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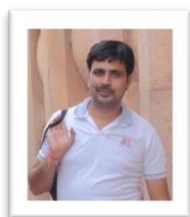
A Case Study of the Sakhya Sagar Lake Shivpuri with Special Reference to Physico-Chemical Properties of Water and Its Environs

Abstract

The study was conducted in Sakhya Sagar Lake which is situated in the Shivpuri town.The observations were taken at regular intervals from April, 2006 to March, 2008. Four sampling stations namely station-A, station-B, station-C and station-D were established in the Sakhya Sagar Lake and water samples were collected for detailed studies.Total 19 physico-chemical parameters including water temperature, depth, colour, transparency, turbidity, electrical conductivity, pH, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, chloride, calcium, nitrate, sulphate, phosphate, biochemical oxygen demand and chemical oxygen demand were determined.Mean values of l9 physico-chemical parameters of water of all the four sampling stations were summarized in a table with rang of variation and standard deviation.

Keywords: Physico-Chemical Characteristics, Sakhya Sagar Lake, Sampling Stations, Water Quality, Shivpuri Town

Introduction

Water is needed in all aspects of life. Adequate supplies of water of good quality are required for the entire population of this planet, while preserving the hydrological, biological and chemical functions of ecosystems.Wetlands constitute a treasury of biodiversity. The social demand and dependence on the wetlands provide an accountable economic value to such habitats. They are complex water and land interactive systems and are supposed to be the most fertile and productive sites in the world. The study of fresh water ecosystem of all kinds' lakes, reservoirs, streams, ponds, marshes bogs etc. is known as 'limnology'. The physico-chemical and biological characteristics of water body play an important role in determination of the structure and composition of biotic community of any water body.Anthropogenic nutrient enrichment cause serious alternation in aquatic ecosystem.Most of our natural water resources have been polluted due to rapid increase in population, industrialization and agricultural practices most of our natural water resources get polluted. Disposal of untreated or partially treated industrial effluents or sewage into surface waters is one of the major environmental problems. Inland water covers less than 2% space of earth's surface and is available for anthropogenic requirements. The monitoring of water quality is the first step to be taken before taking up any management and conservation plan of any aquatic ecosystem. Limnological investigations on Indian waters are few. Extensive studies on the ecology of few lentic water bodies have been made by various researchers Mishra et. al (2010).

Study Area

The Sakhya Sagar Lake (Chandpatha Lake) is a large perennial water body located inside the Madhav National Park, Shivpuri. It situated 4 km. east of Shivpuri townand spreads about 309.01 hectares. Geographically it lies between 25º 20'- 25º 38' N latitude and 77º 38'-77 º 57' E longitudes. The lake is under Yamuna basin and Sub-basin of Sindh River. This man-made lake was started construction in year 1915 and Completed in year 1918 and it is under the topo sheet no. 54-G/ 11. The length of dam is 2164 m. with maximum height of 13.81 m and top width of dam is 1.52 m. The catchment area of lake is 72.52 sq. km., submergence area is 217.06 ha., gross storage capacity is 7.78 m.cum and full tank level (F.T.L.) is 1132.00 m. The lake has rocky and mildly sloppy banks with

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Asian Resonance

fringing read-weeds and varieties of aquatic vegetation. The depth of this lake varies from place to place and its basin shows the presence of muram, clay, black soil and sandy loam. The lake is bounded with a huge masonry wall situated along its eastern shore. On the western side of the lake there is a temple and a tourist guest house. A nala called Karbala from the Shivpuri town joins the lake at its southern bank. From winter onwards the nala which feeds the lake get dried up and only the used water of Shivpuri town flows into the lake (Fig. 1).
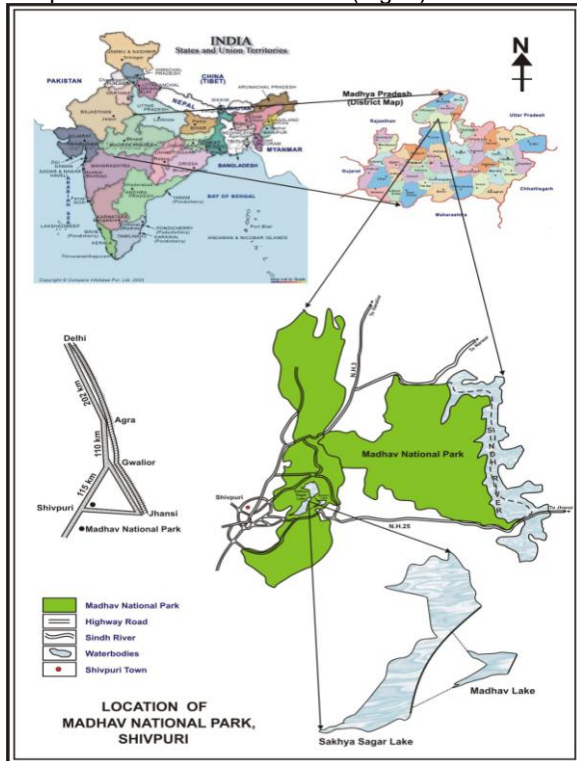

