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INVESTIGATION OF PHYSICOCHEMICAL PROPERTIES OF LOUHAJANG RIVER WATER ALONG URBAN AND RURAL SITE OF TANGAIL, BANGLADESH

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ABSTRACT

The study was conducted to investigate the water quality parameters of the Louhajang river in Tangail district, Bangladesh during March 2021 (pre-monsoon) and December 2021 (Post-monsoon). Water samples were collected from eight different locations, four of which were in urban areas (Lake Par, SP park, Beradoma, Kagmari bridge) and four were in rural areas (Beltoli, Aminbag, Vallukkandi, Aloua). The values of pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), acidity, total alkalinity, total hardness and carbon dioxide (CO_2) were ranged from 7.51-7.95, 866.67-1433.33 µS/cm, 482.67- 810.33 mg/L, 100-503.33 mg/L, 1.97-6.87 mg/L, 1.27-3 mg/L, 35-63.33 mg/L, 400-696.67 mg/L, 230.67-386 mg/L and 25.06-70.6 mg/L, respectively in pre-monsoon season. The values of pH, EC, TDS, TSS, DO, BOD, acidity, alkalinity, hardness and, CO_2 were ranged from 7.19 to 7.49, 496.67-1046.7 µS/cm, 243.33 to 522.67 mg/L, 10.67 to 51.33 mg/L, 5.03 to 8.53 mg/L, 4.03 to 7.77 mg/L, 25 to 61.67 mg/L, 150 to 936.6 mg/L, 185.33 to 306.67 mg/L and 52.65 to 164.27 mg/L, respectively in post- monsoon season. The highest EC, TDS, TSS, acidity, alkalinity, hardness, and CO_2 were found in Beradoma in the pre- monsoon period. DO value was low at every station except the Beltoli area both in the pre and post-monsoon periods. Higher BOD was found in post-monsoon at every station than in pre- monsoon. Correlation is positively significant between TSS and alkalinity, pH, EC, TDS, hardness; pH and alkalinity, EC, TDS, hardness; EC and alkalinity; TDS and alkalinity, EC; Hardness and alkalinity, TDS; DO and CO_2. Correlation is negatively significant between CO_2 and pH; DO and alkalinity, TSS, pH, TDS, hardness; BOD and EC, TDS, hardness, DO. The water quality of urban areas was worse than that of rural in both pre and post-monsoon seasons, according to the study.

Key words: Water quality, river water, rural area, urban area

Introduction

The water quality of a river is made up of various interconnected compounds that are subject to local and temporal fluctuations, as well as the amount of water flowing through it (Mandal *et al*., 2010). As a result of wastewater discharges containing degradable organics, fertilizers, residential sewage, and agricultural waste, the river waters have been contaminated (Dimitrovska *et al*., 2012). Rapid industrialization and indiscriminate use of chemical fertilizers and pesticides in agriculture are polluting the aquatic environment in a variety of ways, causing water quality to deteriorate and aquatic biota to dwindle. As a result, it is vital to monitor the water quality at regular intervals (Gorde and Jadhav, 2013). In urban areas, the careless disposal of industrial effluents and other wastes may contribute greatly to the poor quality of the water (Chindah *et al*., 2004; Emongor *et al*., 2005). Bangladesh's Louhajang River, which runs through Tangail, a strongly industrialized and urbanized metropolis, provides water for a variety of uses. This is vital source for home use, agriculture, and development (Proshad *et al*., 2021). The degradation of the quality of this river's water is due to waste from households, municipalities, and industries (Tonny *et al*., 2015). Due to the disposal of wastewater, effluent from factories, hospitals solid waste, etc. in the Louhajang River, the river water is being polluted (Mia *et al*., 2012). As the river is important for domestic and agricultural purposes, it is a crying need to monitor the water quality of the river. This study determines how much water quality has been already damaged and it also compares water pollution from rural and urban locations of the Louhajang river at Tangail district of Bangladesh.

Objectives of the Study:

i) To assess the present water qualities in respect of pH, EC, TDS, TSS, DO, BOD, acidity, alkalinity, hardness, and CO_2 during pre and post- monsoon season.

ii) To assess the impact level of urban and rural water pollution of Louhajang river.

Materials and Methods

Study area: The study took place along the Louhajang River in Tangail, with latitudes ranging from 24.263653° to 24.220097° and longitudes ranging from 89.895764° to 89.912518° (Fig. 1). The Louhajang River is found in Bangladesh's central region. It originates in Gabsain in Bhuapur, Tangail District, and branches off from the Jamuna near Gabsain. After that, it breaks into two sections before coming back together. Before entering the Bangshi, it passes through Tangail, Karotia, and Jamurki. The Dhaleshwari is linked to the Louhajang (Mannan and Sultana, 2012). The sampling sites are given in the Table 1.

