

## **Quality Assessment of Pond Water in Rajshahi City**

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### **Abstract**

In developing country like Bangladesh there is lack of pure drinking water due to groundwater pollution. To overcome this problem it is necessary to use surface water. For this reason surface water analysis is essential to find out the alternative safe reliable source. In this study it is attempted to analyze pond water quality. On basis of analysis it is found that pH, DO, TDS, Color, Free Chlorine, Residual Chlorine, Alkalinity, Chloride in most of the pond water in different wards are within acceptable limit for drinking purpose and Turbidity, Conductivity, TSS, Organic matter, BOD, COD are not within acceptable limit for drinking purpose according to the guideline of WHO and BD standard. It was found from the field investigation that the pond water is getting polluted day by day due to continuous dumping of kitchen waste, organic wastes, bathing, clothing and sewage running. Hence available pond water is not safe for drinking purposes without necessary treatment.

*Keywords: Pond Water, Alternative Source, Quality, Safety, Management.*

### **1 Introduction**

Water is one of abundantly available substances in nature. It is the most essential and vital resources for all the living things on the earth. Water is distributed in nature in different forms such as rain water, river water, pond water and mineral water. These forms of water are essential for all socioeconomic development work in rural and urban areas. Developing country like Bangladesh, there is lack of safe water for drinking and other purposes. So the people have to depend on different sources of water like groundwater, river water, stream water, pond water for their daily needs. In Bangladesh more than 90 percent of rural households depend on water supply from ground water on their household and domestic usage. These sources of water are being polluted by human waste, animal waste, domestic waste, refuse dump, jute mills, textiles, sugar mills, tanneries, seepage from pit latrines, fertilizer. Arsenic Contamination of drinking water is significant health problem in Bangladesh (Clemett, et al. 2006).

Ponds and lakes are meant for storing water in order to fulfill the basic demands such as irrigation needs. In older days ponds were maintained by the respective village people but nowadays pond are considered as a dumping site for solid wastes and drainage water. Most of the ponds are polluted due to human intervention and lack of public awareness. Due to disposal of different types of wastes in pond, pond transformed as sink for spreading harmful diseases and to create a polluted unhealthy living environment. Due to this incident of water of water borne diseases like diarrhoea, dysentery, typhoid, fever, jaundice, cholera etc has increased in the recent year (Vanitha, et al., 2013).

The total numbers of ponds in Bangladesh are 1288822 covering an area 150000 hectare (Islam and Chowdhury, 2013). According to Rajshahi Development Authority (RDA), in 1961, there were 4,238 ponds, canals, wetlands in the city, in 1981 the number was 2271, in 2000 the numbers have stood at 729 and now city has only 214 water bodies (Sobhan, 2014).

In many ways the water of Rajshahi city is being polluted day by day. Various kinds of bacteria, harmful germs, toxic elements are present in the water of Rajshahi city. The water of Rajshahi city exhibits higher hardness than rest country. Ground water pollution has been found to be a critical problem in Rajshahi City and surrounding areas. The main problems relate to the high iron content which is the 0.4-3.5 mg/L in Rajshahi City Corporation area which exceeds the national drinking water standards for iron 0.3-1.0 mg/L. The level of manganese was

found to be high 0.1-0.2 mg/L in the Rajshahi City area, which exceeding the national drinking water standard of 0.1 mg/L. High levels of arsenic contamination were also in some areas (Clemett, et al. 2006).

Surface water quality is poor in Rajshahi City because untreated urban effluent is discharged through various drains in the ponds and beels (Seasonal ponds). It is affecting agriculture and human health (Clemett, et al. 2006). As a result all the sources of surface water are being polluted by released wastes. In addition to that insecticides, chemical fertilizers etc are being used for fish cultivation that also increases the pollution in the Rajshahi City Corporation area.

Safe drinking water is a basic need of every human being despite of any socioeconomic status. It is impossible to stop water pollution. But it is possible to reduce water pollution by proper management if necessary. Water pollution level is not same in all places in Rajshahi City Corporation area. It varies time to time and season to season. The simplest solution to reduce water pollution to awareness to the people by making known them which water is safe or which water is not safe for drinking and other purposes of work. The aim of this study is to evaluate the quality of pond water in Rajshahi city and evaluate the safety of using of these pond water as still local people are using pond water for various domestic and household purposes.