Fig. 1: Location map of Madhav National Park, Shivpuri Showing Wetlands (Sakhya Sagar Lake and Madhav Lake) under study.

Review of Literature

Limnological studies on the water bodies in and around Gwalior- Chambal region have also attracted the attention of various workers.According toSakhre and Joshi (2002)the level of dissolved oxygen in a water body depends on factors like temperature, salinity and density of phytoplankton.The physico-chemical characteristics of water depends upon several factors including location of water bodies, types of sewage and domestic waste disposal, localization human population and their activities (Raoet al., 2003). The physico-chemical characteristics of Tekanpur tank (Verma, 1969),Ramua reservoir (Agrawal, 1980), Harsi reservoir (Kushwar, 1988),Chandanpura tank (Kaushiket al., 1989),Tighra reservoir (Dixit, 1989), Chambal tank (Kaushiket al., 1991),Motijheel (Kaushik and Saksena, 1992), Kailasagar tank (Dagaonkar and Saksena, 1992), Rampur reservoir (Sharma and Yadav 2007),Harsi reservoir and Ramsagar reservoir (Garget al., 2006) have been studied.

Materials and Methods

Limnological characteristics of water are extremely valuable in the assessment of quality or pollution status of the water. The observations were taken at regular intervals from April, 2006 to March, 2008. Four sampling stations namely station-A, station-B, station-C and station-D were established in the Sakhya Sagar Lake and water samples were collected for detailed studies (Fig. 2). The superficial water samples were collected in the iodine treated double stoppard plastic bottles during the forenoon between 7.00 a.m. to 10.00 a.m. The physico-chemical characteristics of lake including water temperature, depth, colour, transparency, turbidity, electrical conductivity, pH, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, chloride, calcium, nitrate, sulphate, phosphate, biochemical oxygen demand and chemical oxygen demand were determined. Some of the physico-chemical parameters of water determined at the sampling stations and some others were analyzed in the laboratory within 4 to 6 hours of collection water sample and different methods outlined by APHA (1985) and Trivedi and Goel (1986) were used.

Fig. 2: Map of Sakhya Sagar Lake showing Sampling Stations

Results and Discussion

In the freshwater habitats various physical and chemical parameters of water have inter-relationships which have a cumulative effect upon the growth of plankton and other aquatic organisms. The light penetration in the water body, on which depends the growth of phytoplankton and other aquatic plants, is influenced by the colour, turbidity and transparency of the water bodies. Kant and Vohra (1989) and Aryaet, al. (2012) have rightly suggested that the management of any aquatic ecosystem is conservation of freshwater habitat with an aim to maintain the quality or to rehabilitate the physico-chemical and biological quantity of water. Before any step of environmental management and conservation is taken, the monitoring of water quality is the first requirement.

Results and Discussion

Locations and different characteristics of all the fourSampling Station are as follows: (Plate- 1).

Sampling Station-A

Sampling Station-A (Plate-1I) was established near BhadaiyaKund where the nala namely Karbala drains in to the Sakhya Sagar Lake. The depth of water

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is 7.5 feet to 18 feet respectively from shore to centre. It has some submerged and floating vegetation. The bottom at this station has higher percentage of clay, sand and gravel. This station receives sewage water from Shivpuri town. The Karbala nala is also used for washing clothes as a form of dhobighat. Illegal fishing activities are comparatively high at this site. The water at this site was found to be turbid and greenish in colour.

Sampling Station-B

Sampling Station-B (Plate-1 II) was established at the mid-point of the Sakhya Sagar Lake, in front of Sailing Club. This site was most important having the deepest portion of the lake with minimum depth of 15.25 feet and maximum depth of 28 feet. Bottom of this station was predominately covered by mud, clay and silt. The water at this site was found to be slightly transparent greenish in colour.

