

POTENTIALITY OF POND WATER AS ALTERNATIVE SOURCE

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ABSTRACT

This study has taken an attempt to analyse the quality of ponds water in Rajshahi City. Fourteen water quality parameters were analysed for water samples collected from thirty different ponds from thirty wards. The quality of water has extremely failed to satisfy the drinking standard for suspended solids, turbidity, pH, conductivity, dissolved oxygen, organic matter, BOD₅, COD, total cloiform and also faecal coliform. It is evident from the study that the pond water of Rajshahi City is found to be severely polluted. So pond water cannot be used as a source of drinking purposes without treatment. The pond must be protected from contamination to use as alternative source for domestic use.

Keywords: Pond water; alternative source; domestic use; polluted; treatment

INTRODUCTION

Water is one of the important natural resources useful for developmental purposes in both urban and rural areas. Despite this, most of the rural communities in the developing countries, especially Bangladesh, lack access to portable water supply. They rely commonly on rivers, streams, wells, and ponds for daily water needs (Nevondo and Cloete, 1991). However, World Health Organization (WHO, 2011) mentioned that water from most of these sources is contaminated, yet they are used directly by the inhabitants.

Agricultural wastes such as pesticides, fungicides and fertilizers, human and animal feces, seepage from pit latrines and septic tanks, refuse dump, industrial, domestic and municipal wastes released into water bodies are often responsible for surface water contamination. Contaminated water is associated with health risks. The diseases associated with most surface water supplies include Campbacteriosis, Shigellosis, Salmollosis, Cholera, Dysentery, Typhoid, Diarrhea and a varieties of other bacteria as well as fungi, viral, and parasitic infection (Grabow, 1996).

It is ancient practice of Rajshahi city dwellers to use pond water for their, bathing, washing of cloths, utensils and cattle and even cooking. However, pond is being polluted day by day through various ways. Toxic element and harmful germs may present in the surface water body of the city. All most all minor surface drains are linked with pond in any way and septic tanks are connected with these minor surface drains. Beside these, there are 149 industries in the BSIC industrial area of Rajshahi City (Alexandra, et al. 2006) from which, waste discharges into the surface water. As a result, all the sources of surface water are being polluted by the released wastes. In addition to that insecticides, chemical fertilizers, cow dung etc. are being used for fish cultivation that also increases the pollution level of surface water of the study area. However, water supply coverage is not satisfactory in Rajshahi city (Bari, et. Al, 2005). As a consequence, searching for alternative source is becoming a prime necessity.

Clean, safe and adequate freshwater is vital to the survival of all the living organisms and the smooth functioning of ecosystems, communities and economics. It might not be possible to make the water pollution free by overnight but it is possible to define different sources for different uses with proper treatment if necessary. The water of the study area might not equally polluted by the all contaminants. Pollution level might vary from place to place, time to time and season to season. Some are suitable for drinking, water from some sources are suitable for household works and some are so polluted that even cannot touch. The easiest solution to make the inhabitants free from diseases by making them

known which water should be used for what purposes. Therefore, the aim of this study is to determine the scope of using the existing pond water through the determination of their water qualities as an alternative source of groundwater to reduce the pressure on it.

METHODOLOGY

The study is conducted following sequential standard procedure of selection of ponds, collection of water sample from sources and experimental analysis of water quality parameters. The surrounding physical conditions such as connection with surface drain, domestic wastes disposal, fish culture, etc. of the ponds were also observed.

Selection of Ponds

Total 30 ponds were selected taking one from each ward of Rajshahi City Corporation area. The pond which is larger and frequently used for bathing, washing and other purposes by the people was selected. The selected pond from 30 wards are Horogram Munshiparara pukur, Horogram Notunparar pukur, Bohorompur Pukur, Bulonpur pukur, Mohishbathan pukur, Baganpara pukur, Vatapara pukur, Kajihata pukur, Shahmakhdum dargah pukur, Medical Campus pukur, Methorparar pukur, Fudkipara pukur, Gorhanga pukur, Terokhadia College pukur, Boro pukur, Koyerdara pukur, Postal Academy pukur, Asham Colony pukur, Nol pukur, Sultanabad pukur, Shagorpara pukur (1); Shagorpara pukur (2); Ramchandrapur State Waqof pukur, Ramchandrapur pukur, Raninagar pukur, Meherchhondi Gojari pukur, Shiroil Moth pukur, Dharampur pukur, Dashmari pukur, Iblish Chottor pukur, respectively.

