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## An assessment of vital water quality parameters of Teesta River closest to barrage region in Lalmonirhat district of Bangladesh

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### Abstract

This study was conducted to monitor the key water quality parameters of Teesta river ecosystem closest to Teesta barrage from July 2018 to April 2019 (10 months) situated in the Lalmonirhat district of Bangladesh. Water samples were collected twice in every month from different six sampling sites selected from the upstream and downstream regions of the barrage. Monitored minimum temperature (21.67 °C) was recorded in the month of January and it was maximum in the month of July (32.03 °C). Gradual increase of temperature was recorded from March to July (early monsoon) indicated that water temperature was normally uplifted according to the seasonal change. The observed dissolve oxygen level showed relatively in the month of July (6.5 mg/l) and higher in the month of January (8.1 mg/l). Average temperature and dissolved oxygen fluctuations were significantly ( $p < 0.05$ ) varied among different sampling months. Inverse relationships were observed between water temperatures and dissolve oxygen level. It is important to note that downstream region of barrage had slightly higher DO level than the upstream region that might the impact of barrage water flow. The recorded pH revealed that slightly alkaline pH level found in all the year round (7.1 to 7.7). Besides, both nitrate-nitrogen and phosphate-phosphorous levels were observed little higher in the late monsoon. The findings of this study suggested that better ecosystem health (temperature, pH and abundance of plankton) was observed in early monsoon season.

**Keywords:** Teesta River, water quality, ecosystem health, barrage region

### 1. Introduction

Teesta is one of the longest rivers of the northern part of Bangladesh and makes a total run of about 170 km from its entrance and merges with Brahmaputra River just south of Chilmari Thana of Kurigram district. The Teesta dependent area covers almost the entire greater Rangpur district that includes Lalmonirhat, Nilphamari, Gaibandha, Kurigram and Rangpur located in the north-eastern part of the country<sup>[1]</sup>. Teesta river has great importance for bearing country's largest irrigations project.

Water is one of the most important compounds to the ecosystem. The productivity depends on physicochemical characteristics of the water body<sup>[2]</sup>.

Better quality of water is described by its suitable physical, chemical and biological characteristics. But some correlation was possible among these parameters and the significant one would be useful to indicate quality of water<sup>[3]</sup>. Water quality can be defined as an ensemble of physical, chemical and biological (including bacteriological) characteristics of the given water<sup>[4]</sup>. Water quality provides information on the health of water bodies and help for developing strategies that facilitates better management of catchment and water resources. Changes in nature of freshwater habitats can cause rapid changes in biodiversity composition<sup>[5]</sup>.