Sampling Station-C

Sampling Station-C (Plate-1 III) was established at the location of Landing No. 10, near the dam wall in front of shooting box. The depth of this station is much reduced in the month of summer. The bottom of this station is completely rocky and stony, so numbers of macrophytes species were much lesser than other areas of the lake. The depth of water in this station ranges 05 feet to 20 feet. The water at this site was found to be transparent greenish in colour.

Sampling Station-D

Sampling Station-D (Plate-1 IV) was established at the mid-point in front of Landing No. 5. The depth of water in this station ranges 09 to 22 feet. At this station, macrophytic vegetation occurred in moderate to rich level. Illegal fishing activities by the local villagers of surrounding areas are also seen at this site. The water at this station was found to be slightly transparent greenish near the dam wall and near the banks and transparent in the middle part of the lake.

I. Sampling Station 'A'   **II. Sampling Station 'B'**

III. Sampling Station 'C'   **IV. Sampling Station 'D'**

Plate-1: Photos Showing Sampling Stationsstation A, Station-B, Station-C and Station-D were Established in Different Areas of the Sakhya Sagar Lake

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Table- 1: Mean Values of Physico-Chemical Characteristics of Sakhya Sagar Lake During April, 2006 to March, 2007													
S.No.	Parameters	Units	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
1.	Temperature	°C	30.08	30.95	32.75	32.00	27.00	27.38	26.20	25.63	20.63	19.18	19.90	25.00
2.	Depth	Feet	11.50	9.19	10.88	13.00	15.03	15.88	21.33	19.18	18.00	16.38	14.75	13.25
3.	Color		T.G	T.G	T.G	Turbid	Turbid	Turbid	Turbid	T.G	T.G	T.G	T.G	T.G
4.	Transparency	cm	107.50	107.00	125.50	99.50	95.00	90.00	123.75	102.50	101.25	98.75	94.50	96.25
5.	Electrical conductivity	µS/cm	466.25	488.75	446.25	387.50	413.75	380.00	341.25	357.50	392.50	416.25	428.75	446.25
6.	Turbidity	NTU	9.50	7.63	7.50	15.50	14.50	14.50	7.75	6.75	5.75	6.25	5.00	4.00
7.	Total dissolved solids	mg/l	231.25	227.50	247.50	240.00	238.75	248.75	231.25	221.25	220.00	200.00	208.75	223.75
8.	pH		7.90	7.70	7.85	7.48	7.48	7.63	7.48	7.35	7.55	7.63	7.58	7.65
9.	Dissolved oxygen	mg/l	6.75	6.38	7.00	7.63	8.13	8.23	8.05	7.84	8.58	9.18	9.03	8.28
10.	Free carbon dioxide	mg/l	Nil	Nil	Nil	Nil	3.00	2.70	3.10	Nil	Nil	Nil	Nil	Nil
11.	Total alkalinity	mg/l	118.25	111.25	123.75	77.50	83.25	86.25	80.00	80.00	106.25	116.25	115.75	89.50
12.	Total hardness	mg/l	160.00	193.75	195.00	183.75	192.50	161.25	177.50	187.50	200.00	171.25	196.25	167.50
13.	Chlorides	mg/l	177.50	198.75	218.75	210.00	206.25	217.50	198.75	176.25	156.25	130.00	143.75	158.75
14.	Calcium	mg/l	16.44	14.06	10.74	10.28	19.42	23.10	16.52	15.13	27.30	10.58	12.47	11.76
15.	Sulphates	mg/l	7.75	6.96	3.25	5.75	5.44	6.44	7.81	9.25	7.43	6.03	5.39	6.69
16.	Nitrate	mg/l	5.04	5.29	4.66	4.31	6.71	6.44	7.63	6.75	5.96	5.68	5.33	4.95
17.	Phosphate	mg/l	0.59	0.34	0.26	0.43	0.57	0.34	0.65	0.60	0.46	0.26	0.35	0.29
18.	BOD	mg/l	4.09	3.10	3.38	2.66	2.84	3.40	4.00	3.81	2.34	3.39	3.25	3.48
19.	COD	mg/l	7.25	9.00	9.31	7.70	8.31	7.94	6.38	6.23	4.83	3.81	4.85	5.13
	T.G. = Transparent Green													

