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Study of the Seasonal Variations in Physicochemical and Biological Aspects of the Padma River at Paturia Ghat, Manikganj

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Abstract

The study was conducted from 31 March 2010 to 28 February 2011 to investigate the seasonal variations in physicochemical and biological aspects and to identify the quality of the water of the Padma River at Paturia Ghat, Manikganj. Ten (10) physicochemical parameter of water, plankton community, total coliform and four (4) physicochemical parameter of the sediment were studied. The average value of temperature, pH, salinity, hardness, DO, EC, TDS, TSS, BOD_5 and turbidity were 27.5±3.36˚C, 7.67±0.7, 0.13±0.05 ppt, 88.33±19.08 ppm, 7.79±0.86 ppm, 162.17±48.45 µs/cm, 84.08±21.74 ppm, 120.82±68.33 ppm, 4.25±0.43 ppm, 53.37±21.06 FTU, respectively. Total thirty five (35) genera under six (6) classes of phytoplankton were observed. The average value of Clorophyceae, Bacillariophyceae, Cyanophyceae, Xanthophyceae, Euglenophyceae and Dinophyceae were 2209±2659, 3421.58±4411.28, 168.7±210.72, 31.17±79.5, 15.75±25.19, 6.25±20.73 ind./100L from March 2010 to February 2011, respectively. The greatest number (31389 ind./100L) of phytoplankton occurred in May and lowest number (189ind./100L) in August. Total twelve (12) genera of four (4) classes of zooplankton were identified. The average number of Rotifers, Copepods, Cladocerans, Ostracods were 346.67±321.4, 104.44±92.86, 112.57±71.72, 82.6±54.76 ind./100L from March 2010 to February 2011, respectively. The greatest number (2322 ind./100L) of zooplankton was observed in February 2011 and the lowest number (152 ind./100L) in August 2010. Most dominant class of phytoplankton was Bacillariophyceae and most dominant class of zooplankton was rotifers. The highest number of total coliform observed in monsoon. The average value of soil pH, moisture, OC, OM were 6.32±0.36, 53.9±7.3 %, 2.29±0.14 %, 3.96±0.26 %, respectively. Temperature was negatively correlated with pH (r=-.183), Salinity (r=-.341), Hardness (r=-.435), DO (r=-476), EC (r=-.271), TDS (r=-.025), BOD (r=-.048) and positively correlated with TSS (r=.357), Turbidity (r=.353). Organic matter of soil was positively correlated with pH (r=.164) and negatively correlated with moisture (r=-.513). River water did not show any significant pollution during the study period. It was suitable for irrigation, fisheries, recreational, industrial and navigation purposes but not suitable for drinking purposes. The fertility of the sediment carried out by the river was also high which was suitable for agriculture.

Key words: Physicochemical parameter, Biological parameter, Pollution

Introduction

Rivers have always been the most important freshwater resources, along the banks of which our ancient civilizations have flourished, and most developmental activities are still dependent upon them. River water finds multiple uses in every sector of development like agriculture, industry, transportation, aquaculture, public water supply etc. However, since old times, rivers have also been used for cleaning and disposal purposes. Huge loads of waste from industries, domestic sewage and agricultural practices find their way into rivers, resulting in large scale deterioration of the water quality. The growing problem of degradation of our river ecosystem has necessitated the monitoring of water quality of various rivers all over the country to evaluate their production capacity, utility potential and to plan restorative measures (Datar and Vashistha, 1992; Das and Sinha, 1993).

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Water quality deals with the physical, chemical and biological characteristics in relation to all other hydrological properties. Any characteristic of water that effects the survival, reproduction, growth and production of aquaculture species, influences management decisions, causes environmental impacts or reduces product quality and safety can be considered a water quality variable. Other factors being the same, aquaculture species will be healthier, production will be more, environmental impacts will be less and quality better in culture systems with "good" water quality than in those with "poor" water quality (Chhatawal, 1998). Water quality provides current information about the concentration of various solutes at a given place and time. Water quality parameters provide the basis for judging the suitability of water for its designated uses and to improve existing conditions. For optimum development and management for the beneficial uses, current information is needed which is provided by water quality programmes (Lloyd, 1992). Unequal distribution of water on the surface of the earth and fast declining availability of useable fresh water are the major concerns in terms of water quantity and quality (Boyd & Tucker, 1998).

