Original Research Paper

Limnological Study of Jadhav Sagar Lake, Shivpuri Town, Madhya Pradesh, India

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ABSTRACT

Due to rapid increase in population, industrialization and agricultural practices most of the natural water resources get polluted. Disposal of untreated or partially treated industrial effluents and sewage into surface waters is one of the major environmental problems. The study was carried out on Jadhav Sagar lake in Shivpuri town for a period of April 2006 to March 2007. Jadhav Sagar lake is one of the oldest water bodies which is situated in central part of the Shivpuri town. In the past, it represented the source of drinking water and fish culture. In recent times it has changed considerably due to human interference in the form of encroachment and development of residential areas, and dumping of waste and sewage. The results showed that the Jadhav Sagar lake is polluted and the water cannot be used for human needs and fish culture. The water quality of lake is deteriorating rapidly due to intense human activities and influx of pollutants from surrounding.

INTRODUCTION

Clean water is one of the nature's greatest gifts to the mankind. Water is one of the most important and precious natural resources. Reservoirs, made by constructing dams across the rivers serve a variety of purposes like drinking, irrigation, industrial processes, fish and waterfowl, flood protection, recreation and generation of hydroelectricity. Unfortunately, the clear water resources are not only shrinking in the size but are also getting more and more polluted becoming less suitable for various uses. Kant & Vohra (1989) have rightly suggested that the management of any aquatic ecosystem is the conservation of habitat with an aim to maintain its physicochemical quality of water. The monitoring of water quality is the first step to be taken before taking up any management and conservation plan of any aquatic ecosystem.

STUDY AREA

Shivpuri town is the districts headquarters. It is located between $25°24'$ to $25°26'$N latitude and $76°38'$ to $76°41'$ E longitudes. Construction of Jadhav Sagar lake started in 1915 and was completed in 1932. It is under the control of Scindia's Chhatri Trust and is located in the municipal area of Shivpuri town. Originally, the lake had water spread of over 50 hectares with maximum depth of 15 feet. The lake was built to supply water to the fountains, kunds and gardens of Chhatri area. Till 1932 it was also used for boating. Since its construction idols visarjan is being done in this lake near Ganesh Mandap. Singhara (*Trapa)* cultivation and fisheries were done in the lake since 1932. However, fisheries has now been stopped due to pollution problem. The lake receives a drain containing sewage of the town. Present paper reports status of some physicochemical parameters of the lake water.

MATERIALS AND METHODS

Monthly samples were collected from two different sampling stations, namely J1 and J2 for one year fro April 2006 to March 2007. The samples were collected at 10-11 a.m. The physicochemical parameters were analysed as per the procedure given in APHA 1981 and Trivedy & Goel 1986.

RESULTS

Various physicochemical parameters are given in the Tables 1 and 2. The summary of the results is as under.

Colour: The water is almost colourless. It was turbid during monsoon. The colour as reflected from the lake was green during winter and light green during summer.

Temperature: The temperature varied from 18.6ºC to 30.2ºC. The minimum water temperature was recorded at station J1, 18ºC during January 2007, and maximum at station J2, 30.2ºC during May 2006. During December 2006 the temperature was recorded 24.2ºC at the both the stations.

Transparency: Transparency was recorded maximum during February-March at both the stations, 69.2 cm at station J1 and 66.9 cm at J2. The minimum values were recorded during September at both the stations, 30.0 cm at station J1 and 31.5 cm at station J2.

Turbidity: Turbidity is a measure of extent to which light is either scattered or absorbed by the suspended material in water. The turbidity ranged from 35.1 in March to 71.0 NTU in September at station J1, and 29.9 in December to 70.0 NTU in September at J2.

pH: Jadhav Sagar lake maintained an alkaline pH throughout the investigation period and recorded between 7.1 and 8.9. The pH was minimum 7.1 in the September 2006 and October 2006 at sampling station J1 and J2 respectively. The maximum value of 8.9 was recorded in May 2006 and July 2006 at sampling station J1 and J2 respectively.

