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Some aspects of water quality of the Tangon River in Bangladesh

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Abstract

The study was carried out to document the water quality, planktonic and ichthyo-diversity of riverine ecosystem. Tangon river was selected for the purpose of the study. Data were collected fortnightly from four sampling sites from April 2016 to March 2017. Water temperature was fluctuated between 19.70 and 35.90°C, Dissolved oxygen (DO) content ranged between 5.00 and 9.40mg/L, pH fluctuated in the acidic to alkaline range (6.26-9.40) and total alkalinity fluctuated between 4.00 and 18.00mg/L. The abundance of phytoplankton to total plankton was high (83%) and their diversity in the river is represented by four groups in order of dominance as follows: Chlorophyceae> Bacillariophyceae> Cyanophyceae> Euglenophyceae. A total of 17 fish species belonging to 7 families were identified from the River. However, it is suggested that the river is still in productive condition. Therefore, the policy makers should take different management tactics to keep the riverine ecosystem pollution free and sustainable for capture fisheries as well.

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Introduction

Tangon River is one of the notable trans-boundary river of Bangladesh and passing through the Indian state of West Bengal and North-West part of Bangladesh. The importance of this river is very crucial for ecology, biology, biodiversity and socio-economic condition of the adjacent localities. Moreover, fish is the best source of protein for the people who live around the river. Tangon River is playing a significant role as a nursery ground of Indian major carps and native fishes. Some parts of the river are declared as fish sanctuary and serves as natural habitats, breeding grounds, feeding and spawning ground of small and large native fishes. The suitable water quality parameters are prerequisite for a 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 (Rahman, 1992). As productivity depends on the physico-chemical characteristics of the water body, the highest productivity is attained when the physical and chemical parameters are at the optimum level. Water quality is paramount factor in ecosystem productivity (Huet, 1986). Numerous limnological works have been done on the river ecosystem in many parts of Bangladesh but no limnological works have been done so far in the Tangon River. In addition, a significant cause is that rubber dam is established on this river and it is located at Saguni bridge in Pirganj upazila under Thakurgaon district which is used for irrigation and water is controlled by Bangladesh Water Development Board (BWDB).

It is presumed that due to high siltation of this river water retention capacity has been decreased. Consequently, there is absence of regular current. In this circumstance, it is urgent need to know various water quality aspects of the river. Therefore, the present study was undertaken to study on some important aspects of water quality including physical, chemical and biological factors of the Tangon River in Bangladesh.

Materials and methods

Study area

The study was carried out in a riverine ecosystem (Fig.1) To understand the present condition of water quality, data were recorded from four different sites (Site1- near Senihary village, Site 2- near Saguni village, Site 3- Saguni bridge, Site 4- Rail bridge) of the river in Pirganj upazila under Thakurgaon district, Bangladesh. Data of different water quality aspects as well as plankton samples were collected fortnightly with three horizontal replicates from each site. Duration of the research work was twelve months, from April 2016 to March 2017.

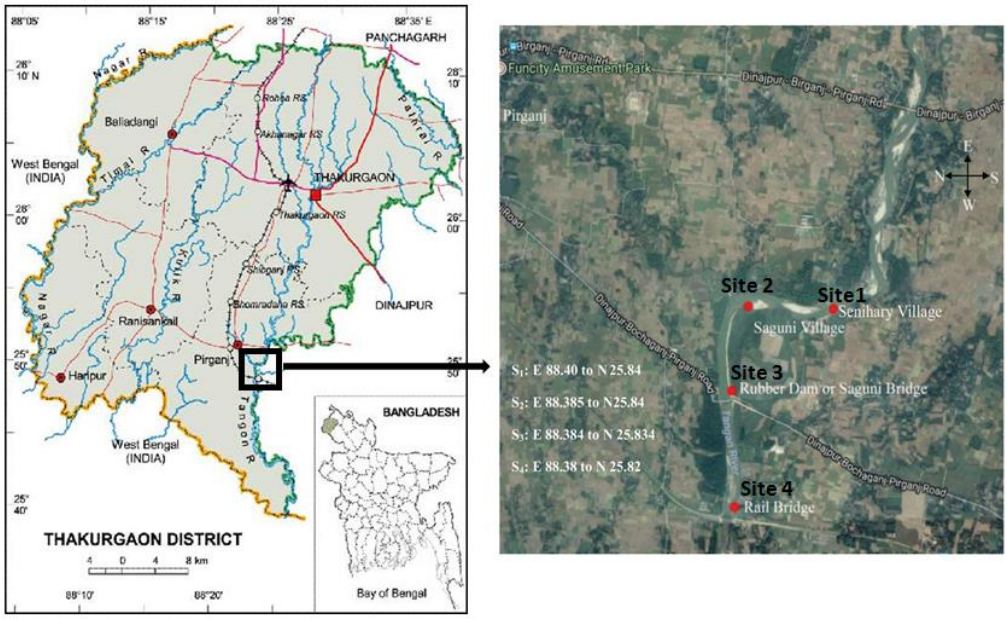

Fig. 1. Satellite image and location of the study area (Google Earth).