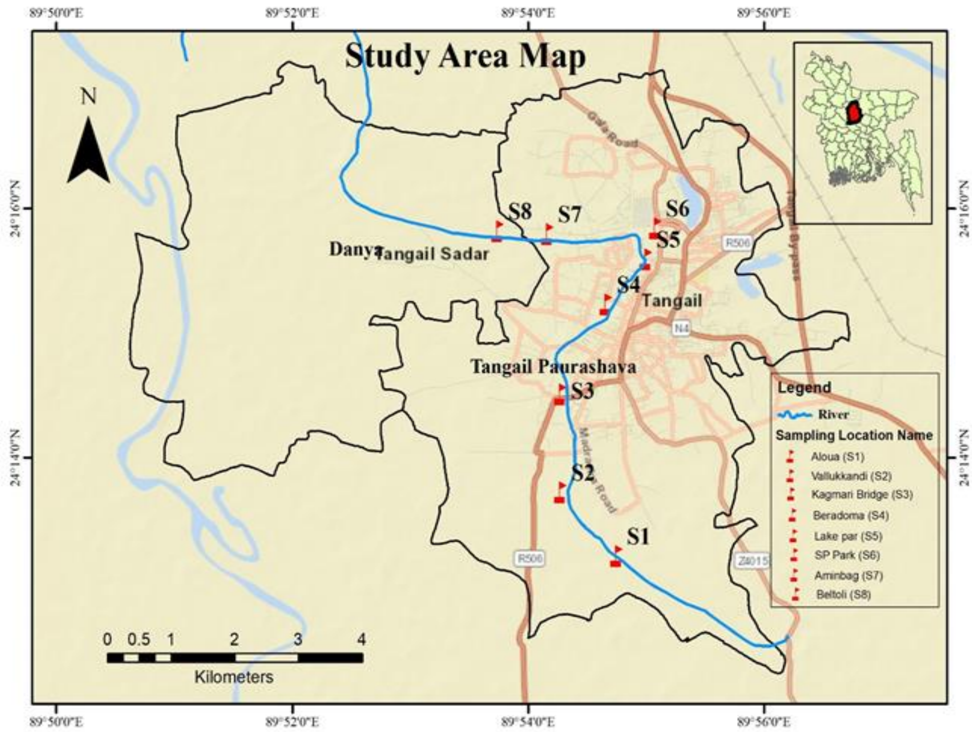

Fig.1. Map showing the study area in the Louhajang River, Tangail

Sample Collection: In the pre-monsoon and post-monsoon season, samples were collected from eight locations along the river in March and December 2021. The research was carried out using an experimental approach. The samples were assessed using an experiment using the independent variable, which was obtained as a sample from the study area of Louhajang River and compared to the standard level of water quality parameters, which is a control variable that already exists. The experimental data was meticulously collected and analyzed. 2000 cc water was collected from each sampling station in plastic bottles with double stoppers to assess the water quality. Before sampling, the bottle was cleaned and rinsed with a detergent solution before being treated overnight with 5% HNO_3. The bottles eventually dried after being cleaned with deionized water. Following the sampling, the bottles were carefully screwed shut and labeled with the appropriate identification number.

Sample Analyses: Different methods and instruments were used to determine the physicochemical parameters of water samples. pH was analyzed by using Digital pH meter (Model: pH Scan WP 1,2 Malaysia), EC was analyzed by using Digital EC meter (Model: HM digital and produced in Germany), TDS was analyzed by using Digital TDS meter (Model: HM digital and produced in Germany), TSS was analyzed by using Filtration and Gravimetric analysis, DO was analyzed by using Digital DO meter (Model: D.46974, Taiwan), BOD was analyzed by using Titrimetric Winkler Method. Acidity, Total Alkalinity, Total Hardness, and CO_2 were analyzed by using Titrimetric Method.

Table 1. Sampling Stations of Louhajang River with actual location

Sl. No.	Stations Name	Latitude	Longitude
01	Aloua, S1	24.220097	89.912518
02	Vallukkandi, S2	24.228680	89.904680
03	Kagmari Bridge, S3	24.241796	89.904622
04	Beradoma, S4	24.253968	89.911039
05	Lake Par, S5	24.259841	89.916723
06	SP Park, S6	24.264029	89.91801
07	Aminbag, S7	24.263229	89.902793
08	Beltoli, S8	24.263653	89.895764

Statistical Analysis: The collected data were compiled and tabulated in proper form and were subjected to statistical analysis. The Microsoft Office Excel software and SPSS software were used to present and interpret the collected data. The results of the study were presented in graphs and tabular forms.