Conductivity: Conductivity was recorded minimum during December 2006 at 1405 μmhos at sampling station J1, and during September 2006 at 1620 μmohs at sampling station J2.

Alkalinity: Alkalinity showed higher value during summer and lower value during monsoon and winter. The maximum value of alkalinity was 330 mg/L in May 2006 at J1 sampling station.

Dissolved oxygen: Dissolved oxygen was 10.5 mg/L at station J1, and 11.5 mg/L at station J2 in the lake during May 2006. However, oxygen was 7.0 mg/L at station J1, and 7.2 mg/L during the month of August at station J2.

Chloride: Chloride varied from 810 mg/L at sampling station J1 during December to 920 mg/L at sampling station J2 during May. From June onwards the values showed a decreasing trend up to December.

Total dissolved solids: The maximum value of TDS of 1050 mg/L was recorded during September at sampling station J1, and minimum of 890 mg/L in January at sampling station J1.

Iron: Maximum value of iron was recorded to be 0.65 ppm in month of December at sampling station J1, and minimum of 0.22 ppm in April at sampling station J1.

Nitrate: The maximum nitrate was 22 mg/L in November at sampling station J1, and minimum of 08 mg/L in the months of January and February at sampling station J1.

Fluoride: The maximum fluoride was recorded to be 0.45 ppm in December at sampling station J1, and minimum of 0.2 ppm in April at both sampling stations J1 and J2.

DISCUSSION

Temperature of Jadhav Sagar lake varied from 18.6ºC to 30.2ºC throughout the year. The fluctuation in the water temperature has relationship with the air temperature being maximum during summer and minimum during winter (Rao 1955, Saha & Pandit 1986). Temperature is a vital parameter for growth of organisms. Atmospheric and water temperature both play an important role in the physico-chemical and physiological behaviour of the aquatic systems. The pH of the lake fluctuated from 7.1 to 8.9. pH constantly remained above 7 due to high buffering capacity of the system. The higher range of pH indicates higher productivity of water (Khan & Khan 1985). The present study showed minimum transparency during monsoon. Higher turbidity value was observed during rainy session, which may be due to silt load. The low depth of visibility during monsoon is attributed to the higher turbidity caused by suspended silt and organic debris. Similar results were observed by Bhat & Negi (1985) and Balkhi (1987).

High values of conductivity during monsoon may be attributed to high turbidity, as indicated by Acre & Boyed (1980) that the conductivity of water increases with concentration of solids in the water. Alkalinity is an important parameter for aquatic life in freshwater bodies because of it equilibrated pH changes that occur naturally as a result of photosynthetic activity of the chlorophyll bearing vegetation. Total alkalinity was high during summer session and low during rainy session on account of dilution of water (Jain et al. 1996). Alkalinity is generally imparted by the salts of carbonates, bicarbonates, phosphates, nitrates, borates, silicates, etc. together with hydroxyl ions in free states (Sakhare & Joshi 2002).

Chloride level of lake water was higher during summer and lower during winter. It was higher due to mixing of sewage of Shivpuri town in the Jadhav Sagar lake. It is directly correlated with the pollution level. Oxygen is an important parameter of water quality in lakes and reservoirs. It is essential for the metabolism of all aquatic organisms, which perform aerobic respiration. Presence of DO in water is due to direct diffusion from air and photosynthetic activity of autographs. The DO value of the lake was suitable for potability and aquaculture (Yogesh & Pendse 2001). Dissolved oxygen is very essential for metabolism of all aquatic organisms for aerobic biochemistry. The present study show minimum value of DO in September and maximum during May. The higher values of DO during summer are associated mainly with the higher phytoplanktonic population (Bhatt & Negi

Table 1: Physico-chemical analysis of Jadhav Sagar lake, Shivpuri, M.P. at sampling station J1 during April 06 to March 07.

