

Study of Physico-chemical Characteristics of Some Water Ponds of Ayodhya-Faizabad

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Increasing industrialization and population causes increase in living standard, which results decrease in the quality of water. Pond water [Khirgali pond (A), Indira pond (B), Vidya Kund pond (C) and Dantdhawan Kund pond (D)] were analyzed for various physico-chemical characteristic (temperature, pH, dissolved oxygen (DO), biological oxygen demand (BOD), electrical conductivity (EC), total dissolved solids (TDS), alkalinity, hardness, total phosphate and total nitrate). TDS, BOD, alkalinity, total hardness and total phosphate were found to be beyond permissible standards, while pH, DO, total nitrate was recorded within the limit. Of these 4 ponds, Khirgali pond is most polluted. These water bodies are not suitable for domestic and drinking purposes, so that possible remedial measures should be adopted for these water resources of Ayodhya and Faizabad.

KEYWORD

Physico-chemicals, Water ponds, Pollution.

INTRODUCTION

Water is an elixir of life. It governs the evolution and functions of universe on the earth hence water is 'mother of all living world'. Majority of water available on the earth is saline in the nature; only small quantity exists as fresh water. Fresh water has become a scarce commodity due to over exploitation and pollution (Ghose and Basu, 1968; Gupta and Shukla, 2006; Patil and Tijare, 2001; Singh and Mathur, 2005). Industrial, sewage and municipal wastes are being continuously added to water reservoirs, affect physico-chemical quality of water making them unfit for use of livestock and other organisms (Dwivedi and Pandey, 2002). Ayodhya and Faizabad are located at the bank of river Saryu, in a 6 km down stream, stretch, at 26° 47' N latitude and 82° 13' E longitude with a 12 km² area. There is no sewerage system for sewage disposal and thus almost all of the sewage and waste of domestic and municipal origin including industries and workshops are either thrown directly into river water or carried through open drainage liquid effluents into Saryu and other small fresh water bodies within municipal limit of the township.

Uncontrolled domestic wastewater discharge into the pond have resulted in eutrophication of ponds as evidence by substantial algal bloom, dissolved oxy-

gen depletion in the subsurface water, large fish kill and malodor generation (Pandey and Pandey, 2003). These conditions continued unabated and gave rise to a monoculture of water hyacinth that covered almost the entire ponds. Excessive algal growth has been noticed in the ponds due to high concentration of nutrients. Khirgali pond (A) and Indira pond (B) located in mid of the city Faizabad is such pollution load by the wastes. Interference with fishing and irrigation type of water bodies, which have been found under the stress of purpose, loss to human health and cattle population, etc., are the some serious and alarming situation of these ponds due to regular discharge of municipal wastes/sewage in them. Ayodhya has great religious importance, so million of pilgrims from every corner of India visit it every year. Vidya Kund (C) and Dantdhawan Kund (D) pond located in mid of Ayodhya. Human activities affect physico-chemical parameters and cause eutrophication. There were no such studies from this region and, therefore, present work was undertaken to find out status of these pond waters.

MATERIAL AND METHOD

The physico-chemical characteristic of water is important determinant of the aquatic system. Their characteristics are greatly influenced by climatic vegetation and general composition of water. The present study was carried out in the month of July, 2005 to June, 2006 for these water ponds of Ayodhya and Faizabad.

Table 1. Comparative study of physico-chemical properties of different pond waters, in ppm

Parameter	Khargali pond (A)			Indira pond (B)		
	Summer	Rainy	Winter	Summer	Rainy	Winter
Temp., °C	30.8 ±	26.0 ±	18.8 ±	30.5 ±	26.3 ±	18.4 ±
	4.32	2.37	2.51	2.94	3.01	2.08
pH	7.8 ±	7.1 ±	7.6 ±	7.6 ±	7.2 ±	7.4 ±
	0.91	0.81	0.58	0.81	0.58	0.80
EC, µmhos/cm	617.2 ±	522.2 ±	562.8 ±	555.7 ±	485.9 ±	503.8 ±
	50.15	46.38	61.37	49.37	42.37	49.58
TDS	653.8 ±	678.7 ±	641.2 ±	573.5 ±	590.3 ±	548.6 ±
	59.28	72.51	69.08	61.08	52.39	55.46
DO	1.5 ±	1.8 ±	2.1 ±	1.8 ±	2.0 ±	2.3 ±
	0.09	0.13	0.11	0.21	0.13	0.28
BOD	76.3 ±	66.5 ±	53.3 ±	65.0 ±	58.4 ±	50.8 ±
	6.83	7.05	4.37	5.29	6.73	7.01
Alkalinity	358.4 ±	324.8 ±	298.5 ±	289.1 ±	255.2 ±	244.6 ±
	32.28	35.81	23.76	24.51	32.19	28.17
Total hardness	583.5 ±	598.4 ±	552.2 ±	571.2 ±	580.9 ±	550.5 ±
	64.91	52.86	49.91	51.07	61.53	49.98
Total N ₂ + nitrate	5.1 ±	6.0 ±	4.8 ±	2.2 ±	2.6 ±	1.5 ±
	0.62	0.79	0.34	0.26	0.23	0.09
Phosphate	3.0 ±	3.5 ±	2.6 ±	2.1 ±	2.6 ±	1.7 ±
	0.17	0.27	0.31	0.18	0.28	0.21

