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Investigation on water quality in the Ashulia *beel*, Dhaka

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Abstract
The study was conducted to get an idea about the water quality of the Ashulia *beel*, and its temporal change over wet and dry seasons due to change of the physicochemical parameters. The water body has become a dumping ground of all kinds of solid, liquid and chemical wastes of bank side population and industries. Encroachment and illegal dredging has become a serious threat for the sound environment of the *beel*. The water parameters of pH 7.1-7.8 and alkalinity 30-63 mg/l in wet, and pH 7.1-8.4 and alkalinity 90-115 mg/l in dry season, respectively, which were within the standard range of DoE investigation. During wet season, EC 130-310 mg/l, TDS 80-132 mg/l, DO 1.1-2.1 mg/l and BOD -4.4-1.6 mg/l were measured. In dry season, EC 341-442 mg/l, TDS 207-276 mg/l, DO 0.5-2.0 mg/l and BOD 1.0-3.0 mg/l were measured. The comparative analysis showed that most of the water quality parameters of the Ashulia *beel* were suitable for aquatic organisms including fishes while the DO contents were much lower than the desirable level which may not be suitable for fishes.

Key words: Ashulia *beel*, DO, BOD, Alkalinity

Introduction

The *beels* are large surface water bodies that accumulate the surface runoff water through internal drainage channels. These depressions are mostly topographic lows produced by erosions and are seen all over the Bangladesh. From the ecological point of view, the *beel* has the potential for restoring and conserving habitats for rich biodiversity of flora and fauna, and conserving specific species with local and global significance and with vital roles to maintain ecological balance in the locality (Haque *et al.* 2005). The *beels* are freshwater wetlands which play a vital role in the improvement of water quality. The quality of aquatic environment generally depends on four kinds of factors, such as physical, chemical, biological and meteorological factors. Water quality is controlled and determined by the combinations of all kinds of factors in various ways and intensities (Rahman 1992).

Just by assessing the physical, chemical and biological characteristics of water, one can conclude about its quality (Barthwal 2002). According to Sabbir *et al.* (2010), water quality focuses on the various aspects of physicochemical parameters that detect the status of pollution and suitability of a particular water body for various aquatic

organisms. Seasonal or annual variations in the availability of freshwater may at times cause water quality degradation (EEA 1999, EGIS 2002). The Department of Environment (DoE), Institute of Water Management (IWM) and Water Resource Planning Organization (WARPO) have monitored surface water level and quality and found continuous deterioration of water quality of the surrounding rivers and lakes which are close to industrial districts or areas (Rahman and Alam 2005).

Water resources of Dhaka city is the most important and is the burning issue in terms of extreme degradation of water quality of the surrounding water bodies, for example, rivers, lakes, ponds and canals. Huge quantities of industrial effluents; solid waste from river-side settlements; petroleum products from ships, launches, cargoes, boats; and untreated sewage regularly get dumped into the Buriganga, Balu, Turag and Shitalakshya rivers, which are already severely polluted (Rahman and Alam 2005). The Ashulia *beel* is located adjacent to Dhaka city which is connected with Turag river. Ashulia *beel* plays a vital role as catchments area in facilitating the drainage of water from Dhaka city in the wet season (Khan *et al.* 2007). In the present study, existing water quality parameters are emphasized for aquatic organisms in Ashulia *beel*. The water quality parameters are compared with the standard values of DoE as well as other relevant standards to know the present status of water quality of Ashulia *beel*. The study was made consciousness to the concerned authority in developing the present situation of the *beel* area and to make it environmentally sustainable.

Materials and methods

Study area

The Ashulia *beel* is located adjacent to Dhaka city which covers approximately 5,000 acres of low land connected with the Turag river. One branch of the Turag river extends over the north-eastern part of the Ashulia thana. The north and east of Ashulia mainly constituted of low lands which forms *beel*, locally known as Ashulia *beel*. The soil of the *beel* is of Madhupur tract on which sediments deposit each year during monsoon flood. Being low land, the lands remain submerged for 6 to 7 months due to monsoon in a year with a water depth of more than 180 to less than 275 cm (SRDI 1992). The water samples were collected for physiochemical analysis from Taltola (Site 1), Ashulia landing center (Site 2), Berulia (Site 3), Pam house (Site 4) and Sluice gate (Site 5) sites in wet (July-September, 2010) and dry (October-December, 2010) season, respectively. Each sampling sites were divided into four sampling stations or points, and from each sampling stations, 500 ml of water was collected by plastic bottles with double stoppers. Before sampling, the bottles were cleaned and washing with detergent solution and treated with 5% HNO_3 over night. The bottles were finally rinsed with deionized water and dried. After sampling, the bottles were screwed carefully and marked with the respective identification number.

