

# Seasonal Variations of Some Physico-Chemical Parameters of Ramsagar Dighi, Dinajpur, Bangladesh

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DOI: <https://dx.doi.org/10.51244/IJRSI.2025.12120096>

Received: 22 December 2025; Accepted: 27 December 2025; Published: 13 January 2026

## ABSTRACT

Physico-chemical parameters of water in Ramsagar Dighi, Dinajpur were studied during the period of May 2022 to January 2023 in detail. Samples were collected from fourteen sampling points of the study area and were analyzed for the important water quality parameters, e.g. total dissolved solids (TDS), temperature, turbidity, electric conductivity (EC), dissolved oxygen (DO), biochemical oxygen demand (BOD), pH, arsenic, iron, chlorine, nitrate and salinity etc. These parameters indicate the level of quality of water for drinking and other domestic purposes. The parameters then were compared to Bangladesh standards. The study found that all physico-chemical parameter values varied significantly for all sampling sites in summer, winter and monsoon seasons. Water qualities were comparatively moderate in all season. But nitrate condition exceeded the standard value in all seasons.

**Keywords:** Water quality, aquatic environment, Bangladesh standard, seasonal variation.

## INTRODUCTION

Bangladesh is one of the deltaic region countries in South-east Asia. Akonda (1989) reported that nearly 7-8 million ha of wetlands exists in Bangladesh including rivers, haors, baors, beels, true lakes, man-made lakes, ponds, floodplains and reservoirs which have significant role in the ecology, economy and livelihood of the country. Beside fish production, some inland waterbodies e.g., Kaptai Lake, Foy's Lake, Dhanmondi Lake, Ramsagar Dighi, Dinajpur etc. with recreational uses are also playing increasingly important role in economy. Water is an indispensable natural resource for sustenance of life and also for any developmental activity (Kumar et al., 2010). About 80% of the earth surface covered with water. Out of the estimated 1,011 million km<sup>3</sup> of the total water present on the earth, only 33,400 m<sup>3</sup> of water is available for drinking, agriculture, domestic and industrial consumption (Dara, 2007). The quality of aquatic environment generally depends on four kinds of factors, such as physical, chemical, biological and meteorological factors (Stanitski et al., 2003). Water quality can be evaluated by assessing the physical, chemical and biological characteristics (Barthwal, 2002).

Research works have been carried out to determine some vital water quality parameters of different lakes those affect the water quality (Parvin et al, 2018, 2019, 2024, Nusrat et al, 2013, Alom, 2019). Recently environmental scientists of the country are interested to study the limnological status of surface water bodies to assess the water quality and biodiversity for conservation planning of the wetlands (Mohuya et al. 2010; Hossain et al., 2010; Khondker et al. 2012; Islam and Chowdhury, 2013 etc.). Recently, monthly variation of benthic fauna was studied by Latifa et al. 2021. Contamination of Dhanmondi and Gulshan lake waters was studied by Hossain et al. (2010). Aziz and Tanbir (2003) studied on phytoplankton of Ramsagar lake in Dinajpur district. But, there is a little works have been done on the study of water quality of Ramsagar Dighi. Therefore, the present study was designed to assess the water quality of Ramsagar Dighi, Dinajpur, Bangladesh during summer, monsoon and winter to make the water drinkable to people as water scarcity is the main problem in the northern part of Bangladesh.

## Experimentals

### Study Area

Ramsagar Dighi was selected as study area which is located in  $25^{\circ}33'00''\text{N}$   $88^{\circ}37'30''\text{E}$  at Tejpur near Dinajpur district in the north-west of the country. The dighis around 1.03 km long and 0.36 km wide and is located on a 60 hectare elevated land which is about 8 km south of Dinajpur city. The main construction of Ramsagar Dighi was initiated by king Ram Nath between 1750 and 1755 AD. Now, the water body is playing significant recreational role in tourism. At present, the Dighi is taken care by the department of fisheries (DoF) (Khondker et al. 2012) and the catchment is occupied by secondary forests and managed by the forest department of Bangladesh.

