

## WATER QUALITY AND FISH DIVERSITY STATUS IN MEGHNA RIVER AT NARSINGDI IN BANGLADESH

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### ABSTRACT

A study was conducted to be known the water qualities and richness of fisheries resources in Meghna river at Narsingdi region of Bangladesh during the period from December 2015 to February 2016. The water samples were collected from five different stations indicated as St-1 (Narsingdi launch ghat), St-2 (Hajipur), St-3 (Champa nagar), St-4 (Korimpur) and St-5 (Nazarpur) from the study zone under Narsingdi district. Fish samples were collected from three locations (St-2, St-3 and St-5) capturing by fishing net. A questionnaire survey was also performed in order to assess the impact of water quality degradation on the abundance of fishes in Meghna River. The result of the study showed that the temperature, EC, TDS, DO, BOD, pH and hardness of the Meghna river water were ranged from 19.1 to 19.6°C, 525 to 714  $\mu\text{S}/\text{cm}$ , 113 to 197.67 mg/l, 3.33 to 4.3 mg/l, 1.23 to 2.9 mg/l, 7.72 to 7.91 and 94 to 126 mg/l, respectively during the study period. The obtained results assured the desired quality of water in terms of above parameters except DO. The study identified a total of nine fish species under five orders and six families. Here Foli (*Notopterus notopterus*) considered as vulnerable accordingly IUCN (2000). It was also found that water quality degradation (33.75%) negatively influenced the abundance of fish species. Proper management and monitoring along with implementation of existing laws and regulations for industrial discharge of waste should be carried out to maintain the water quality of Meghna river so that the river can remain as a healthy ecosystem and habitat for fresh water fishes.

**Key words:** Meghna river, water quality, fish diversity, physicochemical parameters.

### Introduction

Though water is the most valuable and vital resource for sustenance of life (Kumar *et al.*, 2010), but susceptibility to pollution because of waste and wastewater accessibility (Ahmed *et al.*, 2011). The surface water qualities of the rivers of Bangladesh are getting highly polluted day by day (DoE, 1992; Alam *et al.*, 2007). In recent years, the river systems in Bangladesh have become more polluted as a consequence of rapid population growth, uncontrolled development on the riverbanks, urbanization, unplanned industrialization, and agricultural operations (Islam *et al.*, 2015a). The pollution from industrial effluents and from agro chemicals into rivers has reached alarming levels; resulting in serious effects on aquatic organisms as well as fish species (Islam *et al.*, 2014). Bangladesh has extensive water bodies that have a high potential for fisheries production. There are 260 indigenous freshwater species and 475 species of marine water fishes in Bangladesh (DoF, 2013). Recently fish is considered as one of the most endangered species in Bangladesh (IUCN, 1998). The population of natural fish species has declined considerably due to increased fishing pressure and various anthropogenic activities leading to siltation, aquatic pollution and loss of natural habitat for spawning and growth (Akhteruzzaman *et al.*, 1998). The Meghna river flows over Narsingdi sadar upazila. It is one of the great sources of fishing and supports many people in their livelihood. Many settlements, towns and industries have sprung up on both the banks of the Meghna. In this aspect, the present study was an attempt to investigate the present status of water quality, fish biodiversity and to find out the major causes of water quality degradation of Meghna river which is being impacted on fisheries resources.

### Materials and Methods

**Study area:** The study was conducted in the Meghna River at Narsingdi sadar upazilla of Narsingdi district (central Bangladesh), during the period from December 2015 to February 2016. The river is located

between 23°46' to 24°15'N latitudes and 90°34' to 90°59'E longitudes. The Meghna river originates from the south slope of Naga and Manipur. It enters Bangladesh from two branches the Surma and Kushiya at Sylhet border. The Meghna meets with the old Brahmaputra at Bhairab Bazar passes through Narsingdi and Narayanganj.