The relationship between the physico-chemical parameters and plankton production of water bodies are of great importance in management strategies of aquatic ecosystems. Reservoirs, ponds, rivers and ground waters are used for domestic and agricultural purposes. The quality of water may be described according to their physico-chemical and plankton characteristics. The phytoplankton in a reservoir is an important biological indicator of the water quality. While phytoplankton are important primary producers and are at the base of the food chain in open water, some species on the other hand can be harmful to human and other animals by releasing toxic substances (hepatotoxins or neurotoxins etc.) into the water (Whitton and Potts, 2000). Phytoplankton is recognized worldwide as bioindicator organisms in the aquatic environment (Yakubu *et al*., 2000). Zooplanktons are heterotrophic planktonic animals floating in water which constitute an important food source for many species of aquatic organisms. In addition, they serve as indicator organisms of water type, fish yield and/or total biological production. These probably explain why much of the fascination in the study of lakes lies in the structure and dynamics of zooplankton populations (Goldman and Horne, 1983). Coliform is the major microbial indicator of monitoring water quality (Brenner *et al.,* 1993, Grant, 1997). Total Coliform (TC) and fecal coliform (FC) counts are the most widely used bacteriological procedures for assessment of the quality of drinking and surface waters (Mcdaniels. *et al*, 1985).The TC bacteria test is a primary indicator of potability, suitability for consumption of drinking water. It measures the concentration of TC bacteria associated with the possible presence of disease causing organisms (Craun, 1978).

Bangladesh is a land of river. Around 230 rivers flow in the country including 57 international rivers (DoE, 2001). The Padma is a major trans-boundary river in Bangladesh. It is the main distributary of the Ganges, which originates in the Himalaya. The Padma enters Bangladesh from India near Chapai Nababganj. It meets the Jamuna near Aricha and retains its name, but finally meets with the Meghna near Chandpur and adopts the name 'Meghna' before flowing into the Bay of Bengal (CARE, 1994). Its water is used for agriculture, aquaculture, transportation etc. So it is very necessary to monitor the water quality of the river.

Materials and Methods

A part of the river Padma near Paturia ghat, Manikganj was selected for the study. The study area was about 68 km west of Dhaka city and the location is 23°48'15" N Longitude and 89°44'16" E Latitude.

Determination of physicochemical parameter of water: Water temperature: Water temperature was measured by a centigrade thermometer. Water pH: pH of water was determined by using a glass electrode pH meter (EcoScan Ion6).Water salinity: The salinity was measured by using salinity meter (HANNA, H180333). Hardness: Hardness was estimated by following EDTA titration method (Cannors, 1950).Dissolved oxygen: DO content of sample water was determined by using a DO meter. EC: EC was measured by using electric conductivity meter (HANNA H180333). TDS: Total dissolve solids (TDS) was measured by using TDS meter (HANNA H18734).TSS: Total Suspended solid (TSS) was measured by oven dried method (Wyckoff, 1964). BOD_5: Biochemical oxygen demand is measured by 5 day BOD_5 test (USEPA, 1986). Turbidity: Turbidity of water is measured by using turbidity meter (HANNA, HI 93703).

Determination of plankton: 100 L of sample water was filtered through plankton net by using a container of 10 L. Then filtered plankton was collected to a sample bottle and immediately added 5% by volume of formalin. Compound microscope was used for plankton analysis.

Determination of total coliform (TC): Sterile 1000 ml reagent bottle was taken for sample collection. Carefully unscrew the cap and immediately submerged the bottle under the water. Water filled up to 900 ml and a small air space is left to make shaking before analysis. Collected sample delivered to laboratory within 20 to 30 minutes and inoculated. The samples were transported by using an ice cooler for storage during transport to the laboratory. Membrane filter method was used for the analysis of total coliform.

Determination of physicochemical parameter of soil:
Soil pH and moisture: Soil pH and moisture was measured using pH meter.
Soil organic carbon: Soil organic carbon content was estimated by following Walkley and Black (1934)'s wet oxidation method as described by Jackson (1973).
Soil organic matter: The organic matter content of the soil was determined by multiplying the percentage of organic carbon with conventional van Bemmelen's factor of 1.724 (Piper, 1950).