Table- 2: Mean Values of Physico-Chemical Characteristics of Sakhya Sagar Lake During April, 2007 to March, 2008													
S.No.	Parameters	Units	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
1.	Temperature	°C	27.13	28.68	32.55	32.63	28.13	25.63	24.63	24.88	22.13	20.25	21	24.13
2.	Depth	Feet	12.75	11.25	12.38	14.75	16	18	20.25	18.25	16.68	16.08	15.25	13.88
3.	Color		T.G	T.G	T.G	Turbid	Turbid	Turbid	Turbid	T.G	T.G	T.G	T.G	T.G
4.	Transparency	cm	97.5	92.5	108.75	90	108	100	92.5	81.75	75.75	91.5	83.25	98.50
5.	Electrical conductivity	µS/cm	475	437.5	458.75	500	463	392.5	425	397.5	386.25	348.75	379.5	391.5
6.	Turbidity	NTU	7.75	7.50	7.5	15.75	16.75	14.5	11.25	10.25	7.25	6.5	6	6.00
7.	Total dissolved solids	mg/l	213.75	228.75	236.25	240.00	239.25	240.5	247.5	236.25	206.25	176.25	189.25	209.5
8.	pH		8.23	8.00	7.88	7.58	7.85	7.28	7.35	7.45	7.6	7.55	7.75	7.9
9.	Dissolved oxygen	mg/l	6.25	6.50	6.25	6.63	7.5	7.66	8.25	8.85	8.68	9.35	9.35	7.68
10.	Free carbondioxide	mg/l	Nil	Nil	Nil	2.33	Nil	1.8	2.14	Nil	Nil	Nil	Nil	Nil
11.	Total alkalinity	mg/l	122.5	105	118.75	88.75	81.75	98.75	98.75	90	87	80.25	103.25	107.5
12.	Total hardness	mg/l	182.5	205	202.5	178.75	210	178.75	166.25	166.25	188.75	178.75	171.75	177.5

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13.	Chlorides	mg/l	187.5	197.5	212.5	220	232.5	271.25	273.75	216.25	157.5	143	155	176.5
14.	Calcium	mg/l	17.25	15.08	16.10	10	12.11	19.13	18.1	15.13	23.81	10.09	11.73	12.86
15.	Sulphates	mg/l	7.38	5.50	4.38	6.43	5.19	7.13	8.05	10.25	8.81	10.3	6	6.85
16.	Nitrate	mg/l	4.05	5.10	4.56	4.58	6.28	6.01	6.83	6.39	5.58	5.03	4.98	4.53
17.	Phosphate	mg/l	0.60	0.84	0.73	0.65	0.69	0.63	0.84	0.91	0.89	0.72	0.63	0.66
18.	BOD	mg/l	5.38	4.70	4.20	4.55	4.01	2.52	3.14	2.30	3.24	2.83	3.43	2.68
19.	COD	mg/l	7.25	10.25	11.50	12.13	10	9.38	4.38	5.06	8.50	6.75	6.75	6.50

T.G. = Transparent Green

Table- 3: Range of Variation, Mean and Standard Deviation of the Physico-Chemical Characteristics of Sakhya Sagar Lake During April, 2006 to March, 2008

S.No.	Parameters	Units	2006-2007					2007-2008				
			Range of variation		Mean and Standard deviation			Range of variation		Mean and Standard deviation		
			Min.	Max.				Min.	Max.			
1.	Temperature	°C	19.8	32.75	26.39	±	4.45	20.25	32.63	25.98	±	3.87
2.	Depth	Feet	9.19	21.33	14.86	±	3.40	11.25	20.25	15.46	±	2.53
3.	Color		T.G.	Turbid	0.00			T.G.	Turbid	0		
4.	Transparency	cm	90	125.5	103.46	±	10.63	81.75	108.75	93.29	±	9.52
5.	Electrical conductivity	µS/cm	341.25	488.75	413.75	±	42.25	348.75	500	421.25	±	43.74
6.	Turbidity	NTU	4	15.5	8.72	±	3.79	6	16.75	9.75	±	3.75
7.	Total dissolved solids	mg/l	200	248.75	228.23	±	14.06	176.25	247.5	221.96	±	21.80
8.	pH		7.35	7.9	7.60	±	0.15	7.28	8.23	7.70	±	0.27
9.	Dissolved oxygen	mg/l	6.38	9.18	7.92	±	0.83	6.25	9.35	7.74	±	1.11
10.	Free carbondioxide	mg/l	Nil	3.1	2.93	±	0.17	Nil	2.33	2.09	±	0.22
11.	Total alkalinity	mg/l	77.5	123.75	99.00	±	16.95	80.25	122.5	98.52	±	13.05
12.	Total hardness	mg/l	160	200	182.19	±	13.66	166.25	210	183.90	±	14.11
13.	Chlorides	mg/l	130	218.75	182.71	±	28.81	143	273.75	203.60	±	40.86
14.	Calcium	mg/l	10.28	27.3	15.65	±	5.11	10	23.81	15.11	±	3.91
15.	Sulphates	mg/l	3.25	9.25	6.51	±	1.46	4.38	10.3	7.19	±	1.81
16.	Nitrate	mg/l	4.31	7.63	5.73	±	0.95	4.05	6.83	5.32	±	0.84
17.	Phosphate	mg/l	0.26	0.65	0.43	±	0.14	0.6	0.91	0.73	±	0.11
18.	BOD	mg/l	2.34	4.09	3.31	±	0.50	2.3	5.38	3.58	±	0.93
19.	COD	mg/l	3.81	9.31	6.73	±	1.72	4.38	12.13	8.20	±	2.37