Parameters	Units	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
pH	-	8.7	8.9	8.1	8.2	7.8	7.1	8	8.1	8.3	8.1	8.3	8.5
Temperature	ºC	28.5	30	27	26	25.9	24.5	24.1	24.2	22.5	18.6	21	26
Colour	-	Light green	Light green	Light green	Turbid	Turbid	Turbid	Green	Green	Green	Green	Green	Green
Turbidity	NTU	45	49.5	57.5	64.2	67.5	71	57.9	49.6	30.9	39.1	37.9	35.1
Alkanity	mg/L	275	330	300	271	264	240	222	115	118	180	225	245
Conductivity	μmhos	1460	1450	1508	1520	1556	1620	1410	1420	1405	1380	1390	1380
Transparency	cm	64	56.5	51.8	45	40.1	30	41.2	48	56.5	61	69.2	68
DO	mg/L	6	6.5	5.5	6.5	6.8	7.5	7	6.8	7.5	7.8	7.6	7.2
TDS	mg/L	949	940	980	985	1010	1050	915	920	910	890	905	895
Iron	ppm	0.22	0.25	0.25	0.35	0.33	0.4	0.55	0.55	0.65	0.6	0.35	0.3
Chloride	mg/L	890	920	910	870	850	840	820	815	810	830	860	865
Nitrate	mg/L	14	12	12	15	12	18	20	22	8	8	10	18
Fluoride	mg/L	0.2	0.3	0.25	0.25	0.32	0.35	0.35	0.4	0.45	0.25	0.3	0.35

Table 2: Physico-chemical analysis of Jadhav Sagar lake, Shivpuri, M.P. at sampling station J2 during April 06 to March 07.

Parameters	Units	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
pH	-	8.7	8.8	8.2	8.2	7.6	7.3	8.2	8.2	8.5	8.3	8.4	8.7
Temperature	C	28	30.2	27.5	26.5	25.5	24.8	24.6	24.2	22.6	19.2	21.6	26.8
Colour	-	Light green	Light green	Light green	Turbid	Turbid	Turbid	Green	Green	Green	Green	Green	Green
Turbidity	NTU	43	46.5	56.5	63.2	65.5	70	59	44.6	29.9	38.1	38.9	36.1
Alkanity	mg/L	272	325	305	268	270	242	228	120	128	190	230	250
Conductivity	μmhos	1450	1460	1516	1505	1540	1600	1420	1390	1430	1380	1395	1385
Transparency	cm	66.1	55.2	50.5	48.5	42.5	31.5	43	42.5	55.2	60.2	63.5	66.9
DO	mg/L	6	6.8	5.5	6.8	6.5	7.2	7.2	6.5	7.5	7.9	7.5	7.3
TDS	mg/L	940	950	985	985	1005	1040	920	905	925	895	910	900
Iron	ppm	0.25	0.35	0.35	0.4	0.42	0.4	0.5	0.52	0.62	0.56	0.35	0.25
Chloride	mg/L	880	915	910	860	845	840	830	820	815	825	850	865
Nitrates	mg/L	12	14	12	14	12	16	18	20	10	10	12	16
Fluoride	mg/L	0.2	0.3	0.24	0.25	0.35	0.35	0.4	0.42	0.4	0.25	0.35	0.3

1985). Total dissolved solids denote mainly the various kinds of minerals available in water. In natural waters dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, sulphates, phosphates, nitrate, calcium, magnesium, sodium, potassium and iron (Esmaeili & Johal 2005). Nitrate is one of the most important nutrients in aquatic ecosystems. High concentration of nitrates is useful in irrigation but their entry into water resources increase the growth of nuisance algae and trigger eutrophication and pollution (Trivedy & Goel 1986).

The study reveals that the water quality of Jadhav Sagar lake is deteriorated due to entry of sewage from the town. The water is unfit for drinking, fish culture and recreational purposes. Since the lake is an important source of drinking water and irrigation, the sewage inflow should be checked or let to flow into the lake after treatment. The dumping of solid waste along shoreline should be avoided.

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