Asian Journal of Environment & Ecology

12(2): 29-37, 2020; Article no.AJEE.53177
ISSN: 2456-690X

Assessment of Water Quality Parameters of Meghna River Kishoreganj, Bangladesh

Romana Rima[1*], Abdullah Al Ryhan[1], Ruhul Amin Khan[2], Sony Ahmed[1], Rafiq Islam[1], Sharif Hossain Munshi[1] and Sabbir Azam[1]

[1]Department of Applied Chemistry and Chemical Engineering, Noakhali Science and Technology University, Sonapur, Noakhali, 3814, Bangladesh.
[2]Department of Environmental Science and Engineering Laboratory, Institute of Radiation and Polymer Technology, Bangladesh Atomic Energy Commission, Savar, Dhaka, Bangladesh.

Authors' contributions

This work was carried out in collaboration among all authors. Authors RAK and RI designed the experiment. Authors RR and AAR carried out the research work. Authors RR and S. Ahmed drafted the manuscript. Authors SHM and S. Azam helped in literature survey. All the authors review the paper for preparing the final manuscript.

Article Information

DOI: 10.9734/AJEE/2020/v12i230156
Editor(s):
(1) Dr. Margarita Tecpoyotl Torres, Universidad Autonoma del Estado de Morelos, Mexico.
(2) Dr. Adamczyk Bartosz, Natural Resources Institute, Finland.
(3) Dr. Liliane Catone Soares, Federal University of Ouro Preto, Brazil.
(4) Dr. Wen-Cheng Liu, National United University, Taiwan.
(5) Professor, Daniele de Wrachien, State University of Milan, Italy.
Reviewers:
(1) Hiren B. Soni, Institute of Science, Technology for Advanced Studies and Research, India.
(2) Chadetrik Rout, Maharishi Markandeshwar University, India.
(3) Hideharu Shintani, Chuo University, Japan.
Complete Peer review History: http://www.sdiarticle4.com/review-history/53177

Original Research Article

Received 20 January 2020
Accepted 25 March 2020
Published 08 April 2020

ABSTRACT

The Meghna River is one of the most important rivers in Bangladesh, one of the three rivers, the Ganges delta, and the largest delta in the world in the Bay of Bengal. The water quality of Meghna has become a matter of concern due to serious levels of pollution. The present study was conducted to assess the surface water quality of upstream of the Meghna River using physic-chemical parameters in summer and winter season at five different points. Water quality was evaluated by laboratory analysis considering a total of six water quality parameters, pH, DO, BOD, COD, salinity and TDS and water samples were collected from five stations. The study indicates that some parameters exceed the permissible limit for drinking purpose, it may cause potential threat to the human, but the water of this river is not immediate threat to human or ecosystem.

**Corresponding author: E-mail: rimu.nstu@gmail.com;*

Keywords: Meghna River; water quality; physiochemical parameters; summer season; winter season.

