Physico-chemical attributes of water of Hakaluki Haor, Sylhet, Bangladesh

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Abstract

Water quality assessment has been carried out in the Hakaluki Haor of greater Sylhet district during May, 2013 to February, 2014. Water samples were collected from 5 spots during 4 seasons and a total of 15 physico-chemical parameters were studied. Significant seasonal variation was observed in all seasons among physico-chemical parameters. p^H values varied from 5.9 - 7.1, water temperature varied from 23.7 – 26.7 ^{O}C, transference varied from 23-53 cm, TSS varied from 18.1-192 mg/l, TDS varied 25-193.5 mg/l, EC varied from 30-680 µs/cm , DO content of water varied from 4.6 - 5.6mg/l, BOD varied from 0.2-2.614 mg/l, COD varied from 38-312 mg/l, NO_3-N varied from 0.1-30.4 mg/l, NH_3 varied from 0.9-2.18 mg/l, alkalinity varied from 12-42 mg/l and PO_4 varied from 0.9 -13.4 (mg/l). Agricultural and inorganic pollutants have been observed as the main causes of the Haor water pollution.

Key words: Physico-chemical attributes, Water, Hakaluki Haor, Sylhet.

INTRODUCTION

Wetlands play an important role in maintaining the ecological balance of ecosystems. Hakaluki Haor is located in the North-East of Bangladesh and belongs to two districts consisting of Moulvibazar (70% of the territory) and Sylhet (30% of the territory) under Sylhet division. Hakaluki Haor is one of the Ecologically Critical Areas (ECA), which was once with plenty of aquatic resources including swamp forest. Macrophytes are the integral components of wetlands which are amongst the most productive ecosystems. Physico-chemical water parameters are among the factors, which determine the status of wetland ecosystem. Wetlands in Bangladesh have great ecological, economical, commercial and socio-economical values. They contain very rich components of biodiversity of national and regional significance. Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and ground water). Water pollution occurs when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds (Sharma & Dubey, 2011). Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities. Water quality refers to the chemical, physical and biological characteristics of water. There are the measures of the conditions of water relative to the requirements of one or more biotic species and or to meet any human need

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or purpose. These are the most frequently used as references (Jamie & Richard,1996) to set standards against which compliance can be assessed. The most common standards used to assess water quality relate to health of ecosystems, human contact and drinking water. Water quality standards for surface waters vary significantly due to different environmental conditions, ecosystems, and intended human uses. The water quality parameters are determined by its intended use. Water quality depends on the local geology and ecosystem, as well as human uses such as sewage discharge, industrial pollution, use as collecting water and overuse. Contaminants that may be in untreated water include microorganisms such as viruses, protozoa and bacteria; inorganic contaminants, such as salts and metals; organic chemical contaminants discharge from chemical and petroleum industries use; pesticides, herbicides; and radioactive contaminants. Water quality of any wetlands is greatly changed by domestic sewage, herbicides, pesticides, insecticides, fertilizers, and industrial pollutants, which can seriously reduce the quality of river water and adversely affect aquatic life. The physical and chemical characteristics of water have strong influence on aquatic life. Fresh water has large and varied chemical contents. Innumerable materials enter the system from atmosphere, the catchments and its own basin. The chemical properties of fresh water not only alter the physical properties of the medium but also have significant bearing on the presence distribution and metabolic activities of aquatic organisms (Datta & Datta, 1995). Physical and chemical water parameters are among the factors, which determine the status of wetland ecosystem; therefore considering increasing anthropogenic impact on Hakaluki Haor ecosystem, it is important to gather baseline data, which will allow to understanding the seasonal variations and changes the Physico-Chemical conditions of the wetlands.

