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Water quality assessment of Kshir Sagar water body at Ujjain (M.P.) India.

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Abstract

Present study deals with the investigation of the physico-chemical parameters for making an assessment of water quality of Kshir Sagar which is one of perennial temple pond in Ujjain. Physico-chemical parameters of Kshir Sagar water body at Ujjain (M.P.) India were studied during July 2010 to June 2011. During the study period various Physico-chemical parameters (turbidity, pH, DO, BOD, COD, total alkalinity, TDS, total hardness, total salinity and nitrate) were analyzed. Investigated all physico-chemical parameters indicate that water of Kshir Sagar water body is highly polluted due to its exploitation and disorders of anthropogenic activities.

Keywords: Kshir Sagar, BOD, COD, TDS, total hardness, Physico-chemical parameters.

Introduction

Aquatic ecosystems are very productive ecosystems which help in the regulation of biological cycles, maintenance of water quality, nutrient movement and support of food chains. In addition they provide refuge for endangered species of plants and animals and economic benefits (Mini *et al*., 2003). Fresh water is essential for agriculture, industry and human existence. It is a finite resource of earth. Rapid growth of urban areas directly or indirectly affected existence of the pond such as over exploitation of resources and improper waste disposal practice (Thilaga *et al.*, 2005). Limnology plays a very important role in the decision making process in aquaculture practices. A change in water quality affects the biotic community of an aquatic ecosystem ultimately reducing the primary productivity (Iwama *et al.*, 2000).

Further, Fresh water is the most suitable and cheapest source for domestic and industrial needs and they provide convenient west disposal system. The increased demand of water as a consequence of population growth, agriculture and industrial development has forced environmentalists to determine the chemical, physical and biological characteristics of natural water resources (Regina and Nabi, 2003). Quality of an aquatic ecosystem is dependent on the physico-chemical parameters of water. The healthy aquatic ecosystem is depended on the physico-chemical and biological characteristics (Venkatesharaju *et al.*, 2010).

Fresh water is a critical, finite, vulnerable, renewable resource on the earth and plays an important role in our living environment, without it, life is impossible. Studies of urban pond ecology have mostly concentrated on physicochemical characteristics. Since the beginning of the industrial revolution, increasing human population, economic activities as well as shortcomings in their management have resulted in more pollutants being introduced into watercourses. An increasing number of surface water bodies have come under serious threat of degradation. The global

freshwater resources are under increasing pressure (GWP Technical Advisory Committee, 2000).

Temples are main centers of worship for Hindus. Many temples in Madhya Pradesh and other states of India have ponds in their vicinity called as temple ponds which are polluted by human activities like dumping of ritual materials, washing and bathing etc. Present study deals with the investigation of the physico-chemical parameters for making an assessment of water quality of Kshir Sagar which is one of perennial temple pond in Ujjain.

Materials and Methods

Kshir Sagar is known as third pond of Sapt sagar at Ujjain (M.P.). It is situated near Madhav Rao Sindhia Gate. It is a perennial temple pond. Area of this water body is about 2 hac. and depth is 3 to 4 meter. The pond water is used for bathing, washing and other purposes also. Religious human activities are also effect the water quality of this water body especially during "Adhikmass."

Water samples were collected from four randomly selected points of pond. Water samples were collected in first week of each month for 12 months (July 2010 to June 2011) on fixed date. The pH of water samples was measured by digital pH meter. Physico-chemical analysis (turbidity, DO, BOD, COD, total alkalinity, TDS, total hardness, total salinity and nitrate.) of the samples was done according to the standard methods APHA- AWWA, WPCF, 1989 and Saxena, 1998.

Results and Discussion

The monthly variations of physico - chemical parameters of Kshir Sagar water body are given in Table 1-

Table 1. -Physico-chemical parameters of Kshir Sagar during July 2010 to June 2011.

