

## ASSESSING THE SURFACE WATER QUALITY FOR USING IRRIGATION, DRINKING AND LIVESTOCK CONSUMPTION PURPOSES AT GOURNADI UPAZILA, BARISHAL, BANGLADESH

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### ABSTRACT

A study was conducted to assess the surface water quality of Gournadi Upazila for using irrigation, drinking, and livestock consumption. Twenty samples were collected and prepared for analysis in the Department of Agricultural Chemistry, Patuakhali Science and Technology University (PSTU). The chemical analyses included pH, EC, TDS, Ca, Mg, K, Na, S, and P. The pH indicated that surface water samples were neutral to alkaline in nature and were suitable for irrigation, drinking, and livestock consumption (pH value 6.7-8.10 in surface water). On the basis of EC, all the samples were found to be non-saline (EC value 0.18-0.50mS/). The concentration of Ca, Mg, Na, P, S, and K for surface water ranged from 10.16-23.0, 4.87-45.42, 301.10-703.41, 0.52-1.96, 4.66-44.28 and 3.15-16.98 mg/L, respectively. The surface waters were rated suitable for irrigation, drinking, and livestock consumption on the basis of Ca, Mg, Na, and P, S, and K concentrations.

**Key words:** Drinking, irrigation, water quality, surface water

### Introduction

Water is the most valuable and vital resource for the sustenance of life and also for any developmental activity (Kumar *et al*, 2010). About 80% of the earth's surface is 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). Bangladesh is a low-lying flat country with big inland water bodies, including some of the biggest rivers in the world, and is extremely vulnerable because of its geographical characteristics (Matin and Kamal, 2010). Water quality is deteriorating day by day due to biological, physical, and chemical variables. The primary causes of the deterioration of surface water quality are the decomposition of municipal, domestic, industrial, and agricultural wastes (Todd, 1980). It is also contaminated by mixing with rains and floods which wash down some agrochemicals into rivers, canals, and ponds. If these elements exceed the acceptable limit, it becomes harmful to fish cultivation. However, the water toxicity varied from season to season. In most cases, macro and micronutrients were higher in the winter season than those during the monsoon season (Mitra and Gupta, 1999). The main soluble constituents of water are Ca, Mg, Na, and sometimes K as cations and Cl, SO<sub>4</sub>, HCO<sub>3</sub> and sometimes CO<sub>3</sub> as anions. However, ions of some other elements such as Li, Si, Br, I, Cu, Ni, Co, F, B, Zr, Ti, V, Ba, Ru, Ce, As, Bi, Sb, Be, Cr, Mn, Pb, Mo, Se and P and organic matter are present in minor quantities (Michael, 1997). Quality water is necessary for every type of use, but the quality of natural water is judged by its total salt concentration, a relevant proportion of cations and anions, the concentration of toxic substances like As, Cd, Cr, Pb, Hg, Co, Cu, Mn, Fe, Mo, B, etc. It can be said that any element present in water above the international limit for specific use may be treated as a pollutant. The chemical composition of water is a major factor in determining its quality (Gupta and Gupta, 1998). The stakeholders of Gournadi Upazila mainly use surface water for irrigating their crops, aquaculture, livestock farming, and other purposes. Considering the above points in mind surface water of different union of Gournadi Upazila of Barishal district were assessed to evaluate their quality and suitability.

## Materials and Methods

Research work was done to analyze groundwater samples collected from the different unions of Gournadi Upazila in the Barishal district (Fig. 1). Geographically, the experimental site is located at 22.9736°N 90.2306°E. It has 37,047 households and a total area of 144.18 km<sup>2</sup>.