Results and Discussion

pH: The pH is considered an essential factor for determining the quality of water. It indicates the acidic or base condition of a water body. In natural water, the pH is normally dependent on the carbonic acid equilibrium. The pH values of eight sampling points ranged from 7.51±0.01 to 7.95±0.01 in pre-monsoon season and 7.19±0.11 to 7.49±0.11 in post- monsoon season (Fig. 2).

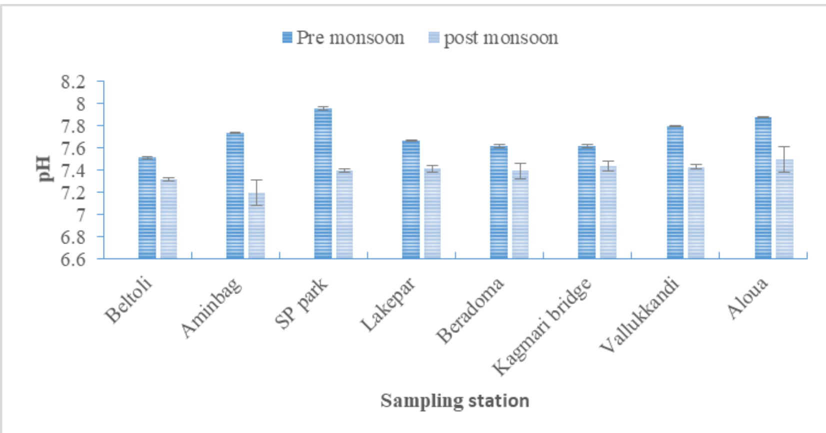

Fig. 2. Variation of pH at different sampling stations in pre and post-monsoon season

The highest pH 7.95 was found at the SP Park area in pre-monsoon season and the lowest value was found at the main bag area in post-monsoon season. The pH standard limit for inland surface water is 6.5 to 8.5 (EQS, 1997), which noted that though the water was slightly alkaline, but was within the permissible level.

Electrical Conductivity (EC): The ability of a substance to carry an electric current is measured by its electrical conductivity (EC). It is conductive because of the presence of several species in the solution. Electrical conductivity (EC) readings ranged from 866.67±11.55 to 1433.33±15.28 µS/cm in pre-monsoon season and 496.67±11.55 µS/cm to 1046.7±5.77 µS/cm in post- monsoon season (Fig. 3).

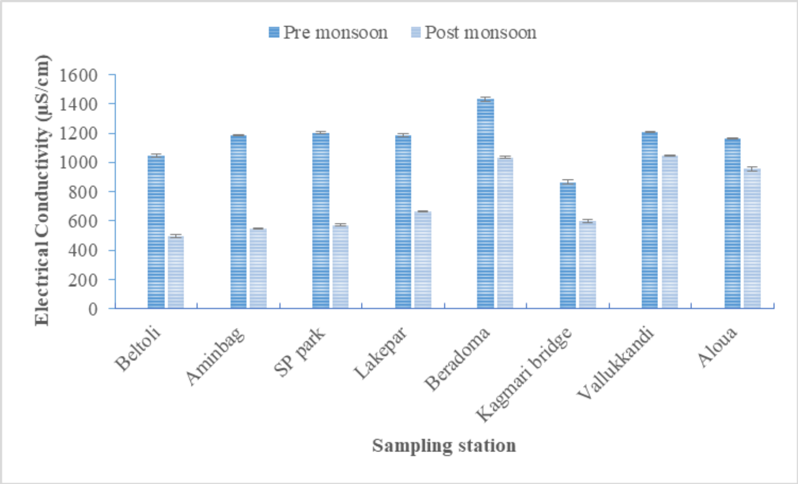

Fig. 3. Variation of EC at different sampling stations in pre and post-monsoon season

The highest EC value 1433 µS/cm was found at Beradoma in pre- monsoon season and the lowest value 496.67 µS/cm was found at Beltoli in post- monsoon season. The EC values were higher at every station in pre-monsoon season than in the post-monsoon season and the standard value of EC is 700 µS/cm (EQS,1997). The study revealed that the urban sites of river were showing high range electrical conductivity than the rural sites in pre- monsoon season.

Total Dissolved Solids (TDS): The total dissolved solid (TDS) mainly describes the availability of different kinds of materials that comprise both of colloidal and dissolved solids in water.