1. INTRODUCTION

Water is essential to life. An adequate, safe and accessible supply is certainly available to everyone. Improving access to safe drinking water results in significant health benefits. Every effort should be made to achieve a drinking water quality as safe as possible [1]. Many people struggle to get access to safe water. A clean and treated water supply may be the norm in every home in Europe and North America, but in developing countries, access to both clean water and sanitation is not the rule and waterborne infections are common. Two and a half billion people have no access to improved sanitation, and more than 1.5 million children die each year from diarrheal diseases [2]. According to the WHO, the death toll for waterborne diseases exceeds 5 million people every year. From these, more that 50% are microbial intestinal infections, with cholera standing out in the first place. The highest microbial risks are related to water contaminated by human or animal feces. Wastewater discharges in fresh waters and costal sea waters are the major source of fecal microorganisms, including pathogens [3-4]. Those suffering from diarrheal are those who have low financial resources and the poorest health facilities. Children under five, primarily in Asian and African countries, are the most affected by microbial diseases transmitted through water [5]. Microbial waterborne diseases also affect developed countries. In the United States, it has been estimated that 560,000 people suffer from acute water-borne diseases each year, and 7.1 million suffer from a mild to moderate infection, resulting in 12,000 deaths a year [6]. Testing for microbes that cause disease (i.e. *Salmonella typhymurium* and *Vibrio cholera*) can be expensive and if the bacteria are present in low numbers, they may escape detection. Instead, numerous other bacteria indicate water contamination. *Echerichia coli* has been as an indicator of fecal pollution for decades. The bacterium is present in the intestinal tract in huge numbers and is more numerous that the disease-causing bacteria and viruses. *Echerichia coli* also had the advantage of not being capable of growing and reproducing in the water (except in the warm and food-laden waters of tropical countries). Thus, the presence of the bacterium in water is incentive of recent fecal pollution. Finally, *Escherichia coli* can be detected easily and inexpensively [7-10]. Salinity is an ambiguous term. As a basic definition, salinity is the total concentration of all dissolved salts in water [11]. These electrolytes form positive and negative charges each as the ionic particles dissolve. As such, salinity is a powerful contributor to conductivity. While salinity can be measured by a complete chemical analysis, this method is difficult and time consuming [12]. Seawater cannot simply be evaporated to a dry salt mass measurement as chlorides are lost during the process [13]. More often, salinity is not measured directly, but is instead derived from the conductivity measurement [14]. This is known as practical salinity. These derivations compare the specific conductance of the sample to a salinity standard such as seawater [15]. Therefore, the research work which is trying to evaluate the physical-chemical parameters of the Meghna River that is used for drinking, irrigation and industrial activity.

2. MATERIALS AND METHODS

2.1 Study Area

Meghna was formed inside Kishoreganj district of Bangladesh over the city of Bhairab Bazar. This river originated as the Barak River in the eastern Indian hills [16]. The coordinates of the sampling locations are as follows: Station nº 1:25º54′16″N and 92º53′5″E; Station nº 2:25º54′22″N and 92º53′30″E; Station nº 3:24º53′23″N and 92º53′29″E; Station nº 4:25º54′60″N and 92º53′28″E; Station nº 5:25º54′64″N and 92º53′5″E. Moreover, five stations were selected to collect water samples for laboratory analysis. This is done by using a map are shown in Fig. 1.

2.2 Methodology

Preliminary data were collected from direct field observations through questionnaire surveys, and five water samples were collected using four different stations during the summer and winter seasons. Water samples were collected from four different Meghna river stations in a water sampling bottle for pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), salinity and total dissolved solids (TDS).

2.2.1 Experimental techniques

Testing procedure of water microorganisms: Counting Bacterial Colonies - Pour Plate Method. Calculating bacterial colonies on agar plates is a

Fig. 1. Study area sampling stations in the study area

simple and effective method for determining the number of viable bacteria in a sample. This method will count only the living or durable bacterial cells, depending on the development of a bacterial cell on the agar plate to form visible colonies. The aseptic technique is used for all steps.

2.2.2 Mixing the dilutions into agar plates

Liquefy at least 100 ml of appropriate agar by self-recognition. Place the molten agar bottle in a bath at 50°C and allow the agar to cool to 50 °C. Mark of six blank disinfected agar plates (petri dishes) from 10^{-1} to 10^{-6} without making a lid. the agar suitable for self-recognition is at least 100 ml. Remove the agar bottle from the 50°C water bath and wipe the outside of the bottle with paper toweling to remove water. Working quickly to avoid cooling of the agar to 42°C (this is the temperature at which it sets) pour about 15 ml of molten agar into each of the six plates. The agar should be about 7 mm thick. 1 ml of each pipette of each mixture on the base of the properly labeled plate using separate pipettes to avoid carrier errors. Gently swirl each plate to mix the 1 ml of diluted sample into the 15 ml of agar.