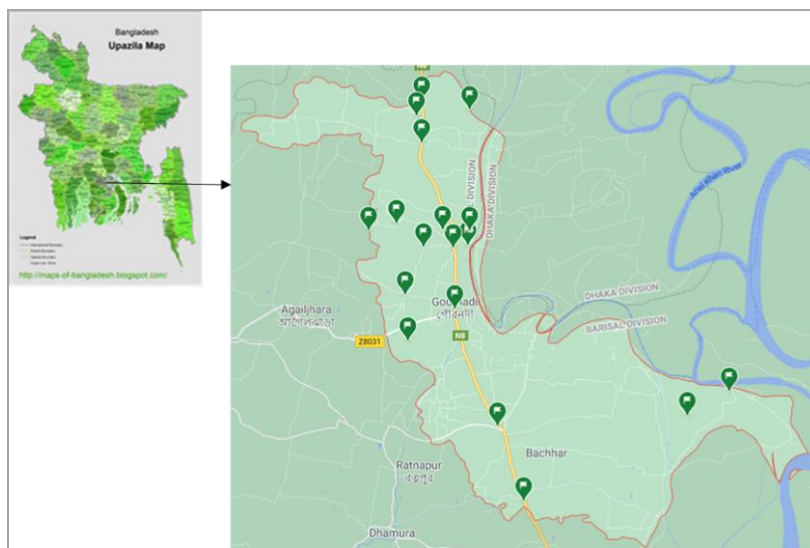


Fig. 1. Sampling locations (green balloons) of Gournadi Upazila

**Collection of water samples:** Samples were collected from each union of Gournadi Upazila. Twenty surface water samples were collected in each 500 ml plastic containers maintaining 2-3 kilometer intervals. Before sampling, containers were again rinsed 3 to 4 times with water to be sampled. The collected samples were tightly sealed immediately to avoid exposure to air. Samples were filtered through Whatman no.1 filter paper to remove undesirable solid and suspended materials. The water samples after proper marking and labeling were carried to the Agricultural Chemistry laboratory, PSTU. The samples were analyzed as early as possible on arrival at the laboratory. Water sampling techniques were followed as outlined by Hunt and Wilson (1986).

**Analytical procedures:** The pH values of water samples were determined by taking 50 ml of the sample in a 100 ml beaker and inserting the electrode of the pH meter (Model: METTLER TOLEDO AG) into the water as stated by Eaton *et al.* (1995). The electrical conductance of samples was determined electrometrically using a conductivity meter (Model: METTLER TOLEDO) as outlined by Tandon (1995). 50 ml of sample was taken in a beaker. The cell of the conductivity meter was rinsed with distilled water and then placed into the water sample. A total dissolved solid (TDS) is the measure of total inorganic salts and other substances that are dissolved in water. TDS was determined following the procedure of Richard (1968) by using an Electrical Conductivity (EC) meter. The chemical analyses were done following the instructions of APHA (2005). The content of phosphorus was measured with the help of a spectrophotometer (Model T60 U) at 660 nm after 15 minutes after the addition of ascorbic acid within 12 hours. The content of potassium and sodium was determined by a flame emission spectrophotometer. Sulfur was determined by turbidimetric method with the help of a spectrophotometer. Calcium and Mg were determined by the atomic absorption spectrophotometric method.

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

**Results and Discussion**

**pH in surface water:** In Gournadi Upazila of Barishal district, the pH value of surface water ranged from 6.66 to 7.24 (Fig. 2). The highest value (7.24) was found in Baurgahti and the lowest value (6.66) was found in Changutia.

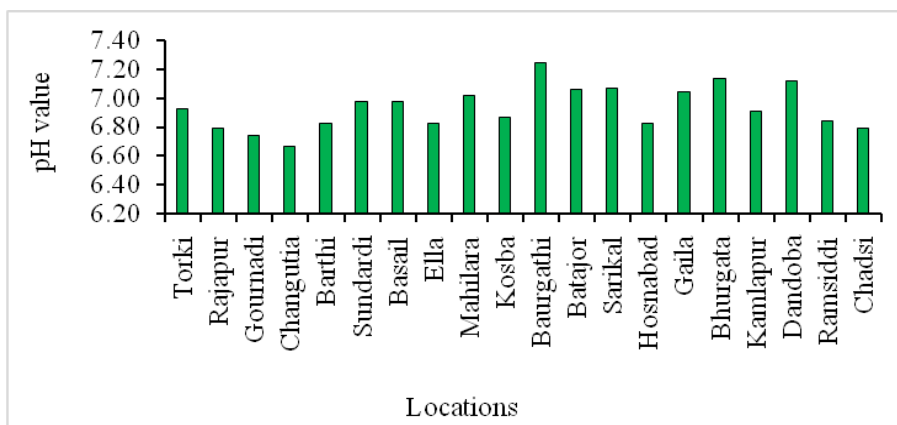


Fig. 2. pH value of surface water samples of different locations

**Electrical conductivity (EC):** Electrical conductivity is the measure of the capacity of a solution to conduct electric current. It is a rapid measure of the total dissolved solids present in ionic form. In Gournadi Upazila of Barishal district, the electrical conductivity of all the collected water samples from different unions was within the limit of 0.18 to 0.50 mS/cm (Fig. 3).



Fig. 3. EC value of surface water samples of different locations

**Total dissolved solids (TDS):** The amount of total dissolved solids (TDS) in surface water samples of different unions of Gournadi Upazila ranged from 112.0 to 322.2 mg/L (Fig. 4). The highest value of TDS (322.2 mg/L) was found in Gaila and the lowest value of TDS (112.0 mg/L) was found in Changutia and Hosnabad.

**Calcium (Ca) content:** In the different unions of Gournadi Upazila of Barishal district, the concentration of Ca ions ranged from 10.16 to 22.5 mg/L. The highest value of Ca ion (22.5 mg/L) was found in Basail and the lowest value (10.16 mg/L) was found in Sarikal and Hosnabad (Fig. 5).