Physico-chemical aspects

Among different physico-chemical aspects water temperature, water level, transparency, pH, dissolved oxygen were measured in the field using digital thermometer, measuring scale, secchi disk, pH meter (HANNA instrument, model: HI-8140), dissolved oxygen meter (YK-22DO), respectively. To determine total alkalinity, samples were collected from the respective sites and brought to the laboratory of Department of Fisheries Management in Hajee Mohammad Danesh Science and Technology University, Dinajpur 5200. Total alkalinity was determined by titration method using 0.02 N Sulfuric acid (H_2SO_4) and methyl-orange indicator (APHA, 1992).

Plankton enumeration

Plankton samples were collected by filtration technique using 25µm mesh sized plankton net. Taxonomic identification of plankton was carried out with the help of taxonomic keys from the text book of Potin, 1978; Lind and Brook, 1980; Barbar and Haworth, 1981 and Bellinger, 1992 with magnification of 10×0.25 under binocular microscope. Then abundance was calculated using the following formula (Stirling, 1985): Number of plankton, $N = \frac{A \times C \times 1000}{F \times V \times L}$

Where, N = No. of plankton cells per Liter, A = Total no. of plankton counted, C = Volume of final concentrate of samples in miliiter, F = Number of fields counted, V= Volume of a field in cubic milimeter, L = Volume of original water sample in Liter.

Ichthyo-diversity

Identification of resident as well as migratory fishes was done through the collection of different species directly from fishermen's catch and surveying local fish markets. Fishermen's perception has been considered primarily for conceptual knowledge regarding the identification of resident fishes. The collected fishes were identified later on following standard reference book (Rahman, 1989).

Statistical Analysis

An analysis of variance (One Way ANOVA) and Tukey's test was applied for determining significant variation at 5% level of significance among the sampling sites by using SPSS (Statistical Package for Social Science), version 20.

Results and discussion

Water is absolutely vital not only for the survival of human beings, but also for plants, animals and all other living organisms (Razo *et al.,* 2004). To assess the water quality status of the Tangon River the present study was conducted. In all the four sampling sites, some water quality aspects were recorded and analyzed. Records are tabulated in the Table 1-3.

Water quality aspects

Temperature

The fluctuation in river water temperature usually depends on the season, geographic location, sampling time and temperature of effluents entering the stream (Ahipathy, 2006). Rahman, 1992 stated that water temperature ranging from 26.0 to 31.0°C was found suitable for aquatic life. In the present study, water temperature was fluctuated from 19.70 to 35.90°C (Table 1), where lower water temperature was found at Site 2 in the month of January and highest temperature at Site 4 in the month of May. Similar observation was also reported by Ara *et al.*, 2018 in the Dhepa river (16.20 to 34.80°C) and Ferdoushi *et al.*, 2013 in the Punarbhaba river (26.00 to 34.50°C) of Dinajpur district, Bangladesh. Findings were more or less similar due to the same geological position.

The changes of water temperature among months or periods or place may be due to difference in season and geographical weather (Ahipathy, 2006). On the other hand, physico-chemical parameters were significantly affected by water temperature (Bellos and Sawidis, 2005). Additionally, the cause of higher temperature is a result of atmospheric fact as well as solar radiation.

Transparency

In the present study, the values of transparency showed variation at different sampling months as well as sampling sites, which might be due to abundance of phytoplankton. Rahman, 1992 reported that the transparency of productive water bodies should be

40cm or less. Water transparency was found to vary 24.00 to 95.00cm, where lower value was found in Site 1 in the month of July and highest value in Site 2 in the month of June. Boyd, 1990 noted that the transparency of water was affected by various factors such as silt, microscopic organisms, suspended organic matter, season of the year, latitude and intensity of light, application of manure, grazing pressure of fishes and recommended a transparency between 15 and 40cm.

