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QUALITY ASSESSMENT OF WATER USING WATER QUALITY INDEX METHOD: A CASE STUDY ON THE OLD BRAHMAPUTRA RIVER, JAMALPUR SEGMENT

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ABSTRACT

As a factor Water plays a crucial part in human existence. Because of the huge level of pollution in Bangladesh, the current condition of water quality as the most pollution happened in the river is absolutely essential to assess the scenario. Keeping this in mind the study is intended to determine the water quality index (WQI) and to see through the current status of the overall water quality of the old Brahmaputra river, Jamalpur. Determining different water quality parameters are quite expensive process. For water quality index designation, the National Sanitation Foundation-Water Quality Index (NSF-WQI) method had been used. To do so the required parameters were pH, Turbidity, Total Dissolve solids (TDS), Temperature change, Total Phosphate, Total Nitrates, Dissolve oxygen (DO), Biological Oxygen Demand for 5 days (BOD5) and Fecal coliform. In the months of May 2019 and July 2019, samples were gathered from three distinct locations. All the Parameters had been compared to standard values of the Department of Public Health Engineering (DPHE), Bangladesh. Since WQI is a single value for total water quality, the general features of the river should be more understandable to the public.

The average value of WQI of May'19 was 50.62 and 53.28 was found in the month of July,19 which means the quality of the water is medium.

Keywords: *Water quality index; NSF-WQI; Pollution; Parameters.*

1. INTRODUCTION

Bangladesh is known as the river nation with 700 river figures which is 24140 km (15000 miles) long. (River & Drainage System, n.d.).. Brahmaputra, One of Asia's main rivers. The Brahmaputra split into two branches; the western and the eastern which is formally known as the old Brahmaputra. It covers Mymensingh, Jamalpur, Sherpur and Netrokona district. (Brahmaputra River, n.d.). Water accounts for 71% of the earth's complete surface, with only 3% of fresh water. 75% water forms in glaciers and polar icebergs, 24% water storage and only 1% water are available in rivers, lakes or lakes as fresh water which is appropriate for human use. (Dugan, P.R. 1972). Water contamination is spreading in epidemic form at present owing to a number of reasons, such as industrialization, waste water and sewage, mining activity, marine dumping, accidental leakage of oil, fossil fuel combustion, chemical fertilizers and pesticides, waste from sewerage lines, radioactive wastes, urban growth. Rivers perform an important part in the assimilation or transport of industrial and municipal waste water, manure disposal, and rivers from the river pollution areas, streets and highways. The fluvial regime flowing across Bangladesh consists of the 3rd biggest water supply in the oceans. (Ali, 2002).The water quality index is described as a method that gives the general water quality a composite impact ranking of the various water quality parameters. (Akkaraboyina MK et al. 2012).The water quality index (WQI) is the most significant scheme for certifying water quality in a straightforward manner that can react to modifications in water fundamental features. The National Sanitation Foundation (NSF) has created the WQI Water Quality Index as a normal technique to compare the relative quality of multiple water bodies. (Said et al., 2004). Multiple national and international organization had been developed various WQI methods: Weight Arithmetic Water Quality Index (WAWQI), National Sanitation Foundation Water Quality Index (NSFWQI), Canadian Council of Ministers of the Environment Water Quality Index (CCMEWQI), Oregon Water Quality Index (OWQI) etc. (Paun et al., 2016). The water quality index of the old Brahmaputra had been evaluate using National Sanitation Foundation Water Quality Index (NSF-WQI). By taking a look at the parameters measured, the advantages of this method may generally indicate the old Brahmaputra water quality. In numerous developed countries, NSF-WQI was also extensively used for assessing river water quality. NSF-WQI has been developed with reference to the Horton index by Brown, McClelland, Deininger and Tozer since 1970. Different environmental specialists have used NSF-WQI and have demonstrated that this is a credible index to describe environmental quality. (Ott, 1978).

The necessary parameter for developing WQI using NSF-WQI: temperature Change, total dissolved solids (TDS), turbidity, dissolved oxygen (DO), pH, Biological Oxygen Demand (BOD), total nitrate, Total Phosphate, and fecal coliform.

2. METHODOLOGY

2.1 Study Area

The Study had been conducted in the selected points shown in figure-1. Station B was taken at the bottom of Brahmaputra Bridge. The Stations A and C each are taken at a distance of 2 km roughly to the east and west.