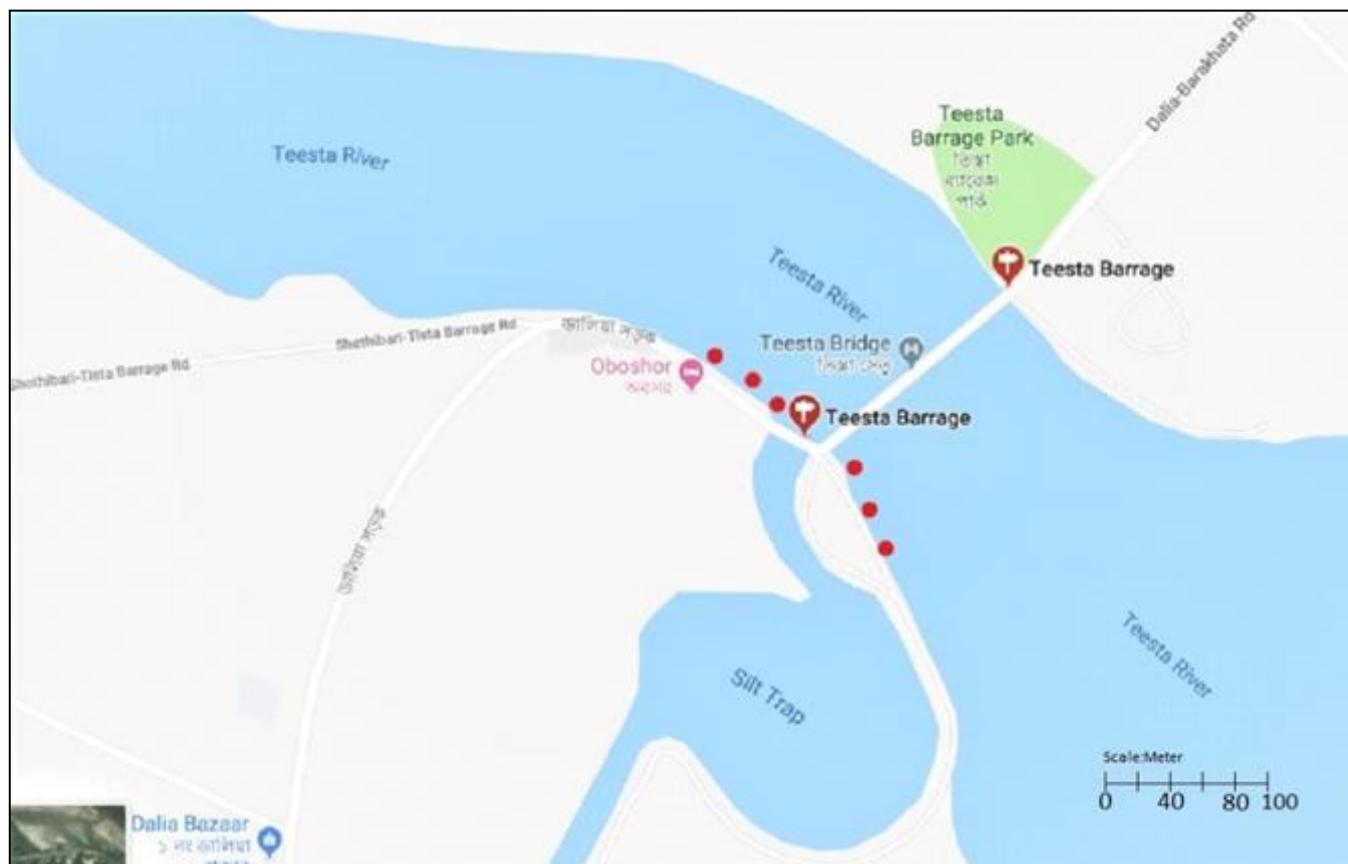
Water quality focuses on the various aspects of physicochemical parameters that detect the status of pollution and suitability of a particular water body for various aquatic organisms. Seasonal or annual variation in the availability of fresh water may cause water quality degradation<sup>[6]</sup> (Islam *et al.* 2010)<sup>[1]</sup>. So, water quality monitoring is therefore of immense importance to activities involving the use of water bodies in the management of fisheries, water supply, pollution, sewage reservoir and Impoundment<sup>[7]</sup>.

Previously, very few studies has been reported to measure the suitable water quality parameter as well as to understand the health status of Teesta river ecosystem near barrage region. Therefore, this research work has been conducted with the aim of assessing the vital water quality parameters nearest to barrage region of Teesta river.

## 2. Materials and Methods

### 2.1 Sampling sites and collection of data

The proposed research work has been carried out in the upstream and downstream regions of Teesta barrage in Teesta river where six different sampling sites from both upstream and downstream regions of the barrage (Fig 1) were selected.



**Fig 1:** Sampling points from where water samples and data were collected and recorded in Teesta river. Sites in the upstream region (site-1: latitude-26.18051, longitude-89.05412; site-2: latitude-26.17838, longitude-89.05683; site-3: latitude-26.17824, longitude-89.04712). Sites in the downstream region (site-1: latitude-26.177616, longitude-89.05001; site-2: latitude-26.17564, longitude-89.05026; site-3: latitude-26.17541, longitude-89.054)

### 2.2 Sample collection and data record

Sampling were done twice per month from July, 2018 to April, 2019. From every sampling point, water temperature, dissolve oxygen (DO), pH, nitrate ( $\text{NO}_3\text{N}$ ) and phosphate ( $\text{PO}_4\text{P}$ ) ion concentration were measured.

### 2.3 Statistical analysis

One way Analysis of Variance (ANOVA), Post Hock and Duncan tests were performed to compare the data and significance level. Differences were regarded significant when  $P < 0.05$ . All analyses were done using SPSS 22.0.

## 3. Results and Discussions

The suitable water quality parameters are prerequisite for healthy aquatic environment and for the production of sufficient fish food organisms. Primary productivity of a water body depends on the physical, chemical and others factors of the environment [8]. Water temperature is one of the most important among the external factors which influence the aquatic ecology [9]. According to the recorded data (Table 1), minimum temperature (21.67 °C) was found in pre-monsoon season particularly in the month of January and it reached to maximum in monsoon season specifically in the

month of July (32.03 °C) in the upstream region. Similar trend was also visualized in the downstream region. Gradual increase of temperature was recorded from March to July (early monsoon) indicated that water temperature was normally uplifted according to the seasonal change without abrupt thermal change.