## 2 Methodology

On the basis of usage and importance, 30 ponds were selected through field observation taking one from each of 30 wards of Rajshahi City Corporation. Samples were collected, transported and stored following standard sampling procedure for carrying out the tests in laboratory. The physical and chemical parameters viz., DO, BOD, COD, TS, TSS, TDS, Organic matter, colour, pH, Alkalinity, Turbidity, conductivity, residual chlorine, free chlorine and chloride were analyzed. Field investigation for each selected ponds was conducted considering the surrounding environment, dumping of domestic wastes, connection of household wastewater line, connection of surface drain, purposes of use like bathing, washing cloth, washing cattle, etc. that may pollute the pond water and affect on public health. The rates of discharge of drain water to the ponds were also measured during the field investigation.

## 3 Results and Discussions

Collected water samples from 30 ponds were tested for 15 parameters in triplicate. The obtained results are presented in Table 1. The Environmental Conservation Rules 1997 prescribed the standard of DO of water for drinking purpose must be 6 mg/L or above and for other purposes like irrigation, fisheries, recreational activities etc. must be 5 mg/L or above. The experimental results shows that the DO of selected ponds varying from 2.53 to 5.03 mg/L. The concentrations of DO of all ponds are below the 5 mg/L except pond in ward no. 22. Therefore, these ponds water is not suitable for drinking and even for other purposes.

Biochemical Oxygen Demand (BOD) value is used to determine the biological activity of the micro flora and characteristics of the water. According to the Bangladesh Drinking Water Standards (BDSW) allowable limit of Biochemical Oxygen Demand for drinking water purpose is 0.2 (mg/L) and for the other purpose 5mg/L or less. From Table 1 it is seen that Biochemical Oxygen Demand of each pond in every ward is above the allowable limit of drinking purpose and they are varying from 0.6 to 2.07 mg/L. So pond water cannot be used for drinking purpose but pond water can be used for irrigational and fishing purpose.

There are some drawbacks of Biochemical Oxygen Demand. In order to compensate them Chemical Oxygen Demand test is carried out. The method of measurement of Chemical Oxygen Demand depends upon the chemical oxidation of the sample with a strong chemical oxidizing agent, such as potassium dichromate which is capable of oxidizing all the organics. Chemical Oxygen Demand of a sample may be defined as the amount of oxygen required by organic matter in a sample of water for its oxidation by a strong chemical oxidizing agent such as potassium dichromate. In the domestic and industrial purpose COD is 2.5 times than BOD. According to the Bangladesh Drinking Water Standards the allowable limit of the Chemical Oxygen Demand is 4 mg/. The COD of selected ponds vary from 4.43 to 9.32 mg/L which shows the high contamination and not safe for using in domestic purposes.

According to BDWS allowable limit of total solid, total suspended solid and total dissolved solid of water for drinking purpose are 1000 mg/L, 10 mg/L and 500 mg/L. The experimental results show that total solids, total suspended solid and total dissolved solid vary from 370 to 938 mg/L, 50 to 140 mg/L and 298 to 847 mg/L, respectively that indicates the pond water is not suitable for drinking purpose.

Table 1. Experimental results of water quality parameters for 30 ponds in rajshahi city

