

Short note

DETERMINATION OF QUALITY INDEX FOR SURFACE AND GROUND WATER OF JASHORE, BANGLADESH

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Abstract

The purpose of present study was to estimate the water quality index (WQI) for describing water quality of both surface water and groundwater of Jashore, Bangladesh. The samples were collected from pond and tube-well water of the campus area of Jashore University of Science and Technology and Bhairab river, Jashore in February 2019. The collected samples were analyzed to calculate WQI from the following parameters: pH, electrical conductivity, total alkalinity, total suspended solids, total dissolved solids, dissolved oxygen, total hardness, chloride ions, biological oxygen demand, and sulphate ions. WQI values found in this study for tube-well, pond and river water samples were in the range of 43-47, 61-85, and > 100 which demonstrate the status of water as good, poor, and polluted, respectively. The published results obtained from this investigation may acquaint the residents of the research area about using the water mainly in drinking purpose.

Keywords: WQI, pond water, tube-well water, river water.

Water is one of the most essential resources for life. If we search for finding of life to anywhere, the first question we ask is that is there any existence of water? About 70% of the body weight of almost all living organisms comprises of water (Rajankar *et al.*, 2009). Three main sources of water used in drinking, irrigation and industrial applications are rain, surface water and ground water. Only 2.8% of water on earth is present as fresh and remaining is salty (Peter, 1993). Among other sources groundwater is superior for drinking purpose because of effective filtering effect. It is the cheapest and most practical means of providing water to communities (Peter, 1993).

Surface water (pond and river) is the main source of irrigation, household activities, and industries applications.

The rapid growth of urban areas and industries, along with the excessive uses of chemicals and pesticides in irrigation has further affected the quality of both surface water and groundwater. Over exploitation of resources and improper waste disposal are polluting water day by day (UN-Water, 2001). Polluted water is harmful for all cases to make comfortable of aquatic and biotic life. An estimation of Witt based on (WHO, 1992) report suggests that about 80% of all human diseases in the developing

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countries like Bangladesh are mainly due to water pollution. There is a report that more than fourteen thousand people die because of water borne illness per day (UNESCO, 2009).

In Bangladesh, ground water is mainly used as drinking and surface water is used for industrial, household and irrigation purposes. No doubt, the quality of water is always questionable (WHO, 2018). Day by day, the level of ground water is going down from

earth surface and contaminating by heavy metal pollutants. 8.5% of the total death in this country is caused by water, sanitation, and hygiene related issues every year (UN-water, 2013). Therefore, it is a great demand to know the quality of water, its maintenance, and effects on human health. In this study, our attempt was to determine the important water quality parameters of surface and groundwater from different sites of Jashore and increase