S. No.	Parameter studied	July	August	September	October	November	December	January	February	March	April	May	June
1	Turbidity (NTU)	103± 1.921	105± 3.786	110± 4.203	52± 6.164	45± 2.081	33.3± 1.738	32± 3.511	36.2± 0.611	67± 2.645	94± 2.645	98± 3.605	102± 2.516
2	pH	8.9± 0.493	8.9± 0.351	8.7± 0.458	8.3± 0.351	8.5± 0.100	8.7± 0.251	8.4± 0.251	8.6± 0.152	8.7± 0.230	8.4± 0.230	9.2± 0.305	9± 0.216
3	DO (mg/L)	11.1± 0.200	11.3± 0.435	12± 0.461	14.4± 0.513	14.7± 0.556	13.2± 0.308	15.1± 0.208	10.2± 0.416	9.8± 0.321	10.4± 0.404	8± 0.208	8.1± 0.152
4	BOD (mg/L)	14± 0.416	13.5± 0.581	13.1± 0.264	12.1± 0.321	13.8± 0.529	13.2± 0.414	10.6± 0.208	13.4± 0.369	15.7± 0.360	18.4± 0.360	21.3± 0.655	23.7± 0.960
5	COD (mg/L)	47± 0.995	42± 0.305	43.2± 0.374	43.9± 0.264	43± 0.300	35.1± 0.550	36.3± 0.416	40.2± 0.611	47.7± 0.351	56.3± 0.375	67.8± 0.709	70.8± 0.351
6	Total Alkalinity (mg/L)	95± 0.816	92± 3.213	88± 2.081	84± 2.081	87± 2.081	85± 3.135	83± 2.081	86± 1.527	88± 4.933	85±± 2.972	94± 5.522	99± 5.522
7	TDS (mg/L)	585± 2.081	580± 2.380	590± 2.516	570± 2.516	593± 3.511	615± 2.081	625± 2.516	621± 3.214	630± 1.527	596± 1.527	590± 1.000	596± 3.055
8	Total Salinity (mg/L)	593± 2.081	521± 2.645	535± 4.933	553± 3.055	571± 3.214	585± 1.154	593± 3.055	605± 6.429	607± 3.055	615± 7.572	619± 5.291	617± 3.786
9	Total Hardness (mg/L)	280± 2.000	274± 3.214	272± 2.534	278± 3.605	295± 2.516	328± 2.449	341± 4.000	318± 3.000	295± 1.154	270± 3.188	298± 4.163	340± 4.359
10	Nitrates (mg/L)	1.12± 0.200	1.2± 0.017	0.92± 0.073	0.86± 0.0351	0.98± 0.036	0.91± 0.044	1.01± 0.044	1.04± 0.030	1.2± 0.052	1.3± 0.028	0.94± 0.035	0.99± 0.030

Data are given in Mean ± SE of three replicates.

Turbidity:

In the present study, turbidity was reported within the range from 32 to 110 NTU during the study period in selected water body. The turbidity of Kshir Sagar was highest in September and lowest in January. The turbidity was increased in rainy season while decreased in the winter season (Fig. 1). During monsoon season silt, clay and other suspended particles contribute to the turbidity values while during winter season settlement of silt, clay resulting low turbidity (Garg *et al*., 2010). Bhaumik *et al*., 2003; Garg *et al*., 2006a; Garg *et al.*, 2009, have also reported high turbidity during rainy season during their study period.

pH:

pH means H^+ ions are compensated with OH^- ions (Sharma and Darve, 1991). The highest pH of Kshir Sagar was 9.2 in May and lowest 8.3 in October. pH was found to be alkaline in nature in all observations. Prapurna and Shashikanth (2002) also reported the pH in alkaline trend during the study period. The pH was observed decrease during winter and increase during summer season (Fig. 2). Similar trend was also found by Hutchinson (1957). Agarwal and Rajwar, 2010, reported that pH is affected not only by the reaction of carbon dioxide but also by organic and inorganic solutes present in water. Any alteration in water pH is accompanied by the change in other physico-chemical parameters.

DO:

In the present study DO was reported within the range from 8.0 mg/L to 15.1 mg/L during the study period selected water body. The maximum DO was reported in winter season and minimum was in summer season due to high temperature (Fig. 3). Similar trend in dissolved oxygen values have also reported by Prasad *et al.*, 1985; Deshmukh and Ambore, 2006. The quantity of DO in water is directly or indirectly dependent on temperature of water (Chaurasia and Pandey, 2007). Oxygen content is important for direct needs of many organisms and affects the solubility of many nutrients and therefore the periodicity of aquatic ecosystem (Wetzel, 1983).