Table 1**:** The co-ordinates of water sampling stations.

Serial No.	Stations	Co-ordinates	
		N	E
01	A	24°55'56.0"	89°57'01.6"
02	B	24°55'24.4"	89°58'04.2"
03	C	24°54'47.0"	89°58'57.2"

Figure-1: Station A, B and C. (Source: Google Maps).

2.1.1 Sampling

1.5 litter plastic bottle was used during the collection. For fecal coliform test specialized glass bottle had been used which was wrapped with aluminium foil paper. And the plastic bottle was wrapped with black colour plastic polythene. 7th day of the month of May'19 and July,19 at the time of 9.00 am – 11.00 am the samples were collected from the stations. The samples were preserved at 4°C to maintain its proper quality.

2.2 Water Quality Index Development

Horton in 1965 first categorized water quality. In 1970, a general water quality index was developed by Brown et al. (Tirkey et al., 2013). For calculating the water quality index (WQI), raw analysis results are converted into unit-less sub-index values for the selected water quality variables with different calculated units. (Cude, C. 2001). In theory, the water quality indices consist of sub-index scores given by comparing their calculation in a scale of 0-100 for each quality parameter with a particular parameter rating curve, optionally weighted, and combined into the final index. (Yagow & Shanholtz, 1996)
The equation of developing water quality index,

$$WQI = \sum_{i=1}^{n} w_i I_i$$

Here,
W i = Weight parameter untill i, scale 0-1.0
I i = Value Sub Index for i th (Q-value)
n = The number of water quality parameters

Table 2**:** Weighting factors of the quality parameters of the water. (Thukral et al.,2005).

No.	Parameters	Weighting Factors
01	Dissolved Oxygen (% Saturation)	0.17
02	Temperature	0.10
03	Turbidity	0.08
04	Phosphate	0.10
05	TDS	0.07
06	Nitrate	0.10
07	pH	0.11
08	Fecal Coliform	0.16
09	BOD_5	0.11

Table 3: Water Quality Rating. (Thukral et al.,2005)

No.	WQI range	Quality of Water
01	>90-100	Excellent
02	>70-90	Good
03	>50-70	Medium
04	>25-50	Bad
05	0-25	Very bad

3. RESULT

Table 4,5 and 6 presents the concentrations of the quality parameters and quality index of the stations A, B and C for May'19 and table 7,8 and 9 representing for July'19 respectively.

Table 4: WQI of May'19 at station A

No.	Parameters	Concentration Present	Unit	Bangladesh Standard (For Drinking)	Q-Value	Weighting Factor	WQI
01	DO (%saturation)	12.9	-	-	8.74	0.17	1.49
02	Temperature	28.77	°C	20-30	11.23	0.10	1.123
03	Turbidity	265	NTU	10	5	0.08	0.4
04	Phosphate	0.19	mg/L	6.0	92.4	0.10	9.24
05	TDS	187	mg/L	1000	74.3	0.07	5.201
06	Nitrate	5.8	mg/L	10	61	0.10	6.1
07	pH	8.09	-	6.5-8.5	80.85	0.11	8.89
08	Fecal Coli.	13	N/100ml	0	69.3	0.16	11.09
09	BOD_5	0.86	mg/L	0.2	95.7	0.11	10.53
						∑WQI	54.064
						Quality of Water	Medium

Table 5: WQI of May'19 at station B

No.	Parameters	Concentration Present	Unit	Bangladesh Standard (For Drinking)	Q-Value	Weighting Factor	WQI
01	DO (%saturation)	12.97	-	-	8.79	0.17	1.49
02	Temperature	28.71	°C	20-30	11.29	0.10	1.129
03	Turbidity	243	NTU	10	5	0.08	0.4
04	Phosphate	0.15	mg/L	6.0	94	0.10	9.4
05	TDS	190	mg/L	1000	74	0.07	5.18
06	Nitrate	5.85	mg/L	10	60.75	0.10	6.075
07	pH	8.3	-	6.5-8.5	73.5	0.11	8.085
08	Fecal Coli.	159	N/100ml	0	39.87	0.16	6.38
09	BOD_5	0.83	mg/L	0.2	95.85	0.11	10.54
						∑WQI	48.68
						Quality of Water	Bad