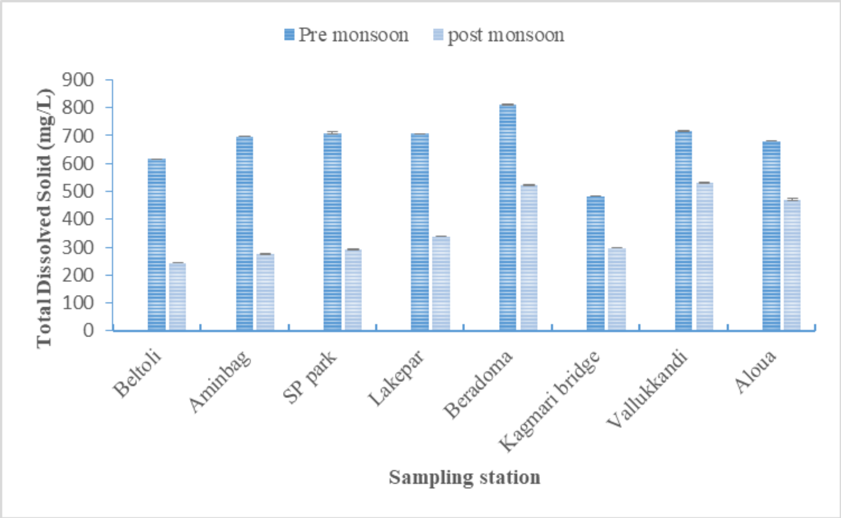

Fig. 4. Variation of TDS at different sampling stations in pre and post- monsoon season

TDS values of the various sampling points ranged from 482.67±0.58 to 810.33±1.53 mg/L in pre-monsoon season and 243.33±0.58 to 522.67±2.52 mg/L in post-monsoon season (Fig. 4). The highest TDS value was found from Beradoma both in pre and post- monsoon seasons. The urban sites of the river are highly contained by dissolved solids than the rural sites of the river. Total dissolved solids (TDS) are usually low for freshwater sources, at less than 500 mg/L (Moran, 2018). The study showed that values from all stations were greater than the standard values except the Kagmari bridge area in pre-monsoon season than in post-monsoon season. This might due to the urban runoff and municipal wastes containing inorganic compounds.

Total Suspended Solid (TSS): Total suspended solid (TSS) of Louhajang river water is highly significant for its highly polluted water. TSS values of various sampling sites were ranged from 100±10 to 503.33±5.77 mg/L in pre monsoon and 10.67±1.15 to 51.33±1.15 mg/L in post monsoon season (Fig. 5). The highest TSS value was found in the Beradoma sampling station in pre monsoon season and the lowest value was found from Beltoli in post monsoon season. Bangladesh standard for TSS in terms of inland surface water is 150 mg/L (Sarwar *et al*., 2010). The study showed that mean values of TSS were found higher in the urban sites than rural sites in both pre monsoon season and post-monsoon season.

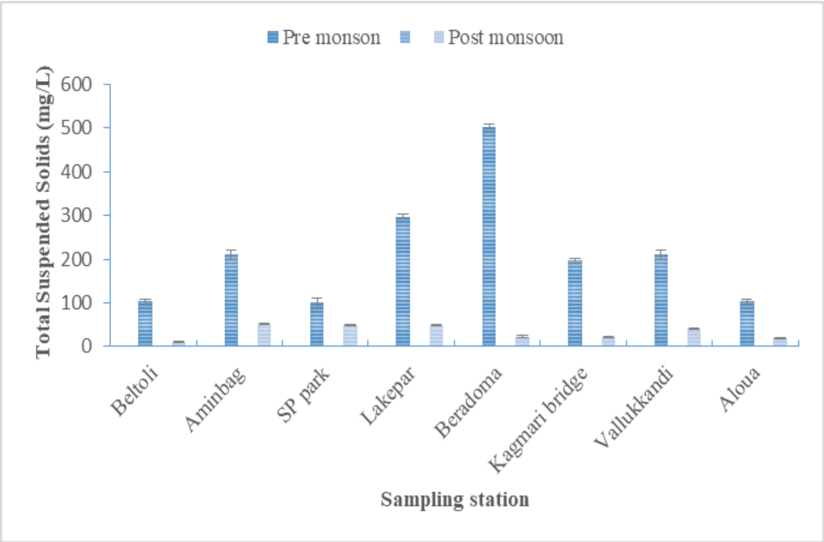

Fig. 5. Variation of TSS at different sampling stations in pre and post- monsoon season

Dissolved Oxygen (DO): DO values of various sampling sites were ranged from 1.97±0.05 mg/L to 6.87±0.05 mg/L in pre- monsoon season and 5.03±0.95 mg/L to 8.53±0.05 mg/L in post- monsoon season (Fig. 6). According to De (2006), the standard value of DO for fresh water aquatic life is 4-6 mg/L. The study showed that Louhajang river had low DO values from different sampling stations except the Beltoli area in pre monsoon season. The decrease in DO level may be due to sewage effluent, decaying aquatic vegetation, contaminated waste water discharge from all human activities.

