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Seasonal Variation in Wastewater Quality of Mymensingh Municipality Area Discharged into the Brahmaputra River

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Abstract: The present study was undertaken to monitor the seasonal variations in wastewater quality of Mymensingh municipality area discharged into different locations at the Brahmaputra River. Five sample collection points were purposively selected from five different discharge locations of the study area. The samples were collected during January to November 2012. Collected samples were analyzed for pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Total Nitrogen and Available Phosphorus. The study results revealed that the value of EC, TDS, DO, Total Nitrogen and Available Phosphorus of the wastewater samples varied with seasons. The pH was consistently same through out the year, EC, TDS, Total Nitrogen and Available Phosphorus were relatively low in rainy season and high in winter, but DO was high in rainy season and low in winter. Considering the investigated parameters, the wastewater of Mymensingh municipality area that discharged into the Brahmaputra River was suitable for rice irrigation. For aquacultural purposes most of the discharge points of wastewater were not suitable except in rainy season, because the majority part of the year Dissolved Oxygen level was very low that may results in fish mortality. The wastewater containing excess phosphorus and nitrogen may cause algae growth in quantities sufficient to create bad odor. Dead and decaying of algae may also cause oxygen depletion which can kill fish and other aquatic organisms in the Brahmaputra River in winter season.

Keywords: wastewater, quality parameters, irrigation, aquaculture

Introduction

Water is an important and essential component of this universe and plays a vital role in the proper functioning of the earth's ecosystem. The availability of water supply should be adequate in terms of both quantity and quality essential to human existence. Increasing populations and greater economic development require more water and competition occurs among the water demands of agriculture, urban, residential and industrial uses. Now a days due to lack of availability of pure water it is the time to think about the use of wastewater in agriculture. Some researchers already found the importance of using wastewater and proper way to use it (Razakov, 1991 and Rutkowski *et al.,* 2007). Planners are now forced to consider any sources of water, which might be used economically and effectively to promote further production of crops. Marginal or low quality water will have to be considered for use in agriculture whenever good quality water or fresh water is not available. Municipal wastewater, industrial wastewater, etc. are the examples of low quality water which can be used for successful irrigation through proper management. Wastewater may supply organic matter and mineral nutrients that are beneficial to crop production, and reduces the cost of fertilizer application. However, urban wastewater may also contain hazardous substances including heavy metals and pathogenic micro-organisms (Rusan *et al*., 2007). In many countries, untreated wastewater is disposed to nearby surface water bodies like rivers and streams that are invariably used for various purposes further downstream. Options to reduce the pollution of these water bodies are to reuse the wastewater close to the town for irrigation. However, this practice is often associated with local health and environmental risks owing to its high contents of nutrients and fecally transmitted pathogens (Haruvy, 1998 and Flores *et al.*, 1992).

Keeping the above discussion in view, this study was undertaken to monitor the seasonal variations of wastewater quality discharged into different point at the Brahmaputra river from Mymensingh municipal area for assessing the suitability of using municipal wastewater for irrigation and aquaculture.

Methodology

Municipal wastewater samples were collected from different selected discharge locations in Mymensingh municipal area. All the samples were collected during January to November of every alternate month. Five samples collection points were chosen from five different wastewater discharge drains of the study area. The wastewater samples were collected in 500 ml plastic bottles. The bottles were cleaned and then washed with drinking water followed by distilled water before sampling.

After collecting the sample, the bottles were sealed immediately by tighten head to avoid exposure to air. To provide necessary information for each sample such as date of collection, location, source of water, etc. the bottles were labeled separately with a unique identification number (Table 1). The parameters like pH, EC, TDS and DO directly measured by the "Water Quality Monitor" in Environmental Engineering Laboratory of the Department of Farm Structure and Environmental Engineering, Total Nitrogen and Available Phosphorus of the samples were determined in Agri-Varsity Humboldt Soil Testing Laboratory of the Department of Soil Science, Bangladesh Agricultural University, Mymensingh. Total Nitrogen and Available Phosphorus were found out by nitrogen distillation unit using semi-micro Kjeldal method and colorimetric method respectively (APHA, 1995; USEPA, 1979).