Minimum dissolved oxygen concentration has to be at least 5.00 mg/l for maintaining aquatic life in healthy condition and dissolved oxygen concentration less than 5.00 mg/l are indicative of pollution [10]. The observed dissolve oxygen (mg/l) level in the Teesta river showed comparatively lower DO level in the month of July (6.5 mg/l) and was relatively higher in the month of January (8.1 mg/l) (Table 1). Average temperature and dissolved oxygen were significantly ( $p < 0.05$ ) varied among different sampling months. There was an inverse relation between river water temperature and dissolve oxygen level. It was also noted that downstream region of barrage had slightly higher DO level than the upstream region which might the impact of water flow. The recorded available pH values revealed that more or less similar pH level was remained in the Teesta riverine ecosystem all the year round where the range was varied from 7.1 to 7.7 (Table 1).

**Table 1:** Average temperature (°C), dissolve oxygen (mg/l) and pH recorded from different sampling points of the study area

Year	Month	Temperature		Dissolve Oxygen (DO)		pH	
		Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
2018	July	32.03±.06 <sup>a</sup>	32.66±.15 <sup>a</sup>	6.5±.06 <sup>a</sup>	6.8±.06 <sup>a</sup>	7.1±.06	7.4±.10
	August	30.17±.15	30.9±.20	6.7±.06	7.1±.06	7.2±.15	7.4±.12
	September	25.60±.26 <sup>b</sup>	26.26±.21 <sup>b</sup>	7.1±.15	7.3±.15	7.2±.05	7.5±.06
	October	25.10±.17	25.86±.21	7±.10	7.4±.10	7.5±.06	7.6±.10
	November	22.87±.15 <sup>c</sup>	23.47±.15 <sup>c</sup>	7.4±.05	7.5±.05	7.5±.06	7.5±.10
	December	22.06±.12	22.63±.15	7.2±.12	7.8±.05	7.3±.06	7.6±.10
2019	January	21.67±.50	22.03±.05	7.6±.05 <sup>b</sup>	8.1±.06 <sup>b</sup>	7.4±.05	7.7±.06
	February	21.86±.15	22.47±.15	7.4±.10	7.8±.10	7.5±.06	7.6±.06
	March	26.23±.21	26.60±.53	7.2±.10	7.5±.10	7.2±.12	7.5±.06
	April	28.10±.17 <sup>d</sup>	28.63±.15 <sup>d</sup>	7±.10	7.3±.10	7.4±.06	7.4±.15

Mean values in the same column with different superscript letters varied with 5% level of significance ( $p < 0.05$ ).

Considering the pH level in the upstream and downstream regions of Teesta barrage, it can be said that comparative higher pH level was recorded in the downstream region [11]. observed 6.6-8.0 pH in Shitalakhya river water which showed less pH compare to the present study. A proportional

relationship was observed between thermal change and plankton concentration (Table 2) indicated that plankton concentration was increased with the increased water temperature.

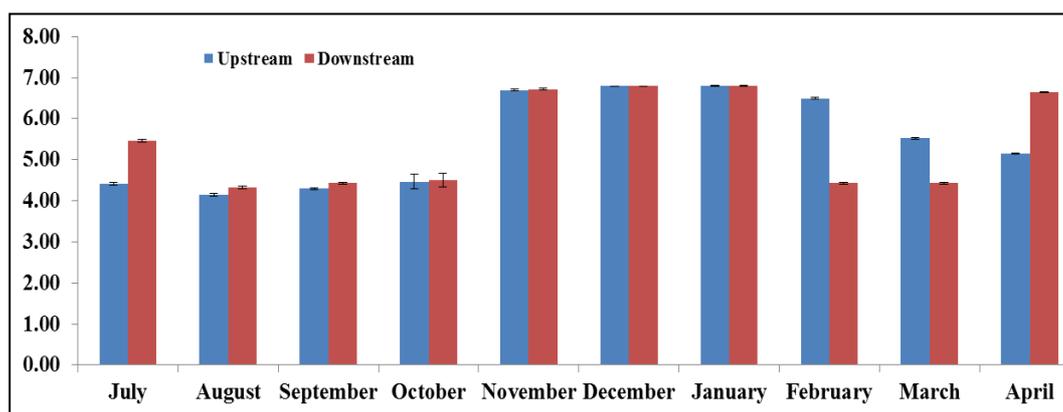
**Table 2:** Observed average temperature (°C) and relevant plankton concentration (no./liter) in the Teesta barrage region of Teesta river during study period.