Ward No.	DO (mg/l)	BOD (mg/l)	COD (mg/l)	TS (mg/L)	TSS (mg/l)	TDS (mg/L)	OM (mg/L)	Color (Pt-Co)	PH	Alkalinity (mg/l)	Turbidity (NTU)	Conductivity ( $\mu$ s/cm)	Residual Chlorine(mg/l)	Free Chlorine (mg/l)	Chloride (mg/L)
1	3	0.6	9.32	400	50	350	350	0.2	6.55	88.7	17.56	1444	0.2	0.1	154.3
2	3.1	0.97	6.35	730	95	635	275	0.05	6.79	89.3	12.57	1210	0.4	0.3	202.7
3	2.7	1	5.64	370	70	300	270	0.2	8.11	94.3	3.44	761	0.3	0.1	174.3
4	3.55	1.17	6.41	625	120	505	293.3	0.05	8.23	82.4	7.68	563	0.2	0.1	175.7
5	3	1.2	5.17	515	105	410	311.7	0.1	7.53	78.4	8.43	1035	0.2	0.2	200.7
6	4.13	1.23	5.56	621.67	63.33	558.3	488.3	0.05	7.43	111	9.76	1155	0.2	0.15	213.9
7	4.07	0.83	9.04	505	121.7	383.3	508.3	0.2	8.03	94.4	7.81	656.7	0.1	0.2	221.7
8	3.67	1.87	7.45	440	123.3	316.7	276.7	0.1	7.62	78.27	6.36	728.3	0.3	0.3	171.7
9	4.43	0.97	4.43	828.33	140	688.3	440	0.05	8.03	107.4	14.1	867	0.2	0.15	161.4
10	3.33	1.1	7.57	665	85	580	350	0.05	8.26	79.6	9.06	708	0.1	0.1	187
11	2.53	0.7	6.68	778.33	56.67	721.7	516.7	0.2	6.23	96.8	9.56	734.3	0.1	0.10	175.9
12	4.43	0.87	6.36	735	110	625	161.7	0.1	7.44	85.43	7.85	555.7	0.2	0.2	222
13	2.6	1.2	5.79	570	100	470	280	0.05	8.43	85.3	5.07	1150	0.2	0.1	195.3
14	2.9	1.6	6.21	620	80	540	300	0.1	8.22	79.2	5.11	1159	0.1	0.2	171.2
15	3.47	1.67	7.23	938.33	128.3	810	216.7	0.05	8.42	72.6	11.1	973	0.1	0.2	179.5
16	3.73	1.33	7.5	863.33	130	733.3	383.3	0.1	8.56	56.2	7.34	1016	0.3	0.1	210.6
17	3.9	1.5	6.89	680	70	610	385	0.1	8.29	96	10.18	854	0.2	0.3	201.4
18	3.23	1.83	6.82	558.33	78.33	480	473.3	0.2	7.64	90.33	9.87	1305	0.2	0.2	163.4
19	2.97	0.93	7.66	781.67	65	716.7	330	0.1	8.59	74.47	6.57	845.3	0.1	0.3	142.5
20	3.3	1.3	6.87	876.7	115	756.7	265	0.1	6.58	99.4	9.87	1003	0.3	0.2	182.3
21	2.7	1.3	6.39	480	80	400	260	0.05	8.43	88.4	5.07	827.3	0.1	0.2	175.5
22	5.03	1.57	8.52	450	70	380	163.3	0.1	7.52	112.6	9.5	908.3	0.3	0.1	146.9
23	3.6	1.87	6.17	898.33	51.67	846.7	278.3	0.05	8.65	75.13	5.66	760	0.1	0.1	159.8
24	2.9	0.8	8.23	630	80	550	160	0.05	8.16	85.6	7.43	1074	0.2	0.2	194.1
25	3.17	0.76	7.46	741.67	85	656.7	193.3	0.2	8.38	83.33	12.25	710.7	0.1	0.2	245.4
26	3.5	2	5.67	450	70	380	230	0.05	8.36	90	7.79	1153	0.2	0.3	164.6
27	4.63	2.07	5.01	416.66	118.3	298.3	110	0.05	7.68	71.87	5.84	916	0.2	0.1	181.2
28	4.07	1.63	6.66	641.67	71.67	570	405	0.1	6.86	106.3	3.96	1323	0.2	0.2	229.7
29	4.43	1.6	5.02	800	90	710	230	0.1	8.19	97.3	8.37	823	0.3	0.2	166.3
30	3.9	1.5	5.47	420	90	330	200	0.05	8.23	86.6	9.75	884	0.2	0.2	194.7

The results show that the concentrations of organic matter are varying from 110 to 516.7 mg/L which is extremely higher than the allowable limit of 25 mg/L for drinking water. Colour in the water primarily due to the presence of coloured organic substances, metals such as iron, manganese or highly coloured wastes. According to BDSW and WHO the standard value of colour ranged from 0.05 to 0.20 Hazen unit (Pt-Co). From the results it is seen that the value of color of 30 ponds are within the standard value for drinking purpose. Furthermore the pH value is also within the allowable limits of 6.5-8.5.

The alkalinity of water is a measure of its capacity to neutralize acids. The alkalinity is due primarily to salts of weak acids and strong bases. For the fresh water alkalinity ranges between 20 - 100 mg/L. The water having alkalinity less than 250 (mg/L) is desirable for domestic consumption and R.C.C construction. According to the BDSW allowable limit of alkalinity for the drinking purpose is 120 (mg/L). The obtained results show that the

alkalinity of pond water varies between 56.20 (mg/l) to 112.60 (mg/l) which is within allowable limit of drinking water considering alkalinity.

Turbidity is an expression of certain light scattering and light absorbing properties of a water sample and depends, in a complex manner, on such factors as the number, size, shape, and refractive index of the particulate matter present in the water. Results of turbidity are expressed in NTU. According to the Bangladesh Drinking Water standards standard value of turbidity is 5 NTU and 10 JTU, According to WHO guideline (1993) standard value of turbidity 5 JTU. From the table it is seen that most of the sample having the turbidity more than 5 NTU. So water should be treated before domestic usage but it can be used for other purposes.