Table 1. continue

Vidya Kund (C)			Dantdhawan Kund (D)			WHO standard
Summer	Rainy	Winter	Summer	Rainy	Winter	
29.9 ±	26.1 ±	18.8 ±	29.8 ±	25.8 ±	18.6 ±	-
3.37	3.12	22.34	23.71	22.28	20.01	
7.5 ±	6.9 ±	7.2 ±	7.5 ±	7.2 ±	7.2 ±	
0.83	0.49	0.67	1.01	0.81	0.56	7.0-3.5
498.6 ±	363.2 ±	430.9 ±	415.2 ±	389.7 ±	419.4 ±	
44.31	41.37	39.52	35.68	31.09	46.37	
510.0 ±	549.7 ±	450.0 ±	548.7 ±	565.8 ±	528.5 ±	500.0
56.07	60.19	49.87	48.26	49.89	55.31	
2.0 ±	2.2 ±	2.8 ±	2.1 ±	2.4 ±	3.0 ±	
0.14	0.28	0.38	0.17	0.18	0.38	4.0-6.0
37.4 ±	30.4 ±	23.9 ±	48.1 ±	43.1 ±	36.8 ±	
4.92	2.19	1.99	3.94	4.08	4.13	
233.3 ±	202.9 ±	185.7 ±	253.2 ±	223.4 ±	216.8 ±	120.0
21.8	23.64	20.01	21.27	18.92	23.72	
548.1 ±	560.5 ±	528.4 ±	558.7 ±	565.8 ±	548.0	
61.72	59.75	45.29	59.91	16.80	49.78	500.0
2.2 ±	3.3 ±	1.1 ±	1.6 ±	1.8 ±	1.0 ±	
0.18	0.41	0.08	0.09	0.15	0.12	
1.2 ±	1.6 ±	0.6 ±	2.9 ±	3.5 ±	1.6 ±	10.0
0.08	0.18	0.07	0.18	0.24	0.18	

Note : All values are Mean ± SEM of three replicates.

Study area

Khirgali pond (A) : It is semi permanent type of pond acquiring an area of 0.049 ha, in dense populated area of the town. It is actually a meeting junction of 2 main city surface sub drain, namely Railway Station and Fatehganj. It is situated 8 km east-south the Faizabad.

Indira pond (B) : It is situated west-north to Faizabad near civil line and the area is approximately 1.303 ha.

Vidya Kund pond (C) and Dantdhawan Kund pond (D) : It is situated east-north to Ayodhya and the area are 0.253 ha and 0.594 ha, respectively. Their depths are approximately 25 feet and 18 feet, respectively.

The water samples were collected in 1 L container from surface water at all the sites around 10.00 am. All the 4 ponds were selected for regular monitoring of physico-chemical factors. Water temperature recorded by centigrade thermometer. The pH and DO of the water samples was determined on spot. All other physico-chemical parameters (electrical conductivity (EC), total dissolved solids (TDS), biochemical oxygen demand (BOD), alkalinity, hardness, total phosphate and total nitrate) were analyzed by the standard methods (APHA, AWWA, WEF, 1993).

RESULT AND DISCUSSION

The result obtained by physico-chemical analysis of all sample are given in the table 1. During the experimental period maximum temperature found in A pond in summer season (30.8 °C) and minimum water temperature (18.4 °C) in B pond in winter season. The water temperature largely followed the changes in solar radiation. The ambient air temperature influence and water temperature. Temperature is one of the most important factors in the aquatic environment (Singh and Mathur, 2005). The temperature plays a crucial role in physico chemical and biological behaviour of aquatic system (Dwivedi and Pandey, 2002). Temperature has no direct on aquatic life up to 39 °C in the river (Ghose and Basu, 1968), while Joshi and Singh (2001) observed that solubility of oxygen in the water increased when water temperature decreases. The pH value of A pond was recorded as 7.8 in summer while it was 6.9 in C pond in rainy season (Table 1). High value of pH was recorded in the summer season because of due to utilization of bicarbonate and carbonate buffer system (Bohra,

1976). The low pH value was found to be during monsoon season because of due to influence of fresh water influx, dilution of lake, low temperature and organic matter decompositions (Zingde *et al.*, 1987).