Table 1: Wastewater sampling location of Mymensingh municipal area

Serial No.	Sampling location (Outlet drain)	Sample ID No.
1	Sultana Razia Hall (Annex)	S1
2	Morakhola Bridge	S2
3	Shomvuganj Residential Area	S3
4	Jublighat	S4
5	Kachijuli	S5

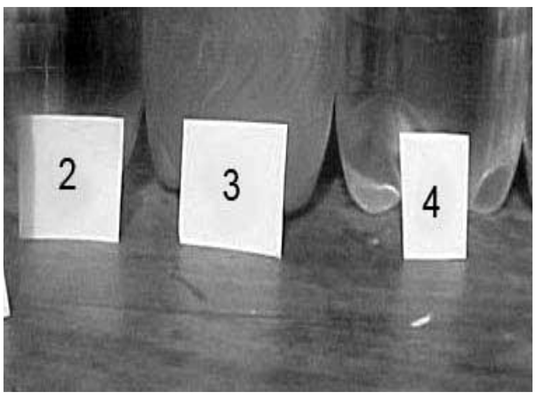

Fig 1: Wastewater samples collected from different location

Fig 2: Testing of wastewater sample by Water Quality Monitor

Results and Discussion

The test results of different parameters of collected wastewater samples from different discharge locations of Mymensingh municipal area are presented in Figures 3 to 8 and discussed under appropriate headings in the light and support of relevant available research findings whenever applicable.

Hydrogen ion concentration (pH)

The comparison of pH values of different samples are presented in Figure 3. The pH values of the samples ranged from 6.02 to 6.77. The highest pH values were obtained for sample 1 and the lowest for sample 4. For all the wastewater samples of all sources, the pH value was relatively low during May-June and comparatively high during November-December.

The normal pH range is 6.0 to 8.5 for irrigation water (Westcot, 1997). The pH values outside this range are a good warning that the water is abnormal in quality. The pH can also affect fish health. For most freshwater species a pH range from 6.5-9.0 is ideal, but most marine animals typically cannot tolerate as wide range pH as freshwater animals, thus the optimum pH is usually between pH 7.5 and 8.5 (Boyd, 1998).

Electrical Conductivity (EC)

Figure 4 reveals the comparison of EC values of different samples. The EC values of the tested samples ranged from 0.145 to 1.068 mS/cm. The lowest value of EC (0.145 mS/cm) was found for sample 1 and the highest (1.068 mS/cm) for sample 3. For all the wastewater samples of all sources the EC value was lower during June-July and higher during December-January.

Following Richards (1968), on the basis of EC values the irrigation water were classified into four groups such as low salinity (EC = <0.25 mS/cm), medium salinity (EC = 0.25 - 0.75 mS/cm), high salinity (EC = 0.75 - 2.25 mS/cm) and very high salinity (EC = >2.25 mS/cm). According to this classification sample 1, 2 and 5 exhibited low salinity during June-August and rest of the periods showed medium salinity. Sample 3 and 4 showed medium salinity during April-September and rest of the season's revealed high salinity. Considering the EC value sample 1, 2 and 5 are suitable for irrigation through out the year. Sample 3 and 4 are suitable for April-September and rest of the year they are not suitable for irrigation purposes.

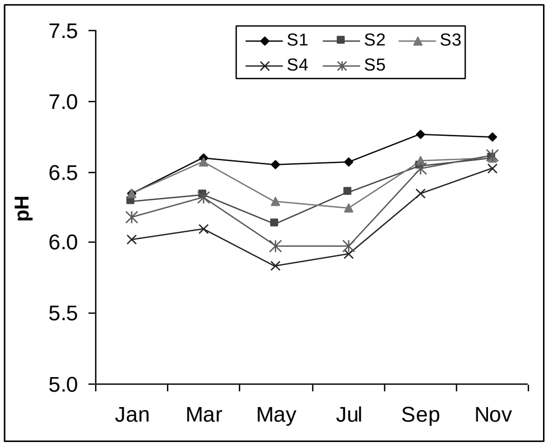

Fig 3: pH of the samples

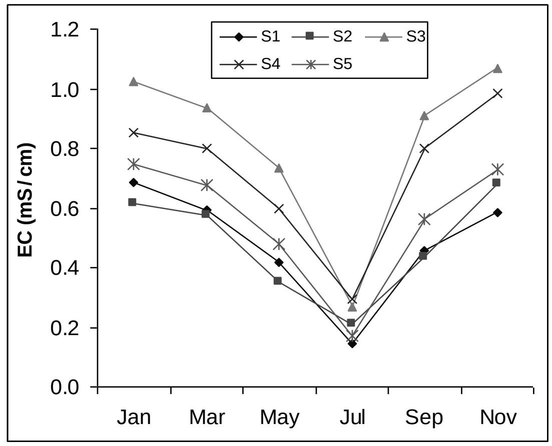

Fig 4: Electrical Conductivity (EC) of the samples

Total Dissolved Solids (TDS)