Sample analysis

The water quality parameters such as temperature and pH were determined by the Thermometer and digital pH meter, respectively. Buffer solution containing pH 7.0 was used to calibrate the digital pH meter. Transparency was measured by Secchi Disc method. Electric conductivity (EC) and Total dissolved solids (TDS) were determined by digital EC meter and TDS meter, respectively. Dissolve oxygen (DO) was determined by digital DO meter where sodium thiosulphate (0.025N) was used as a reagent. Acidity was measured by titration with 0.05N NaOH after addition with phenolphthalein indicator which is known as Titration method. Alkalinity was measured by titration with 0.1N HCl after addition 2-3 drops of methyl-orange indicator. The EDTA method was used to determine the hardness of water where eriochrome black T was used as indicator and titration with EDTA solution. BOD was measured by two steps where initial BOD (BOD_1) was measured immediately after collection and after 5 days BOD (BOD_5) was measured by incubation in the dark condition at 20^0C for 5 days. Then the total BOD (BOD_1 - BOD_5) was measured according to Trivedy and Goel (1984), and Huq and Alam (2005).

Results and discussions

The water temperature was found 28.7-31.7^{0}C during wet season and 22.4-25.6^{0}C during dry season, respectively, which was found within the EQS (1997) standard ranged from 20-30^{0}C used for all purposes (Table 1). In the Ashulia *beel*, the temperature of the water samples descended from 31.7-22.4^{0}C in the month of July to December due to seasonal variation. The range of water temperature (wet season) of the studied *beel* indicated that almost suitable for fishes or aquatic habitat and breeding ground as well. The ranges of pH were investigated 7.1-7.8 during wet and 7.1-8.4 during dry season that confirmed the slightly alkaline nature of water of the beel (Figs. 1 and 2). The transparency of productive water bodies should be 40 cm or less (Rahman 1992). In this study, the transparency was found 6.85-21.50 cm during wet and 5.25-13.75 cm during dry season. It was indicated that the water of the studied *beel* was suitable for the aquatic organisms including fishes both in wet and dry season, because of transparency within the desirable range (Table 1). Due to current of water, it didn't possible to measure transparency in some sampling stations. In wet season the ranges of Electric Conductivity were 130-140, 200-210, 200-310, 200-210 and 200 μs/cm in Taltola, Ashulia landing center, Berulia, Pam house and Sluice gate, respectively. In dry season the ranges of EC were 420-435, 354-442, 341-427, 426-437 and 428-430 μs/cm in Taltola, Ashulia landing center, Berulia, Pam house and Sluice gate, respectively (Table 1). Due to seasonal variations, all sites showed lower EC value than the standard value of DoE (700 μs/cm). Among the five sites, Berulia and Ashulia landing center showed higher EC value during wet and dry season, respectively. The Taltola site showed lower TDS value in wet season than dry season. Other four sites showed relatively similar TDS value in the wet season but they were also lower than the standard limit of DoE (165

ppm). In the dry season, the TDS value ranged from 207-276 mg/l in the studied area which was higher than wet season and exceeded the standard limit (Table 1).

Table 1. Water quality parameters of the Ashulia *beel* in wet and dry season

Parameters	Sampling sites	Wet season (July-September)		Dry season (October-December)		Standard
		average*	range	average*	range	
Temperatures (^{0}C)	1	30.85		24.55		
	2	29.30		25.18		20-30 (EQS 1997)
	3	28.93	28.7-31.7	23.2	22.4-25.6	
	4	29.33		23.1		
	5	29.18		23.18		
Transparency (cm)	1	18.7		6.77		
	2	8.9		9.03		40 or less (Rahman 1992)
	3	9.9	6.85-21.50	8.27	5.25-13.75	
	4	9.2		9.5		
	5	9.05		13.25		
EC (μs/cm)	1	132.5		427.5		
	2	205		417.75		700 (EQS 1997)
	3	230	130-310	390.75	341-442	
	4	207.5		431.5		
	5	200		429		
TDS (ppm)	1	81.25		271.25		
	2	128.25		258.75		165 (Huq and Alam 2005)
	3	127.75	80-132	245.75	207-276	
	4	129.25		270.25		
	5	127		267.25		