Table 6: WQI of May'19 at station C

No.	Parameters	Concentration Present	Unit	Bangladesh Standard (For Drinking)	Q-Value	Weighting Factor	WQI
01	DO (%saturation)	12.9	-	-	8.74	0.17	1.49
02	Temperature	28.96	°C	20-30	11.04	0.10	1.104
03	Turbidity	308	NTU	10	5	0.08	0.4
04	Phosphate	0.21	mg/L	6.0	90.9	0.10	9.09
05	TDS	188.30	mg/L	1000	74.17	0.07	5.19
06	Nitrate	5.23	mg/L	10	63.85	0.10	6.385
07	pH	7.9	-	6.5-8.5	87	0.11	9.57
08	Fecal Coli.	315	N/100ml	0	33.55	0.16	5.37
09	BOD_5	0.89	mg/L	0.2	95.55	0.11	10.51
						∑WQI	49.109
						Quality of Water	Bad

Table 7: WQI of July'19 at station A

No.	Parameters	Concentration Present	Unit	Bangladesh Standard (For Drinking)	Q-Value	Weighting Factor	WQI
01	DO (%saturation)	13	-	-	8.8	0.17	1.50
02	Temperature	28.10	°C	20-30	11.89	0.10	1.19
03	Turbidity	252	NTU	10	5	0.08	0.4
04	Phosphate	0.23	mg/L	6.0	88.7	0.10	8.87
05	TDS	73	mg/L	1000	85.7	0.07	6.0
06	Nitrate	5.2	mg/L	10	64	0.10	6.4
07	pH	7.7	-	6.5-8.5	91	0.11	10.01
08	Fecal Coli.	10	N/100ml	0	72	0.16	11.52
09	BOD_5	0.84	mg/L	0.2	95.8	0.11	10.54
						∑WQI	56.43
						Quality of Water	Medium

Table 8: WQI of July'19 at station B

No.	Parameters	Concentration Present	Unit	Bangladesh Standard (For Drinking)	Q-Value	Weighting Factor	WQI
01	DO (%saturation)	12.9	-	-	8.74	0.17	1.49
02	Temperature	27.7	°C	20-30	12.3	0.10	1.23
03	Turbidity	283	NTU	10	5	0.08	0.4
04	Phosphate	0.27	mg/L	6.0	84.3	0.10	8.43
05	TDS	76	mg/L	1000	85.4	0.07	5.98
06	Nitrate	4.9	mg/L	10	65.5	0.10	6.55
07	pH	7.7	-	6.5-8.5	91	0.11	10.01
08	Fecal Coli.	130	N/100ml	0	41.9	0.16	6.7
09	BOD_5	0.86	mg/L	0.2	95.7	0.11	10.53
						∑WQI	51.33
						Quality of Water	Medium

Table 9: WQI of July'19 at station C

No.	Parameters	Concentration Present	Unit	Bangladesh Standard (For Drinking)	Q-Value	Weighting Factor	WQI
01	DO (%saturation)	13	-	-	8.8	0.17	1.50
02	Temperature	28.2	°C	20-30	11.8	0.10	1.18
03	Turbidity	377	NTU	10	5	0.08	0.4
04	Phosphate	0.23	mg/L	6.0	88.7	0.10	8.87
05	TDS	76	mg/L	1000	85.4	0.07	5.98
06	Nitrate	5.4	mg/L	10	85.2	0.10	8.52
07	pH	7.8	-	6.5-8.5	90	0.11	9.9
08	Fecal Coli.	350	N/100ml	0	32.5	0.16	5.2
09	BOD_5	0.87	mg/L	0.2	95.62	0.11	10.52
						∑WQI	52.07
						Quality of Water	Medium

3.1 DISCUSSION

The river is slightly alkaline with an average pH concentration of 7.915 and the water is highly turbid as it has an average concentration of 288 NTU. Fecal coliform concentration in both months is low at station A comparing to other stations as several municipal sewerage system opening located near station B and C. The inclusive phosphate (avg. 0.21 mg/L) and nitrate (avg. 5.4) concentration are below of their standards. Low Q-value of sub-indices i.e., DO, temperature, turbidity, fecal coliform is the major reason behind the low value of WQI.