Table 1. Mean values (±SE), ranges and comparison of physico-chemical parameters in four sampling sites of the Tangon River.

Parameters	Sampling Sites				ANOVA Significance
	Site 1	Site 2	Site 3	Site 4	
Water temperature(°C)	26.89±0.44^{c} (19.80-32.70)	27.32±0.45^{bc} (19.70-33.10)	27.60±0.46^{b} (20.10-33.40)	28.28±0.49^{a} (20.40-35.90)	*
Transparency (cm)	55.68±1.66^{a} (24.00-92.00)	56.72±1.62^{a} (25.00-95.00)	56.24±1.41^{a} (28.00-88.00)	50.22±1.53^{b} (19.00-77.00)	*
Water level (m)	1.25±0.07^{a} (0.46-3.05)	1.24±0.06^{a} (0.49-2.77)	1.18±0.06^{ab} (0.55-2.69)	1.08±0.07^{b} (0.19-2.51)	*
Dissolved oxygen (mg/l)	6.99±0.11^{a} (5.30-9.20)	6.92±0.13^{a} (5.20-8.90)	6.92±0.15^{a} (5.00-9.40)	6.66±0.15^{b} (6.60-9.10)	*
pH	7.79±0.11 (6.45-9.23)	7.73±0.11 (6.26-9.38)	7.84±0.10 (6.60-9.40)	7.81±0.05 (6.60-9.10)	NS
Alkalinity (mg/l)	11.94±0.33 (5.40-16.00)	12.14±0.33 (5.40-18.00)	12.10±0.34 (4.60-17.40)	12.09±0.36 (4.00-18.00)	NS

NS= Mean values are not significantly different (P>0.05), *Mean values with different superscript letters in the same row indicate significant difference at 5% level based on one way ANOVA followed by Tukey's test.

Water level

Fluctuation of water level was ranging from 0.19 (in April) to 3.05m (in October) with mean value of 1.25±0.07, 1.24±0.06, 1.18±0.06 and1.08±0.07 m in Site 1, 2, 3 and 4 respectively. The variation of depth among different sampling sites in the Tangon River is due to topographic difference of the bottom of this river and rainfall as well.

Dissolved oxygen (DO)

Mean value of DO was 6.99±0.11, 6.92±0.13, 6.92±0.15 and 6.66±0.15mg/L in Site 1, 2, 3 and 4 respectively. The highest value of DO (9.40mg/L) in Tangon River was recorded in the month of January and the lowest (5.00mg/L) in March. This result is more or less similar to Ara *et al.*, 2018 who found DO concentration 4.80 to 8.95mg/L in Dhepa River, Dinajpur, Bangladesh. It might be due to alteration of photosynthesis, abundance of phytoplankton and respiration by different aquatic organisms of the river. As per the Environmental Quality Standard (EQS, 1997), the accompanying requirements for DO are recommended: 6mg/L for drinking, 4 to 5mg/L for entertainment, 5mg/L for industrial application and 4 to 6mg/L for fish and domesticated animals. However, Boyd, 1998 reported the water body having more than 5mg/L DO is suitable for fishes.

pH

The pH value of Tangon river was found acidic to alkaline ranging from 6.26 to 9.40. Water pH was found mostly alkaline at Site 3 in December and the lowest value was recorded at Site 2 in June. However, Ara *et al.,* 2018 recorded pH value of Dhepa River 6.34 to 8.96. According to Swingle, 1967 pH value 6.5 to 9.0 is suitable for fish production and more than 9.0 is unsuitable because free CO_2 is not available in this situation. The pH acceptable limit for inland surface water is from 6.5 to 8.5 (EQS, 1997). pH significantly influences the biological activity of a waterbody. It additionally influences a few aspects of water body, activity of creature and viability of poisonous substances exhibit in the aquatic environment.

Total alkalinity

Boyd, 1998 cited total alkalinity more than 20mg/L is suitable for aquatic environment. The value of total alkalinity of Tangon river was found from 4.00 to 18.00mg/L which indicates presence of less nutrients as well as lower productivity of the river.

The estimation of alkalinity and pH is expected to decide the corrosiveness of the waterbody.

Plankton community

Plankton plays an important food source for carnivorous and omnivorous fishes (Alam *et al.,* 1987). Phytoplankton are responsible for about 90% of all primary production in a body of water (Boney, 1989). They are the main source of food for fishes in lakes and river, they use photosynthesis to fix carbohydrate and produce oxygen. They serve as primary producers in the aquatic ecosystem. They do not only produce oxygen but also use ammonia produced by fish as nutrients (Swann, 2004). The larvae of Carps feed mostly on zooplankton because zooplankton provides the necessary amount of protein for the rapid growth of gonad of fishes of brood fishes (Dewan *et al*., 1977). The availability of zooplankton as food for larval fish is thought to be one of the key factors that strengthen commercial fisheries (Kane, 1993).