**Sample collection:** The study was carried out through experimental method and social survey. A total of 80 respondents who are directly and indirectly depend on the Meghna river for their livelihood were surveyed from the study area. The water samples were collected by 500 ml plastic bottles with double stoppers for physicochemical analysis from five sampling stations of the river namely St-1 (Narsingdi launch ghat), St-2 (Hajipur), St-3 (Champa nagar), St-4 (Korimpur) and St-5 (Nazarpur) with a distance of 1 km from each, in dry season. Fish samples were collected by fishing net from three different sites namely Hajipur (St-2), Champa nagar (St-3) and Nazarpur (St-5); those were preserved in formalin and brought to the laboratory for identification.

**Sample analysis:** The physicochemical parameters of water samples were analyzed in the laboratory of the Department of Environmental Science and Resource Management (ESRM), Mawlana Bhashani Science and Technology University (MBSTU), Tangail. The water temperature and pH were determined by the thermometer and digital pH meter (Model: pH Scan WP 1, 2; made in Malaysia), respectively. Digital EC and TDS meter (Model: HM digital, made in Germany) were used to determine EC and TDS, respectively. The DO was determined by digital DO meter (Model: D.46974, made in Taiwan). The BOD was measured by two steps where initial DO<sub>1</sub> was measured immediately after collection and after 5 days DO<sub>5</sub> was measured by incubation in the dark condition at 20°C for 5 days. Hardness was determined by titration method. The identification of fish species was done based on morphometric and meristic characteristics with the help of different reference books.

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

## Results and Discussion

**Water quality parameters:** Temperature of water recorded at the different sampling stations of Meghna river found to be more or less similar in entire study period. The highest temperature (20.9°C) was found in December at St-1 and lowest temperature (18.2°C) was found in February at St-2 (Table 1). The fluctuation of temperature in river water usually depends on the season, geographic location, sampling time and temperature of effluents entering the stream (Ahipathy and Puttaiah, 2006). Temperature of the Meghna river water was found below 20°C in January and February months. It could be the result of climatic condition because it was winter season. The temperature of water found in the Tista river was ranged from 17.0 to 18.4°C during dry season (Islam *et al.*, 2015a), which is mostly similar with the present study. The TDS contents of all collected water samples were within the range of 123 to 207 mg/l. The highest content of TDS (207 mg/l) was found at St-1 in February and the lowest content (123 mg/l) was found at St-3 in December. Higher TDS content in water indicate the presence of salts (bicarbonates, sulphates and chlorides of Ca, Mg and Na) due to waste and showed the water is not suitable for fish production. From the investigation it was observed that the TDS contents of all the sampling stations were within the standard level (Table 1). The EC contents of Meghna river water were within ranges from 500 to 725 µS/cm. The standard of EC for fishing water is 1000 µS/cm (ADB, 1994). In the present study, the EC contents of all the sampling stations were within the standard level.

The contents of DO were found to vary from 2.9 to 4.5 mg/l. Adequate DO is necessary for good water quality, survival of aquatic organism and decomposition of waste by microorganism (Islam *et al.*, 2010). All the observed values including the average concentration were much lower than the standard limit ( $\geq 5$  mg/l) for fisheries (Table 2). The lower level observed could be due to agricultural slurry, surface runoff of nutrients and enrichment by nutrients. Lower concentration of DO indicate higher level of organic pollutants and lower level of oxygen concentration in water (Islam *et al.*, 2012).

Table 1. Physical parameters of water quality of the Meghna river during the study period

Parameters	Sampling stations	Months			Average	Range	Standard for fisheries
		December	January	February			
Temperature (°C)	St-1	20.9	19.7	18.3	19.6	18.2 - 20.9	20-30°C (EQS, 1997)
	St-2	20.5	19.6	18.2	19.4		
	St-3	19.9	19.1	18.4	19.1		
	St-4	20.4	18.9	18.6	19.3		
	St-5	20.3	18.8	18.2	19.1		
	Mean±SD				19.3±0.21		
TDS (mg/l)	St-1	187	199	207	197.67	123 - 207	<400 mg/l (Meade, 1998)
	St-2	161	164	175	166.67		
	St-3	123	130	141	131.33		
	St-4	115	112	127	113		
	St-5	135	147	154	143.33		
	Mean±SD				150.4±32.83		
EC (µS/cm)	St-1	500	534	541	525	500 - 725	1000 µS/cm (ADB, 1994)
	St-2	668	704	710	694		
	St-3	697	725	720	714		
	St-4	682	708	701	697		
	St-5	650	677	668	665		
	Mean±SD				659±76.95		

