

Analysis of Bhadra River Surface Water during Rainy Season

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ABSTRACT

Water samples were collected from Bhadra river along four different significant points and analyzed various temperature correlated parameters during the period rainy season 5th July, 2014 to 22nd August, 2014 using standard method. Water samples were collected from about 10 cm depth with three replications from each station during low tides and high tides of the day. The study was conducted to know the present status of the water quality of the Bhadra river and the change of water quality parameters with the change of temperature. The study is significant due to huge practice of aquaculture at the adjacent area using the river water. The other significant feature is the connection of the river with Sundarbans river system. This study involves the determination of some physical and chemical parameters which are mainly temperature correlated such as pH, transparency, salinity, electrical conductivity (EC), total alkalinity, total acidity, dissolved oxygen (DO) and dissolved free carbon dioxide of the surface water at four locations. The mean of parameters of different stations were temperature 29^oC; pH 7.68; transparency 10.88 cm, salinity 3.18 ppt, electrical conductivity (EC) 4.78 mS/cm, total alkalinity 103.91 mg/L, total acidity 8.4 mg/L, dissolved oxygen (DO) 5.1 mg/L, dissolved free carbon dioxide 3.89 mg/L. According to the results the parameters found less deviation from the standard water quality for aquatic habitat of river water.

Keywords: Bhadra river, Ecosystem, physico-chemical parameters, water quality.

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I. INTRODUCTION

Water temperature is a physical property expressing how hot or cold water is. Water temperature plays a major role in the quality of aquatic life and habitats. Heat flow and the fluctuation of temperature determine what species will live and thrive in a body of water [1]. Temperature is an important factor to consider when assessing water quality. In addition to its own effects, temperature influence several parameters and can alter the physical and chemical properties of water. These influencing parameters are called temperature correlated parameters [2]. Such as pH, transparency, salinity, electrical conductivity (EC), total alkalinity, total acidity, dissolved oxygen (DO) and dissolved free CO₂. Considered alone, water temperature can affect the metabolic rates and biological activity of aquatic organisms [3]. As such, it influences the chosen habitats of a variety of aquatic life. Some organisms, particularly aquatic plants flourish in warmer temperatures, while some fishes such as trout or salmon prefer colder streams [4]. Water temperature shows a direct relationship with metabolic rates. This occurs as many cellular enzymes are more active at higher temperatures [5]. For most fishes, a 10^oC increase in water temperature will approximately double the rate of physiological function [6]. Increased metabolic function can be noticed in respiration rates and digestive responses in most species. Increased respiration rates at higher temperatures lead to increased oxygen consumption, which can be detrimental if rates remain raise for an extended period of time. Furthermore, temperatures above 35^oC can begin to denature or breakdown, enzymes, reducing metabolic function [5]. Temperature fluctuations can also affect the behavior choices of aquatic organisms, such as moving to warmer or cooler water after feeding, predator-prey responses and resting or migrating routines. Some species of sharks and stingrays will even seek out warmer waters when pregnant [6]. Plants are also affected by water temperature. While some aquatic plants tolerate cooler water, most prefer warmer temperature [7]. Temperature can also inhibit plant respiration and photosynthesis. In general, algal photosynthesis will increase with temperature, though different species will have different temperatures for optimum photosynthetic activity [8]. In addition to its effects on aquatic organisms, high water temperatures can increase the solubility and thus toxicity of certain [9]. These elements include heavy metals such as cadmium, zinc and lead as well as compounds like ammonia [10]. Water temperature can not only increase the solubility of toxic compounds, but it can also influence an organism's tolerance limit. This occurs because tissue permeability, metabolic rate and oxygen consumption all increase with increased water temperature [11]. Water