BOD:

BOD is the amount of oxygen required by the living organisms engaged in the utilization and ultimate destruction or stabilization of organic water (Hawkes, 1963). In the present study BOD was reported within the range from 10.6 to 23.7mg/L during the study period in selected water body. The values of BOD are clearly showing that it was higher during summer season and low during winter season (Fig. 4).

BOD is measure of oxygen required by microbes to degrade the organic matter under aerobic condition. BOD increases with increased inflow of the domestic waste (Athalye and Patil, 2003). High BOD depletes the oxygen level to a critical condition thus indicating the pollution status of water, due to discharge of animal faucal wastes coupled with high temperature indicating organic pollution (Kiran, 2010). Thus a significant positive correlation is found between temperature and BOD.

COD:

The chemical oxygen demand (COD) is a measure of the total amount of oxygen which is required to oxidize all the organic matter in a sample to CO_2 and H_2O (Boyd, 1982). The highest COD of Kshir sagar was reported 70.8 mg/L in June and lowest 35.1 mg/L in December. In selected pond, the COD values were decreased in winter season and increased in summer or pre monsoon period (Fig. 5). Seasonal analysis reveals that maximum values of COD noted in summer and mansoon and minimum in winter. Similar treads also reported by Kudesia *et al*., 1986.

Total alkalinity:

Total alkalinity was reported in this water body within the range from 83 to 99 mg/L. The total alkalinity of Kshir Sagar was highest in June and lowest in January. Maximum total alkalinity was reported in summer and rainy season while minimum total alkalinity was reported in winter season (Fig. 6). Jadhav *et al.* (2006) found the alkalinity values varied from 94 to 112 mg/lit. at different sampling sites of Sonkhed Dam. Increases in total alkalinity during rainy season were due to input of water and dissolution of calcium carbonate ion in the water column (Padma and Periakali, 1999).

TDS:

Total dissolve solids was reported in this temple pond within the range from 570 to 630 mg/L. In present study, the higher values of total dissolved solids were reported in pre monsoon season while the lower values were reported in monsoon season (Fig. 7). Devi (1997) also reported the maximum total dissolved solids during pre monsoon season and lowest during monsoon in Shathamraj and Ibrahimbag reservoirs of Hyderabad. Total Dissolved solids reduce the water clarity decreases photosynthesis and increases water temperature (Krishna Ram *et al.*, 2009).