A total of 66 genera of plankton were identified from Tangon River. Chlorophyceae (24 genus) was the dominant group in terms of diversity and numbers followed by Bacillariophyceae (13 genus), Cyanophyceae (9 genus) and Euglenophyeeae (3 genus) (Table 2). Table 3 is showing the mean values and ranges of different plankton groups in four sampling sites. Total phytoplankton was found highest (17.86×10^3 cells/L) and lowest (2.45×10^3 cells/L) at site 2. Similar observation was also made by Ferdoushi and Rakiba, 2014 and Ara *et al.,* 2018 at Dhepa River in North-West part of Bangladesh. Among the zooplankton groups Rotifera was ranked first dominant group which is similar to the findings of Ahsan *et al*., 2012 and Ara *et al*., 2018. Total zootoplankton was recorded highest (4.62×10^3 cells/L) and nil (0.00×10^3 cells/L) at site 4 of the Tangon River. Four groups of zooplankton population namely Copepods, Rotifers, Cladocera and Ostracods from the another trans-boundary River Meghna were reported by Ahmed *et al*., 2003 which is more or less similar to the findings of present study. Statistical analysis revealed no significant difference ($P>0.05$) among different planktonic groups from four sampling sites except Cyanophyceae and total phytoplankton ($P<0.05$). In the present study, percentage composition of the phytoplankton was higher than the zooplankton (Fig. 2).

Ichthyo-diversity

A total of 17 fish species belonging to 7 families were identified from the Tangon River (Table 4). Few species were very common such as *Cirrhinus reba* (locally called juary or khorki or morshian), *Mastacembelus armatus* (Baim) and *Esomus danricus* (Darkina). Some species were very rare such as *Sperata aor* (Ayre) and *Nandus nandus* (Veda). Hossain, 2012 found 40 fish species in Punarvhaba River whether Islam, 2012 recorded total 22 fish and shellfish species from the Tangon River. The ichthyo-diversity might be reduced due to indiscriminate fishing, pollution and lack of proper management of the river.

Table 2. Generic status of plankton with their different groups recorded from Tangon River throughout the study period

Plankton	Group	Genera/Larvae
Phytoplankton	Euglenophyceae	*Euglena, Phacus, Trachelomonas*
	Cyanophyceae	*Anabaena, Anabaenopsis, Microcystis, Oscillatoria, Gleocapsa, Aphanizomenon, Aphanocapsa, Nostoc, Spirulina*
	Bacillariophyceae	*Astorionella, Cyclotella, Diatoma, Melosira, Nitzschia, Surirella, Tabellaria, Actinella, Cymbella, Fragillaria, Navicula, Meridion, Synedra*
	Chlorophyceae	*Actinastrum, Botryococcus, Planktosphaeria, Closterium, Cosmarium, Hydrodictyon, Microspora, Pediastrum, Sphaerocystis, Staurastrum, Tribonema, Treubaria, Ankistrodesmus, Chlorella, Coelastrum, Ceratium, Chlorogonium, Oedogonium, Scenedesmus, Spirogyra, Stigeoclonium, Ulothrix, Volvox, Zygnema*
Zooplankton	Copepoda	*Cyclops, Diaptomus*
	Rotifera	*Asplanchna, Filinia, Lecane, Monostyla, Brachionus, Keratella, Trichocerca, Notholca*
	Cladocera	*Bosmina, Daphnia, Diaphanosoma, Moina, Sida, Ceriodaphnia*
	Crustacean larvae	Nauplius

Table 3. Mean values (±SE), ranges and comparison of plankton group in four sampling sites of the Tangon River.