Sample Collection and Storage

The water samples were collected following standard procedure in well washed PET bottles with screw cap to make sure that it is completely free from any undesirable materials. Three samples are collected from each pond. The collected samples are stored in refrigerator for carrying out the analysis at suitable time in the laboratory.

Experimental Procedure

The water quality parameters such as TDS, TSS, TS, pH, DO, Conductivity, Turbidity, Colour, Chloride, Alkalinity, BOD₅, COD, and Organic matter were analyzed. Total Solids (TS), Total Dissolved Solids (TDS) and Suspended Solids (SS) are determined according to APHA 2540B (2005), APHA 2540C (2005) and APHA 2540D (2005), respectively. Conductivity, Dissolve Oxygen (DO) concentration and pH were measured with HACH instrument (APHA 2510, 2005). Turbidity was measured with Turbidity Meter and Colour was measured with Colour disk and Hatch colour kit. The amount of chloride present in water was determined by titrating the given water sample with silver nitrate solution (APHA 4500-ClB, 2005). The alkalinity of water was determined by titrating the water sample with Sulphuric acid of known values of pH, volume and concentrations according to APHA 2320 (2005). The Biochemical Oxygen Demand (BOD₅) and the Chemical Oxygen Demand (COD) were determined as described in APHA 5210B (2005) and APHA 5220C (2005), respectively. The content of organic matter was determined by heat and loss method.

RESULTS AND DISCUSSIONS

Ninety water samples from 30 selected ponds were tested for 14 water quality parameters in the laboratory. The average results of all parameters of selected 30 ponds waster are presented in Fig. 1 to 4.

Total Dissolved Solids

Total dissolved solids (TDS) are the measure of presence of mineral impurities which may indicate the salinity behaviour of water. Water containing more than 1000 mg/l of TDS is not considered desirable for drinking as per Bangladesh and WHO standard. It is found from the experiment that the total dissolved solids are varying from 221.3 mg/l to 782.7 mg/l which is within the acceptable limit. However, total dissolved solids for 19 ponds are above the 500 mg/l out of 30 ponds and in eight ponds it is within 70% to 80% of allowable limit which is alarming for the users. This higher level of TDS is due to washing of cloths by detergent, putting chemical fertilizer for fish culture and minerals coming from the household through drainage connection.

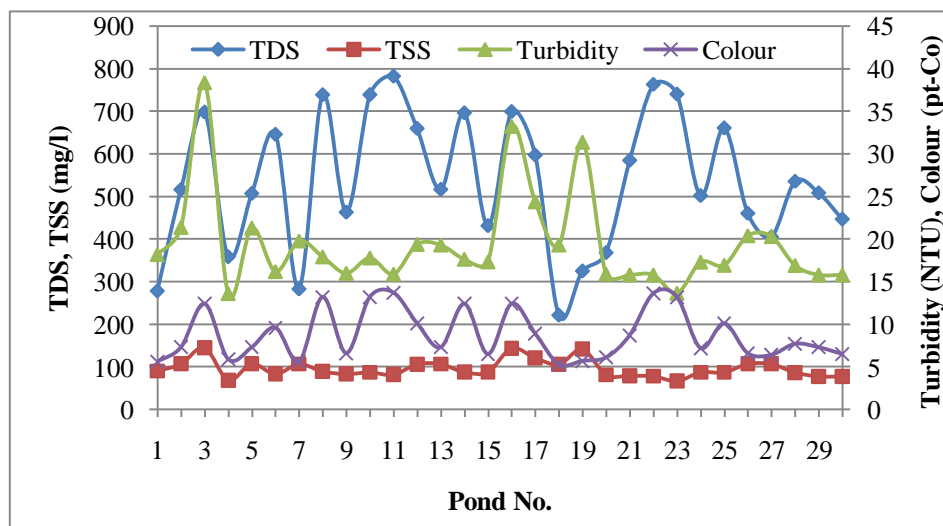


Fig. 1: Concentration of TDS, TSS, Turbidity and Colour of water of 30 ponds in Rajshahi city

Suspended solids

Suspended solids can cause the turbidity of water which indicates the presence of impurities and contaminants. The higher level of suspended solid can cause the aesthetic problem of the users. Therefore, suspended solid should be below the 10 mg/l according to Bangladesh standard for drinking purpose. The results show that the suspended solid in pond water varies from 66.3 mg/l to 144.6 mg/l which is extremely very high. The causes of high suspended solid in all ponds water is due to the throwing of household wastes, drainage connection, fish culture and so one.