Results and Discussion

Seasonal variation of physicochemical parameter: Fresh water environments, unlike the marine ones, are subjected to variations in the environmental factors such as temperature, dissolved oxygen, light penetration, turbidity, density etc. These factors are responsible for distribution of organisms in different fresh water habitats according to their adaptations, which allow them to survive in that specific habitat (Jaffries & Mills, 1990).

The highest temperature was 30.2 °C in August 2010 and lowest temperature was 20 °C in December 2010, which is compatible with the DoE standard. The average temperature was

27.5±3.36 °C which is higher than 23.5 °C of the river Mouri, Khulna (Kamal et al, 2007) and lower than 29.4 °C of the river Padma at Mawa Ghat, Munshiganj (Ahmed, 2004). High temperature in the summer is due to the excess heat from the sun and lowest in the winter because on that time air temperature was low. Temperature is the most important factor, which influences chemical, physical and biological characteristics of water bodies. Temperature of water may not be as important in pure water because of the wide range of temperature tolerance in aquatic life but in polluted water temperature can have profound effects on dissolved oxygen (DO) and biological oxygen demand (BOD_5). The fluctuation in river water temperature usually depends on the season, geographic location, sampling time and temperature of effluents entering the stream (Ahipathy, 2006). Temperature was negatively correlated with pH (r=-.183) and DO (r=-476).

Table1: Seasonal variations in physicochemical parameter of water.

Date	Temperature, °C	pH	Salinity, ppt	Hardness, ppm	DO, ppm	EC, µs/cm	TDS, ppm	TSS, ppm	BOD, ppm	Turbidity, FTU
31-Mar-10	28	8.6	0.12	120	7.9	193	87	20.4	3.9	33.6
29-Apr-10	30.4	8.66	0.24	60	7.06	89	43	102.8	4.1	53
27-May-10	27	6.8	0.06	60	7.5	200	70	237.4	4.4	57
30-Jun-10	29.5	7.01	0.07	60	7.3	160	70	198	4.8	32.71
28-Jul-10	31.2	7	0.13	80	8	112	68	132	3.9	54
27-Aug-10	32.3	7.41	0.08	80	8.1	132	97	105	4.2	86
21-Sep-10	30	7.44	0.1	100	7.92	210	101	217.92	5.1	66
25-Oct-10	27.2	7.3	0.12	100	6.21	122	112	140	3.5	78
27-Nov-10	26	7.21	0.13	100	6.8	140	102	138	3.8	81
26-Dec-10	20	7.39	0.23	100	9.61	118	53	85.9	4.5	48.82
26-Jan-11	24	8.6	0.12	100	8.3	240	109.5	30.2	4.2	36.63
28-Feb-11	24.5	8.66	0.11	100	8.73	230	96.5	42.2	4.6	13.4
Average	27.51	7.67	0.13	88.33	7.79	162.17	84.08	120.82	4.25	53.35
STDEV	3.36	0.69	0.05	19.08	0.86	48.45	21.74	68.33	0.43	21.06