MATERIALS AND METHODS

Sites selections were based on literatures reviews, consultation meeting of the experts in the related field and reconnaissance survey in the study area. Physical parameters have been studied at sites and chemical parameters were studied in the laboratory of the Department of Environment, GoB, Sylhet. Samples were collected from five locations of Hakaluki Haor as shown in Figure 1. Water samples were collected in four distinct seasons *i.e*. pre-monsoon (March-May), Monsoon (June-August), post monsoon (September-November) and winter seasons (December-February) from the selected spots. 15 vital parameters were selected for water quality analysis under two categories, viz. a) Physical parameters- pH, turbidity, Total Suspended Solid (TSS), Total Solid (TS) and Total Dissolved Solid (TDS) (APHA, 1971)   b) Chemical parameters- Electrolitic Conductivity (EC), Dissolve Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), NO_3-N, NH_4-N, Alkalinity, Phosphate (APHA, 1971). Study area and selected sites have been shown in maps (Fig. 1).
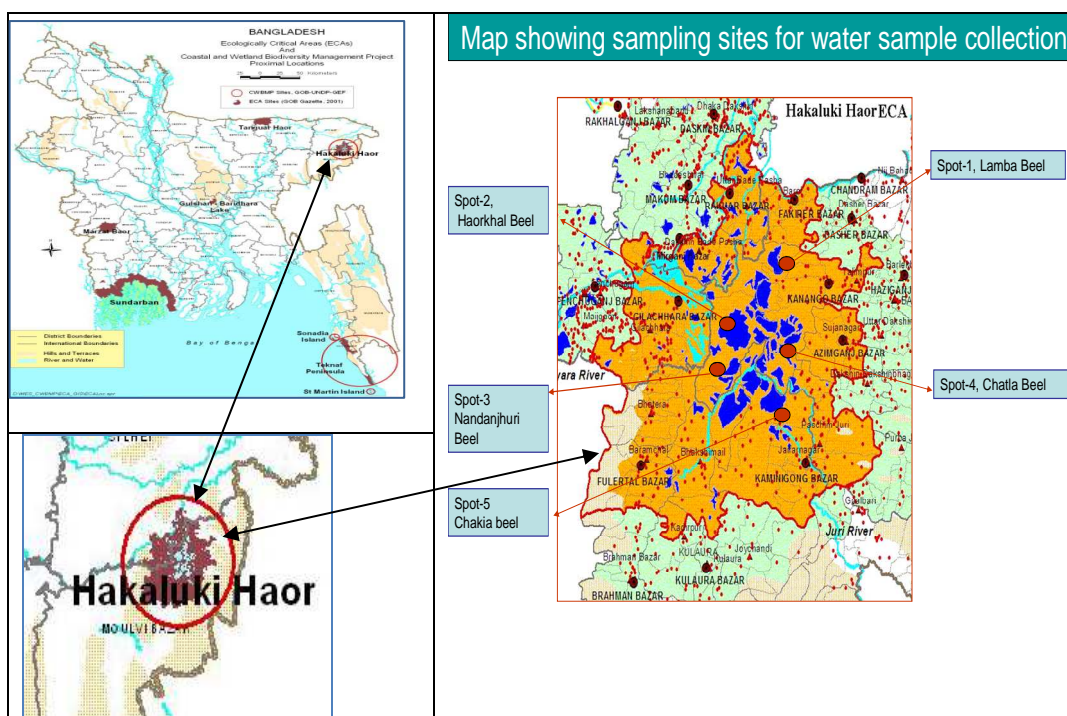
Fig. 1. Map showing Hakaluki Haor and selected study sites

Proper sampling procedures were followed carefully to inhibit the intrusion of any foreign particles that may affect the results. Rests of the samples were analyzed in laboratory. Physical parameters studied as described below: pH were measured by pH meter, water temperature were measured by centigrade thermometer, transparency by Sacchi disc, water color by visual method, water depth by meter scale, TSS, TDS and TS by gravimetric method (Goutom, 1990), while EC by Hanna model 8033, DO by (Hanna, model, H19143).