2.2.3 Counting bacterial colonies

Check the plates for a colonic growth after a suitable incubation time. Colonies will be formed on top of the agar along with the agar. The agar tops will be large, but all colonies have to be counted. Select the plates that appear to have colonies between 30 and 300 in the agar as it gives the best statistical representation of the number of bacteria in the sample. Use a light box or a colony counter (if it is available) and place a marker pen (count as one point above each colony), counting the number of colonies containing 30 to 300 colonies in each dilution. It will become easier with practice. All viable cells form colonies. Each colony counted is composed of a bacterial cell.

2.2.4 Microbial condition before treatment

Microbiological test is to detect the level of pollutions caused by living thing especially human who live or work in the area especially upstream of the site. These tests are based on coliform bacteria as the indicator organism. The presence of these indicative organisms is evidence that the water has been polluted with feces of humans or other warm-blooded animals. There are a lot of organisms found it surface river water by pour plate method are shown in Table 1 and Fig. 2.

2.2.5 Microbial condition of water after treatment

Microbial condition of water after treatment are shown in Table 2 and Fig. 3.

2.2.6 Physical parameters

Sample was collected from Meghna River Water of Bhairab Bazar, Kishoreganj, Bangladesh. This sample is used for assessment of water for summer season and winter session are shown in Table 3.

Table 1. Colony forming in river water before treatment

Sample	Dilution	CFU/ml	Sample	Dilution	CFU/ml
1	10^{-1}	88	2	10^{-1}	30
	10^{-2}	58		10^{-2}	27
	10^{-3}	15		10^{-3}	20
	10^{-4}	5		10^{-4}	1
	10^{-5}	1		10^{-5}	Absent

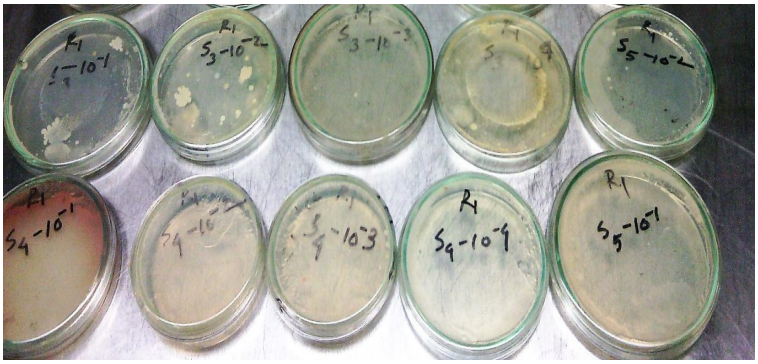

Fig. 2. Microbial condition of water before treatment

Table 2. Colony forming in river water after treatment

Sample	Dilution	CFU/ml	Sample	Dilution	CFU/ml
1	10^{-1}	2	2	10^{-1}	1
	10^{-2}	1		10^{-2}	1
	10^{-3}	Absent		10^{-3}	Absent
	10^{-4}	Absent		10^{-4}	Absent
	10^{-5}	Absent		10^{-5}	Absent

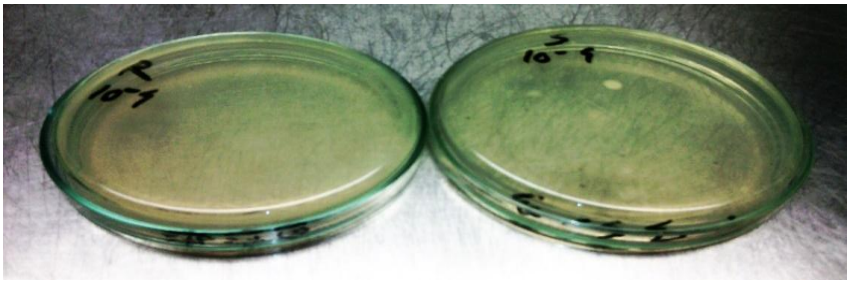

Fig. 3. Microbial condition of water after treatment

Table 3. Physical parameters of Meghna River water at Meghna River in summer and winter season

Sample	Summer season			Winter season		
	p^H	TDS (mg/l)	Salinity (%)	p^H	TDS (mg/l)	Salinity (%)
1	6.42	34	0.1	6.80	24.0	0.1
2	6.81	38.5	0.2	6.95	28.5	0.1
3	6.92	38.1	0.1	7.01	29.1	0.1
4	6.87	41.8	0.2	6.97	30.8	0.2
5	6.91	39.3	0.2	6.98	29.3	0.2

2.2.7 Chemical parameters

Sample was collected from Meghna River Water of Bhairab Bazar, Kishoreganj, Bangladesh. This sample is used for assessment of water for summer season and winter session are shown in Table 4.