Biological Oxygen Demand (BOD): BOD values of various sampling sites ranged from 1.27±0.11 to 3±0.01 mg/L in pre-monsoon season and 4.03±0.67 to 7.77±-0.58 in post-monsoon season (Fig. 7). According to EQS (1997), the standard value of BOD is ≤ 2 mg/L. The study showed that Louhajang River had higher BOD values from every sampling station in the monsoon season whereas in pre- monsoon season BOD levels were lower. Decomposing of aquatic vegetation, municipal waste discharge, sewage disposal etc. may be the reasons of higher BOD in urban sites.

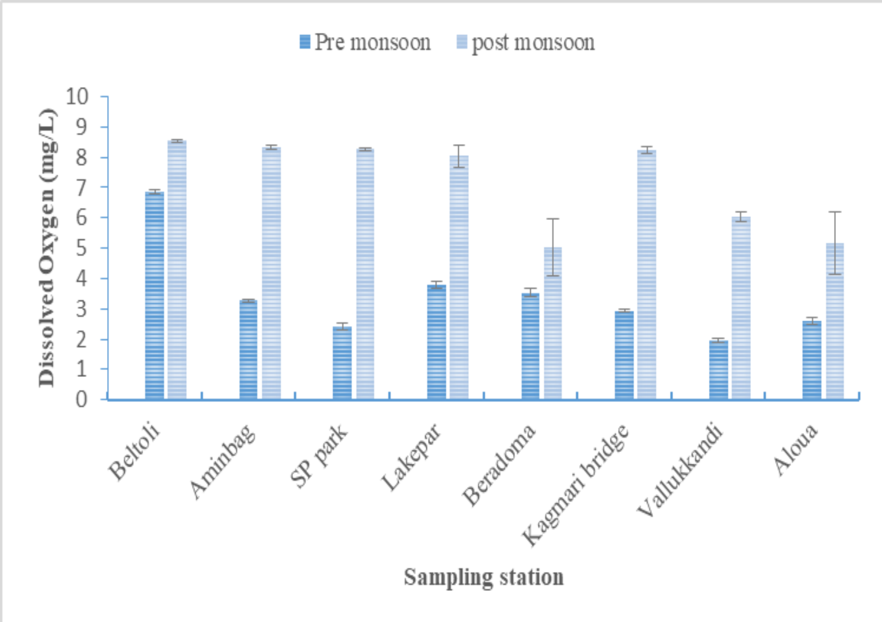

Fig. 6. Variation of DO at different sampling stations in pre and post- monsoon season

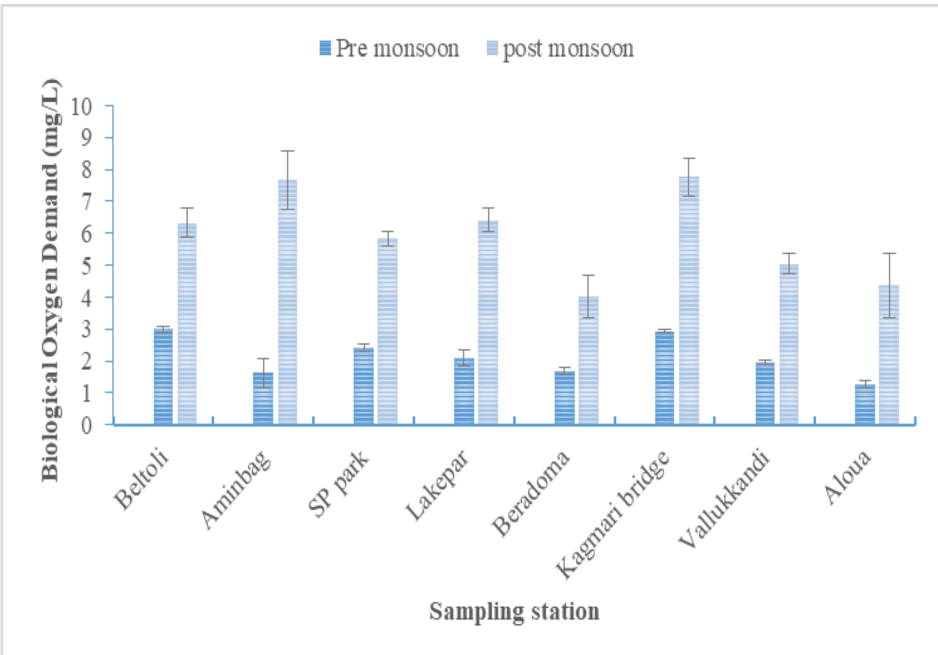

Fig.7. Variation of BOD at different sampling stations in pre and post- monsoon season