Estimation of the chemical variables which include, BOD by Winkler`s method De (1996) and Sawyer *et al.* (2002), COD by Trimetric method De (1996) and Sawyer *et al.* (2002), Nitrate- Nitrogen by Colorimetric method (1996) and Sawyer *et al.* (2002), Ammonia by Microkjeldahl distillation method (1996) and Sawyer *et al.*(2002), Phosphate by Blue color method and Alkalinity by Titrimetric method (1996) and Sawyer *et al.* (2002). Micro-kjeldhal distillation method as described by Jackson (1962) and titrimetric method as described by Vogel *et al.* (1989) respectively.

RESULTS AND DISCUSSION

Physico-chemical data of the present study have been presented in Table 1. Water quality of Hakaluki Haor decline gradually due to anthropogenic pressure and human interventions. Most aquatic animals prefer pH range of 6.5 – 8.0. Outside of this range (6.5 to 8) the diversity in the haor reduces because it stresses the physiological systems of most aquatic organisms and can reduce reproduction. In Post-monsoon the average highest pH was 6.66 and in winter the lowest p^H was 6.22. The Hydrogen ion concentration (pH) is an important factor as measure of water quality. The waste water can alter the pH of natural water (Motwari *et al*. (1956). Trevedi & Raj (1992) reported that 6.8 to 9.0 as the optimum pH range for the aquatic life in water bodies. Higher turbidity increases the water temperature because suspended particles absorb more heat or sunlight, in turn reduced DO because of warm water holds less DO. The DO content of natural water varies with the temperature, photosynthetic activities and respiration or decomposition of plants and animals (Cunningham & Siago, 1995). According to Lagler (1972) DO content less than 3mg/l is harmful to fishes. High turbidity levels can reduce the amount of light reaching lower depths, which can inhibit growth of plants depends on them. Turbidity diffuses sunlight and slows photosynthesis. Plants begin to die and increasing BOD reducing the amount of DO and increasing the acidity. Highest turbidity observed in the pre-monsoon and winter and lowest in monsoon. Dissolve Oxygen did not cross the standard value, STV=4.5-8 mg/l, (ECR, 1997), which is normal for aquatic organism and for macrophytes. Highest DO observed in the monsoon because of water comes from upstream and lowest in winter. Dissolved oxygen below 5.0 mg/L stresses aquatic life, below 1-2 mg/L can result in massive fish kills. BOD_5 is harmful to aquatic flora and fauna like fish and microorganisms (Kabir *et al*., 2002). Oxygen levels also can be reduced through over fertilization of water bodies by runoff from fields containing phosphate and nitrates. Under these conditions the number and size of aquatic plants increase. If weather becomes cloudy for several days, plants use more oxygen for respiration. In some spots EC value was higher than that of standard value which affects the aquatic flora. In the post monsoon EC value of all spots cross the standard value, which is harmful for aquatic lives of the Haor.

Total Suspended Solids below 20 mg/L is considered to be clear; between 40-80 mg/L appears cloudy; above 150 mg/L is considered to be dirty. Water was cloudy in the post monsoon. Highest TSS observed in the post monsoon and lowest in the winter. TSS varied from 18.1-192 mg/l, which in some spots crossed the standard value (STD=150 mg/l), which is harmful for aquatic organism. TDS varied from 18.2-159.5 mg/l, (STD=150 mg/l) .The values higher than standard values would affect the aquatic flora. Highest TDS observed in the Post- monsoon and lowest in the monsoon. It crossed the standard value during post monsoon which would create stress on the aquatic life.

BOD varied from 0.2-2.614mg/l, which crossed the standard values (STV=0.2 mg/l, ECR, 1997). BOD is one of the most common measures of organic loading in water. Low BOD means good water quality and high BOD means polluted water. Highest BOD observed in monsoon and lowest in winter. Highest COD observed in post-monsoon and lowest in monsoon. Typically, unpolluted surface water has BOD values of 2 mg/l or less.