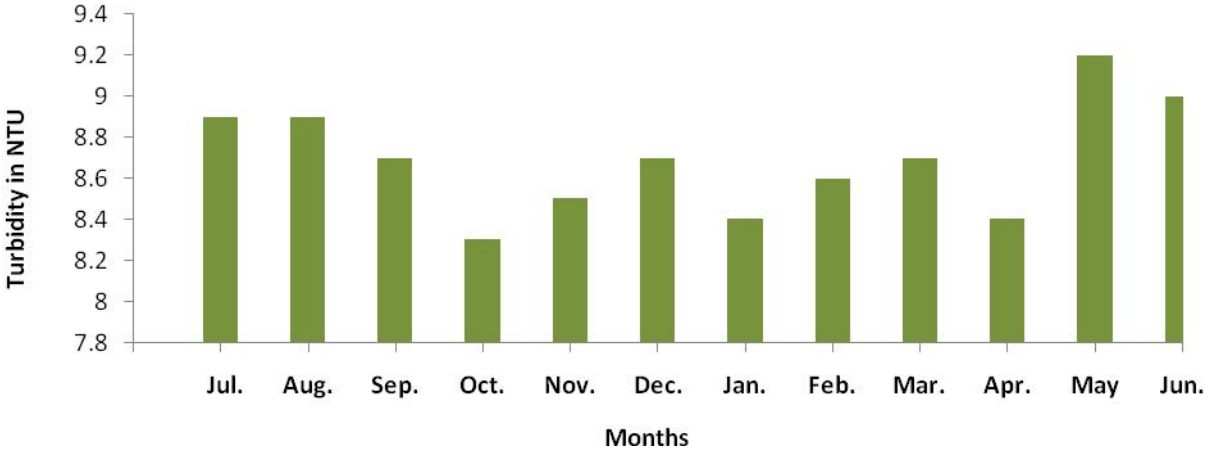

Figure 1. Values of turbidity during the study period in selected water body

Figure 2. Values of pH during the study period in selected water body

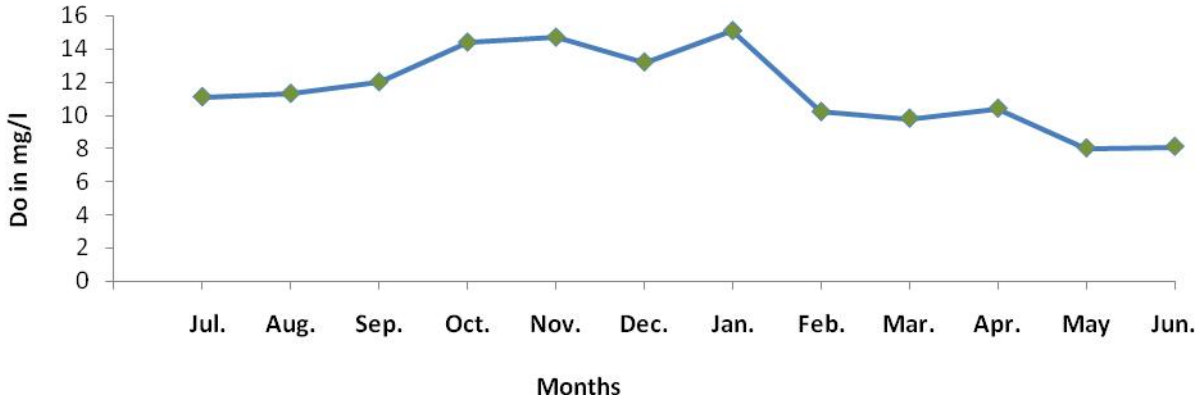

Figure 3. Values of DO during the study period in selected water body

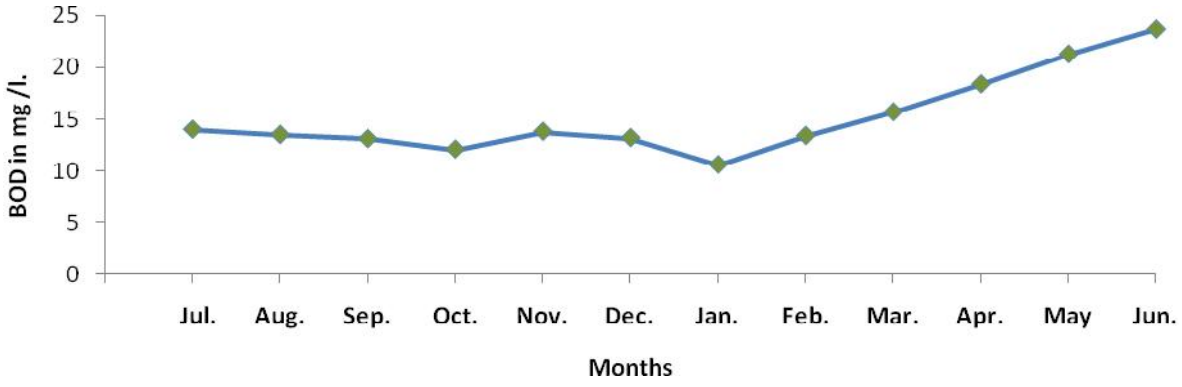

Figure 4. Values of BOD during the study period in selected water body

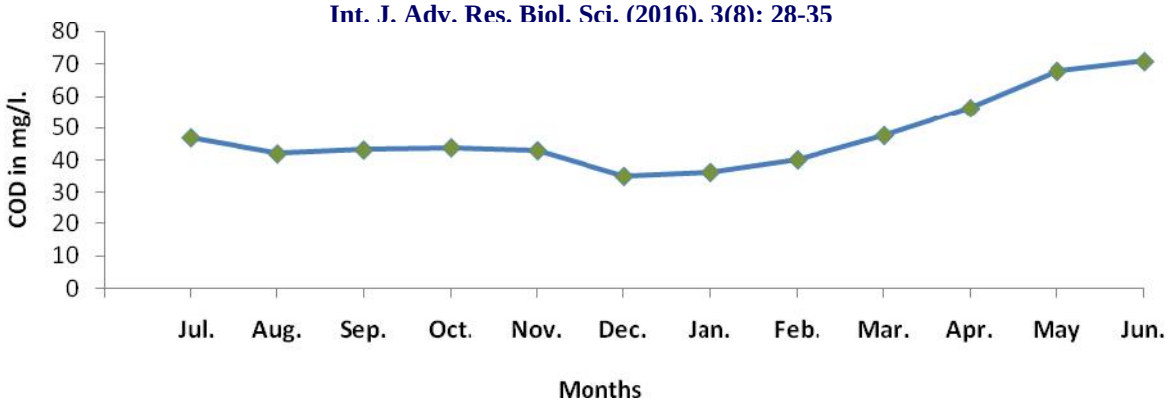

Figure 5. Values of COD during the study period in selected water body

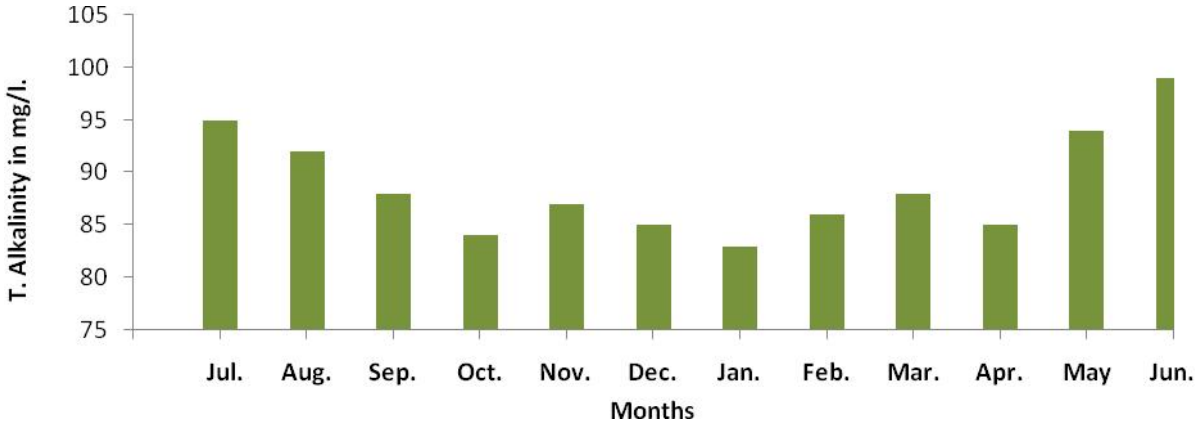

Figure 6. Values of T.Alkalinity during the study period in selected water body

Figure 7. Values of TDS during the study period in selected water body

T. Salinity:

The total salinity of Kshir Sagar was highest 619 mg/L in May and lowest 521 mg/L in August. The total salinity was reported highest in summer and rainy season by evaporation and entry of salts along with rain water in pond respectively (Fig. 8).

Total Hardness:

The total hardness of Kshir Sagar was highest 341 mg/L in January and lowest 270 mg/L in April.

Sawyer (1960) classified water on the basis of hardness into three categories are following-

(a) Shoft water- (0-75 mg/L).
(b) Moderately hard water- (76-150 mg/L).
(c) Hard water- (above 151 mg/L)

According to this classification Kshir Sagar water body included in to the category of hard water bodies. Water hardness refers to the concentration of Ca and Mg. As calcium and magnesium bond with carbonates and bicarbonates, alkalinity and water hardness are

closely interrelated and produce similar measured levels. The hardness of water is not a pollution parameter but indicates water quality. Highest value of total hardness was recorded during summer and winter while lowest during the rainy season (Fig. 9). Similar observations were found by various workers (Kumar, 1995; Naik and Purohit, 1996; Kiran, 2010).

Nitrate:

The value of nitrate in studied water body was highest 1.30 mg/L in April and lowest 0.86 mg/L in October (Fig. 10). Agarwal and Rajwar (2010) reported the values of nitrate ranged from 0.08 to 0.97 mg/L showing highest values in summer months and early monsoon on all the sites. The higher inflow of water and consequent land drainage cause high values of nitrate in these ponds (Thilaga *et al*, 2005). Runoff and decomposition of organic matter is the main sources of nitrate in the water bodies. Unpolluted natural water contains usually only minute amount of nitrate (Shinde, 2010). In Kshir sagar only one macrophytic species *Spirodela polyrhiza* (20 % F) was reported during the study period.