T.G. = Transparent Green

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Water Temperature

The water temperature at Sakhya Sagar Lake had a range from 19.18°C (January, 2007) to 32.75°C (June, 2006) with an average mean of 26.39±4.45°C during 2006-2007, while during 2007-2008 the fluctuation in water temperature ranged between 20.25°C (January, 2008) and 32.63°C (June, 2007) with an annual mean of 25.98±3.87°C. Thus, the water temperature was higher during summer season and minimum water temperature was observed in the winter season during both of study years (Fig. 3).

Water Depth

Water depth was varied from 9.19 feet (May, 2006) to 21.33 feet (October, 2006) with an average mean of 14.86±3.40 feet during 2006-07 and from 11.25 feet (May, 2007) to 20.25 feet (October, 2007) with an average mean of 15.46±2.53 feet during 2007-2008. The water level was found to increase up to October during both the years of study, however, the water level decreased in May(Fig. 4).

Colour

The water colour was found to vary from transparent green and turbid. The transparent green colour of water was found in the month of April, May, June, December, January, February and March. Turbid water was observed in July, August, September and October during both the years. The water colour was turbid due to soil particles introduced in to the lake water along the runoff water during rainy season (Fig. 5).

Transparency

The transparency was fluctuated from 90 cm (September, 2006) to 125.50 cm (June, 2006) with an annual mean of 103.46±10.63 cm during first year while during second year, it ranged from 75.75 cm (December, 2007) to 108.75 cm (June, 2007) with an annual mean of 93.29±9.52 cm. The data on transparency in the lake water clearly indicate that the light penetration was greater during first year in comparison to second year (Fig. 6).

Electrical Conductivity

The electrical conductivity had a range between 341.25 µS/cm (October, 2006) to 488.75 µS/cm (May, 2006) with an average mean of 413.75±42.25 µS/cm. during 2006-2007, while during 2007-2008 it fluctuated from 348.75 µS/cm. (January, 2008) to 500 µS/cm (July, 2007) with an annual average of 421.25±43.74 µS/cm. Thus, the electrical conductivity was higher during 2007-08 in comparison to the values obtained during 2006-07 (Fig. 7).

Turbidity

The turbidity had a range from 4.00 NTU in March, 2007 to 15.5 NTU in July, 2006 with an average mean of 8.72±3.79 NTU during first year while during second year it was ranged from 6.00 NTU in February and March, 2008 to 16.75 NTU in August, 2007 with an annual mean of 9.75±3.75 NTU. This indicates that the turbidity was higher during second year in comparison to first year. The turbidity was low during post monsoon season and high during monsoon season (Fig. 8).

Total dissolved solids

The total dissolved solids had shown a seasonal fluctuation between 200 mg/l (January, 2007) to 248.75 mg/l (September, 2006) with an annual mean of 228.23±14.06 mg/l during first year, while during second year, it ranged from 176.25 mg/l (January, 2008) and 247.5 mg/l (October, 2007) with an annual mean of 221.96±21.80 mg/l(Fig. 9).

pH

The pH varied from 7.35 (November, 2006) to 7.9 (April, 2006) with an annual mean of 7.60±0.15 during 2006-07 and from 7.28 (September, 2007) to 8.23 (April, 2007) with an average of 7.70±0.27 during 2007-08 (Fig. 10).