Conductivity is the measure of salinity due to the presence of various mineral salts. According to standards of BDWS the allowable range for conductivity is 2.5  $\mu\text{S}/\text{cm}$  and allowable range of conductivity for other purpose is 1055  $\mu\text{S}/\text{cm}$ . The conductivity of selected pond water varies from 555.7 to 1444  $\mu\text{S}/\text{cm}$  which represents the presence of mineral content. The excess conductivity makes the water unsuitable for drinking.

The residual chlorine limit in water should cross 0.2 mg/L because excessive residual chlorine produce bad odour. It causes eye irritation, skin diseases. Water should be boiled before domestic use to remove excessive chlorine in water. According to WHO guidelines (1993) Standard value range of residual chlorine is 0.6 mg/l - 1.00 mg/l and according to Bangladesh Drinking Water Standards, standard value of residual chlorine is 0.2 mg/l. From Table 1 it is seen that according to Bangladesh Drinking Water Standards residual chlorine limit in most of the pond water are within limit. The pond water which residual chlorine are within 0.2 (mg/l) can be used any purpose if residual chlorine contamination is considered. The water which residual chlorine is above than 0.2 (mg/l) must be treated before use. The residual chlorine is maximum in the pond of ward no 2. On the other hand, the standard value for free chlorine is 0.2 mg/l for drinking purpose. In this aspect most of the ponds water satisfies the standard limit of free chlorine for drinking purpose.

Chloride concentration in water is also the measure of salinity that caused by dissolved minerals. According BDWS drinking water standards for chloride is 150-600 mg/l and according to WHO drinking water standards for chloride is 250 mg/l. From the Table 1 it is seen that in all pond water chloride is below 250 mg/l. Therefore, considering chloride content, these ponds water is suitable for drinking and other purpose such as irrigation, etc.

During the field investigation, it was observed that domestic wastes are dumped besides the pond and mixed with pond water. Surface drains are connected with several numbers of pond and discharging wastewater. The banks of the ponds are not protected from pollution by adding foreign matters. Few ponds are also used for washing of cattle. However, same pond is used for washing the utensils, cloths and bathing. The discharge of drain water was measure and the results are shown in Figure 1.

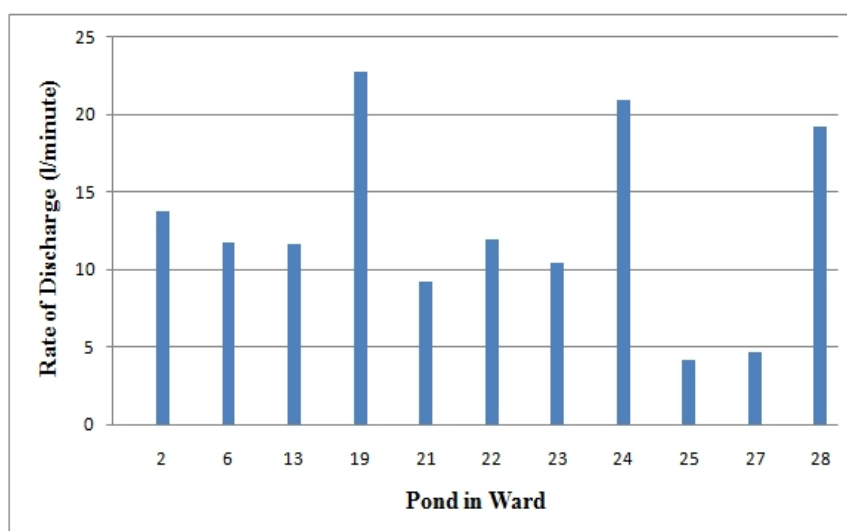


Figure 1. Rate of discharge of drain water in several ponds

Among the studied ponds, 11 ponds of ward no. 2, 6, 13, 19, 21, 22, 23, 24, 25, 27 and 28 have connection with surface drains. The highest discharge of about 23 L/min was measured for the pond in ward no. 19 and the lowest discharge of about 4 L/min was measured for the pond in ward no. 25.

#### 4 Conclusions

From the above results and discussion it could be concluded that water quality of the selected ponds are not suitable for drinking purposes and even for other domestic purposes. The excessive pollution of selected pond water is mainly due to the unprotected bank of pond, drainage connection, disposal of domestic wastes, washing of cattle and lack of awareness. Proper management of ponds can improve the situation.

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