From the results the overall water quality of the Old Brahmaputra can be specified. The highest value was found at station A in July'19 (56.43) which is in a medium criterion and the lowest at station B in May'19 (48.68) is in a bad criterion. The average value of WQI in May'19 was 50.62 and in July'19 the average value was 53.28. So, the overall quality can be summarized as a medium quality of water.

4. ILLUSTRATIONS

Figure 2 and 3 represents the water quality index of the month of May'19 and July' 19 respectively. Axis -X represent stations and Axis -Y represent water quality index.

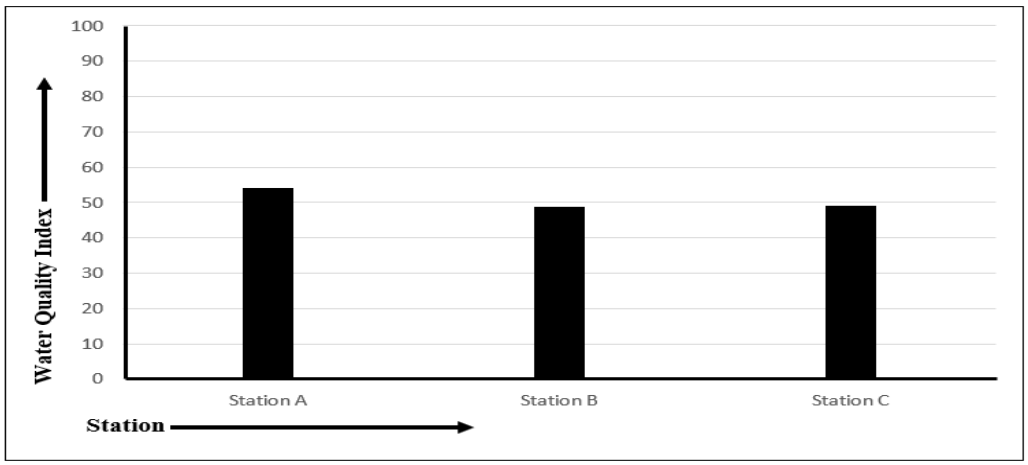

Figure - 2: Water Quality Index of May'19

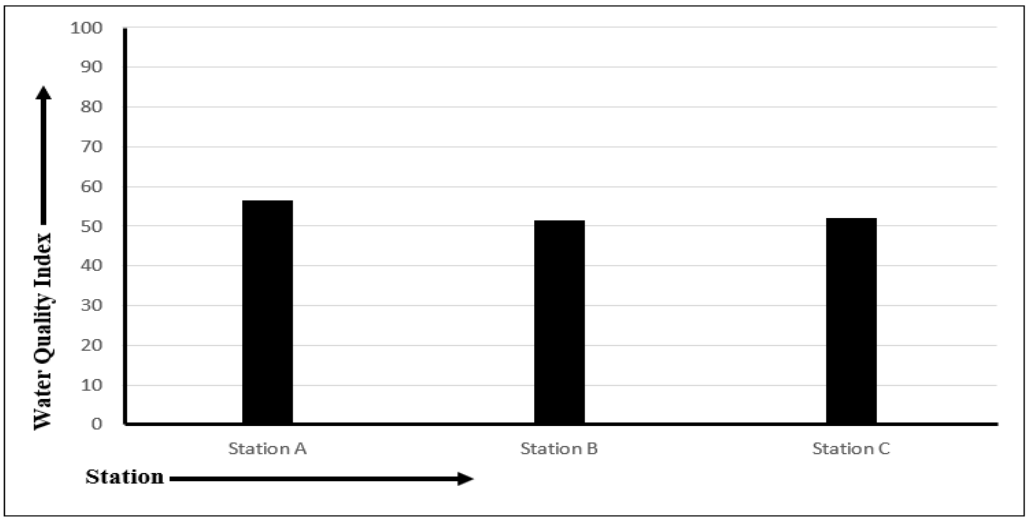

Figure - 3: Water Quality Index of July'19

5. CONCLUSION

The old Brahmaputra River plays a crucial part with work related to irrigation, transport system and drainage system of the whole region. The water quality of this river has been compromised for several reasons. Based on the values of WQI it can be concluded that the water quality is obviously not suitable for drinking. But it can be used for agricultural purposes.

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