Dissolved Oxygen

The dissolved oxygen exhibited a large seasonal variation in the water body. The dissolved oxygen fluctuated between 6.38 mg/l (May, 2006) and 9.18 mg/l (January, 2007) with an average mean of 7.92±0.83 mg/l during 2006-07and from 6.25 (April and June, 2006) to 9.35 (January and February, 2008) with an average mean of 7.74±1.11 mg/l during 2007-08. It was observed the dissolved oxygen was found increasing continuously in winter season and then decreased continuously reaching to minimum in summer (Fig. 11).

Free Carbon Dioxide

The free carbon dioxide was found to be absent during most of the time. Maximum free carbon dioxide 3.10 mg/l was recorded in the month of October, 2006 with an average mean of 2.93±0.17 mg/l during the year 2006-07and was also maximum 2.33 mg/l was recorded in the month of July 2007 with an average mean of 2.09±0.22 mg/l during the year 2007-08 (Fig. 12).

Total Alkalinity

The sum of bicarbonate and carbonate alkalinities is called as total alkalinity. The total alkalinity in the water of Sakhya Sagar Lake varied from 77.5 mg/l (July, 2006) to 123.75 mg/l (June, 2006) with an average of 99.00±16.95 mg/l during first year and from 80.25 mg/l (January, 2008) to 122.5 mg/l (April, 2007) with an annual mean of 98.52±13.05 mg/l during second year (Fig. 13).

Total hardness

The total hardness fluctuated between 160 mg/l (April, 2006) and 200 mg/l (December, 2006) with an average mean of 182.19±13.66 mg/l during 2006-07and from 166.25 mg/l (October and November, 2007) to 210 mg/l (August, 2007) with an average mean of 183.90±14.11 mg/l during 2007-08 (Fig. 14).

Chloride

The chloride fluctuated between 130 mg/l (January, 2007) and 218.75 mg/l (June, 2006) with an average mean of 182.71±28.81 mg/l during 2006-07and from 143 mg/l (January, 2008) to 273.75 mg/l (October, 2007) with an average mean of 203.60±40.86 mg/l during 2007-08 (Fig. 15).

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Calcium

The calcium fluctuated between 10.28 mg/l (July, 2006) and 27.30 mg/l (December, 2006) with an average mean of 15.65±5.11 mg/l during 2006-07and from 10 mg/l (July, 2008) to 23.81 mg/l (December, 2007) with an average mean of 15.11±3.91 mg/l during 2007-08 (Fig. 16).

Sulphates

The sulphate fluctuated between 3.25 mg/l (June, 2006) and 9.25 mg/l (November, 2006) with an average mean of 6.51±1.46 mg/l during 2006-07and from 4.38 mg/l (June, 2007) to 10.3 mg/l (January, 2008) with an average mean of 7.19±1.81 mg/l during 2007-08 (Fig. 17).

Nitrate

The nitrate fluctuated between 4.31 mg/l (July, 2006) and 7.63 mg/l (October, 2006) with an average mean of 5.73±0.95 mg/l during 2006-07 and from 4.05 mg/l (April, 2007) to 6.83 mg/l (October, 2007) with an average mean of 5.32±0.84 mg/l during 2007-08 (Fig. 18).

Phosphates

The phosphates fluctuated between 0.26 mg/l (June, 2006 and January, 2007) and 0.65 mg/l (October, 2006) with an average mean of 0.43±0.14 mg/l during 2006-07and from 0.6 mg/l (April, 2007) to 0.91 mg/l (November, 2007) with an average mean of 0.73±0.11 mg/l during 2007-08 (Fig. 19).

Biochemical Oxygen Demand

The biochemical oxygen demand fluctuated between 2.34 mg/l (December, 2006) and 4.09 mg/l (April, 2006) with an average mean of 3.31±0.50 mg/l during 2006-07and from 2.30 mg/l (November, 2007) to 5.38 mg/l (April, 2007) with an average mean of 3.58±0.93 mg/l during 2007-08 (Fig. 20).