**Magnesium (Mg) content:** In the research area of Gournadi Upazila of Barishal district, the concentration of Mg ions ranged from 4.54 to 45.42 mg/L (Fig. 6). The highest value of Mg ion (45.42 mg/L) was found in Gournadi and the lowest value (4.54 mg/L) was found in Hosnabad.



Fig. 4. TDS value of surface water samples of different locations

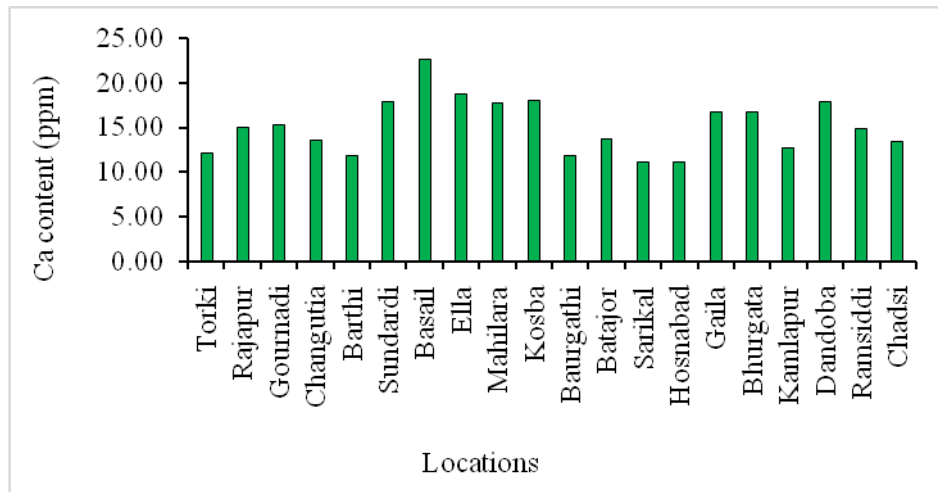


Fig. 5. Ca content in surface water samples of different locations



Fig. 6. Mg content in surface water samples of different locations

**Sodium (Na) content:** In the research area of Gournadi Upazila of Barishal district, the concentration of Na ion ranged from 120.60 to 516.89 mg/L (Fig. 7). The highest value of Na ion (516.89 mg/L) was found in Turki and the lowest value (120.60 mg/L) was found in Basail and Kosba.



Fig. 7. Na content in surface water samples of different locations

**Potassium (K) content:** The amount of total potassium in surface water samples of different unions of Gournadi Upazila ranged from 3.15 to 16.98 mg/L (Fig. 8). The highest value of K (16.98 mg/L) was found in Kosba and the lowest value (3.15 mg/L) was found in Ella.

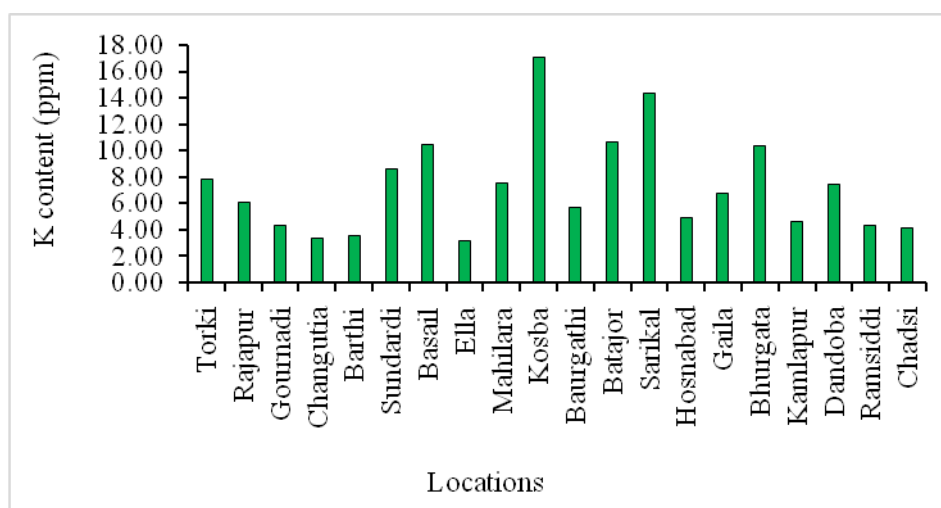


Fig. 8. K content in surface water samples of different locations

**Sulfur (S) content:** In the research area of Gournadi Upazila of Barishal district, the concentration of S ion ranged from 4.66 to 44.28 mg/L (Fig. 9). The highest value of S ion (44.28 mg/L) was found in Changutia and the lowest value (4.66 mg/L) in Barthi.