Table 2. Chemical parameters of water quality of the Meghna river during the study period

Parameters	Sampling stations	Months			Average	Range	Standard for fisheries
		December	January	February			
DO	St-1	3.6	3.5	3.2	3.43	2.9 - 4.5	≥ 5 mg/l (ECR, 1997)
	St-2	3.6	3.2	3.2	3.33		
	St-3	3.9	3.3	2.9	3.36		
	St-4	4.0	3.8	3.5	3.77		
	St-5	4.5	4.3	4.1	4.30		
	Mean±SD				3.63±0.41		
BOD	St-1	1.1	1.4	1.2	1.23	0.9 - 1.7	≤ 2 mg/l (EQS, 1997)
	St-2	1.5	1.7	1.6	1.60		
	St-3	1.3	1.5	1.1	1.30		
	St-4	1.2	1.4	1.7	1.43		
	St-5	1.0	1.1	0.9	2.90		
	Mean±SD				1.32±0.22		
pH	St-1	7.82	7.85	7.94	7.87	7.56 - 8.00	6.5-8.5 (ECR, 1997)
	St-2	7.88	7.90	7.92	7.90		
	St-3	7.56	7.77	7.84	7.72		
	St-4	7.67	7.80	7.85	7.77		
	St-5	7.85	7.88	8.00	7.91		
	Mean±SD				7.83±0.08		
Hardness (mg/l)	St-1	114	116	113	115	90 - 135	123 mg/l (Huq and Alam, 2005)
	St-2	90	92	100	94		
	St-3	115	128	135	126		
	St-4	119	126	128	124		
	St-5	103	118	120	114		
	Mean±SD				114.6±12.68		

The contents of BOD were found to vary from 0.9 to 1.7 mg/l. The highest content of BOD (1.7 mg/l) was found at St-2 in January and at St-4 in February and lowest content of BOD (0.9 mg/l) was found at St-5 in February (Table 2). From the investigation, it was observed that the BOD contents of all the sampling stations were within the standard level. The pH of Meghna river water shows their alkaline nature. The range of variation in pH was from 7.56 to 8.00. Highly alkaline water contains high value of pH. The highest value of pH (8.00) was found at St-5 in February and the lowest value of pH (7.56) was found at St-3 in December (Table 2). The standard of pH for inland surface water is 6.5 to 8.5 (EQS, 1997). So, the pH of all the sampling stations was within the acceptable range for aquatic organisms. The highest content of hardness (135 mg/l) was found at St-3 in February and the lowest content (90mg/l) was found at St-2 in December (Table 2). The contents of hardness found in Meghna river water were within the standard level. Islam *et al.* (2015a) found the content of hardness in Tista river water ranging from 72.33 to 156.33 mg/l during dry season, which is similar with the present study.

**Fish diversity:** A total of 50 individuals of fish were counted and categorized from the study zone of the Meghna river. Among them, 9 species were found which belong to 8 genera, 6 families and 5 orders. Cypriniformes was found as the most dominant order, while Siluriformes ranked in second position in respect of abundance (Table 3).