Figure 8. Values of T.Salinity during the study period in selected water body

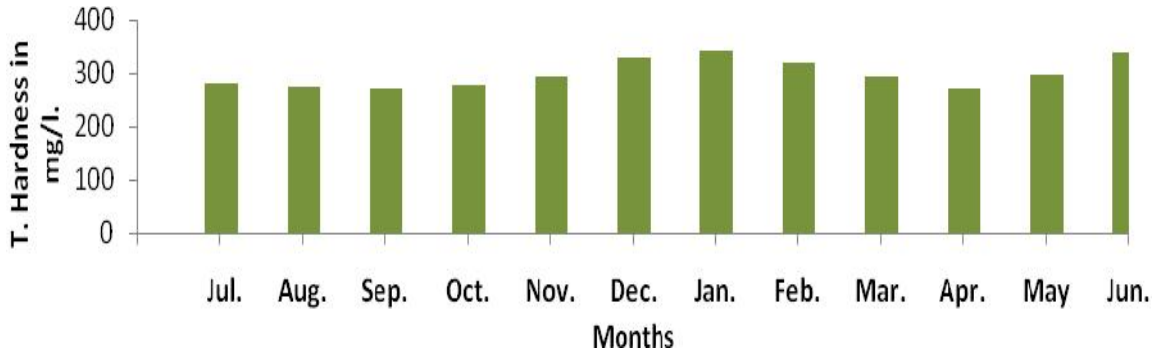

Figure 9. Values of T.Hardness during the study period in selected water body

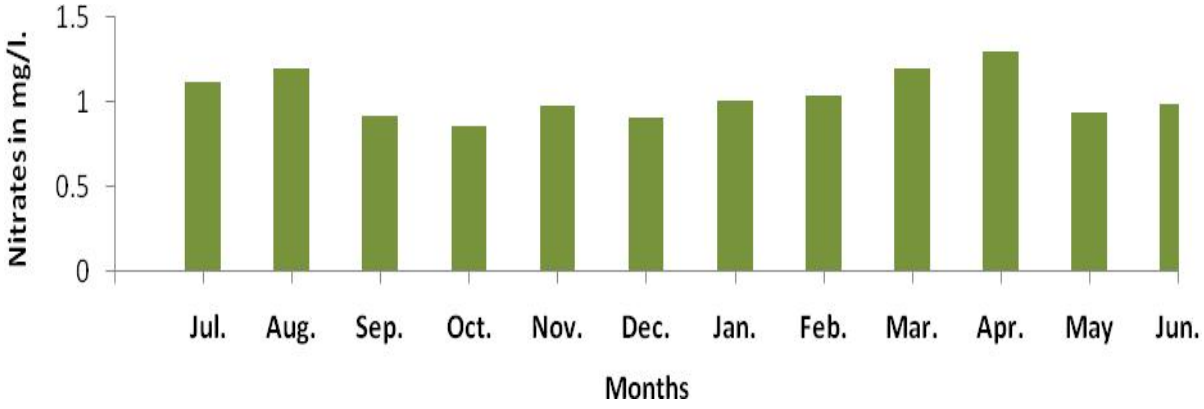

Figure 10. Values of Nitrates during the study period in selected water body

Conclusion

From the results obtained, it can be concluded that Kshir Sagar water body is a highly polluted due to greater biotic stress. All Physico-chemical parameters were obtained as out of safe range. Water of pond is highly polluted so it should be treated before the use for human purpose. Investigated all physico-chemical parameters indicate that water of Kshir Sagar water body is highly polluted due to its exploitation and disorders of anthropogenic activities. Through these activities all parameters of water quality has been reached out of suitable range.

It can't be used directly as a drinking water because all parameters and conditions indicate that water of this pond is not potable. Hence, the water of this pond cannot be used directly for human proposes. The treatment is immediately required for conservation and managements of Kshir Sagar water body to maintain water quality.

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