Water samples were collected from fourteen different locations along Ramsagar Dighi in winter, summer and monsoon seasons and analyzed the pH, EC, temperature, TDS, DO, BOD and nitrate, chlorine, iron, arsenic. Water samples were collected by standard procedure from each location. pH, temperature and DO were determined immediately in the field and other parameters were measured in the laboratory.

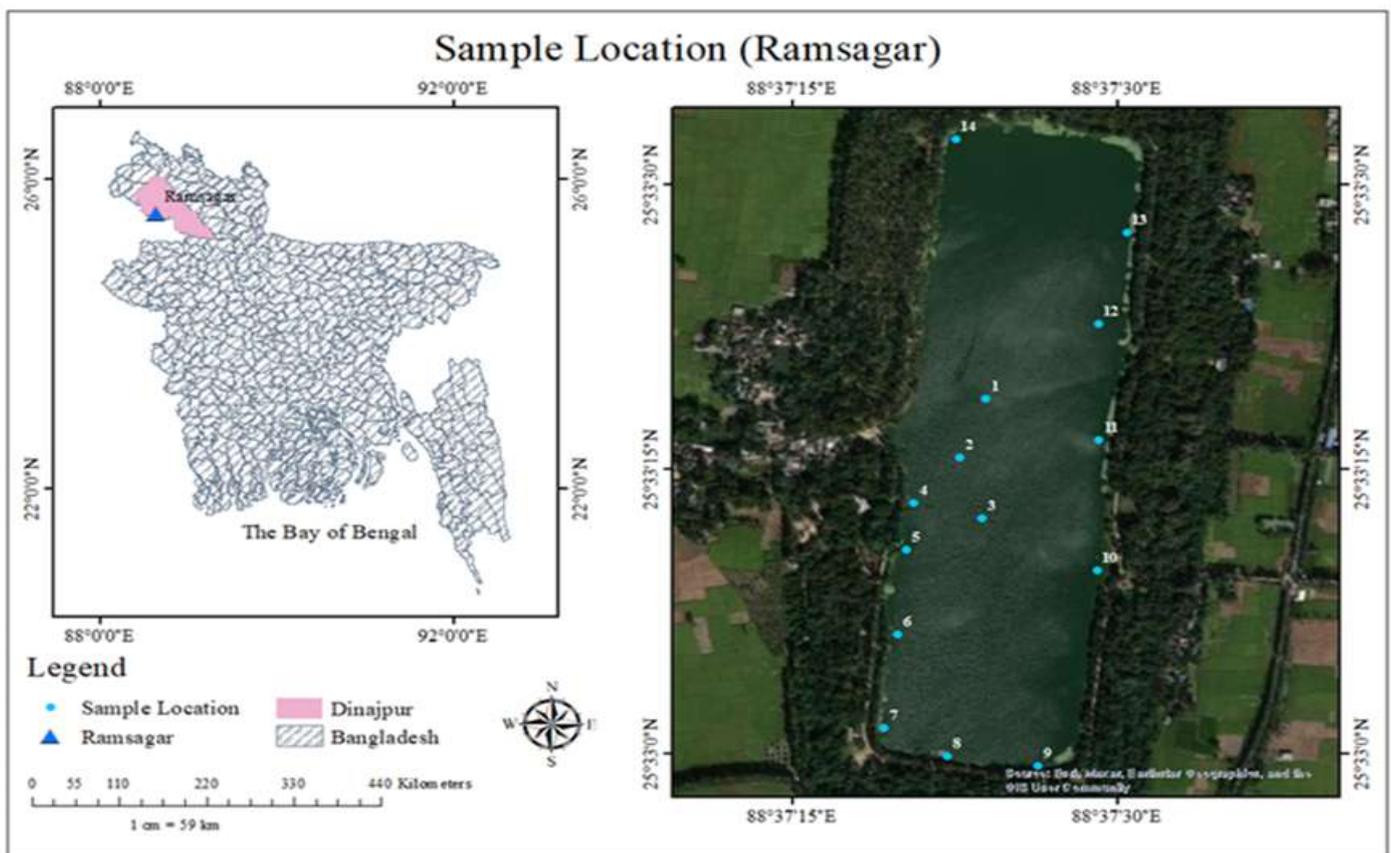


Fig.1. Study area with sample locations.