*=average of 4 stations

The DO indicate the degree of pollution by organic matter, the level of decomposition of organic substances and level of self purification of water. Adequate DO is necessary for good water quality. Dissolved oxygen at levels of 3 ppm or lower should be regarded as hazardous to lethal under average stream and lake conditions (Ellis *et al.* 1946). The range of investigated DO was 1.1-2.1 mg/l during the wet and 0.5-2.0 mg/l during the dry season (Table 2). From the investigation, it was observed that the DO content was much lower than the desired limit of 5.0 (EQS 1997, EGIS 2002, Rahman 1992). So, the *beel* water quality was degraded and it was not suitable for fisheries and aquatic organisms.

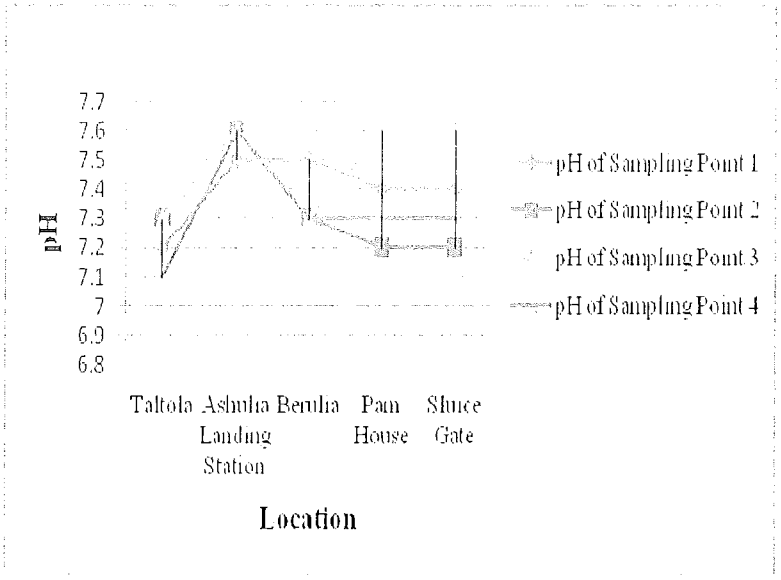

Fig. 1. The pH measured in Ashulia *beel* water during wet season.

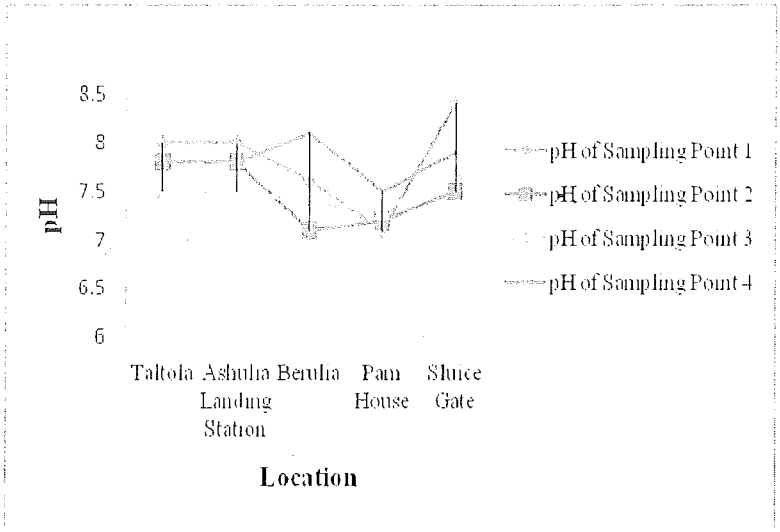

Fig. 2. The pH measured in Ashulia *beel* water during dry season.