In the present study, the maximum value of pH was 8.6 in April and minimum value was 6.8 in May. The pH of the water under study was within the WHO standard of 6.50-8.50. The average value of pH was 7.67±0.7 which was slightly alkaline and it was very useful for freshwater organism. Kamal et al (2007) observed the pH value of Mouri river, Khulna as 7.7. Ahmed (2007) observed the pH value of river Padma as 7.5 at Mawa ghat, Munshiganj. This water could therefore be regarded as neutral and unpolluted (Fakayode, 2005). pH is considered as important chemical parameter in river water since most of the aquatic organisms are adapted to an average pH. The pH is affected not only by the reaction of carbon dioxide but also by organic and inorganic solutes present in water. Any alteration in water pH is accompanied by the change in other physicochemical parameters. pH maintenance (buffering capacity) is one of the most important attributes of any aquatic system since all the biochemical activities depend on pH of the surrounding water. pH increased during summer months and decreased during monsoon and winter months. Maximum values during summer may be due to increased photosynthesis of the algal blooms resulting into the precipitation of carbonates of calcium and magnesium from bicarbonates causing higher alkalinity. The decrease in pH during winter may be due to decrease in photosynthesis, while during monsoon it may be due to greater inflow of water. pH was negatively correlated (r=-.183) with water temperature. The maximum value of salinity was 0.24 ppt in April and minimum value was 0.06 in May. The average value was 0.13±0.05 ppt which was very useful for freshwater organism. Salinity is the saltiness or dissolved salt content of a body of water. It is a general term used to describe the levels of different salts such as sodium chloride, magnesium and calcium sulfates, and bicarbonates. Salinity is an ecological factor of considerable importance, influencing the types of organisms that live in a body of water. As well, salinity influences the kinds of plants that will grow either in a water body, or on land fed by water. Salinity of the river was within the permissible limit. Salinity was negatively correlated (r=-.341) with temperature and positively correlated with pH(r=.370). The range of Hardness was 60-120 ppm which is within the limit set by DoE for drinking water purposes. The average value was 88.33±19.07 ppm. The water hardness on the study sites was higher during summer months which might have caused increased concentration of salts by excessive evaporation. This value of hardness is suitable for fish growth (Boyd & Tucker, 1998). Hardness of water is an important consideration in determining the suitability of water for domestic and industrial uses. Hardness is caused by multivalent metallic cations and with certain anions present in the water to form scale. The principal hardness-causing cations are the divalent calcium, magnesium, strontium, ferrous iron and manganus ions. The hardness of river increases in the polluted waters by the deposition of calcium and magnesium salts. Since the study area is free from industrial pollution, the hardness was observed quite low. Hardness was positively correlated with pH (r=.370), Salinity (r=.083), DO (r=.261), EC (r=.336), and TDS (.581) and negatively correlated with temperature(r = -.435). The highest value of DO was 9.61 ppm in December and the lowest value was 6.21 ppm in October. The average value of DO was 7.79±0.86 ppm & that was excellent for freshwater. Khandaka (1986) recorded the dissolve oxygen in the Karnafuli River as 5.1 ppm. The DO concentrations of the river Padma near Mawa ghat, Munshiganj, varied from 5.1 to 10.3 ppm (Ahmed, 2004). Dissolved oxygen content is one of the most important factors in stream health. Its deficiency directly affects the ecosystem of a river due to bioaccumulation and biomagnifications. The oxygen content in water samples depends on a number of physical, chemical, biological and microbiological processes. DO values also show lateral, spatial and seasonal changes depending on industrial, human and thermal activity. Oxygen is the single most important gas for most aquatic organisms; free oxygen (O_2) or DO is needed for respiration. DO levels below 1 ppm will not support fish; levels of 5 to 6 ppm are usually required for most of the fish population. The average value of DO levels indicates the average quality of river water (APHA, 2005). DO was negatively correlated with temperature (r = -.476). The maximum value of electric conductivity was 240 µs/cm in January 2011 and the minimum value was 89 µs/cm in April 2010. The average value was 162.16±48.45 µs/cm. Ahmed (2004) observed the mean value of conductivity of the Padma river as 177.1 µs/cm at Mawa ghat, Munshiganj. EC value at Mouri River ranged from 164 to 275 µs/cm (Kamal, 2007). The Conductivity is a measure of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions; on their total concentration, mobility, and valence; and on the temperature of measurement. Increasing levels of conductivity and cations are the products of decomposition and mineralization of organic materials (Abida, 2008). In all the stations minima observed in rainy season due to dilution with rain water and maxima in summer owing to evaporation and reduced discharge of sewage water to the river. EC was positively correlated with pH(r=.325), Hardness (r=.336) and negatively correlated with temperature (r = -.271). The highest value of TDS was observed in October, may be due to higher flow of water & the lowest value was in April, may be due to lower flow of water. The average value was 84±21.74 ppm. Ahmed (2004) observed TDS value of Padma river at Mawa ghat ranged from 35.5 to 179.9 ppm and TDS value of river Mouri, Khulna varies from 255 to 305 ppm (Kamal, 2007). This limit value was within the DoE standard. TDS is not generally considered a primary pollutant (e.g. it is not deemed to be associated with health effects) it is used as an indication of aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants. Total dissolved solids indicate the total amount of inorganic chemicals in solution. The portion of dissolved solids has carbonates, bicarbonates, sulphates and chlorides of sodium and calcium. A maximum value of 400 mg L^{-1} of total dissolved solids is permissible for diverse fish population (Chhatwal, 1998). TDS show significant (t=.048) positive correlation with hardness(r=.581).