The highest EC value (617.2) was recorded in A pond, in summer season while lowest in rainy season (363.2). The lowest EC value, in the rainy season was possibly due to rainfall in the catchments area. The present results are in conformity with the earlier works elsewhere (Pandey and Pandey, 2003; Kulshrestha, 1989). However, the concentration of dissolved solids were found to be directly proportional to the ionic strength, and the increase in conductivity may be possibly due to leachate infiltration from the soil (Sastry *et al.*, 1999). TDS was maximum in A pond while minimum in C pond in rainy and winter season, respectively. Due to contamination of domestic wastewater, garbage, fertilizer, etc., in the natural surface water body, the value of TDS was reported to be high. Indeed, high concentration of TDS enriches the nutrient status of water body which were resulted into eutrophication of the aquatic ecosystem (Singh and Mathur, 2005; Swaranlatha and Rao, 1998).

In the present study DO was recorded maximum in D pond while minimum in A pond, in winter and summer season, respectively. The phenomenon of re-oxygenation of water during monsoon may be due to circulation and mixing by inflow after monsoon rain (Hannan, 1979). It further, progressed in winter, may be due to circulation by cooling and draw down of DO in water (Dwivedi and Pandey, 2002). Occurrence of low DO value has been attributed to the process of decomposition of organic matter involving the utilization of oxygen (Rochford, 1951; Jameel, 1998). BOD is the measure of the extent of pollution in the water body. In the present study BOD level was high in A pond while low in C pond in summer and winter season, respectively. The reason of high BOD in summer may be that in summer several microbes present in the water bodies accelerated their metabolic activities with concentrated amount of organic matter in the form of municipal and domestic wastes discharge into water bodies and hence required much amount of oxygen so the demand of oxygen increased (Kumar and Sharma, 2005).

In the present study the level of nitrate was high in A pond while low in C pond in rainy and winter season, respectively. Phosphate level was recorded

maximum in A pond and minimum in C pond. Basic nutrient, like phosphate and nitrate, determines the productivity of the lake water indicated that any amount in the excess of 0.5 ppm of phosphate is an indicator of pollution (Jain *et al.*, 1996). Aneja *et al.* (1992) reported that the concentration of nitrate and phosphate were maximum in monsoon, either due to addition of those elements from the land along with runoff water or from industrial discharge. The maximum alkalinity was obtained in A pond in summer season whereas, minimum in C pond, in winter season may be because of presence of bicarbonate and hydroxide of Ca, Mg, Na, K and borate in pond water. The alkalinity of pond water was maximum during summer followed by monsoon and winter season. It is comparable with the observation of Mansoori *et al.* (1992). During present study maximum level of hardness was recorded in A pond, in rainy season, indicating water is hard. This may be due to the presence of high content of Ca and Mg in addition to sulphate, nitrates and sewage in flow (Angadi *et al.*, 2005). Patel and Sinha (1998) also noted that total hardness is mainly due to Ca, Mg and eutrophication. The presence of carbonate, bicarbonate, sulphate and phosphate in the pond water which may be responsible for high alkalinity as well as total hardness (Durfor and Becker, 1964).

It is revealed that TDS, BOD, alkalinity, total hardness and total phosphate were found to be beyond the permissible limits (WHO, 1995) in the Khirgali pond. The finding clearly indicates that all ponds are polluted but Khirgali pond is most polluted because of discharge of sewage and municipal waste is then creating eutrophication. The all over impact on the ponds have resulted in the deterioration of the water quality, accumulation of toxic chemical and sediment shrinkage of ponds area, and above all loss of the aesthetic value. General public are constantly complaining of bad odours and spreading of water born diseases around the pond water. In order to improve the quality of pond waters, there is continuous monitoring of the pollution level are an urgent need of the day to promote better living conditions of the masses living nearby.

CONCLUSION

The present study leads to the following conclusions:

1. All ponds are polluted but Khirgali pond is most polluted because of sewage and municipal waste discharge.

2. Data indicate that TDS, BOD, alkalinity, total hardness and total phosphate were found to be beyond the permissible limit.

3. To improve the quality of waters there should be continuous monitoring of the pollution level of these ponds.

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