### Sample Collection

Water samples were collected from fourteen different locations in summer, monsoon and winter seasons in 2022-2023. The sampling bottles were prepared as standard procedures before sample collection. During the sample collection all sample bottles were labeled properly by mentioning the number, time and location. For further analysis samples were collected in 1.5 liter polypropylene bottles and preserved properly.

### Sample Analysis

The multi-parameters (HANNA Instrument 211, Microprocessor pH) were used to determine pH, TDS, EC and temperature. Dissolved oxygen was determined by DO meter and Nitrate by Nitrate meter. Arsenic kit,

Chlorine kit and Iron kit were used also for their values. Arc GIS is well known Geographic Information System (GIS) software that is widely used for its user friendliness and stability. Study area map is created by this technique (Arc GIS 10.8). For statistical analyzing the data of the study area, graphs and tables were also presented by Excel 2007.

### Methodological Framework

The methodological framework of this research is shown in Fig. 2.

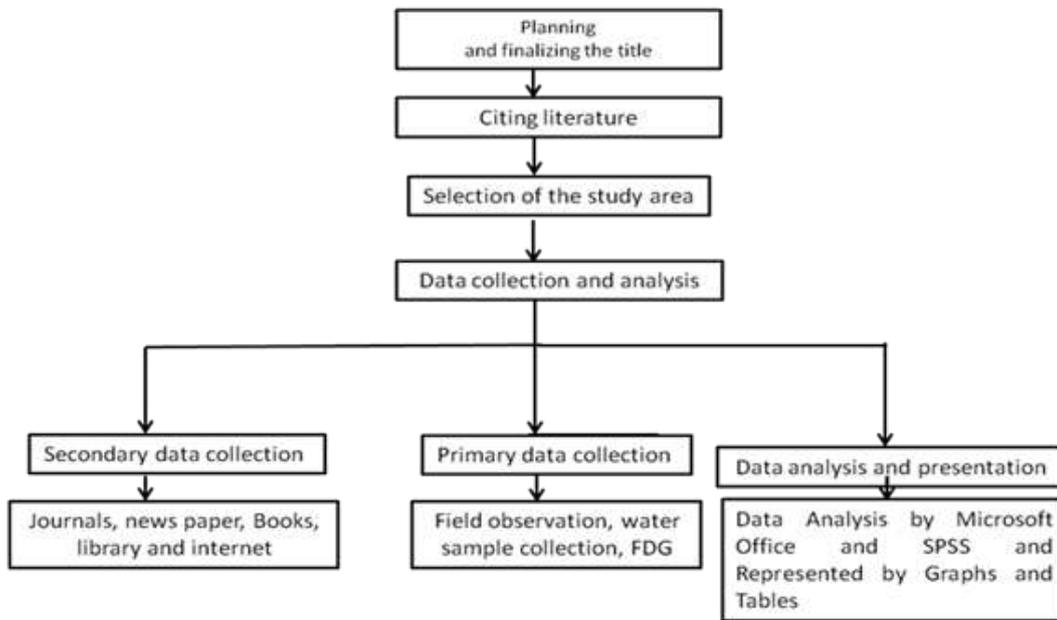


Fig.2 Methodological framework of the research

### RESULTS AND DISCUSSIONS

Water samples were collected from fourteen different locations along Ramsagar Dighi in monsoon, summer and winter seasons and analyzed the pH, EC, temperature, TDS, DO, turbidity, salinity, iron, nitrate, BOD and arsenic content.