The maximum value of TSS was 237.4 ppm in May 2010, may be due to higher flow of water and the minimum value was 30.2 ppm in January 2011, may be due to lower flow of water. The average value was 120.82±68.33 ppm. Ahmed (2004) observed TSS value of Padma River near Mawa ghat ranges from 147.1 to 298.2 ppm. Suspended solids cause ecological imbalance in the aquatic ecosystem by mechanical abrasive action. Suspended solids may be in the form of coarse, floating, fine or colloidal particles as a floating film. The TSS of the study area can be used for recreational and irrigation purposes. TSS show significant (t=.002) negative correlation with pH (r=-.796).The highest value of BOD_5 was 5.1 ppm in September and the lowest value was 3.5 in October. The average value of BOD_5 was 4.25±0.43 ppm. BOD varied from 13.5 to 33.5 ppm in the Mouri River (Kamal, 2007) and varied from 3.4 to 7.2 in the Padma River (Ahmed, 2004). BOD_5 is the amount of oxygen required by the living organisms engaged in the utilization and ultimate destruction or stabilization of organic water (Hawkes, 1963). It is a very important indicator of the pollution status of a water body. Rivers with low BOD_5 have high nutrient levels. Unpolluted, natural waters will have a BOD_5 of 5 mg/l or less. BOD_5 directly affects the amount of dissolved oxygen in rivers and streams. The greater the BOD_5, the more rapidly oxygen is depleted in the stream. This means less oxygen is available to higher forms of aquatic life. The consequences of high BOD_5 are the same as those for low dissolved oxygen: aquatic organisms become stressed, suffocate, and die. Sources of BOD_5 include leaves and woody debris; dead plants and animals; animal manure; effluents from pulp and paper mills, wastewater treatment plants, feedlots, and food-processing plants; failing septic systems; and urban storm water runoff (USEPA 1997).The values of BOD_5 clearly showed higher concentration during most of the summer and rainy months and comparatively low during winter months. The value of present study reveals that the water is suitable for recreational purposes. The result indicates very low level of organic pollution. BOD_5 was positively correlated with DO (r=.481) and negatively correlated with temperature (r=-.048) and pH (r=-.055).The average value of turbidity was 53.35±21.06 FTU. The highest value of turbidity was 86 FTU in August 2010, may be due to higher flow of water & the lowest value was 13.4 FTU in February 2011, and may be due to lower flow of water. Turbidity of Mouri River ranges from 16.5 to 21.5 NTU (Kamal, 2007) and turbidity of Ganga River was 394.5 NTU (Bilgrami et al, 1985). It could be owing to sedimentation during summer seasons and the turbulence arising out of flood-like situations observed during the rainy season. The clarity of natural body of water is an important determinant of its condition and productivity. Turbidity in water is caused by suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, and plankton and other microscopic organisms. Turbidity shows positive correlation with temperature (r=.353) and negative correlation with pH (r=-.541).

Seasonal variation in Phytoplankton community:

Table: 2 Monthly variations in phytoplankton community (ind./100L)