The comparison of TDS values of different samples are presented in Figure 5. The TDS of the tested samples varied from 84.4 to 638.6 mg/l. The lowest value of TDS (84.4 mg/l) was found for sample 5 and the highest (638.6 mg/l) for sample 3. For all sources the TDS value was lower during June-August and higher during September-March.

The TDS in water mainly consists of ammonia, nitrate, alkalies, some acids, sulphates, metallic ions etc. Total dissolved solid is the most important parameter for water quality especially for irrigation water since it controls the availability of water to plants through osmotic pressure regulating mechanisms. Acceptable TDS value for irrigation water is less than 1000 mg/l, but 1000 to 2000 mg/l also permissible for irrigation purpose and for aquaculture required standard of TDS ranges from 500-1200 mg/l (Bauder *et al.* 2005).

Dissolved Oxygen (DO)

DO values of different samples are presented in Figure 6. Dissolved Oxygen of the analyzed samples ranged from 0.04 to 1.27 mg/l. The lowest value of DO (0.04 mg/l) was found for sample 3 and 5 and the highest (1.27 mg/l) for sample 2. For all the wastewater samples of all sources the DO value was lower during September-March and higher during April-August.

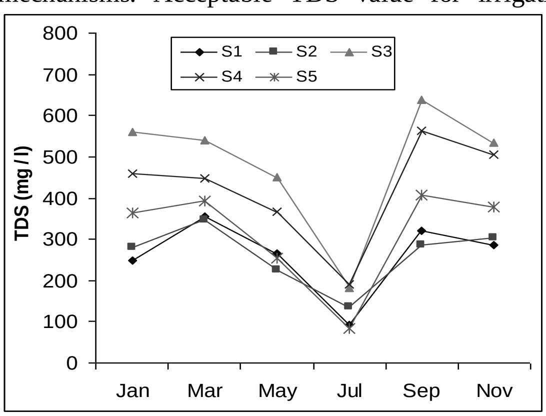

Fig 5: Total Dissolved Solids (TDS) of the samples

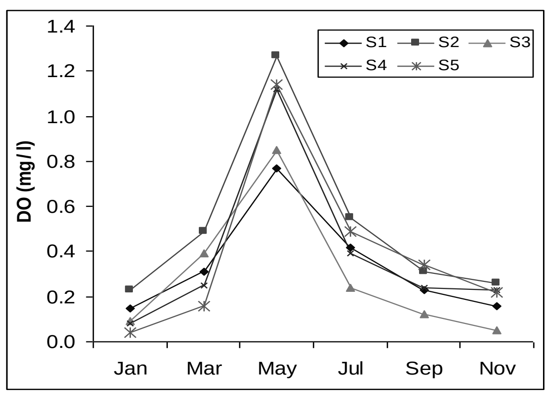

Fig 6: Dissolved Oxygen (DO) of the samples

Dissolved oxygen is considered as one of the most important aspect for aquaculture. It is needed by fish to respire and perform metabolic activities. Thus low levels of dissolved oxygen are often linked to fish kill incidents. On the other hand, optimum levels can result good growth and high production. In general, a saturation level of at least 5.0 mg/l is required. Values lower than this can put undue stress on the fish, and levels reaching less than 2.0 mg/l may result to death (Lloyd, 1992).

Total Nitrogen

The comparisons of the vales of Total Nitrogen of different samples have been presented in Figure 7. Total Nitrogen of the analyzed samples varied from 6.5 to 34.4 mg/l. The lowest value of Total Nitrogen (6.5 mg/l) was found for sample 2 and the highest (34.4 mg/l) for sample 3. For all the samples of all sources the Total Nitrogen value was lower during June-September and higher during November-March. From the figure it is revealed that the sample 1, 2 and 4 showed lower values than that of sample 3 and 5 throughout the year.