Table 3. Available of fish species in the Meghna river during the study period

Order	Family	Local name	English name	Scientific name	Status
Cypriniformes	Cyprinidae	Mola	Mola Carplet	<i>Amblypharyngodon mola</i>	NO
		Mola	India Carplet	<i>Amblypharyngodon microlepis</i>	NO
		Grass Carp	Grass Carp	<i>Ctenopharyngodon idella</i>	NL
		Punti	Pool barb	<i>Puntius sophore</i>	NO
Siluriformes	Heteropneustidae	Shing	Stinging Catfish	<i>Heteropneustes fossilis</i>	NO
	Bagridae	Bajari	Stripped Dwarf	<i>Mystus tengra</i>	NO
		Tengra	Catfish		
Tetraodontiformes	Tetraodontidae	Tepa, Potka	Ocellated Pufferfish	<i>Tetraodon cutcutia</i>	NO
Synbranchiformes	Mastacembelidae	Guchi Baim	Striped Spiny Eel	<i>Macrogathus pancalus</i>	NO
Osteoglossiformes	Notopteridae	Foli	Grey Featherback	<i>Notopterus notopterus</i>	VU

Note: Status in the IUCN Red List according to IUCN (2000), VU: Vulnerable, NO: Not threatened, NL: Not listed.

During investigation, 4 species from Cyprinidae family under the order Cypriniformes were recorded which consist 44.44% of species diversity and 58% of fish individuals. The order Siluriformes were about 18% of the total fish population in numbers and 22.22% regarding species diversity. The lowest number of species was counted for the order Osteoglossiformes, Tetraodontiformes and Synbranchiformes which consist 4, 10 and 10% of fish individuals, respectively. Only one species was obtained during the period of investigation for each of the three orders consist 11.11% of species diversity. Those fish species were *Notopterus notopterus*, *Tetraodon cutcutia* and *Macrogathus pancalus* belong to the family Notopteridae, Tetraodontidae and Mastacembelidae, respectively. Out of the collected 9 species, one species (*Notopterus notopterus*) ranked as vulnerable (VU) and another one not listed (NL) into IUCN Red Book of threatened fishes of Bangladesh.

**Status of fisheries resources:** The present condition of fisheries resources of Meghna river is not much satisfactory. Day by day the amount of cultured fish increased but indigenous species decreased. The

availability of fishes in Meghna river is medium than past revealed by 56.25% respondents, 25% said the availability is lower than past and only 18.75% said the availability of fish is higher than past (Fig. 1).

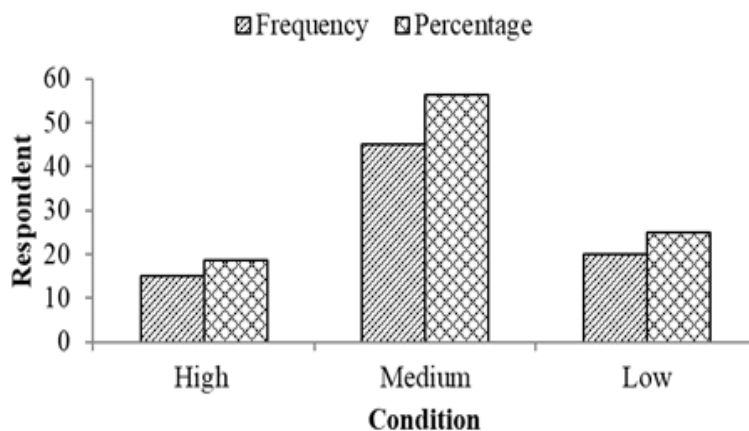


Fig. 1. Present condition of fisheries resources in Meghna river

Table 4. Change in availability of fishes in Meghna river

Variables	Frequency (n=80)	Percentage (%)
Slight increase than past	17	21.25
Drastic increase than past	08	10
Slight decrease than past	32	40
Drastic decrease than past	23	28.75

The availability of fishes in Meghna river decreased than the past. About 40% of respondents said that fishes were slightly decreased than past whereas 28.75% of respondents said that fishes was drastically decreased than the past (Table 4).

The most notable causes of water quality degradation in Meghna river revealed by the survey are industrialization, urbanization, river bank erosion, and water way transport. About 38.75% of respondents said the principal cause of water quality degradation is industrialization (Fig. 2).