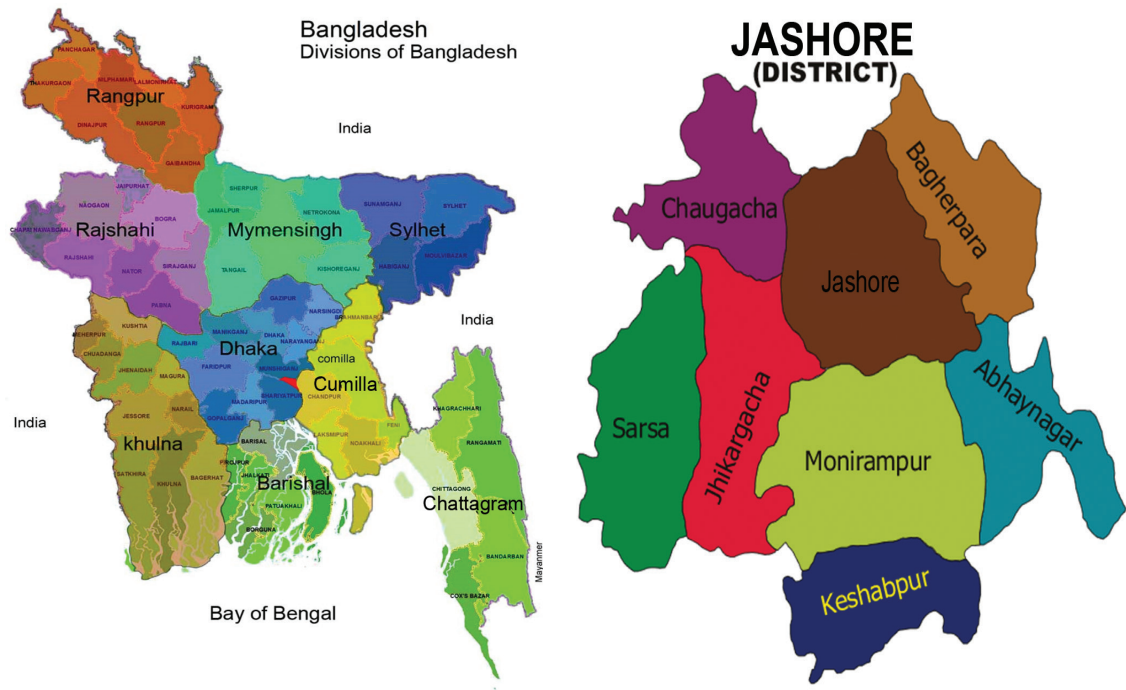


Fig. 1. Map of research area.

the awareness of harmful effects of water pollution among the people.

Overall quality of a water body can be expressed by a simple and single number namely Water Quality Index (WQI), based on several essential water quality parameters (Islam *et al.*, 2013). This single value helps to make the complex and comprehensive water

quality data into easy and understandable information.

The surface water samples were collected from the ponds of JUST campus and Bhairab river at Jashore district in Bangladesh. Groundwater is also collected from the tube-wells and tap of JUST campus. Ten essential and most used water quality parameters namely pH, total

suspended solid (TSS), total dissolved solid (TDS), electrical conductivity (EC), total alkalinity (TA), chloride ions, total hardness (TH), dissolved oxygen (DO), sulfate ions, and biological oxygen demand (BOD) were analyzed by the following standard methods (APHA, 2005; Trivedy and Goel, 1986). WQI was calculated using these parameters by the following weighted arithmetic index method (Brown *et al.*, 1970);

$$WQI = \frac{\sum q_n w_n}{\sum w_n}$$

Where, q_n and w_n are quality rating and unit weight of n th water quality parameters respectively.

Now, q_n is calculated as follow;

$$q_n = \frac{V_n - V_i}{V_s - V_i} \times 100 \quad [V_i = 0, \text{ except for pH } (V_i = 7.0) \text{ and DO } (V_i = 14.6 \text{ mg/l})]$$

Here, V_n , V_i and V_s indicate the actual values, ideal values, and standard values respectively for the n th water quality parameter.

On the other hand, w_n is calculated by following formula;

$$W_n = \frac{k}{V_s} \quad \text{Here, } k = \frac{1}{\left(\sum \frac{1}{V_s} = 1, 2, \dots, n\right)}$$

Water quality index was calculated from the data of observed values and standard values of important water quality parameters using standard method. The statistical summaries of water quality parameters is presented in the following Table 1.

Table 1. Calculation of water quality index for tube-well water (Shahid Mashiur Rahman Hall) (BS, WHO. 2012 and BIS. 2012)

Parameters	Observed values (v_n)	Standard values (v_s)	Unit weight (w_n)	Quality rating (q_n)	$w_n q_n$
pH	7.32	6.5-8.5	0.1722	21.33	3.674
Conductivity	772	300	0.004878	257.3	1.25
TSS	57	120	0.0122	47.5	0.5795
TDS	386	1000	0.001463	38.6	0.0564
Total alkalinity	187	120	0.0122	155.83	1.901
DO	3.52	5	0.2927	115.42	33.78
Total hardness	210	300	0.004878	70.0	0.3415
Chloride ions	150	250	0.005854	60.0	0.351
BOD	0.18	3	0.4878	6.0	2.926
Sulphate ions	84	250	0.005854	33.6	0.1967
	-	k=1.4635	$\sum w_n = 1.0003$	-	$\sum w_n q_n = 45.05$
Water Quality Index = $\sum w_n q_n / \sum w_n = 45.04$					

All parameters are in mg/l except pH and electrical conductivity ($\mu\text{S}/\text{cm}$)

Similarly, the WQI of other sources are calculated using observed and standard values. The literature values and estimated values of WQI, its level, and possible usage of water are shown in Table 2 and Table 3, respectively.