Nitrogen is a necessary macronutrient for plant that can be found in wastewater. Waters high in nitrogen can cause quality problems in crops and excessive growth in some vegetables. However, these problems can usually be overcome by good fertilizer and irrigation management. Total nitrogen is not directly toxic to aquatic life, but may have an adverse impact on water quality through contribution to eutrophication. Total nitrogen standards for effuelent are set tentatively at 4.0 mg/l for safe aquaculture (Lawson, 1995).

Available Phosphorus

Figure 8 shows the comparison of Available Phosphorus values of different samples. Available Phosphorus of the analyzed samples varied from 0.35 to 6.30 mg/l. The lowest value of Available Phosphorus (0.35 mg/l) was found for sample 2 and the highest (6.30 mg/l) for sample 3. For all the samples of all sources Available Phosphorus was lower during April-September and higher during October-March. The results also showed that the sample 1, 2 and 5 exhibited comparatively lower values of Available Phosphorus than that of sample 3 and 4 all over the year.

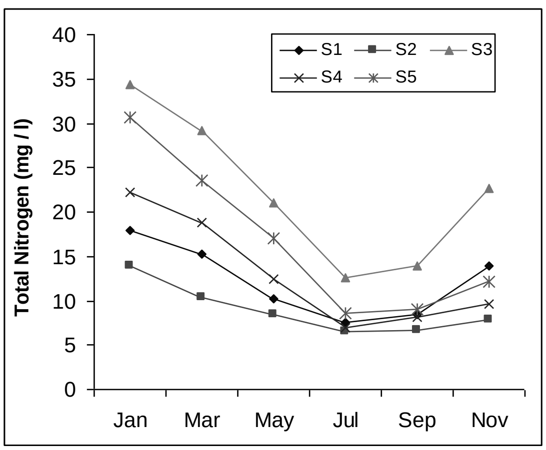

Fig 7: Total Nitrogen of the samples

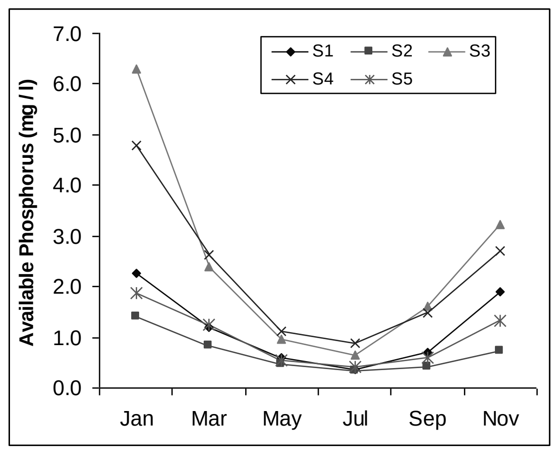

Fig 8: Available Phosphorus of the samples

Wastewater is relatively rich in phosphorus compounds. When wastewater is used continuously as the sole source of irrigation water for field crops, excessive amounts of nutrients could simultaneously be applied to the soil-plant system. This would cause unfavorable effects on productivity and quality parameters of the crops. Phosphorus limits of 2.0 mg/l are permitted for discharges to surface waters which do not have substantial problems with high levels of nutrients (Shahinasi & Kashuta, 2008). For safe aquaculture, total phosphorus associated with suspended matter in unpolluted rivers normally ranges between 0.62 -1.86 mg/l (Furnas, 1992).

Conclusion

The following conclusions can be drawn from the study:

(i) The value of EC, TDS, DO, Total Nitrogen and Available Phosphorus of the wastewater at different discharge locations at the Brahmaputra river in Mymensingh municipality area varied with seasons. The pH was almost same through out the year but EC, TDS, Total Nitrogen and Available Phosphorus were relatively lower in rainy season and higher in winter. The values of DO were higher in rainy season than those in winter.

(ii) Considering the investigated parameters, the wastewater of Mymensingh municipality area was suitable for rice irrigation, but in some discharge point nitrogen and phosphorus level were very high in winter season which cause luxuriant growth of stems and leaves of paddy hampering the overall yield. However, these problems can be overcome by proper management of irrigation water and fertilizer application.

(iii) For aquacultural purposes most of the sources of wastewater were not suitable except in rainy season, because majority part of the year Dissolved Oxygen level was very low that may results in fish mortality. The wastewater containing excess phosphorus and nitrogen may cause algae growth in quantities sufficient to create bad odor. Dead and decaying of algae may also cause oxygen depletion which in turn can kill fish and other aquatic organisms in the Brahmaputra River.

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