERS

Winter, 2018			
Properties/ Sample No.	Sample 1	Sample 2	Sample 3
pH	7.1	7.49	7.39
DO (mg/L)	1.3	1.96	3.5
TS (mg/L)	636	473	494
TDS (mg/L)	570	456	468
TSS (mg/L)	66	17	26
NH_3 (mg/L)	237.5	59	56.25
COD (mg/L)	342	77	114
BOD_5(mg/L)	256	40	100
Summer, 2018			
Properties/ Sample No.	Sample 1	Sample 2	Sample 3
pH	6.8	7.10	7.30
DO (mg/L)	1.24	1.24	1.16
TS (mg/L)	617	625	599
TDS (mg/L)	558	608	568
TSS (mg/L)	64	17	31
NH_3 (mg/L)	206.25	151.25	131.25
COD (mg/L)	294	112	107
BOD_5 (mg/L)	212	98	98

VI. Seasonal Variation of Water Parameters of Wise Ghat (Collected Data) [10], [13]-[15]

TABLE IV
BOD Values (1980 – 2017)

	BOD		
	Summer	Rainy	Winter
1980	2.2	4.1	
1983	2.5	0.85	
1984	4.15	1.2	5.75
1985	2.8	1.8	
1990	2.7	2.2	
1992	2.8	2.3	2.8
1994		3.6	3.5
2000	10	0.9	2.2
2001	3.8	4.5	2
2002	12	3.5	2.8
2011	34	28	11.5
2012	136	41	95.4
2013	100	100	100
2014	100	100	100
2015	57.9	34.79	97.2
2016	16.1	10.3	13.4
2017	24.8		24.8

TABLE V
pH Values (1980 – 2017)

	pH		
	Summer	Rainy	Winter
1980	7.1	7.1	
1983	6.75	5.95	
1984	7.3	6.95	7.2
1985	6.15	6.85	
1988		7.2	7.3
1989	7.3		
1990	7.6	7	7.3
1992	7.5	6.9	7.5
1993	7.6		
1994		6.9	7.6
2000	7.38	7.12	7.1
2001	7.1	6.98	7.15
2002	7.2	6.92	7.15
2011	7.8	7.2	7.6
2012	8.5	7.1	8
2013	7.15	7.15	7.15
2014	6.92	6.92	6.92
2015	7.35	6.93	6.3
2016	7.47	7.1	6.99
2017	7.45	7.15	7.1

VII. Conclusion

A study was undertaken to determine the water quality of Buriganga River and improvement of water parameters due to relocation of Hazaribagh Tannery Industry. So, the water quality parameters were sampled during different seasons (summer, winter) in three different sampling points along the mid of the river. The values represent several disposal of domestic, sewage, industrial effluent is polluting the water of Buriganga River. Though the impact of relocation of tannery industry is positive, but due to past extreme level of pollution and present industrial disposal, it will require more industries to relocate.

TABLE VI
DO Values (1980 – 2017)

	DO		
	Summer	Rainy	Winter
1980	3	6.1	
1983	3	6.15	
1984	5.9	5	5.9
1985	3.15	4.65	
1990	6.4	7	6.3
1992	6.2	6.4	6.1
1994		6.4	4
2000	4	7	5.1
2001	5	7	5.8
2002	2.4	6.7	6
2011		4.8	3.6
2012	0.89	3.5	1.7
2015	0.6	0.69	0.41
2016	1.4	2.57	2.31
2017	1.78	4.61	0.3
2018	1.24		1.96

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