The range of acidity along the Ashulia *beel* was 12.0-23.25 mg/l in the wet and 10.50-17.5 mg/l in the dry season (Table 2). According to Rahman (1992), total alkalinity more than 100 mg/l should be present in a highly productive waterbodies. Waterbodies having total alkalinity 40 mg/l or more are considered more productive than waterbodies of lower alkalinity (Mairs 1966). The concentration of alkalinity was found to vary from 30-63 mg/l in wet and from 90-115 mg/l in dry season. During the dry season, all the sites showed more alkaline water in comparison of the wet season (Table

2). A total hardness of 50 mg/l is considered as the dividing line between hardwater and softwater and 15 mg/l or more is suitable for fish culture (Swingle 1967). The value of hardness was found to vary from 30.0-91.3 mg/l in wet and from 115-127 mg/l in dry season (Table 2). During the dry season all the sites showed more hardness in comparison of the wet season. These variations were lower than the standard limit (123 mg/l) during wet season and around near the standard limit during dry season. Dry season showed about 3-folds higher hardness compared to wet season in Ashulia *beel*.

Table 2. Water quality parameters of the Ashulia *beel* in wet and dry season

Parameters	Sampling sites	Wet season (July-September)		Dry season (October-December)		Standard
		average*	range	average*	range	
Dissolved Oxygen (mg/l)	1	1.18	1.1-2.1	1.03	0.5-2.0	5.0 (EQS 1997)
	2	1.23		0.9		
	3	1.2		1.4		
	4	1.35		1.15		
	5	1.8		1.0		
Acidity (mg/l)	1	16.68	12.0-23.25	13.28	10.5-17.5	-
	2	20.19		13.35		
	3	12.25		11.8		
	4	12.88		11.81		
	5	13.77		11.54		
Alkalinity (mg/l)	1	61.25	30-63	112.35	90-115	>100 (Rahman 1992)
	2	50.88		110.85		
	3	30.75		111.38		
	4	38.0		91.75		
	5	57.98		111.29		
Hardness (mg/l)	1	30.9	30.0-91.3	116.0	115-127	123 (Huq and Alam 2005)
	2	51.13		117.25		
	3	35.95		119.88		
	4	36.5		118.65		
	5	32.7		124.0		

*= Average of 4 stations

The unpolluted waters typically have BOD values of 2 mg/l or less (Chapman 1996). BOD values were found to ranges from -4.42-1.6 mg/l in wet and 1.0-3.0 mg/l in dry season (Figs. 3 and 4). In dry season among the five sampling sites, Berulia (Site 3) showed the highest BOD concentration (3 mg/l). In the field study along the Ashulia *beel* revealed that the BOD concentrations higher than the desirable limit of drinking water (0.2 mg/l) in the dry season though fishing activities can be performed there. In wet season, BOD showed lower concentrations than the standard limit for fishes. So, this season revealed more or less positive condition of the water body.

Chatla *beel* is within the Hakaluki haor of the Sylhet division, in the northeast corner of Bangladesh. The Chatla *beel* represents the poor existing water quality that is being deteriorated day by day due to the different un-accepted human activities (Chowdhury *et al.* 2010, Jhingran and Pathak 1987). Peoples around Chatla *beel* use the water for their domestic and drinking purpose, and they also discharge their waste into that *beel* and consequently they are lacks of having safe drinking water (UNDP 2000).

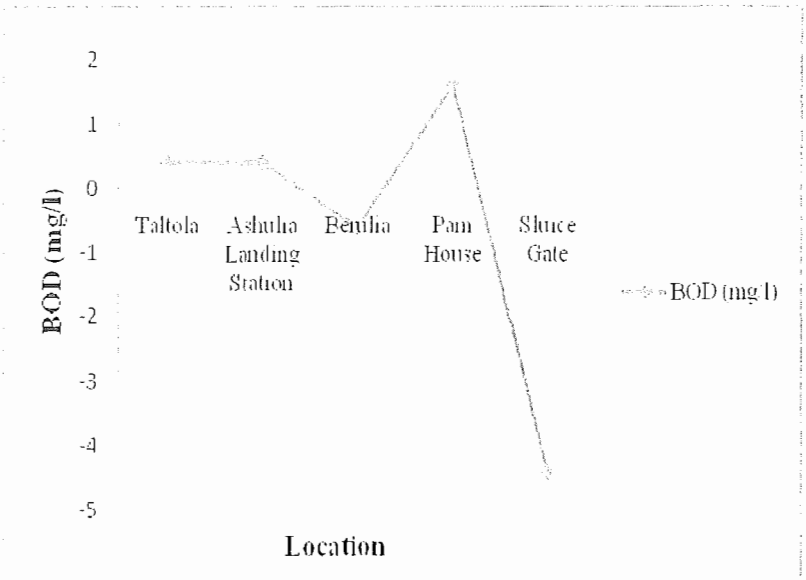

Fig. 3. Biological oxygen demand (BOD) of the Ashulia *beel* water during wet season.