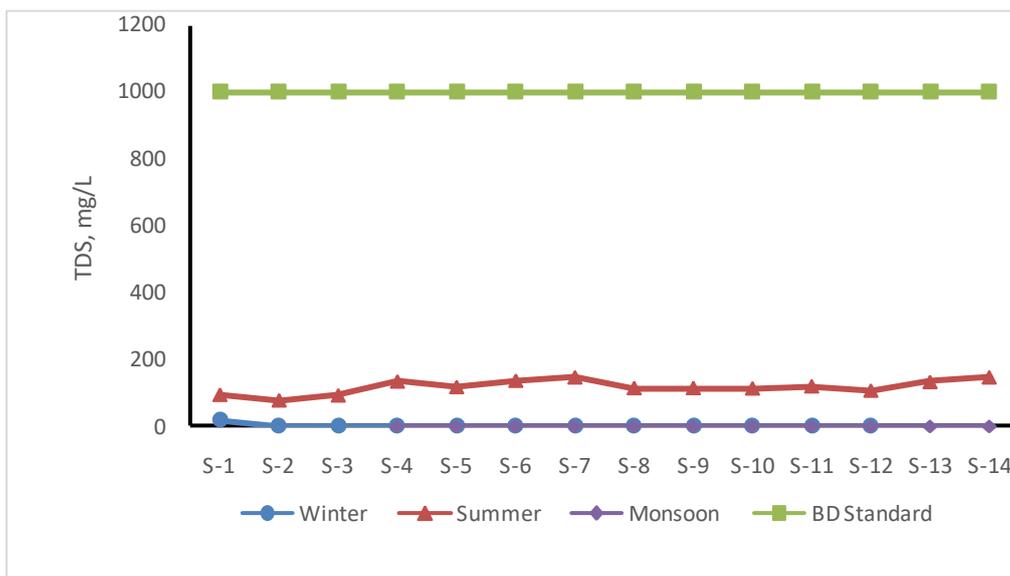


Fig. 3 TDS of different locations at different time periods

### Total Dissolved Solid (TDS)

TDS are the total mineral content of the water, primarily salts, carbonates and metals. Organic compounds may also be dissolved solids. A high concentration of TDS is an indicator of possible high volume contamination. In the study area, it showed that, the total dissolved solids were fluctuated from 0 mg/l to 147 mg/l as shown in Fig. 3. The maximum value (147 mg/l) was recorded in the summer at the sample location 7 & 14 and minimum value (0 mg/l) was recorded in the monsoon and winter seasons at all sample locations. High TDS value in the effluent is not desirable because it increases density of water, reduces solubility of gases (like oxygen) and utility of water for drinking, irrigation and industrial purposes. The enhanced TDS contents indicated that the presence of various salts into the lake, this might be due to the discharged of waste and effluent from locality & agricultural runoff etc. In case of TDS Bangladesh Standard in terms of inland surface water is 1000 mg/L. TDS concentrations of the study areas were below the WHO (2007) maximum allowable limit (500 mg/L) as well as DoE standard of Bangladesh (1000 mg/L).

Table 1 Temperature of water (°C) of Ramsagar Dighi

Season	Sample No.													
	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14
Summer	31	30.8	31.5	32.5	31.3	32.5	33.6	33.6	33.5	33	34.1	32.5	32.2	32.7
Monsoon	-	-	-	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5

### Temperature

Temperature exerts a major influence on biological activity and growth. Temperature governs the kinds of organisms that can live in rivers and lakes. Fish, insects, zooplankton, phytoplankton, and other aquatic species all have a preferred temperature range. As temperatures get too far above or below this preferred range, the number of individuals of the species decreases until finally there are none. Temperature is also important because of its influence on water chemistry. The rate of chemical reactions generally increases at higher temperature.