Chemical Oxygen Demand

The chemical oxygen demand fluctuated between 3.81 mg/l (January, 2007) and 9.31 mg/l (June, 2006) with an average mean of 6.73±1.72 mg/l during 2006-07and from 4.38 mg/l (October, 2007) to 12.13 mg/l (July, 2007) with an average mean of 8.20±2.37 mg/l during 2007-08 (Fig. 21).
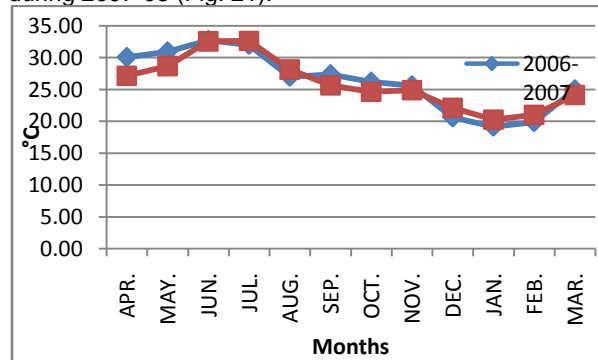
Fig. 3: Monthly Variation of Water Temperature of Sakhya Sagar Lake
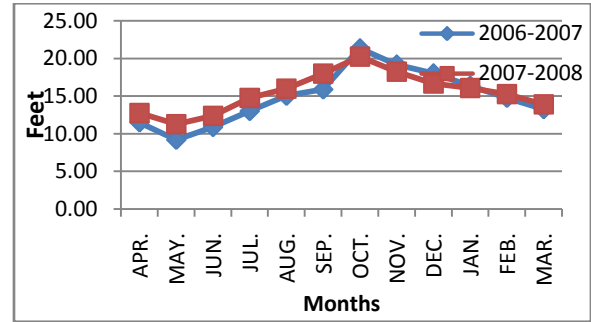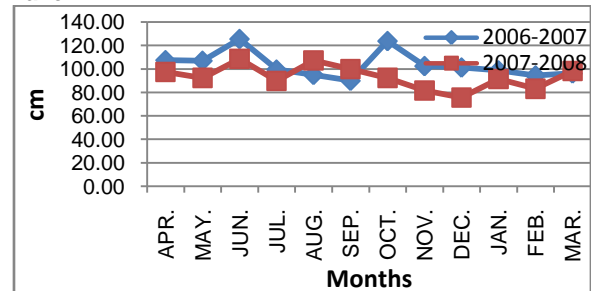
Fig. 4: Monthly Variation of Depth of Sakhya Sagar Lake

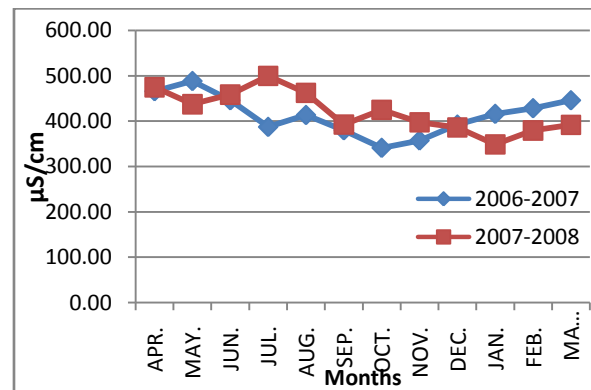**Fig. 5: Monthly Variation of Transparency of Sakhya Sagar Lake**

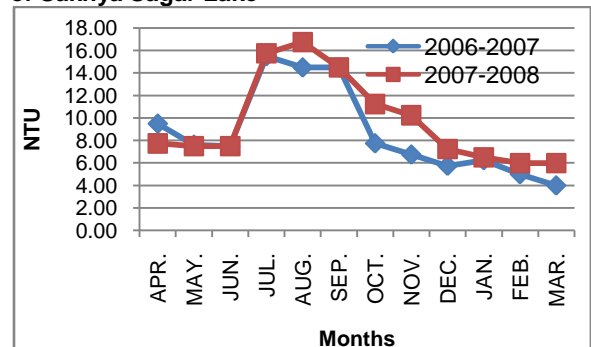**Fig. 6: Monthly Variation of Electrical Conductivity of Sakhya Sagar Lake**

Fig. 7: Monthly Variation of Turbidity of Sakhya Sagar Lake
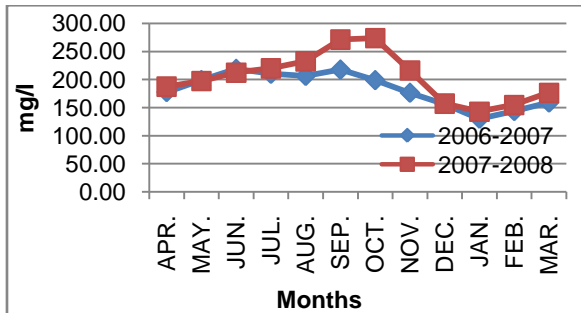
28