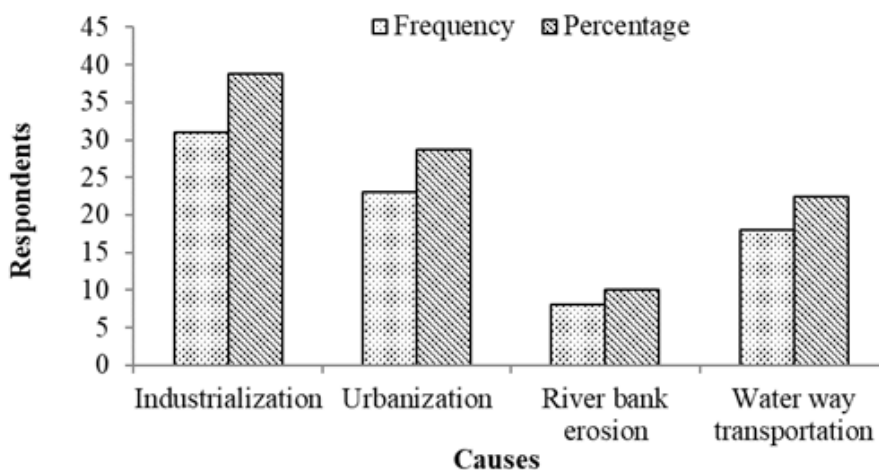


Fig. 2. Causes of water quality degradation in the Meghna river near study area

There are many causes for loss of fisheries resources in Meghna river. But some key causes like water quality degradation, agricultural encroachment, siltation, changes of river direction, multipurpose use of river water are revealed by the respondents in survey. The significance of above factors is shown in Fig. 3.

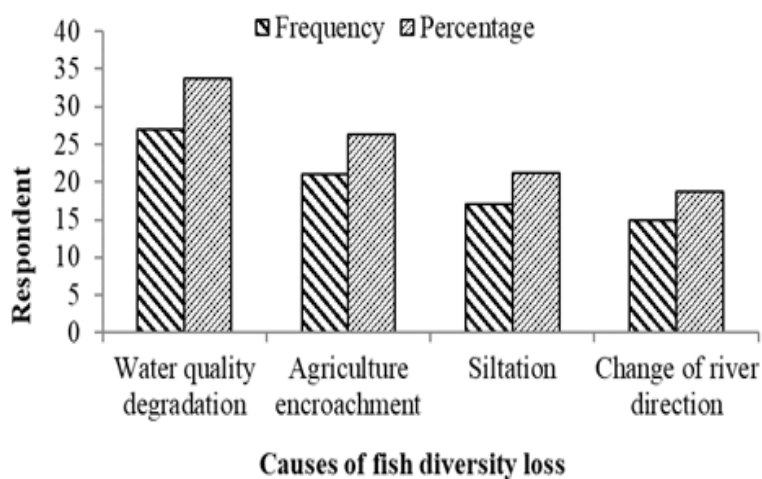


Fig. 3. Causes of loss of fisheries resources in the Meghna river

Polluted water kept negatively influence the daily life. About 46.25% respondents said polluted water created problem in fisheries sector, 21.25% said in agriculture sector and 32.5% said problem occurred in livelihood (Table 5).

Table 5. Impacts of polluted water in different sectors in Bangladesh

Variables	Frequency (n=80)	Percentage (%)
Fisheries	37	46.25
Agriculture	17	21.25
Livelihood	26	32.50

### Conclusion

The water quality of Meghna river is more or less suitable for aquatic organism. The analyzed water quality parameters were within the standard level except DO. But the fisheries resources of Meghna river are decreasing day by day. So, necessary initiative should be taken to improve the overall condition of the river as well as the aquatic environment.

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### References

- ADB (Asian Development Bank). 1994. Training manual for environmental monitoring. Engineering science Inc., USA. 2-16 pp.
- Ahipathi, M.V. and E. T. Puttaiah. 2006. Ecological characteristics of Vrishabhavathi river in Bangalore (India). *Environ. Geo.*, 49: 1217-1222.