Rahman (1992) stated that water temperature ranging from 26.0 to 31.0°C was found suitable for aquatic life. The water temperature of Ramsagar lake is found suitable range throughout the study period. Table 1 revealed that temperature ranges from (22.3°C to 34.1°C). The maximum temperature (34.1°C) was recorded in summer at the location 11 and minimum temperature (22.3°C) was recorded in monsoon at the location 8. Begum *et al.* (2012) reported similar observation (18.0 to 32.0°C) for another manmade lake of Gazipur district of Bangladesh. Findings were more or less similar due to the same geological position. It showed that higher temperature in summer and relatively lowers in monsoon. It's also observed that during summer, water temperature was high due to low water level, high temperature and clear atmosphere. Water temperature plays an important factor which influences the chemical, biochemical and biological characteristics of water body.

### Turbidity

Turbidity is the cloudiness of water caused by a variety of particles. Solid particles suspended in water absorb or reflect light and cause the water to appear cloudy. Particles are suspended inorganic minerals or organic matter picked up over or under the ground. In this study, it revealed that value of turbidity remains within 1.34 - 7.61 NTU during the summer, 0.28 - 1.07 NTU during the monsoon and 1.36 - 4.25 NTU during winter season while the range of Bangladesh Standard of Turbidity is 10 NTU. Fig. 4 showed the turbidity of Ramsagar Dighi water fluctuated from 0.28 NTU to 7.61 NTU. The maximum values (7.61 NTU) measured in the summer. It might be due to decrease in the water level and presence of suspended particulate matter, and minimum value (0.28 NTU) in the monsoon of Ramsagar dighi, Dinajpur.

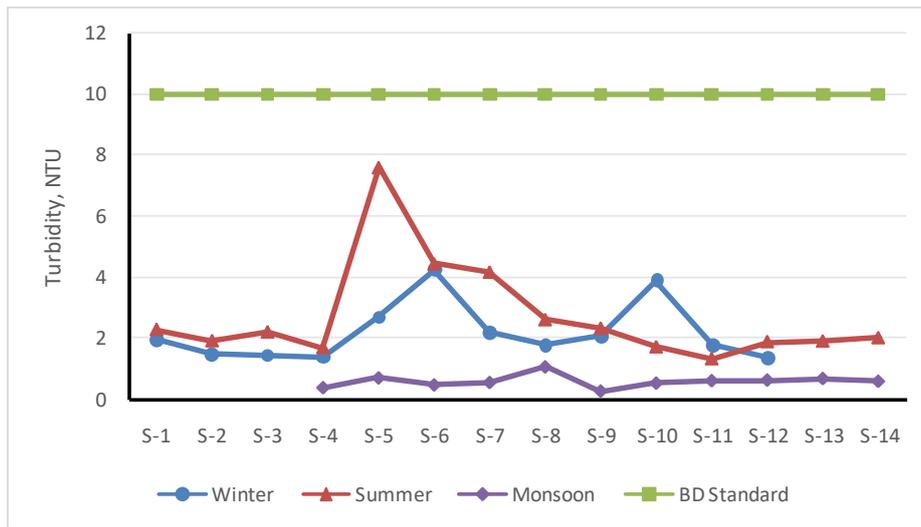


Fig. 4 Variation of turbidity of Ramsagar Dighi

### Dissolved Oxygen (DO) and Biochemical oxygen demand (BOD)

Dissolved oxygen content is one of the most important factors in streamhealth. Its deficiency directly affects the ecosystem of a water body due to bioaccumulation and biomagnifications. Oxygen is the single most important gas for most aquatic organisms; free oxygen (O<sub>2</sub>) or DO is needed for respiration. DO levels below 1.0 mg/L will not support fish; levels of 5 to 6 mg/L are usually required for most of the fish population. The average value of DO levels indicates the average quality of water (APHA, 1992).