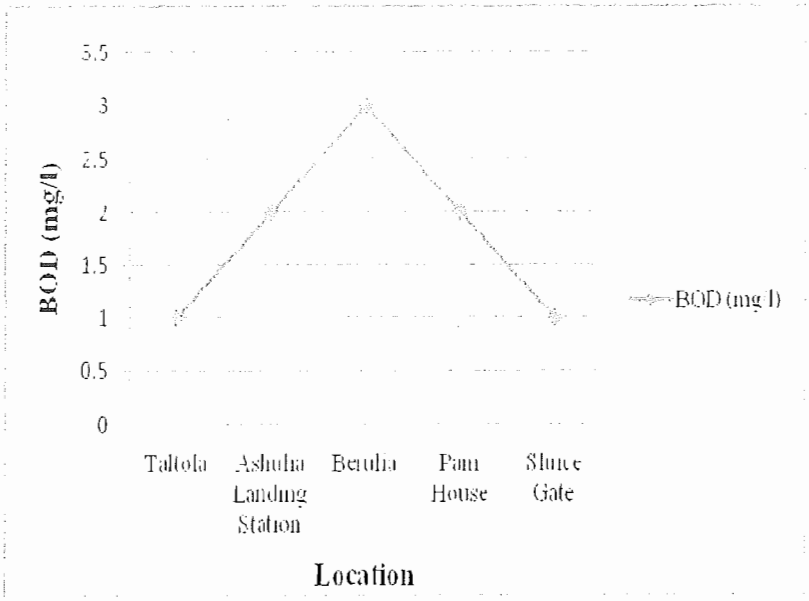

Fig. 4. Biological oxygen demand (BOD) of the Ashulia *beel* water during dry season.

The water qualities of the Ashulia *beel* and the Chatla *beel* were compared (Table 3). The water quality of the *beel* was evaluated based on the concentration of different parameters monitored above. The pH both in wet and dry season of Ashulia *beel* was suitable for fisheries where Chatla *beel* water was slightly acidic (Table 3). The DO value of Chatla *beel* was much better than Ashulia *beel* where the BOD value of Ashulia *beel* was lower than the Chatla *beel*. The hardness in Ashulia *beel* both in wet and dry season was within the standard limit where the hardness exceeded the limit in some points of Chatla *beel*. The alkalinity of Chatla *beel* was lower than the Ashulia *beel* water.

Table 3. Comparison of water quality parameters between Chatla *beel* and Ashulia *beel*

Parameters	Chatla *beel*	Ashulia *beel*	
		Wet season	Dry season
pH	6.5 - 6.9	7.1 - 7.6	7.1 - 8.4
DO (mg/l)	6.6 - 7.0	1.1 - 2.1	0.5 - 2.0
BOD(mg/l)	3.6 - 7.2	-4.42 - 1.6	1.0 - 3.0
Hardness (mg/l)	60 - 180	30 - 91	115 - 127
Alkalinity (mg/l)	25 - 35	30 - 63	90 - 115

The observed pH concentrations and transparency in Ashulia *beel* during both wet and dry seasons were within the standard limit which is sustainable for fisheries. Electrical conductivity (EC) was recorded higher in the Ashulia *beel* water during dry season. TDS content was much higher during dry season than the wet season. Total alkalinity of the sampled waters revealed the higher condition during dry season which was about 2-folds higher than the wet season and hardness was 3-folds higher when compared with wet season. The investigation revealed that higher BOD concentrations were recorded in dry season and Berulia site showed the highest BOD concentration. The waste effluents are disposed into the beel from the surrounding areas which are also responsible for higher BOD concentrations. The DO content was much lower than the desired limit. The average DO content was 1.35 mg/l in wet and 1.1 mg/l in dry season. The lower DO content is responsible for degradation of aquatic environment.