is the most essential resource and without water it is impossible to maintain biodiversity or promote social and economic development [12]. Bangladesh is a land of rivers. Around 230 rivers flow in the country including 53 international rivers. The country is located at the lowest reach of the alluvial system dominated by the combined delta of Ganges, Brahmaputra and Meghna rivers. Most of the big cities and settlements developed near those water bodies. Simultaneously this urbanization becomes main reason of pollution for these rivers and other water bodies [13]. Surface water quality of the rivers of Bangladesh is highly polluting day by day [14-15]. Bhadra river is one of the important rivers through the river system networks across the coastal belt. The river Bhadra is a very old river, which flows through Batiaghata upazila and separate Zolma union from Batiaghata. The river is about 15.5 km long. It starts from Solmari river and finally falls into the Salta. The river has several tributaries such as Koia river, Ghola river, Dumuria river [dead]. The villages adjacent to the river are Baroaria, Gaugara, Botthola, Dhanibunia, Bodnakhali, Choighoria etc. So the geographical location of this river is very significant with ecological perspective. Different land use activities are happening by human being. Due to these activities the water characteristics can be influenced through taking a huge agricultural runoff and other unwanted wastes. So it is important to study the water quality of this river and probable point and diffuse source of pollution which can affect the river and ultimately the ecosystem.

II. EXPERIMENTAL

The study area of Bhadra River is one of the important rivers through the river system networks across the coastal belt. The river Bhadra is a very old river, which flows through Batiaghata upazila and separate Zolma union from Batiaghata. The river has several tributaries such as Koia river, Ghola River, Dumuria river [dead]. The villages adjacent to the river are Baroaria, Gaugara, Botthola, Dhanibunia, Bodnakhali, Choighoria etc. So the geographical location of this river is very significant with ecological perspective. Different land use activities are happening by human being. The river is about 15.5 km long. It starts from Solmari river and finally falls into the Salta. There were four sampling stations such as Baroaria kheyaghat, Gaugara bazaar, Botthola sluice gate and Dhanibunia. The working stations which were selected were more or less similar distance. Those stations are described below table 1.

Table 1: Location, Latitude, Longitude & sample ID of the sampling points

Sl. No.	Location	Latitude	Longitude	Sample ID
1	Baroaria kheyaghat, Khulna	22°38'50.3"N	89°25'56.6"E	Z-1
2	Gaugara bazaar, Khulna	22°42'06.1"N	89°27'14.5"E	Z-2
3	Botthola sluice gate, Khulna	22°43'37.4"N	89°27'55.8"E	Z-3
4	Dhanibunia, Khulna	22°45'55.6"N	89°28'19.0"E	Z-4

2.1) Sample collection:

Water samples were collected from four different stations of the Bhadra River in between 5th July, 2014 to 22th August, 2014 with fortnightly variation. The samples were collected from each station both in high tide and low tide from near about 4 inch or 10 cm depth on the surface of the Bhadra River. For the determination of dissolved oxygen, water samples were collected in different BOD bottles, each of which was 300 ml capacity. In case of other parameters one liter capacity clean plastic bottle was used for collection of samples. To avoid direct sunlight, all the collected samples were placed into a black bag.

2.2) Preservation of samples:

The preservation procedure varies depending of the test to be performed. The samples for DO and dissolved free carbon dioxide, after collection should not be allowed to remain in contacts with the air or be agitated because either condition causes a change in its gaseous contact. The DO sample should be "Fixed" on the spot by some prescribed reagents (such as, Manganase sulfate $MnSO_4 \cdot 4H_2O$ and concentrated H_2SO_4 and Alkali Iodide Azide) as soon as the samples has been collected [14].

2.3) Analytical Method set-up:

In the experimental works, some of the important analytical methods were setup in the Chemistry discipline laboratory of Khulna University. The parameters that were analyzed in this laboratory as chemical Analysis: Total alkalinity, Total acidity and some parameters were measured in situ as Physical Analysis: Temperature, pH, Transparency, Salinity, Electrical conductivity (EC); Chemical Analysis: Dissolved oxygen (DO), Dissolved free carbon dioxide. All physical parameters were measured by instrumentally and chemical parameters were measured by the standard titration method of APHA, 1992 [16].