Plankton type/ group (×10³cells/L)	Sampling sites				ANOVA Significance
	Site 1	Site 2	Site 3	Site 4	
Chlorophyceae	3.80±0.20 (0.34-8.00)	3.96±0.22 (0.72-11.40)	3.79±0.20 (0.36-8.84)	3.61±0.18 (0.66-7.50)	NS
Bacillariophyceae	3.46±0.24 (0.68-11.88)	3.25±0.21 (0.70-8.36)	3.26±0.20 (1.08-9.92)	3.22±0.21 (0.33-8.88)	NS
Cyanophyceae	0.85±0.09[a] (0.00-5.27)	0.65±0.06[ab] (0.00-1.85)	0.61±.05[b] (0.00-2.16)	0.70±.05[a] (0.00-2.40)	*
Euglenophyceae	0.19±0.02 (0.00-0.68)	0.17±0.03 (0.00-1.02)	0.17±0.02 (0.00-0.70)	0.20±0.02 (0.00-0.70)	NS
Total phytoplankton	8.30±0.28[a] (3.60-13.30)	8.10±0.32[a] (2.45-17.86)	7.84±0.29[ab] (2.80-15.04)	7.68±0.25[b] (2.64-12.87)	*
Rotifer	0.70±0.06 (0.00-1.98)	0.72±0.06 (0.00-1.80)	0.74±0.06 (0.00-1.85)	0.80±0.06 (0.00-2.16)	NS
Cladocera	0.22±0.04 (0.00-1.36)	0.25±0.03 (0.00-0.76)	0.28±0.04 (0.00-1.75)	0.24±0.03 (0.00-1.32)	NS
Copepoda	0.29±0.04 (0.00-1.36)	0.25±0.03 (0.00-1.05)	0.26±0.03 (0.00-1.08)	0.28±0.03 (0.00-0.99)	NS
Crustacean larvae	0.37±0.03 (0.00-1.08)	0.41±0.04 (0.00-1.48)	0.41±0.05 (0.00-2.10)	0.38±0.04 (0.00-1.65)	NS
Total zooplankton	1.57±0.11 (0.33-4.08)	1.64±0.10 (0.31-4.45)	1.70±0.11 (0.34-4.55)	1.70±0.11 (0.00-4.62)	NS
Total plankton	9.83±0.25 (4.95-14.40)	9.68±0.31 (4.90-20.14)	9.54±0.27 (5.61-17.28)	9.37±0.24 (5.27-13.86)	NS

NS= Mean values are not significantly different (P>0.05), *Mean values with different superscript letters in the same row indicate significant difference at 5% level based on one way ANOVA followed by Tukey's test.

Table 4. Fish species recorded from the Tangon river.

Family	Local Name	Common name	Scientific Name
Cyprinidae	Rui		*Labeo rohita*
	Katal/Catla	Indian Major Carp	*Catla catla*
	Mrigal		*Cirrhinus cirrhosus*
	Kalibaus	Indian Major Carp/ Orange Fin Labeo	*Labeo calbasu*
	Bhagna/Juari	Reba Carp	*Cirrhinus reba*
	Darkina/Dairka	Flying Barb	*Esomus danricus*
	Mola/Mouka	Mola Carplet	*Amblypharyngodon mola*
	Tit punti	Ticto barb	*Puntius ticto*
Bagridae	Ayre	Long whiskered Catfish	*Sperata aor*
	Tengra	Striped dwarf catfish	*Mystus tengara*
Anabantidae	Koi	Climbing Perch	*Anabas testudineus*
	Khalisa	Banded Gourami	*Colisa fasciatus*
Mastacembelidae	Baim	Zig-zag Eel	*Mastacembelus armatus*
	Tara baim	Lesser Spiny Eel	*Macrognathus aculeatus*
Notopteridae	Chital	Clown Knife Fish	*Chitala chitala*
Nandidae	Veda/Meni	Mud Perch	*Nandus nandus*
Belonidae	Kakila/kaikka	Pipe Fish	*Xenentodon cancila*

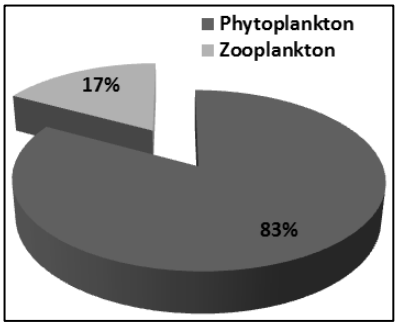

Fig. 2. Percentage composition of plankton in all sampling sites.

Conclusion

In fine, it is suggested that the ecosystem of the Tangon River is not so good. Some parts of the river are used for agricultural purpose and farmers use different kinds of pesticides which threaten the ecosystem. In addition, some parts of this river were completely dried up in downstream during dry season by holding water for irrigation purpose which indicates as a disturbance of fish migration. However, as fish migration is hampered due to rubber dam and

high siltation, so long term study should be conducted for the sustainability of the capture fisheries and also for better management of the river.

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