- Ahmed, K., M. Das, M.M. Islam, M.S. Akter, S. Islam, M.A. Al-Mansur. 2011. Physicochemical properties of tannery and textile effluents and surface water of river Buriganga and Karnatoli, Bangladesh. *World Appl. Sci. J.*, 12:152-159.
- Akhteruzzaman, M., A. H. M. Kohinoor, M. S. Islam, P. C. Modak. 1998. Observations on the induced breeding of indigenous small fish, Bangladesh. *Progress. Agric.*, 9(1-2): 281-284.
- Alam, M. J., Z. Muyen, M. R. Islam, S. Islam and M. Mamun. 2007. Water quality parameters along rivers. *Int. J. Environ. Sci.*, 4(1): 159-167.
- Ali, M., A. Salam, N. Ahmed, B. T. A. Khan and M.Y. Khokhar. 2004. Monthly variation in physicochemical characteristics and metal contents of Indus river at Ghazi ghat, Muzaffargarh, Pakistan. *Pakistan J.zool.*, 36(4): 295-300.
- Bhatnagar, A., S. N. Jana, B. C. Patra, G. Singh and U. K. Barma. 2004. Water quality management in aquaculture. Haryana Agricultural, India. 203-210 pp.
- DoE (Department of Environment). 1992. Annual report, Department of Environment, Dhaka, Bangladesh. 25 pp.
- DoF (Department of Forest). 2013. National Fish Week 2012 Compendium (In Bengali), Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. 144 pp.
- ECR (Environment Conservation Rules). 1997. Ministry of Environment and Forest. Government of the People's Republic of Bangladesh.
- EQS (Environmental Quality Standard). 1997. Bangladesh gazette, registered nr. DA-1, Ministry of Environment and Forestry, Government of Bangladesh, Bangladesh.
- Huq, S. M. I. and M. D. Alam. 2005. A handbook on analysis of soil, plant and water. BACER-DU, University of Dhaka. Bangladesh.
- Islam, M. S., M. A. Islam, M. J. Islam, M. H. Kabir and N. T. Meghla. 2015b. Status of water quality in the Tista river at Kaunia point and its impact on aquatic environment. *J. Environ. Sci. Nat. Res.*, 8(1): 29-33.
- Islam, M. S., M. H. Kabir, S. A. Sifat, N. T. Meghla and T. R. Tusher. 2014. Status of water quality from the Padma river at Bheramara point of Kushtia in Bangladesh. *Bangladesh J. Environ. Sci.*, 27: 110-115.
- Islam, M. S., N. T. Meghla, Suravi, M. Islam and N. Sultana. 2012. Status of water quality in the Dhaleswari river and its effect on aquatic organisms. *Bangladesh J. Environ. Sci.*, 23: 131-138.
- Islam, M. S., Suravi and N. T. Meghla. 2010. Investigation on water quality in Ashulia beel, Dhaka. *Bangladesh J. Fish. Res.*, 14(1-2): 55-64.
- Islam, M. S., T. Datta, I. J. Ema, M. H. Kabir and N. T. Meghla, 2015a. Investigation of water quality from the Brahmaputra river in Sherpur district. *Bangladesh J. Sci. Res.*, 28(1): 35-41.
- IUCN (International Union for Conservation of Nature). 1998. List of threatened animals of Bangladesh. In: Special workshop on Bangladesh Red Book of Threatened Animal, International Union for Conservation of Nature, Dhaka. 13pp.
- Kumar, G. N. P., P. Srinivas, K. G. Chandra and P. Sujatha. 2010. Delineation of groundwater potential zones using remote sensing and GIS techniques: a case study of Kurmapalli Vagu Basin in Andhra Pradesh, India. *Int. J. Water Res. Environ. Eng.*, 2(3): 70-78.
- Meade, J.W. 1998. Aquaculture management. CBS Publishers and Distributors, New Delhi, India. 9 pp.