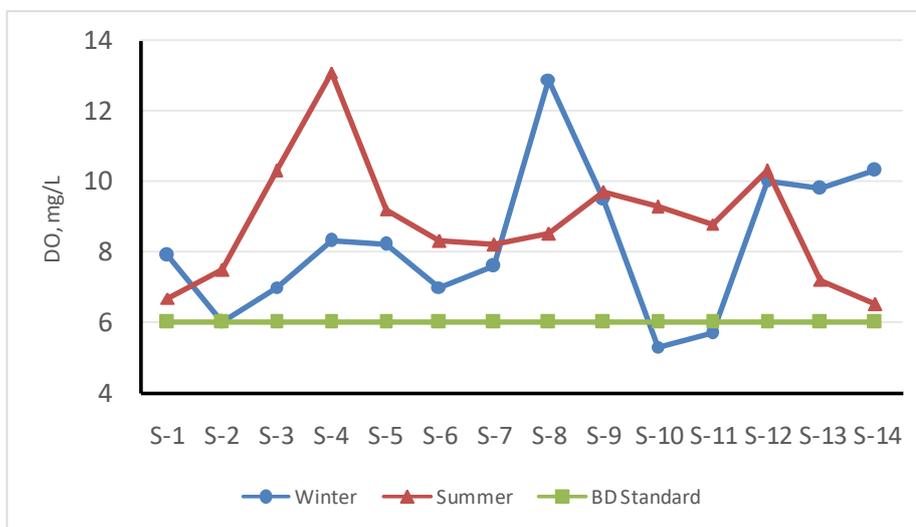


Fig. 5 Seasonal variation of DO values in Ramsagar Dighi

Fig. 5 showed that value of DO remained within (6.5 -13.1) mg/L during the summer and (5.3-12.9) mg/L during the winter while the range of Bangladesh standard of DO is 6 mg/L. Khondker et al. (2010) found DO concentration varied between 0.61 to 11.39 mg/l at lake Bogakain, Bandarban, Bangladesh and Ferdoushi et al. (2015) reported as 5.10 to 9.90 mg/L. It might be due to alteration of photosynthesis, abundance of phytoplankton, respiration by fish and other aquatic organisms of the Dighi. Banerjee (1967) reported that the water body having a range from 5 to 7 mg/l DO is productive, while values having below this range are unproductive one.

BOD values indicate the presence of biologically decomposable substances present in water body. BOD values of the study area at different points were found to be 2.4 to 9.8 mg/ in summer and in winter it was almost negligible.

### Electrical Conductivity (EC)

Electrical conductivity is the ability of any medium to carry an electric current. The presence of dissolved solids such as calcium, chloride, and magnesium in water samples carries the electric current through water. Electrical conductance has been the reciprocal of electrical resistance. It is a measure of the ability of a conductor to convey electricity. Hydraulic conductance is a measure of the ability of a conduit to conduct a fluid and thermal conductance of a substance to conduct heat. The electrical conductivity was found to fluctuate between 10 to 212  $\mu\text{S}/\text{cm}$  (Fig. 6). During the study period the value of EC (120.6 -212)  $\mu\text{S}/\text{cm}$  in summer, (10 – 20)  $\mu\text{S}/\text{cm}$  in monsoon and (10-60)  $\mu\text{S}/\text{cm}$  in the winter season EC High values were recorded during summer might be due to increased concentration of dissolved solids, relatively high flow of water, increased evaporation and input sewage. Garg et al, (2010) also found high value in summer season. The values obtained in this study are within the recommended DoE standard of Bangladesh (GoB, ECR, 1997)