Groups and genera	Mar, 10	Apr, 10	May, 10	Jun, 10	Jul, 10	Aug, 10	Sep, 10	Oct, 10	Nov, 10	Dec, 10	Jan, 11	Feb, 11
A) Clorophyceae												
Pediastrum sp.	412	75	-	38	-	-	-	-	-	-	-	263
Cosmarium sp.	-	-	450	-	-	-	-	38	-	-	-	-
Chlorella sp.	-	1537	1387	-	38	75	-	-	-	-	-	-
Closteriopsis sp.	-	-	38	-	-	38	-	-	-	38	263	-
Spirogyra sp.	3562	1387	38	187	38			337	1162	900	4200	7875
Cylindocystis sp.	-	-	-	-	-	-	-	-	-	-	75	-
Chlorococcum sp.	75	-	-	-	-	-	-	-	-	-	150	-
Ulothrix sp.	75	-	-	-	-	-	-	-	-	75	-	150
Oedogonium sp.	-	-	-	-	-	-	-	-	-	38	562	-
Zygnema sp.	75	-	-	-	-	-	-	-	-	-	-	38
Sphaeroplea sp.	-	-	-	-	-	-	-	-	-	150	187	187
Closterium sp.	-	38	38	-	75	-	-	-	-	-	-	-
Volvox sp.	-	38	-	-	-	-	-	38	-	-	-	-
Cladophora sp.	-	-	-	-	-	38	-	-	-	-	38	-
Total	**4199**	**3075**	**1951**	**225**	**151**	**151**	-	**413**	**1162**	**1201**	**5475**	**8513**
B) Bacillariophyceae												
Melosira sp.	1612	225	4087	38	-	-	300	-	-	375	4875	5737
Synedra sp.	5962	75	2325	337	412	-	937	450	637	1200	1050	4800
Gyrosygma sp.	-	-	-	-	-	-	-	-	-	75	-	-
Navicula sp.	225	-	7987	-	225	-	-	300	-	375	-	337
Cymbella sp.	38	-	-	-	-	-	-	-	-	-	-	-
Fragillaria sp.	112	-	-	-	-	-	-	-	75	-	-	-
Cyclotella sp.	-	38	-	-	-	-	-	-	-	-	-	-
Nitzschia sp.	-	-	38	-	-	-	-	-	-	-	-	-
Deniculata sp.	-	-	-	-	-	-	-	-	-	412	75	38
Ceratoneis sp.	-	-	-	-	-	-	-	-	-	75	-	-
Total	**7949**	**338**	**14437**	**375**	**637**	-	**1237**	**750**	**712**	**2512**	**6000**	**6112**
C) Cyanophyceae												
Microsystis sp.	112	-	-	-	-	-	-	-	112	300	-	75
Anabaena sp.	38	-	-	-	-	-	-	-	150	-	-	-
Oscillatoria	-	-	225	-	-	-	-	-	-	225	-	-
Aphanocapsa	-	-	-	-	-	-	-	-	-	-	-	225
Nostoc	75	-	-	-	-	-	-	-	-	-	-	-
Phormidium	38	-	-	-	-	-	-	-	-	112	-	-
Total	**263**	-	**225**	-	-	-	-	-	**262**	**637**	-	**300**
D) Xanthophyceae												
Ophiocytium sp.	-	-	-	-	-	-	-	-	-	112	-	-
Tribonema	-	-	-	-	-	-	-	-	-	150	-	112
Total	-	-	-	-	-	-	-	-	-	**262**	-	**112**
E) Euglenophyceae												
Euglena	38	-	38	-	-	-	-	-	75	-	-	-
Trachelomonas	-	-	-	-	-	-	38	-	-	-	-	-
Total	**38**	-	**38**	-	-	-	**38**	-	**75**	-	-	-
F) Dinophyceae												
Peridinum sp.	-	-	-	75	-	-	-	-	-	-	-	-
Total	-	-	-	75	-	-	-	-	-	-	-	-
Grand Total	**20924**	**3827**	**31389**	**1125**	**1500**	**189**	**2550**	**1951**	**3260**	**8286**	**18262**	**26736**

The total number of plankton varies from season to season. Number of plankton was higher in winter and lower in monsoon. This is may be due to heavy rainfall during the monsoon. Phytoplankton community was represented by 34 genera belonging to six classes. The average value of Clorophyceae, Bacillariophyceae, Cyanophyceae, Xanthophyceae, Euglenophyceae and

Dinophyceae were 2209±2659, 3421.58±4411.28, 168.7±210.72, 31.17±79.5, 15.75±25.19, 6.25±20.73 ind./100L from March 2010 to February 2011, respectively. Bacillariophyceae was the dominant group in all seasons among the phytoplankton. *Spirogyra* (7875 ind./100L) was the dominant class among the phytoplankton group. Quantitatively, the family of phytoplankton abundance in the river was Bacillariophyceae > Clorophyceae> Cyanophyceae> Xanthophyceae> Euglenophyceae > Dinophyceae. Abundance of diatoms in the rainy season may be ascribed to the mixing of the water during periods of heavy rainfall which would have resulted in recycling of nutrients and probably boosted the growth and subsequent abundance of the algae more in the rainy season (Ugwumba and Ugwumba, 1993). In present study *Ocillatoria* was little in number (225 ind./100L) and *Spirulina* was absent. This is due to very low level of pollution in the study area. Two species of Euglenophyceae and only one species of Dinophyceae was observed during the study period. The high number of phytoplankton represents the high productivity of the river water. It was also observed that the abundance of blue-green algae was not significantly affected by any physico-chemical parameter. This may be the reason for their high proliferation in the reservoir.