Month	Temperature (°C) in upstream region	Plankton concentration (no./liter)
July	32.02 <sup>a</sup>	13166 <sup>a</sup>
August	30.17	11833
September	25.60 <sup>b</sup>	11833 <sup>b</sup>
October	25.10	10333
November	22.87 <sup>c</sup>	10333 <sup>c</sup>
December	22.06	9500
January	21.67	9333
February	21.86	9666
March	26.23 <sup>d</sup>	10166 <sup>d</sup>
April	28.10	13166

The values in the same column with different superscript letters varied with 5% level of significance.

The variation was visualized statistically significant ( $p < 0.05$ ) in different sampling months during the study period [12]. studied the ecology and zooplankton diversity of a wetland in Jhenidah district, Bangladesh and found higher zooplankton diversity in the monsoon season. During the study period the nitrate-nitrogen values were recorded from the studied area

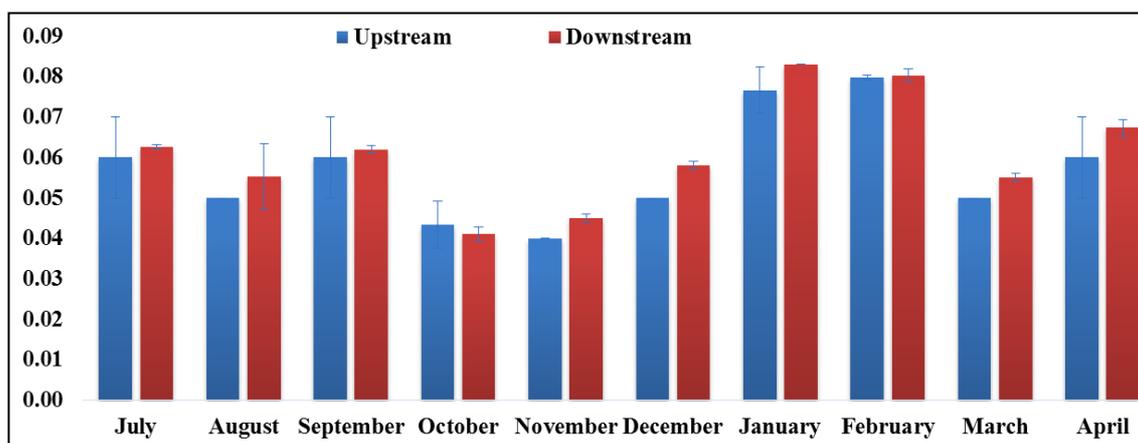
(Figure 2) showed that maximum and minimum nitrate-nitrogen levels were observed in the months of December (6.83 mg/l) and August (4.15mg/l) respectively and significant difference ( $P > 0.05$ ) was visualized among different sampling months.



**Fig 2:** Average values of dissolved nitrate-nitrogen (mg/l) in the Teesta river ecosystem closest to barrage region

Similarly, comparative more phosphate-phosphorous level was also obtained (Figure 3) in the late-monsoon season (November-December) than the monsoon season (July-September). It is mentionable that both nitrate-nitrogen and phosphate-phosphorous levels were observed little higher in the downstream region of the barrage. This variation may be

due to the influences of water flow, seasonal function and depletion of water level [13]. demonstrated that the higher phosphate-phosphorous level was monitored in the month of November where as more nitrate-nitrogen level was recorded in the month of February.



**Fig 3:** Average values of dissolved phosphate-phosphorus (mg/l) in the Teesta river ecosystem closest to barrage region

#### 4. Conclusions

The findings of this study demonstrated that the monitored productivity indicators particularly the availability of planktonic flora and fauna showed comparative better condition in early monsoon and monsoon season than pre-monsoon and late monsoon season. Water temperature was recorded maximum in monsoon season specifically in the month of July when dissolved oxygen level was decreased. The downstream region of barrage had slightly higher DO level than the upstream region. Teesta riverine ecosystem in the barrage region contained slightly alkaline pH in all the year round. Finally, it can be concluded that it is very essential to take all effective necessary actions to prevent manmade interventions for providing good ecosystem health in Teesta river.

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