Turbidity

Turbidity is a measure of light transmission and indicates the presence of suspended material such as clay, silt, finely divided organic material, plankton and other inorganic material. Higher turbidity indicates the presence of possible bacterial contamination. According to WHO guideline, turbidity in excess of 5 NTU (Bangladesh standard is 10 NTU) is usually objectionable for aesthetic reasons. In case of freshwater lakes and ponds, due to contamination and algal growth the turbidity of these water increases to very high levels. The experimental results show that the turbidity is varying from 13.6 to 38.4 NTU among the 30 pond water. It means that water quality in all ponds in Rajshahi city excessively exceeds the WHO as well as Bangladesh standard and not safe for drinking purpose.

Colour

Coloured water is not always harmful to man, but in most cases even if the water is not harmful people for aesthetic reasons do not prefer it. So it is important to limit the colour of water for domestic supplies. According to Bangladesh Environment Conservation Rules (1997) and WHO guideline the drinking water standard for colour is 15 pt-Co units. The experiment shows that the colour for the pond water in the study area is varying from 5.3 to 13.7 pt-Co units. Though the colour is within the allowable limit but in some ponds' water the colour is closer to the limiting value. The cause of colour is usually due to presence of dissolved and suspended impurities in water. Therefore, care should be taken to reduce the dissolved and suspended solids.

pH

The pH values of 30 ponds water were measured to be of 8.01 to 8.89 which means the water are of alkaline in nature. However, the allowable limit is varying from 6.5 to 8.5 as per WHO and Bangladesh standard. The pH values of pond water from ward no. 8, 12 and 13 have exceeded the allowable limit and 7 and 26 are at the limiting value of 8.5.

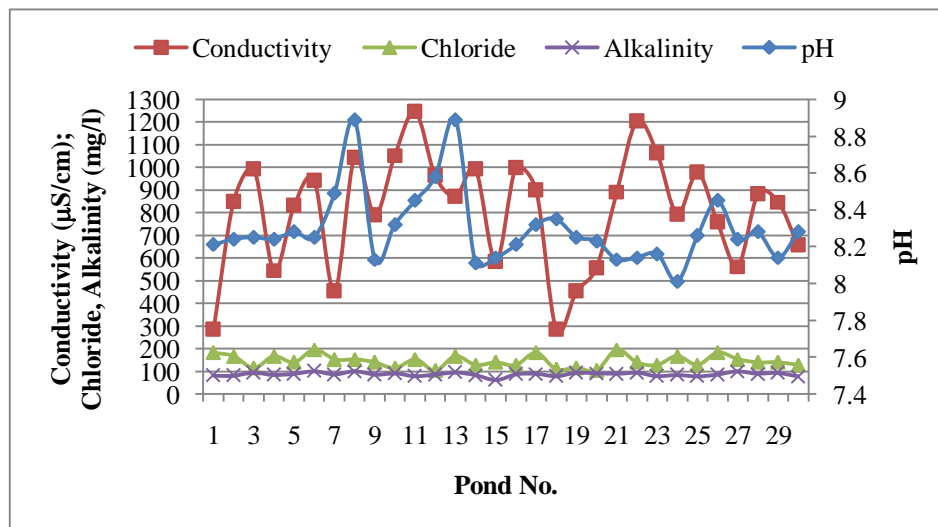


Fig. 2: Concentration of conductivity, chloride, alkalinity and pH of water of 30 ponds in Rajshahi city

Electric conductivity

The electric conductivity value gives a rapid and inexpensive way of determining the ionic strength of a solution. This is an easy measurement to make and relates closely to the total dissolved solids content of water. The total dissolved solids are about seventy percent of the conductivity. In the ground water, the ionisable salts are lesser and thereby the conductivity is also lesser in nature. Water having more number of ionisable salts for example sea water, is having high conductivity. The fresh water bodies only have a minimum amount of salts and have moderate conductivity. The conductivity of distilled water should be of 0.5 $\mu\text{S}/\text{cm}$ and the water having conductivity within the ranges of 500 to 800 $\mu\text{S}/\text{cm}$ can be used for drinking and domestic purposes. The experimental results show that the conductivity of pond water varies from 285 to 1246 $\mu\text{S}/\text{cm}$. Furthermore, it is found that more 50% pond water exceeds the maximum limit of conductivity. However, water can be used as potable water up to the conductivity limit of 1055 $\mu\text{S}/\text{cm}$ (WHO, 2011).