Surface water quality monitoring in Bangladesh is still very much limited and mostly on project based. Whatever the hydro morphological and water quality monitoring exists, mainly confined in the main river systems only. There is no regular monitoring or study on water quality of ponds, beels, etc so far and as a result no clear idea exists in this arena. In compliance to the study objective, investigation of water quality was done in this perennial water body (*beel*) to assess the quality of water, especially in the context of aquatic environment especially for fisheries. The investigation of COD, Nitrogen, Phosphorus, heavy metals and microbiological parameters such as total coliforms and fecal coliforms were not possible due to insufficient laboratory facilities. If the investigations of these parameters are possible then the water quality of *beel* water will be assessed properly. The *beel* is suffering from water quality problems which are a consequence of different water uses and the human

activities in the surrounding areas. If this condition is continuously going on then one day the *beel* will lose its existence and production capacities. For these reasons the study recommended to conserve the quality of the Ashulia *beel* water and its environment: i) regular monitoring of *beel* water quality with the standards of DoE, ii) industrial wastes and effluents must be treated before discharge into *beel* water, iii) halt encroachment, iv) restoration of aquatic habitat, v) keep records about fish species and their status, vi) illegal dredging must be stopped, vii) building awareness among the local people and conserve the *beel* with local participation, and viii) government should take initiatives to implement the recommended steps.

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References

Chakraborty, T.R., 2004. Management of haors, baors and beels in Bangladesh: Lessons for lake basin management. IUCN Bangladesh, Dhaka.

Chapman, D., 1996. Water quality assessment: A guide to the use of biota, sediments and water in environmental monitoring, 2nd ed. UNESCO/ WHO/ UNEP.

Chowdhury, M.A.I., R. Alam, S. Nasrin, S. Afroze and A. Hossain, 2010. Water quality of Chatla beel in Hakaluki haor and its low cost treatment for drinking purpose. *In:* Bangladesh Environment 2010: 651-664.

EEA (European Environmental Agency), 1999. Environment in the European Union at the turn of the Century. Copenhagen, Denmark.

EGIS (Environment and GIS Project for Water Planning), 2002. Water quality approach: Final Report. Ministry of Water Resources, Government of Bangladesh.

Ellis, M.M., B.A. Westfall and M.D. Ellis, 1946. Determination of water quality. Fish and Wildlife Service, US Department of Interior Research Report 9: 122 p.

EQS (Environmental Quality Standard), 1997. Bangladesh Gazette, registered nr. DA-1, Ministry of Environment, Government of Bangladesh.

Haque, R., R. Amin, H.M. Irfanullah and R. Ahmed, 2005. Plan for the sustainable wetland resource management. (ed. I. Nishat), IUCN, Bangladesh Country Office, Dhaka, Bangladesh.

Huq, S.M.I. and M.D. Alam, 2005. A handbook of analyses of soil, plant and water. BACER-DU, University of Dhaka, Bangladesh. 246 p.

Jhingran, A.G. and K. Pathak, 1987. Ecology and management of beels in Assam- a case study of three beels. *In:* Compendium of workshop on Development of Beel Fishery in Assam, Assam Agricultural University, India: 16-36.

Khan, M.A.I., A.M.M. Hossain, M.E. Huda, M.S. Islam and S.F. Elahi, 2007. Physico-chemical and biological aspects of monsoon waters of Ashulia for economic and aesthetic applications: Preliminary studies. Bangladesh J. Sci. Ind. Res., 42(4): 377-396.

Mairs, D.F., 1966. A total alkalinity atlas for marine lake waters. *Limnology and Oceanography*, 11: 68-72.

Rahman, M.S., 1992. Water quality management in aquaculture. BRAC Prokashana, Bangladesh, 84 p.

Rahman, A.A. and M. Alam, 2005. Dhaka city- State of environment. UNEP in collaboration with BCAS and DoE.

Sabbir, W., M.A.A. Masud, S.S. Islam, M.A. Rahman, M.R. Islam and M.L. Rahi, 2010. Some aspects of water quality parameters of the Mouri river, Khulna: an attempt to estimate pollution status. *Bangladesh Res. Pub. J.*, 4(1): 95-102.

SRDI (Soil Resource Development Institute), 1992. Land and soil resource utilization guide, Savar Thana, Dhaka district. Ministry of Agriculture, Government of Bangladesh.

Swingle, H.S., 1967. Standardization of chemical analyses for waters and pond muds. FAO Fisheries Report, 4(44): 397-421.

Trivedy, R.K. and P.K. Goel, 1984. Chemical and biological methods for water pollution studies. Environmental publications, KARAD: 42-74.

UNDP (United Nations Development Programme). 2000. Hydro and meteorological characteristics of Hakaluki haor.

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