3. RESULTS AND DISCUSSION

3.1 pH

From Table 3, the value 6.92 found at station 3 in summer season and 7.01 found at station 3 in winter season. Industrial water dumps directly and indirectly at all stations, and if we move a little from this place the pH is reduced. The average value of pH during the summer season is 6.78 and winter is 6.90 meaning that water is slightly alkaline in acid. All values of selected stations are likely to have lower values of pH within the standard range during the summer season. The pH concentration of the study area is satisfactory for surface water but the high value of pH is found during the winter season. pH values of summer season and winter season was found beyond which is the permissible value for drinking water are shown in Fig. 4.

The results showed that the level of pH in the river water during the summer session was lower than in the winter session (Fig. 4).

3.2 TDS (Total Dissolved Solids)

From Table 3, Maximum TDS value of Meghna River during summer season was found 41.8 and minimum TDS value during winter season was found 24 respectively. Both seasons TDS values are beyond permissible limit (1000 mg/l) for drinking purpose. According to WHO, the expected level of TDS values will be 25 to 500 mg/liter. From the above discussion it is shown that the rigid value of the Meghna river follows the quality constraint. However, due to the waste dumps in the adjacent river region, it has the potential to dissolve solid value are shown in Fig. 5.

The results showed that the level of TDS in the river water during the summer session was higher than in the winter session (Fig. 5).

3.3 Salinity

From Table 3, Salinity refers to the totalconcentration of all ions in water. The minimum and maximum index of surface water content of all study stations was 0.1–0.2% during the summer and winter seasons, respectively. Salinity fluctuations are probably due to the total solids fluctuations in the water, along with the dispersion of the salts in the water. Salinity values are found between 0.1- 0.2% are shown in Fig. 6.

The results showed that the level of salinity in the river water during the summer session was higher than in the winter session (Fig. 6).

3.4 Dissolved Oxygen (DO)

From Table 4, maximum DO value of Meghna river during summer season was found 1.09 mg/l and minimum DO value during winter season was found 0.85 mg/l respectively are shown in Fig. 7. Both seasons DO values are beyond permissible limit (06 mg/l) for drinking purpose.

That means the DO value is remarkably good according to WHO. The presence of dissolved oxygen is a good sign for the Meghna river water. It is suitable for industrial purposes. According to DO standards, the quality of water is satisfactory for fishing, agricultural irrigation and industrial purposes. The results showed that the level of dissolved oxygen in the river water during the summer session was higher than in the winter session Fig. 7.

Table 4. Chemical parameters of Meghna River water at Meghna River in summer and winter season

Sample	Summer season			Winter season		
	DO	COD	BOD	DO	COD	BOD
1	1.0	100	24	70	24.0	22
2	0.7	84	22	87	28.5	20
3	0.9	68	20	71	29.1	16
4	1.1	50	25	87	30.8	24
5	0.8	75	21	75	29.3	19

3.5 Chemical Oxygen Demand (CO)

From Table 4, Maximum COD value of Meghna river during summer season was found 105 mg/l and minimum COD value during winter season was found 76 mg/l respectively are shown in Fig. 8. Both seasons COD values are out of permissible limit (04 mg/l) for drinking purpose.

This means that extensive treatment is necessary for us because people often dump their waste material and slowly mix it with water to pollute these stations. The value of the third and fourth stations requires conventional treatment of river water and can be used for recreational purposes such as bathing, swimming.