III. RESULTS AND DISCUSSION

During the study period the average temperature varied from 28.5°C to 29.5°C. An average difference about 1°C water temperature was recorded between morning and noon in all the stations of the river. The highest temperature was recorded for all four stations during high tide, also lowest during low tide. The water temperature was found between the standard ranges (5°C-36°C) for fisheries [17]. The average pH value of Bhadra river varied from 7.50 to 7.83 during study period. The maximum value of pH, for the river water was observed at Baroaria kheyaghat (Z1) during high tide and minimum value of pH for river water was also observed at Botthola sluice gate (Z3) during low tide. The mean pH found 7.675 ± 0.74 at the Bhadra river. Water with pH ranging from 6.0 to 9.0 was generally regarded as suitable for organism's growth [18]. The average range of transparency value were found to vary from 10.25 cm to 11.13 cm in Baroaria kheyaghat (Z1), 10.38 cm to 11.25 cm in station 2 and 11.0 cm to 11.75 cm in station 3 and 10.63 cm to 11.13 cm in Dhanibunia, Khulna (Z4). The highest transparency (Tr.) of Bhadra river was recorded 13 cm at Botthola sluice gate station. While the lowest was recorded at 10cm at Baroaria kheyaghat, Gaugara bazaar and Dhanibunia station respectively in Fig. 1.

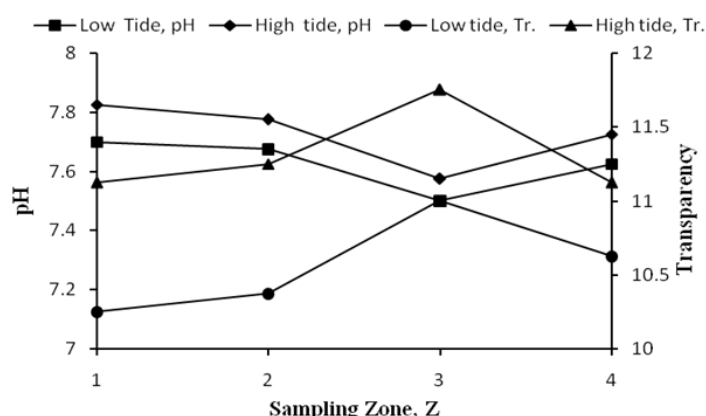


Fig. 1: The pH and Transparency of different location

From Fig. 2, it is observed that in the river mean salinity found 3.18 ± 0.74 ppt at the Bhadra river. For good aquatic growth it has been obtained in salinities of near 0.0 to 10ppt [19]. The highest water salinity was recorded 10.5 ppt at Baroaria kheyaghat(Z1) during high tide while the lowest was recorded 0.2 ppt at Botthola sluice gate (Z3) location during low tide and high tide. And the river was observed high electrical conductivity (EC) content. It average ranged from 2.74 mS/cm to 6.75 mS/cm. The mean EC for Bhadra River was found 4.77 ± 0.97 mS/cm. The highest EC was observed at (Z1) during high tide and the lowest was at Z3 during low tide.

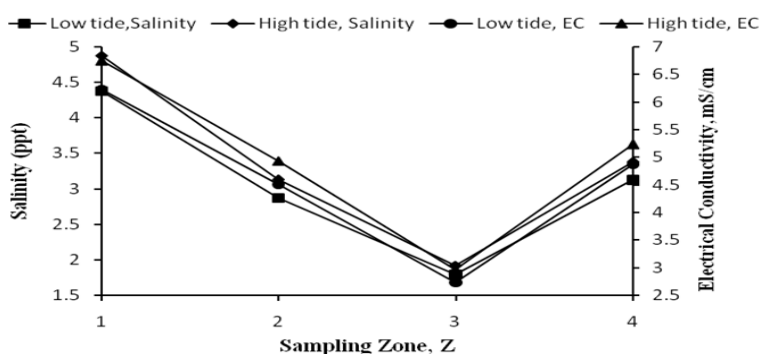


Fig. 2: Salinity and Electrical Conductivity of different location

Average total alkalinity in the study range of the Bhadra River varied from 95.0 mg/L to 115.0 mg/L. The mean alkalinity for Bhadra River was found 103.91 ± 4.5 mg/l. The highly productive water bodies should have more than 100 mg/L alkalinity [20]. And The River Bhadra was observed a high total acidity content in its water. The average total acidity content varied from 6.50 mg/L to 10.15 mg/L. The mean total acidity content of the river was 8.4 ± 0.87 mg/L. The standard value of acidity for river water is less than 19mg/L [21]. The highest total acidity was found 12.6 mg/L at Baroaria kheyaghat station during high tide and lowest was found 4.7 mg/L at Dhanibunia station, which are plotted in Fig. 3.