**Phosphorus (P) content:** The amount of total phosphate in surface water samples of different unions of Gournadi Upazila ranged from 0.52 to 1.96 mg/L (Fig. 10). The highest value of P (1.96 mg/L) was found in Batajor and the lowest value (0.52 mg/L) was found in Rajapur and Kamlapur.



Fig. 9. S content in surface water samples of different locations

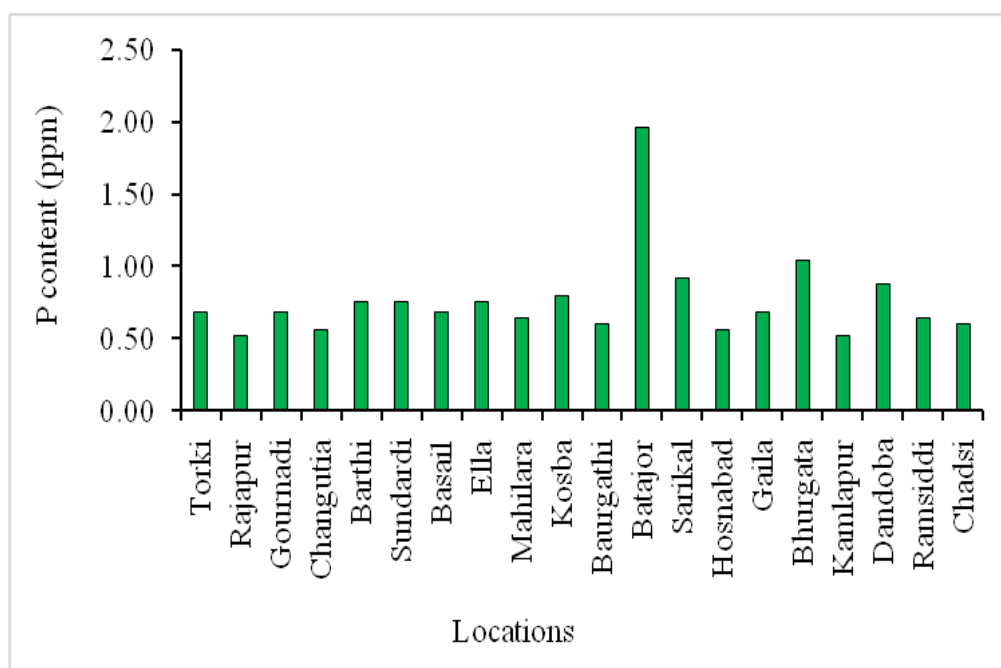


Fig. 10. P content in surface water samples of different locations

The analyzed values were compared with different national as well as international standard and the observations are stated in Table 1. Accordingly to Ayers and Westcott (1985) as well as WHO, (1971) standards all studied surface water samples (except fewer) were suitable for irrigation and livestock purposes.

Table 1. Comparison of average surface water quality of the present study with those of others at coastal Barishal district of Bangladesh

Parameters	Units	Present study	Irrigation standard by Ayers and Westcott, (1985)	Irrigation standard by Freeze and Cherry (1979)	livestock consumption standard by WHO (1971)	Remarks
pH	-	6.66-7.24	6.5 to 8.4	-	6.5 to 9.0	Suitable for drinking, irrigation and livestock consumption purposes
EC	mS/cm	0.18-0.50	-	-	0.05 to 0.60	Suitable for irrigation and livestock consumption purposes
TDS	mg/L	112.0-322.2	-	<1000	-	Suitable for irrigation purpose
Ca	mg/L	10.16-22.5	0.00-800	-	<75	Suitable for drinking, irrigation and livestock consumption purposes
Mg	mg/L	4.54-45.42	<120	-	<45	Suitable for drinking, irrigation and livestock consumption purposes
Na	mg/L	120.60-516.89	<103.5	-	34.5-356.5	Suitable for irrigation and livestock consumption purposes
K	mg/L	3.15-16.98	<2.0	-	11.7-31.2	Suitable for livestock consumption purpose
S	mg/L	4.66-44.28	<20	-	200	Suitable for irrigation and livestock consumption purposes
P	mg/L	0.52-1.96	<2	-	5	Suitable for irrigation and livestock consumption purposes

### Conclusion

The pH indicated that surface water samples were neutral to alkaline in nature and were suitable for irrigation, drinking, and livestock consumption (pH value 6.66-7.24 in surface water). On the basis of EC, all the samples were found to be non-saline (EC value 0.18-0.50mS/cm). The concentration of Ca, Mg, Na, P, S, and K for surface water ranged from 10.16-23.0 mg/L, 4.87-45.42 mg/L, 301.10-703.41 mg/L, 0.52-1.96 mg/L, 4.66-44.28 mg/L and 3.15-16.98 mg/L, respectively. The surface waters were rated suitable for irrigation, drinking, and livestock consumption on the basis of Ca, Mg, Na, and P, S, and K concentrations.

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