3.6 Biochemical Oxygen Demand (BOD)

From Table 4, Maximum BOD value of Meghna river during summer season was found 26 mg/l and minimum BOD value during winter season was found 20 mg/l respectively are shown in Fig. 9. Both seasons BOD values are out of permissible limit (0.2 mg/l) for drinking purpose.

The results showed that the level of Biochemical Oxygen Demand in the river water during the summer session was higher than in the winter session (Fig. 9).

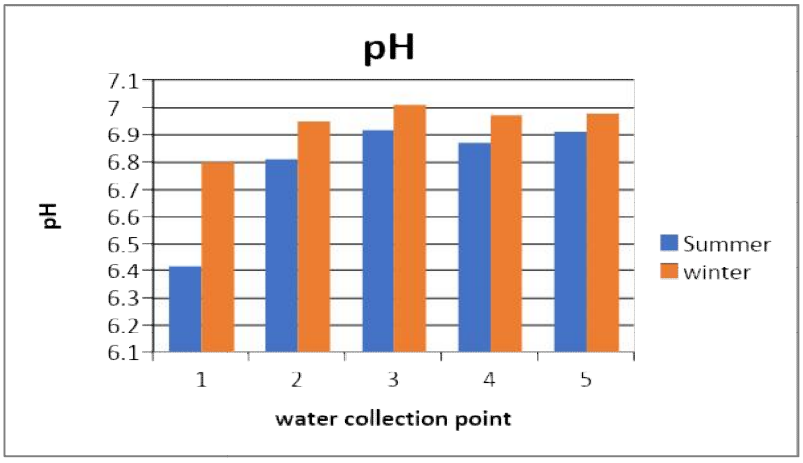

Fig. 4. pH value at five points of Meghna River during summer and winter season showing at the graph

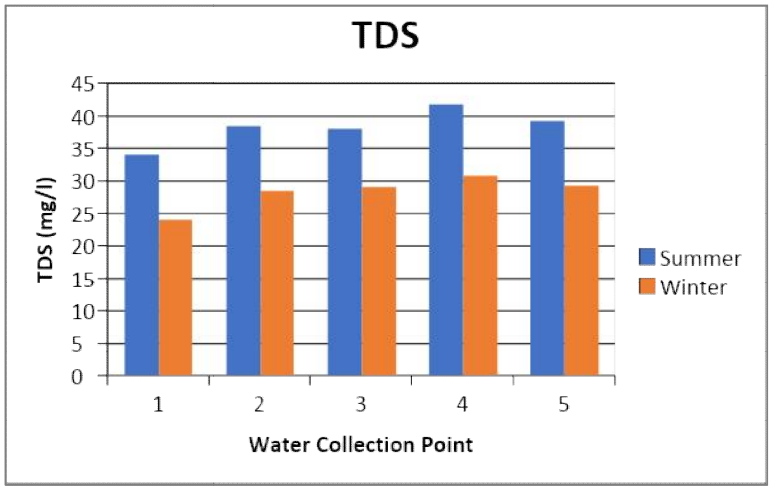

Fig. 5. TDS value at five points of Meghna River during summer and winter season showing at the graph

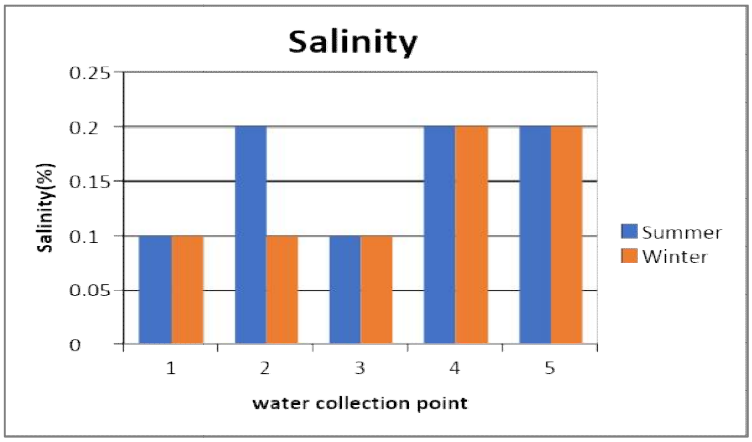

Fig. 6. Salinity value at five points of Meghna River during summer and winter season showing at the graph