Nitrate recommended below 10 mg/l for drinking water and below 0.5 mg/l for aquatic life. The test showed very high concentration of NO_3-N in some spots. Alkalinity was more or less uniform in most of the parts of the present study area. Comparatively highest alkalinity observed in the season of winter followed by post-monsoon and winter and lowest was in pre-monsoon. The values for Ammonia ranged between 0.43 mg/l (winter season) and 1.58 mg/l (Pre-monsoon).The permissible limit of which according to Bangladesh Standard (BDS, 1975) is 0.5 mg/l. Thus ammonium ions in the water of Hakaluki Haor are unsafe for drinking. This can be as a result of human and animal wastes disposal, as well as fertilizers loading. Besides agricultural practices in the khanda of beels and tea garden surrounding Hakaluki Haor and during flash flood water come from upstream with polluted water. Most of the spots have been polluted in all seasons by ammonia without some exception. Phosphate contents were found higher than standard value (STV=6mg/l, Ref. ECR, 1997) probably due to the establishment of 'bathan' (cattle grazing area) during winter inside the haor area, which produces animal and human wastes. Another source is the use of fertilizers in the paddy fields.

Large amount of agrochemical have been used in the paddy field, poisons have been used for fishing after dewatering the beels and chemical have used surrounding tea garden of Hakaluki Haor. These chemicals polluted the water of Hakaluki Haor and ammonia and or nitrate have increased on alarming scale and have polluted the water of Hakaluki Haor. Water qualities of Hakaluki Haor in different seasons have been presented in Table 1.

Table 1. Maximum and minimum values of the physico-chemical properties of water samples of Hakaluki Haor at Sylhet, Bangladesh

Variables	Pre-monsoon (Mar-May) 2013-2014			Monsoon (Jun-Sep.) 2013-2014			Post - Monsoon (Oct-Nov.) 2013-2014			Winter(Dec.-Jan.) 2013-2014			Standard value,
	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min	Max.	Avg.	
pH	6	6.8	6.38	6	7.1	6.56	6.3	7	6.6	5.9	6.6	6.22	6.5-8.5
Turbidity (cm)	48.0	56.0	51.0	30.0	34.0	32.6	36.0	40.0	38.0	48.3	53.3	50.0	0
Temp.(°C)	27.0	26.7	26.6	27.0	28.0	27.6	24.0	24.0	23.9	26.2	26.2	26.2	20-300C
DO (mg/L)	4.5	4.68	4.6	5.0	5.6	5.26	4.6	5.5	5.04	4.5	5.0	4.7	4.5-8
EC(µS/cm)	68.0	125	92.1	36	91.0	61.3	63.0	589.0	204	91.7	324	207.4	1200
TSS(mg/L)	105	193.5	142.22	25.41	63.77	43.03	92.1	292.0	151.66	45.8	175.2	106.5	2100
TDS(mg/L)	33.24	105.7	65.67	18.2	45.6	30.74	53.17	320.2	136.85	18.1	64.6	41.44	150
TS(mg/l)	47.76	137.66	76.55	7.21	18.17	12.29	27.0	132.37	65.824	27.7	110.6	65.05	2250
COD(mg/L)	36.0	133	83.4	38.0	76.0	53.8	51.0	408.0	187	45	312	164.8	200
BOD(mg/L)	0.3	0.86	0.62	1.0	2.6	1.88	0.2	1.3	0.7	0.2	1.0	0.57	0.2
Alkalinity (mg/L)	12.0	42	26.4	12.0	28.0	18.4	12.0	30.0	23.2	18	30.0	23.2	200-500
NO3-N (mg/L)	5.6	29.7	15.6	1.0	30.0	7.54	0	2.2	0.88	0.1	2.3	0.86	10.0
NH3(mg/L)	1.2	2.18	1.58	0	1.1	0.55	0.1	1.5	0.56	0.07	1.1	0.434	0.5
PO4 (mg/L)	3.7	7.9	5.58	1.0	7.5	3.5	5.6	13.0	8.24	5.4	12.2	7.58	6.0

Legend: Min. = Minimum; Max. = Maximum; Avg. = Average

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