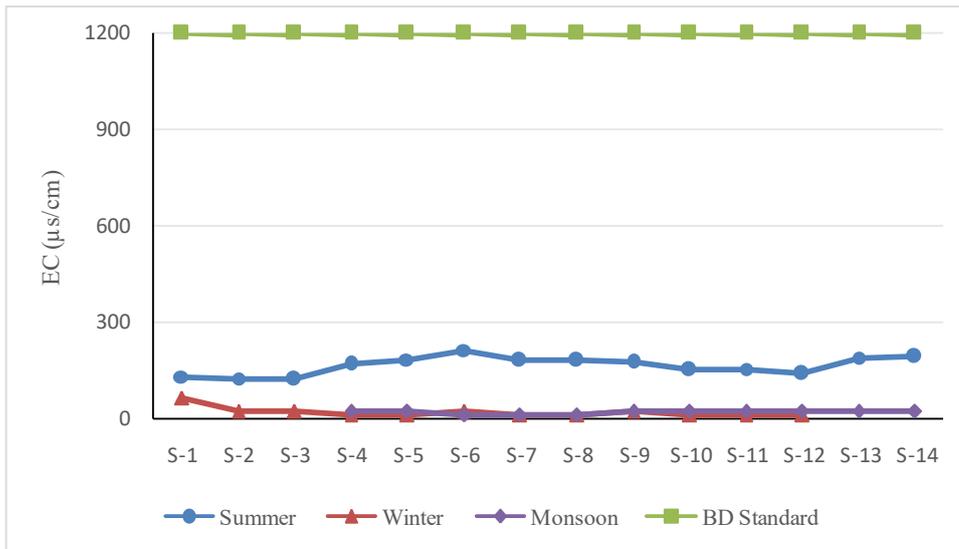


Fig. 6 Electrical conductivity in the study area during three seasons

### pH

pH is a measure of the relative amount of free hydrogen and hydroxyl ions in water. Water that has more free hydrogen ions is acidic, whereas water that has more free hydroxyl ions is basic. Fig. 7 revealed that value of pH were 5.4-9.45 in the summer, 6.7-10.4 in the monsoon and 6.5-9.3 during the winter season while the range of Bangladesh standard of pH is 6.5 to 8.5. The pH of the study area was slightly alkaline except sample 1.

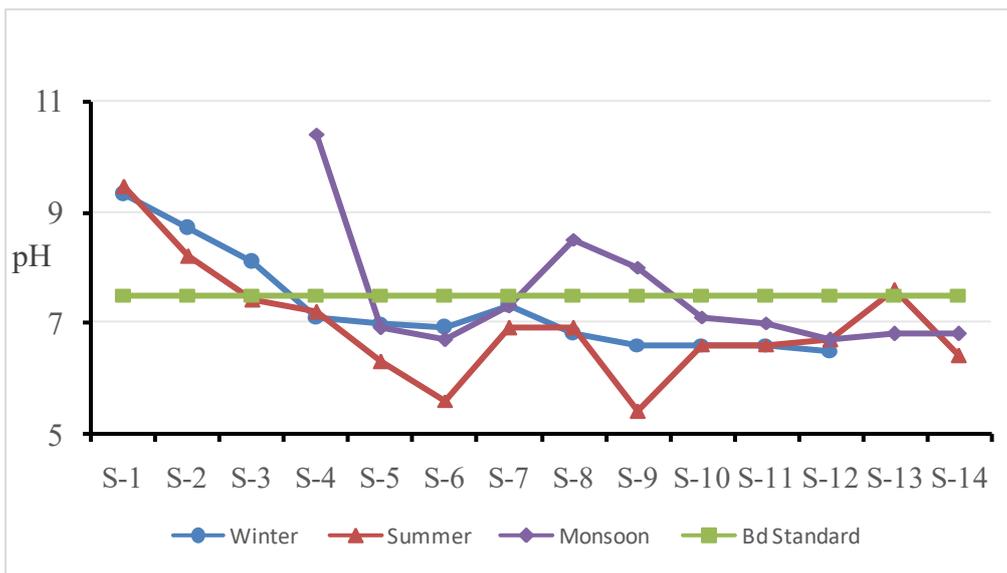


Fig. 7 Seasonal variation of pH values in the study area.