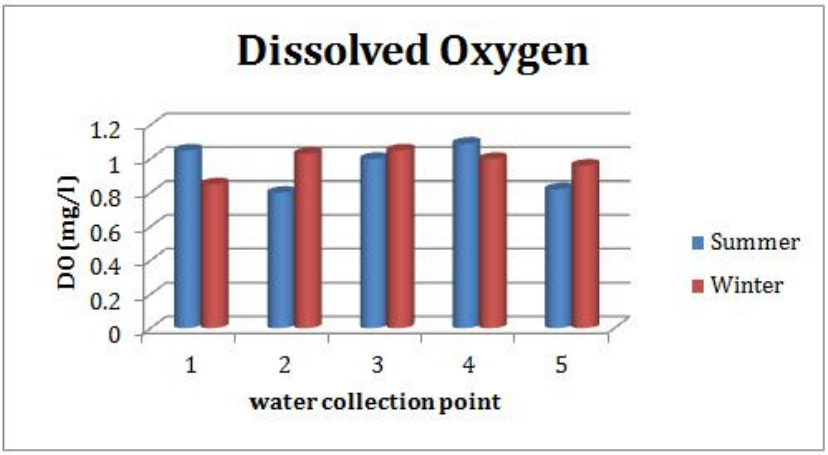

Fig. 7. Dissolved oxygen value at five points of Meghna River during summer and winter season showing at the graph

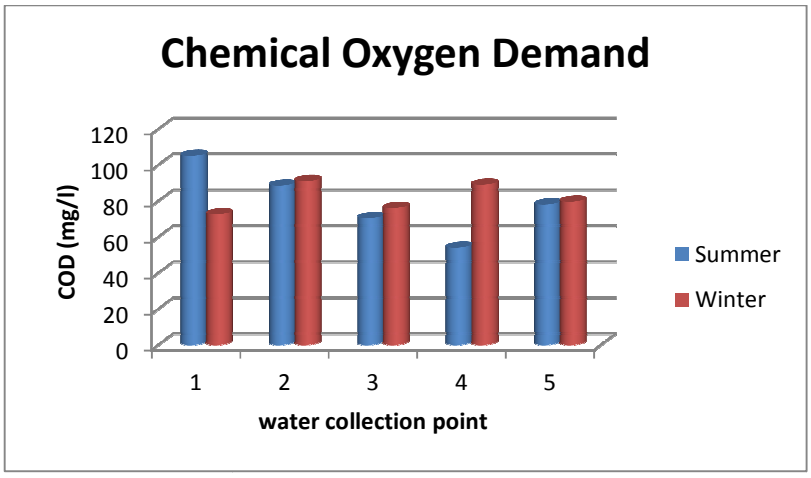

Fig. 8. Chemical oxygen demand value at five points of Meghna River during summer and winter season showing at the graph

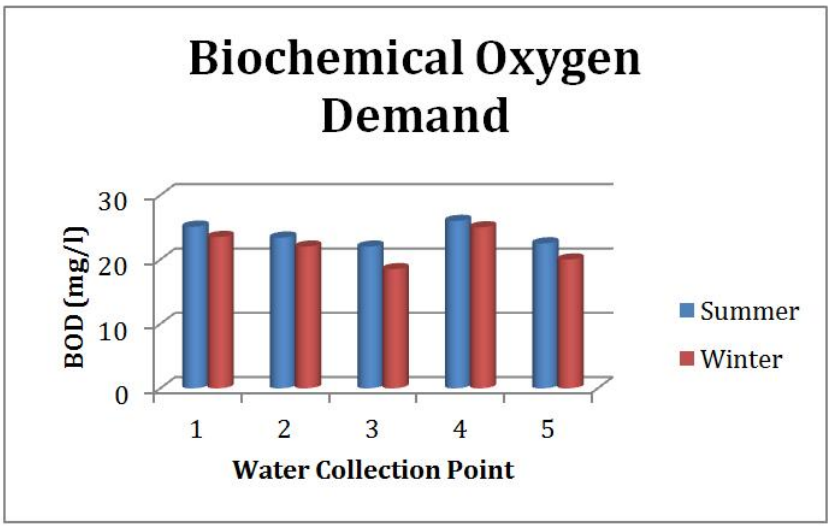

Fig. 9. Biochemical oxygen demand value at five points of Meghna River during summer and winter season showing at the graph