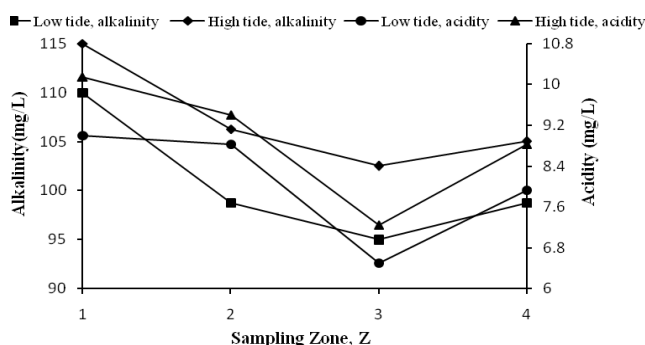


Fig. 3 : Alkalinity and Acidity of different location

In Fig. 4, the average dissolved oxygen content of the river was found to vary from 4.35 mg/L to 6.15 mg/L during the study period. The height DO was recorded during the low tide at Baroaria kheyaghat and the lowest DO was recorded during high tide at Botthola sluice gate station. The mean DO was found 5.1 ± 0.43 mg/L. The optimum DO level should be 5.0 mg/L or more for fish and various aquatic live [22]. As well as in the study period average dissolved free carbon dioxide content of the river was found to vary from 2.75 mg/L to 4.73 mg/L. The highest dissolved free carbon dioxide was recorded at Gaugara bazaar during high tide and the lowest dissolved free carbon dioxide was recorded at Baroaria kheyaghat and Botthola sluice gate during low tide. The mean of dissolved free carbon dioxide was found 3.89 ± 0.46 mg/L. The optimum level of free carbon dioxide level for the survival of organisms is less than 5mg/L [23]. From the data and above discussion it is clear that the various physical and chemical parameters range of Bhadra river fall within standard range and able to maintain the productivity of water and normal physiology of aquatic life.

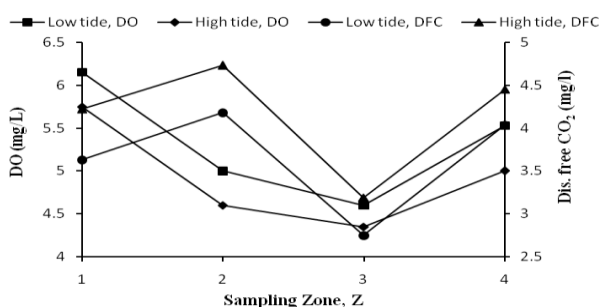


Fig. 4 : Dissolved Oxygen and Dissolved free CO₂ of different location

IV. CONCLUSION

The water quality parameters of the Bhadra river were found mostly between the standard ranges of river water. Very less variation in water quality founds along the river. Only total alkalinity value shows the variation which is slight more than the less variation shown by other parameters. But this alkalinity has a very little effect on the aquatic life. The deviation due to tidal action was not significant also. So, on the basis of these parameters it can be concluded that the water is not polluted. But it is not easy to characterize the water quality fully by measuring these certain parameters i.e pH, transparency, salinity, electrical conductivity (EC), total alkalinity, total acidity, dissolved oxygen (DO), dissolved free CO₂. Because there also other vital parameters such as density, TDS etc. The study was done in a short time and a few water quality parameters were observed. So it will not be wise to info the actual quality of the Bhadra river. However, the findings of the present study would be helpful as baseline information for developing monitoring, management and conservation of the Bhadra river ecosystem in future. However, in-depth studies covering all the months or seasonal variation and more sampling stations would be necessary to make concluding remarks on aquatic ecology of the river.

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