## Nitrate

Nitrates are common components of fertilizers and explosives. Nitrate anion ( $\text{NO}_3^-$ ) is not absorbed by soil and moves with infiltration water. Nitrates are present in water particularly in region where agricultural fertilization is intense and another important routes of entry of nitrogen into water body are municipal and industrial waste water, septic tanks, feedlot discharge, animal wastes and discharge from car exhausts. Small amount of nitrate is essential for the growth of phytoplankton. But high concentration of nitrate can contribute to eutrophication and consequently pose danger for the survival of aquatic organisms including fishes. Some researches stated that determination of nitrate is an important to assess the potential biological productivity of surface water (Schindler, 2006). In the study, it was found that the value of nitrates ( $\text{NO}_3^-$ ) were ranged from 42 to 72 mg/L in the summer and 36 to 200 mg/L during monsoon season as shown in Fig. 8 while the range of Bangladesh standard of Nitrate ( $\text{NO}_3^-$ ) is 10 mg/L. The values for all seasons crossed the permissible limit according to Bangladesh and WHO standard (WHO, 2007).

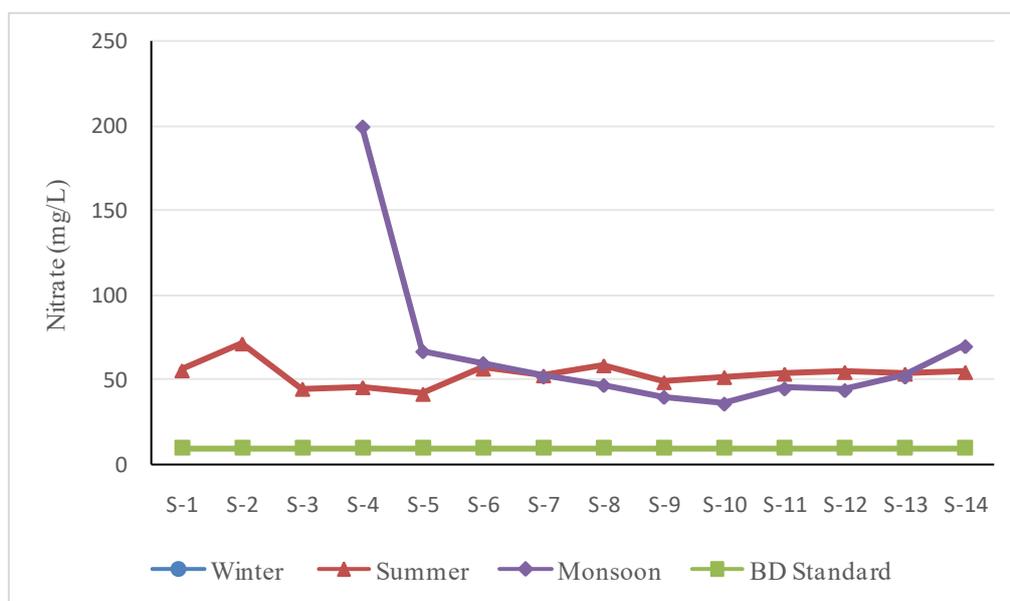


Fig.8 Nitrate concentrations at different locations at different season of the study area

During three seasons, other physicochemical parameters such as Chlorine, Iron, Salinity and Arsenic were measured in our study period and it was found that the results were within the acceptable limit according to ECR 1997.

## CONCLUSION

The water quality status of Ramsagar Dighi indicates that lake is conducive to enhanced fisheries and biological production as well. During the period of study it was found that total dissolved solids was 0 to 147 mg/l, Temperatures was 22.3°C to 34.1°C, Turbidity was 0.28-7.61 NTU, Electrical Conductivity was 10 to 242  $\mu\text{S}/\text{cm}$ , Dissolved Oxygen was 6.5 mg/l to 13.1 mg/L, BOD was 2.4 - 9.8 mg/L, pH was 6.5 to 10.4, Arsenic was (0 ppb), Iron was (1 < ppm), Chlorine was 0.5-2.5 mg/L, Nitrate was 29-350 mg/L, Salinity was 0ppt. Comparisons of the data with the standards recommended by DoE showed that most of the parameters were within the acceptable limit. However, some conservation measures are recommended to be taken by the government to protect the Dighi from environmental pollution from tourism. Moreover, long-term study would be necessary to study the impacts related to increasing access to tourists for picnics.

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