4. CONCLUSION

This study determined some of the physicochemical properties of the Meghna River from separate locations between summer and winter season. Based on six environmental parameters such as pH, salinity total dissolved solids, dissolved oxygen, chemical oxygen demand and biochemical oxygen demand for water quality, it was able to identify three main sources, which are the five main source sampling stations responsible for deteriorating the Meghna river water quality. Water quality parameters such as BOD and COD have reduced pollution levels. It is therefore decided that the Meghna River is polluted and unsafe for human consumption. Overall, this study recommends identifying sources of contamination and monitoring water quality parameters from time to time so that researchers can interpret data and help in the application of remedial measures to prevent river water quality deterioration.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. WHO (World Health Organization). Guidelines for drinking-water quality, incorporating 1st and 2nd Addenda, Recommendations, 3rd ed.; WHO: Geneva, Switzerland. 2008;1.
2. Fenwick A. Waterborne Diseases Could they be Consigned to History? Science. 2006;313:1077–1081.
3. George I, Crop P, Servai P. Use of β-D-galactosidase and β-D-glucuronidase activities for quantitative detection of total and faecal coliforms in wastewater. Can. J. Microbiol. 2001;47:670–675.
4. Grow W. Waterborne diseases: Update on water quality assessment and control. Water SA. 1996;22:193–202.
5. Seas C, Alarcon M, Aragon J, Beneit S , Quiñonez M, Guerra H. Surveillance of bacterial pathogens associated with acute diarrhea in Lima, Peru. Int. J. Infect. Dis. 2000;4:96–99.
6. Medema G, Payment P, Dufour A, Robertson W, Waite M. Safe drinking water: An ongoing challenge. In assessing microbial safety of drinking water. Improving Approaches and Method; WHO & OECD, IWA Publishing: London, UK. 2003;11–45.
7. Chapelle FH. Ground water microbiology and geochemistry. New York: John Wiley & Sons; 2000.
8. Madigan MM, Martinko, Parker J. Brock Biology of microorganisms. 8th ed Upper Saddle River, NJ: Prentice-Hall; 2000.
9. Karner MB, DeLong EF, Karl DM. Archae dominance in the mesopelagic zone of the Pacific Ocean. Nature 409. 2001;507-510.

10. Ruiz GM, Rawling TK, Dobbs FC et al. Global spread of microorganisms by ships. Nature 406. 2000;49.
11. Wetzel R, Limnology G. Lake and river ecosystems 3rd ed. San Diego, CA: Academic Press; 2001.
12. American Public Health Assoc., American Water Works Assoc. & Water Environment Federation. Standard Methods for the Examination of Water and Wastewater 20th ed. Baltimore, MD: American Public Health Association; 1999.
13. Stewart RH. Definition of salinity. In Chapter 6 – Temperature, salinity and density; 2004.
14. Wagner RJ, Boulger JR, Oblinger RW, Smith BA. Guidelines and standard procedures for continuous water-quality monitors: Station operation, record computation and data reporting. USGS Techniques and Methods 1–D3; 2006.
15. Sommer K, Spitzer P, Session H. Ocean Salinity (Powerpoint). In Plenary lecture: WMO-BIPM WS Geneva; 2004.
16. Masud HC. Meghna River. In Sirajul Islam and Ahmed A. Jamal (ed.). Banglapedia: National Encyclopedia of Bangladesh (Second ed.). Asiatic Society of Bangladesh; 2012.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/53177