The pH of research sites is within the acceptable limit. In this investigation, it was observed that the pH values of surface water were higher than the ground water indicating

that this water is not suitable for household and industry uses because of its corrosive property.

Both TSS and TDS values tube-well and pond water were satisfactory. Although, TSS values of surface water were within permeable limit, TDS values were very higher than the standard value. Higher amounts of both TSS and TDS values in water body are problematic to use the water for drinking and industrial purposes.

Table 2. Water Quality Index (WQI), status of water quality and possible usage of the water (Shweta Tyagi *et al.*, 2013)

WQI (Range)	Water quality status	Possible usage
0-25	Excellent	All purposes mainly drinking
26-50	Good	Drinking, irrigation and industrial
51-75	Poor	Irrigation and industrial
76-100	Very Poor	Only irrigation
Greater than 100	Unsuitable for drinking and fish culture	Proper treatment must need before uses.

Table 3. Summary of WQI and water quality status

Sample source	WQI	Status	Comment
Tube-well (Shahid Mashur Rahman Hall)	45.04	Good	May be used as drinking and household activities
Tube-well (Sheikh Hasina Hall)	43.07	Good	May be used as drinking and household activities
Supply water (Bangabandhu Sheikh Mujib academic building)	46.67	Good	May be used as drinking and household activities
Pond water (Central Mosque)	61.45	Poor	Not suitable for drinking
Pond water (JUST hatchery)	84.63	Very poor	Not suitable for drinking
River water (Bhairab river)	136.31	Highly polluted	Proper treatment needed before using in any purpose

Amount of chloride in tube-well water was below the standard value. However, chloride in tap water was a little higher than the standard value 250 mg/L (WHO, 2012). On the other hand, the river water was salty because of high chloride ion concentration. Chloride comes in water body by dissolution of different minerals, surface run-off from irrigation, industrial wastes discharge, animal feed etc.

DO means amount of total oxygen dissolved in water and it depends on physical, chemical and biological activities of water. The amount of DO found for groundwater was the ranges of 3-4 mg/L and in pond water it was 4-5 mg/L. Maximum DO (10.64 mg/L) was observed in river water. A higher concentration of DO (greater than 12-14 mg/L) can cause 'gas bubble disease' in fishes (Puri and Kumar, 2012), while a low amount of DO level has corrosive property (Zuane, 1996).

Biochemical oxygen demand (BOD) indicates the extent of organic pollution of water. Water contaminated diseases mainly cause due to high values of BOD in drinking water. BOD values found in ground water was less than 0.3 mg/L whereas in river water was 12.7 mg/L which indicates the water body of river was highly polluted organic pollutants.

Alkalinity is mainly due to the presence of carbonate (CO_3^{2-}), bicarbonate (HCO_3^-), and hydroxide (OH^-) ions in water body which come from different dissolved minerals in water. The concentrations of alkalinity in both tube-well and pond water were little higher than the tolerable value but in river water it was too high.

Availability of sulphate in groundwater was 80-120 mg/l which is below the threshold concentration in drinking water while in surface water the range was 110-160 mg/L.

Water quality index is very essential to assess and manage the quality of water. The present investigation reveals important insight into the status of overall acceptability of surface (pond and river) and groundwater (tube-well and tap) in three sites of Jashore based on WQI values. It is observed that the water quality statuses of tube-well, pond and river water are good, poor and highly contaminated, respectively. These results indicate that tube-well water of study sites can be used for drinking purpose, pond water can be used for other purposes except drinking and Bhairab river water cannot be used for any purposes before treatment.

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