Chloride content

The high concentrations of chloride ions may aide the corrosion of plumbing system. Very high chloride content of water may also produce laxative effect. An upper limit of 250 mg/l has been set by WHO for the chloride ions but Bangladesh has set a wide ranges varying from 150 to 600 mg/l. An increase in the normal chloride content of water may indicate possible pollution from human sewage, animal manure or industrial wastes. From the graph it is shown that the chloride of all the samples is less than 250 mg/l. So it is within the WHO and Bangladesh standard. This water can be used for any purpose if other parameters satisfy the standard.

Alkalinity

Alkalinity is a measure of the capacity of water to neutralize acids. The predominant chemical system present in natural waters is one where carbonates, bicarbonates and hydroxides are present. Water may have a low alkalinity rating but a relatively high pH or vice versa, so alkalinity alone is not of major importance as a measure of water quality. Alkalinity is not considered detrimental to humans but is generally associated with high pH values, hardness and excess dissolved solids. High alkalinity waters may also have a distinctly flat, unpleasant taste. For the pleasant taste of water, alkalinity should not exceed 200 mg/l for potable water. For the fresh water alkalinity ranges between 20 to 100 mg/l. For drinking purpose the standard desirable limit of alkalinity in potable water is 120 mg/l (WHO, 2011). It is found that the value of Alkanity of pond water of Rajshahi lies within the acceptable limit in drinking water and varying is from 60 mg/l to 100 mg/l.

Dissolved oxygen

Higher value of dissolved oxygen indicates the presence of less organic matter. On the other hand, lower value of dissolved oxygen means the presence of high content of organic substances and continual degradation of it by the microbial action. Lower DO concentration also indicates the presence of high number of microorganisms. For drinking purpose the standard DO value must be 6 mg/l or above as per both Bangladesh and WHO standards. However, the DO value must be 5 mg/l or above for other purposes like irrigation, fisheries, recreational activities. From the experiment it is found that the DO concentration is very low of the ponds in Rajshahi city compared to the standard value. It is varying from 2.5 to 4.9 mg/l. This lower dissolved oxygen might be due to the degradation of household wastes which thrown in the ponds.

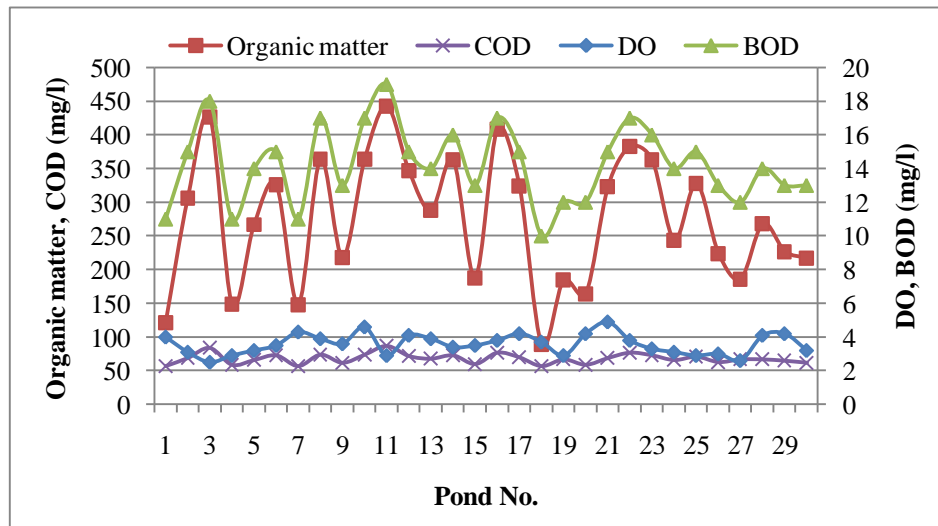


Fig. 3: Concentration organic matter, OD, BOD and COD of water of 30 ponds in Rajshahi city

Organic matters

Organic matters pollute the water. The presence of organic matter in the concentration of more than 500 mg/l, the water is considered as polluted water. If the concentration of organic matter is within 50 mg/l to 500 mg/l then it can be used for other purpose like aquaculture, recreational and irrigational purposes. The allowable level of organic matter for drinking water is less than 50 mg/l. The ponds water of Rajshahi city contain organic matter varying from 89 mg/l to 443 mg/l. Therefore, the water cannot be considered as polluted but cannot be used for drinking purpose without necessary treatment.