Seasonal variations in Zooplankton Community:
Twelve (12) genera of 4 groups (Rotifers, Copepods, Cladocerans and Ostracods) of zooplankton were identified during the study period. The average number of Rotifers, Copepods, Cladocerans, Ostracods were 346.67±321.4, 104.44±92.86, 112.57±71.72, 82.6±54.76 73 ind./100L from March 2010 to February 2011, respectively. The abundance of the genera *Brachionus* and *Keratella* showed that the rotifer fauna was made up of a typical tropical assemblage (Jeje, 1986). The predominance of the *Brachionidae* could however be attributed to their omnivorous nutrition and widespread geographical distribution of most of the members (Goldman and Horne, 1983). In the present study, members of the *Brachionidae* were dominant both in species number and abundance. Quantitatively, the order of zooplankton abundance in the reservoir was Rotifera>Copepoda>Cladocera>Ostrcods. The same order was observed in dry season while in the wet season, the order was Rotifer>Cladocera>Copepoda>Ostrcods. This observation was also in accordance with those of Oben (2000). The increased number of zooplankton observed during the rains could be linked to the influx of nutrient rich flood water as well as mixing of autochthonous material that likely accelerated primary production and consequently, zooplankton production/abundance (Petersen and Cummin, 1974; Evans *et al.*, 1993). The observed change in the order of abundance during dry and rainy seasons in the abundance of dominant zooplankton in the same body of water as observed in this study have been well documented by Egborge (1981) in Asejire Lake and Meyer and Effler (1980) in Onondaga Lake in New York. These changes have been observed to be as a result of changes in environmental factors such as light, oxygen and temperature which were the principal factors noted by Begg (1976).

The diatoms have been used by ecologists to indicate pollution in water bodies and other variations of ecological conditions (Tassaduqe *et al.*, 2003). The diatom, *Cyclotella* when in high numbers is an indicator of relatively clean water (Oben, 2000). However, this genus has also been taken as an indicator of acidification by Boney (1983). Other diatoms like *Synedra, Nitzschia, Melosira* and *Navicula* when in large numbers are indicators of sewage pollution and eutrophic conditions (Mason, 1991). *Spirogyra*, green algae also indicate eutrophy. The blue-green algae, *Microcystis*, *Oscillatoria* and *Anabaena* assayed in this study are potential indicators of organic pollution.

Table: 3 Monthly variations in zooplankton community (ind./100L)

Groups and genera	Mar, 10	Apr, 10	May, 10	Jun, 10	Jul, 10	Aug, 10	Sep, 10	Oct, 10	Nov, 10	Dec, 10	Jan, 11	Feb, 11
A) Rotifers												
Asplancha sp.	112	112	-	38	-	-	38	-	38	-	75	225
Brachionas sp.	187	150	262	75	112	75	38	75	75	225	150	225
Filinia sp.	38	-	-	38	-	-	-	-	-	-	-	187
Keratella sp.	75	187	112	75	112	38	-	-	75	112	187	637
Total	**412**	**449**	**374**	**226**	**224**	**113**	**76**	**75**	**188**	**337**	**412**	**1274**
B) Copepods												
Cyclops sp.	-	38	-	75	-	-	38	38	38	-	-	75
Diaptomus sp.	-	38	-	38	-	-	-	-	-	-	75	112
Mesocyclops sp.	38	75	-	-	38	-	-	-	-	-	112	112
Total	**38**	**151**		**113**	**38**	-	**38**	**38**	**38**	-	**187**	**299**
C) Cladocerans												
Alona sp.	75	-	38	-	-	-	-	-	-	-	-	38
Ceriodaphnia sp.	75	-	-	-	112	-	-	-	-	-	-	75
Monia sp.	38	112	-	112	-	38	-	-	-	75	-	112
Total	**188**	**112**	**38**	**112**	**112**	**38**	-	-	-	**75**	-	**225**
D) Ostracods												
Cypris sp.	-	-	38	-	-	-	-	75	-	-	75	-
Stenocypris sp.	38	-	-	75	-	-	-	-	-	-	112	-
Total	**38**	-	**38**	**75**	-	-	-	**75**	-	-	**187**	-
Grand Total	**940**	**975**	**488**	**826**	**524**	**189**	**152**	**226**	**264**	**487**	**1160**	**2322**

Phytoplankton was positively correlated with pH (r=.435) and DO (r=.304), and negatively correlated with temperature (r=-.450), salinity (r=-.177) and turbidity (r=-.600*). Zooplankton was also positively correlated with pH (r=.675*), salinity (r=.070) and DO (r=.364), and negatively correlated with temperature (r=-.450), salinity (r=-.177) and turbidity (r=-.833**).