Acidity: The values of acidity at different sampling points ranged from 35±8.16 to 63.33±18.40 mg/L in pre- monsoon period and 25±5 to 61.67±2.89 mg/L in post- monsoon season (Fig. 8). The highest acidity values of Louhajang River were found from two sampling points Beltoli and Beradoma and the lowest value was found from the Aloua area in pre-monsoon season. The highest value was found at Beradoma and the lowest values were found at Beltoli and Vallukkandi in post-monsoon season. The study revealed that urban sites were higher in acidity level than rural sites during both pre and post- monsoon season.

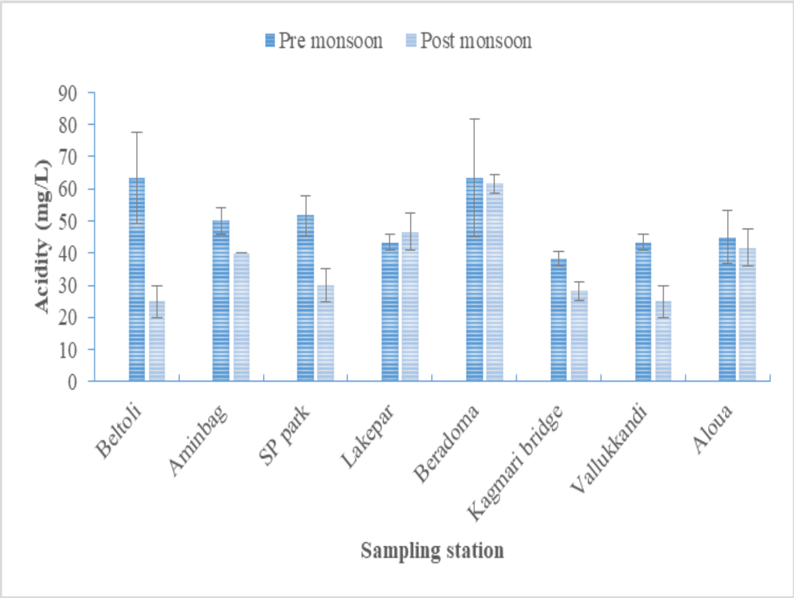

Fig. 8. Variation of Acidity at different sampling stations in pre and post- monsoon season

Alkalinity: The values at different sampling points were ranged from 400±8.16 to 696.67±24.94 mg/L in pre- monsoon season and 150±10 to 936.67±376.34 mg/L in post- monsoon season (Fig. 9).

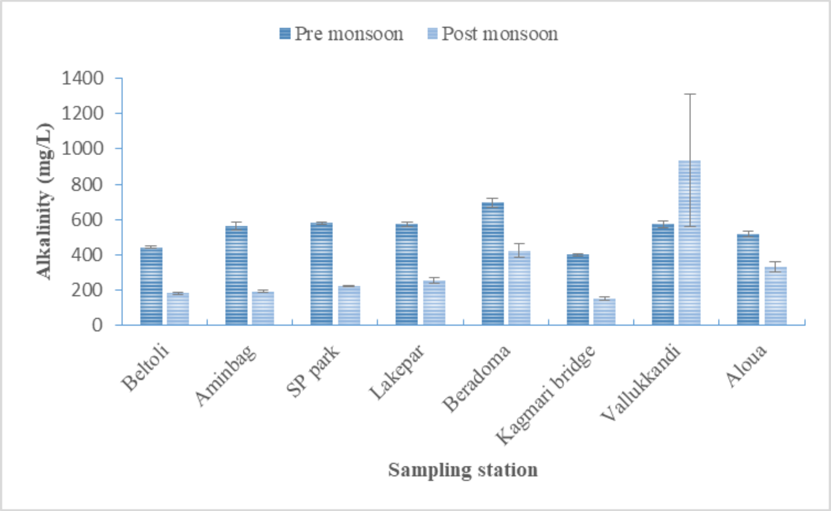

Fig. 9. Variation of Alkalinity at different sampling stations in pre and post- monsoon season

The standard value for alkalinity is 100-250 mg/L for river water (BIS, 2009) and the alkalinity of Louhajang river was higher than the standard value. The study showed that urban sites of the river were higher in alkalinity than rural sites in both pre and post- monsoon season.