Biochemical Oxygen Demand (BOD)

Biochemical Oxygen Demand (BOD) detects only the destructible proportion of organic substances and as a general principle is therefore lower than the COD value, which also includes inorganic materials and those materials which cannot be biologically, oxidized. Ordinary domestic sewage may have a BOD of 200 mg/l. Any effluent to be discharged into natural bodies of water should have BOD less than 30 mg/l. This is important parameter to assess the pollution of surface waters and ground waters where contamination occurred due to disposal of domestic and industrial effluents. Drinking water usually has a BOD of less than 1 mg/l. But, when BOD value reaches 5 mg/l, the water is doubtful in purity (WHO, 2011). The BOD of pond water of the study area is ranges from 10 mg/l to 19 mg/l which is very high compared to the acceptable limit for drinking purpose by WHO. The results indicate that the water of the ponds are containing impurities and cannot be used for drinking without treatment. However, this water can be used for irrigational.

Chemical Oxygen Demand (COD)

For domestic and some industrial wastewater COD is about 2.5 times BOD. The ratio of BOD to COD is useful to assess the amenability of waste for biological treatment. Ratio of BOD to COD greater than or equal to 0.8 indicates that water highly polluted and amenable to the biological

treatment. The standard value of COD by WHO (WHO, 2011) and Bangladesh standard is 4 mg/L (GoB, 1997). The COD of pond water in the Rajshahi city is also higher than the acceptable limit as BOD which is ranging from 57 mg/L to 87 mg/L. This high content of BOD and COD is due to the addition of household organic and inorganic wastes, drainage effluent, fish feed, detergent, etc.

Coliform

Single number of faecal coliform or total coliform is not allowed for drinking water. Total coliform and faecal coliform in pond water are found from 131 CFU/100 ml to 362 CFU/100 ml and 77 CFU/100 ml to 244 CFU/100 ml, respectively. The results depicted that the water of these selected ponds are highly polluted with disease producing bacteria.

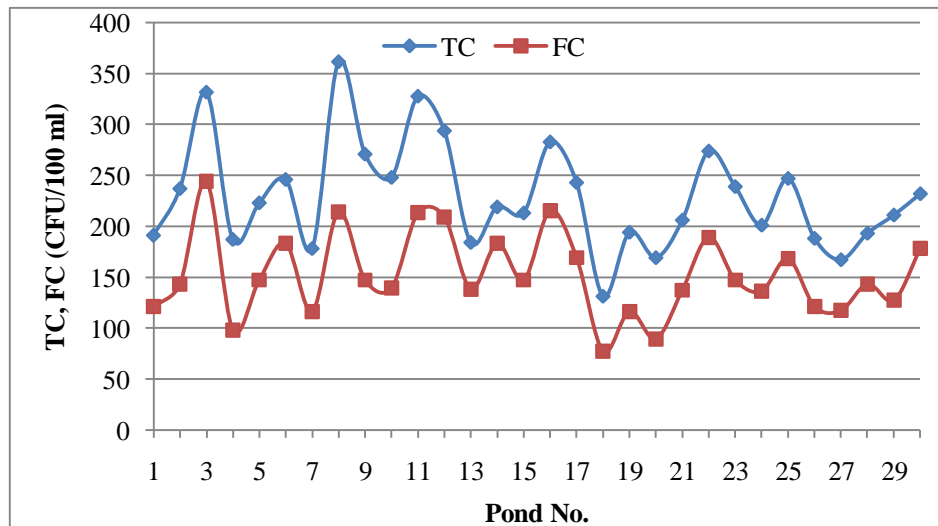


Fig. 4: Bacteriological quality of water of 30 ponds in Rajshahi city

CONCLUSIONS

It can be concluded from the study based on the experimental results that the water of all the ponds are highly polluted and not safe for using in drinking purpose and even for domestic use. The worst quality of water is found in Methorparar pukur under ward no. 11 and on the other hand, relatively less polluted water quality is found in Asham Colony pukur under ward no. 18. The ponds must be protected from wastewater discharge through the drainage connection, household wastes throwing, cattle washing and addition of fertilizer to use the pond water as an alternative source of domestic water supply. At the present situation, the pond water is not safe for even bathing, washing of utensils, washing of cloths, etc.

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