Seasonal changes in Total coliform (TC):

Total coliform was maximum in monsoon and minimum in winter. The value ranges from 97 to 350 CFU/100mL. This may be due domestic sewerage from nearby residents. Total coliform counts in the river reveals that there has a chance of the presence of pathogenic organisms. The value was within the permissible limit for the recreational and fishery purposes but was not suitable for drinking without treatment.

Table: 4 Seasonal changes in Total coliform (TC)

Seasons	Total Coliform, CFU/100mL
Monsoon	351
Winter	97

Seasonal variations in physicochemical parameter of soil:

Soil pH is very important to understand the nutrients status of the soil. pH 6-7 is optimum for adequate availability of nutrients (Miah et al. 2005). The pH value of the present study ranges from 5.7 to 6.8. The average value was 6.3±3.6. This value indicates the slightly acidic nature of soil. This may be due higher microbial activities that make humic acid. The maximum value of moisture content of soil was 62% in April and minimum value was 38% in November. The average value was 53.9±7.3%. The highest value of organic carbon was 2.5 % in October 2010, may be due to higher flow of water & lowest value was 2.12% in March 2010, may be due to lower flow of water. The average value was 2.29±0.14%. The maximum value of organic matter was 4.35% in October 2010, may be due to higher flow of water & the minimum value was 3.65% in March 2010, may be due to lower flow of water. The average value was 3.96±0.26%. Soil organic matter represents an accumulation of partially decayed and partially synthesized plant and animal residues. They act as a nutrient for some aquatic organism. Organic matter increases the amount of water holding capacity of soil and the proportion of this water becomes available for plant growth. It is the main source of energy for soil organism. Which indicates good quality of soil and nutrient load of the soil is very high. The river carried high valued sediment which is very important for the fertility of the soil for agricultural practices. pH of soil was positively correlated with organic carbon (r=.165) and organic matter (r=.164) and negatively correlated with moisture (r= -.123). Organic matter of soil was positively correlated with pH (r=.164) and negatively correlated with moisture (r=-.513).

Table 5: Seasonal variations in physicochemical parameter of soil.

Date	pH	Moisture, %	OC, %	OM, %
31-Mar-10	6.8	6	2.12	3.65
29-Apr-10	5.8	6.2	2.2	3.79
27-May-10	6.8	5.5	2.15	3.7
30-Jun-10	6.5	6	2.4	4.14
28-Jul-10	6.4	4.8	2.3	3.97
27-Aug-10	6.5	5.4	2.4	4.14
21-Sep-10	6.2	6.1	2.2	3.79
25-Oct-10	6.7	4.8	2.5	4.35
27-Nov-10	6.2	3.8	2.4	4.14
26-Dec-10	6.1	4.9	2.2	3.79
26-Jan-11	6.1	5.2	2.5	4.35
28-Feb-11	5.7	6	2.12	3.65
Average	6.316667	5.391667	2.290833	3.955
STDEV	0.363901	0.725457	0.143429	0.260716

Conclusion

Padma is one of the main rivers of Bangladesh. This river plays a vital role as the important freshwater resources of Bangladesh. Its water is used for different purposes such as irrigation, navigation, fisheries, dumping of domestic and industrial waste and recreational purposes. But day by day the flow of the river is decreasing and with increasing population the quality of water also decreasing. Monsoon (June-Oct) months are relatively wet and water quality was better relative to winter (Nov-Feb) months. In dry season, many parts of the river become dry due to excessive evaporation and hamper the navigability. Many of the rivers in Bangladesh are dried up and most of the rivers beside large cities become polluted and importance of freshwater resources is increasing. So monitoring of quality and quantity of rivers of the country is needed. The present study reveals that the water quality of river Padma at Paturia Ghat, Mnikganj was within limit set for the inland water by Department of Environment (DoE). Its water was suitable for irrigation, fisheries, recreational purposes and industrial purposes but not suitable for drinking purposes. By simple treatment processes the water can also be used for public water supply as the need for domestic use of water was increasing. Biological investigation reveals that the productivity of the river Padma was high during the summer seasons. Physicochemical investigation of soil indicates the high quality of the sediment carried out by the river which was very significant for agricultural practices. So the sustainable water quality management is needed for prevention of the deterioration of the quality of water.

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