Hardness: The values of hardness at different sampling points were ranged from 230.67±7.02 to 386±7.21 mg/L in pre- monsoon season and 185.33±3.05 to 306.67±6.11 mg/L in post- monsoon season (Fig. 10). The highest value of hardness was found at Beradoma in pre- monsoon season and lowest value was found at Aminbag in post- monsoon season. According to McGowan and Harrison (2000), water containing hardness below 60 mg/L is considered as soft and hardness level 60 mg/L to 120 mg/L is considered moderately hard and hardness level greater than 120 mg/L is considered as very hard water. On the basis of total hardness, water can be classified as soft (<75 mg/L), moderately hard (75-150 mg/L), hard (150-300 mg/L) and very hard (>300 mg/L) (Sawyer & McCarty, 1967). The study revealed that water of the Louhajang river was very hard.

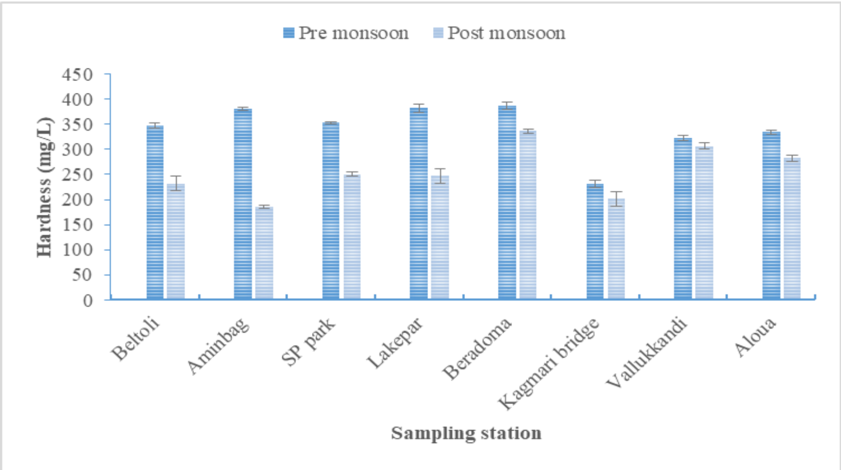

Fig. 10. Variation of Hardness at different sampling stations in pre and post- monsoon season

Total Carbon Dioxide (CO_2): The values of Carbon dioxide at different sampling points were ranged from 25.06±1.50 to 70.6±1.83 mg/L in pre monsoon season and 52.65±7.36 to 164.27±12.70 mg/L in post-monsoon season (Fig. 11).

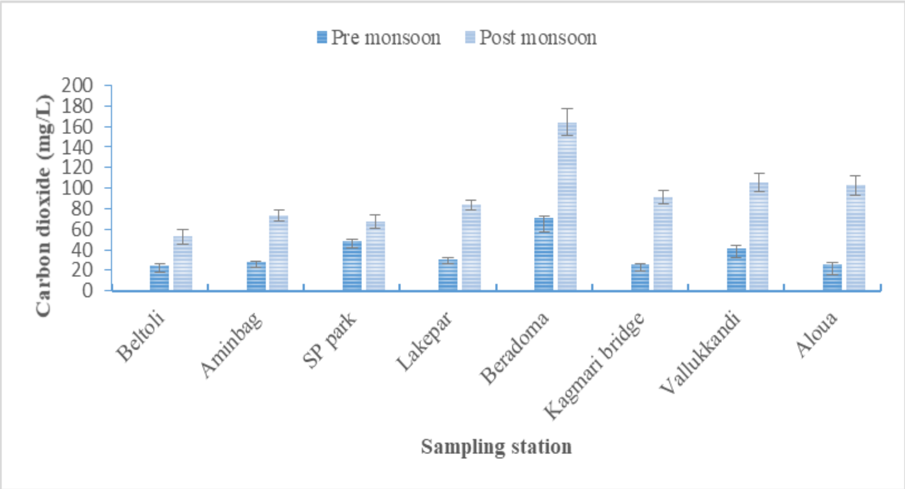

Fig. 11. Variation of total CO_2 at different sampling stations in pre and post- monsoon season

The lowest value of Carbon dioxide was found at Beltoli both in pre and post- monsoon season. The highest value was found at Beradoma both in pre and post- monsoon season. The standard value of Carbon dioxide level for water is less than 30 mg/L (EQS, 1997). The study showed that urban sites of the river had higher CO_2 level than rural sites in pre- monsoon season and higher CO_2 level was present at both urban and rural sites in post- monsoon season.

Pearson correlations: Correlations were positively significant between TSS and alkalinity, pH, EC, TDS, hardness; pH and alkalinity, EC, TDS, hardness; EC and alkalinity; TDS and alkalinity, EC; Hardness and alkalinity, TDS; DO and CO_2. Correlations were negatively significant between CO_2 and pH; DO and alkalinity, TSS, pH, TDS, hardness; BOD and EC, TDS, hardness, DO (Table 2).

Table 2. Pearson Correlations among the parameters

Parameters	Acidity	Alkalinity	TSS	pH	EC	TDS	Hardness	CO_2	DO	BOD
Acidity	1									
Alkalinity	.202	1	.							
TSS	.402**	.465**	1							
pH	.165	.476**	.581**	1						
EC	.487**	.766**	.693**	.742**	1					
TDS	.485**	.732**	.717**	.799**	.986**	1				
Hardness	.546**	.682**	.551**	.651**	.911**	.910**	1			
CO_2	-.018	-.075	-.351*	-.520**	-.199	-.339*	-.199	1		
DO	-.274	-.589**	-.628**	-.851**	-.844**	-.861**	-.676**	.352*	1	
BOD	-.445**	-.604**	-.633**	-.812**	-.888**	-.920**	-.838**	.469**	-.899**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Conclusion

Louhajang river is mostly significant for the Tangail municipality area as well as surrounding of Tangail town. It is an essential source of water for the local population. It can provide water for a multitude of uses ranging from agriculture to bathing, fisheries, irrigation, waste disposal, etc. But, from the study, we found that the Louhajang river water was highly polluted in both pre and post- monsoon seasons, which is extreme in the pre-monsoon season. So, the river water was not suitable for fisheries, irrigation, bathing, drinking, household work, and recreation purposes.

References

Chindah, A. C., Braide, A. S., & Sibeudu, O. C. (2004). Distribution of hydrocarbons and heavy metals in sediment and a crustacean (shrimps: Penaeus notialis) from the Bonny/New Calabar River Estuary, Niger Delta. *African Journal of Environmental Assessment and Management*, *9*, 1-17.

De, A. . (2005). *Environmental chemistry* (5th ed.). New Age International Publishers.

Dimitrovska, O., Markoski, B., Toshevska, B. A., Milevski, I., & Gorin, S. (2012). Surface water pollution of major rivers in the Republic of Macedonia. *Procedia Environmental Sciences*, *14*, 32-40.

Emongor, V., Nkegbe, E., Kealotswe, B., Koorapetse, I., & Keikanetswe, S. S. and S. (2005). Pollution Indicators in Gaborone Industrial Effluente. *Journal of Applied Sciences*, *5*, 147–150.

Gorde, S. P., & Jadhav, M. V. (2013). Assessment of water quality parameters: a review. *J Eng Res Appl*, *3*(6), 2029-2035.

Mandal, P., Upadhyay, R., & Hasan, A. (2010). Seasonal and spatial variation of Yamuna River water quality in Delhi, India. *Environmental Monitoring and Assessment*, *170*(1), 661-670.

Mannan, M., & Sultana, S. (2012). *Assessment of Water Quality in the Industrial Area of Louhajang River*. Mawlana Bhashani Science and Technology University.

Mia, M. D. Y., Farzana, Hossain, S., & Uzzal, M. D. (2012). Urban Environmental Conditions Assessment in Tangail Municipal Area, Bangladesh. *Journal of Science and Technology*, *2*(2), 187-194.

Moran, S. (2018). *Chapter 6 - Clean water characterization and treatment objectives* (S. B. T.-A. A. G. to W. and E. T. P. D. Moran (ed.); pp. 61-67). Butterworth-Heinemann. https://doi.org/https://doi.org/10.1016/B978-0-12-811309-7.00006-0

Proshad, R., Zhang, D., Idris, A. M., Islam, M. S., Kormoker, T., Sarker, M. N. I., Khadka, S., Sayeed, A., & Islam, M. (2021). Comprehensive evaluation of chemical properties and toxic metals in the surface water of Louhajang River, Bangladesh. *Environmental Science and Pollution Research*, *28*(35), 49191-49205. https://doi.org/10.1007/s11356-021-14160-6

Sarwar, M., Majumder, D. A. K., & Islam, M. (2010). Water Quality Parameters: A Case Study of Karnafully River Chittagong, Bangladesh. *Bangladesh Journal of Scientific and Industrial Research*, *45*. https://doi.org/10.3329/bjsir.v45i2.5722

Sawyer, C. N., & McCarty, P. L. (1967). *Chemistry for sanitary engineers* (2nd ed.). McGraw-Hill.

Tonny, I. J., Fatema, K., Afrin, R., & Mia, M. (2015). Chemicals and Nutrients Removal Efficiency of Duckweed (Spirodelapolyrrhiza) in Improving the Quality of the Louhajang River Water, Tangail, Bangladesh. *ASA University Review*, *9*(2).