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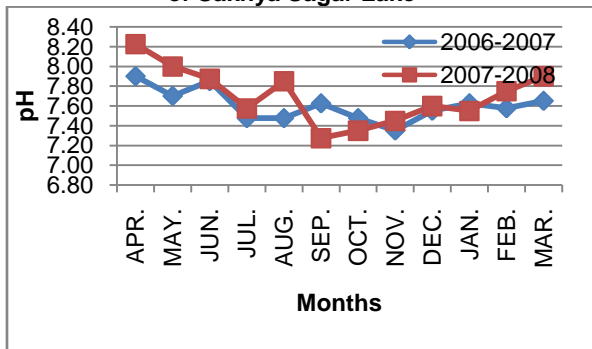**Fig. 8:Monthly Variation of Total Dissolved Solids of Sakhya Sagar Lake**

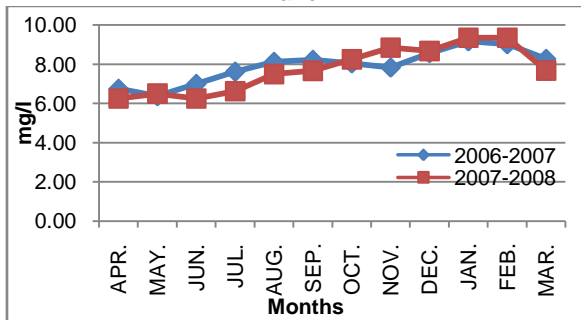**Fig.9:Monthly variation of pH of Sakhya Sagar Lake**

Fig.10: Monthly Variation of Dissolved Oxygen of Sakhya Sagar Lake
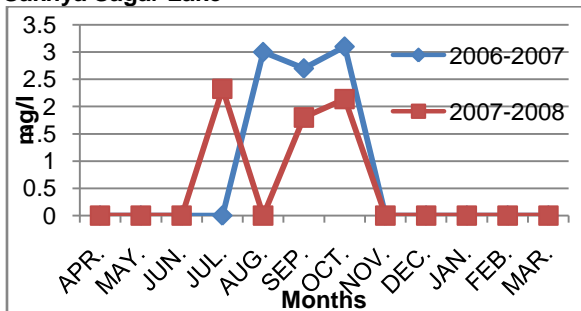

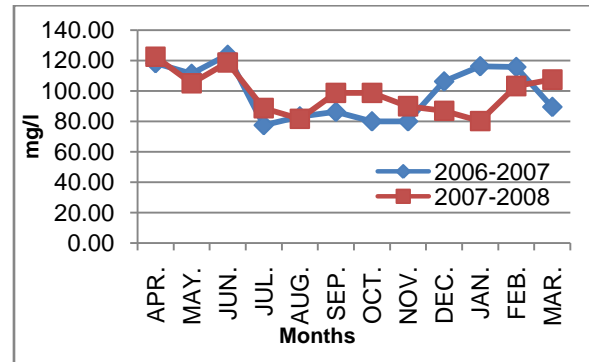**Fig. 11: Monthly Variation of Free Carbon Dioxide of Sakhya Sagar Lake**

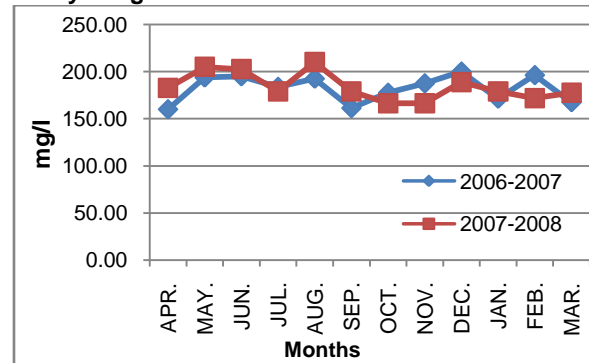**Fig. 12: Monthly variation of total alkalinityof Sakhya Sagar Lake**

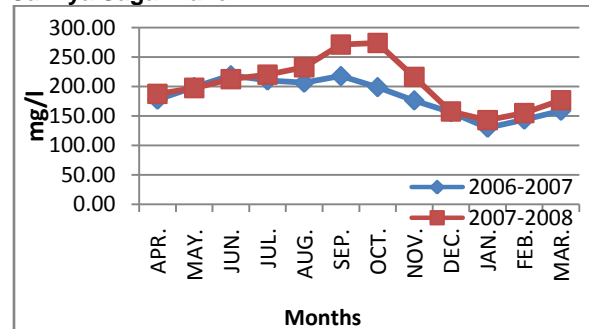**Fig. 13: Monthly Variation of Total Hardness of Sakhya Sagar Lake**

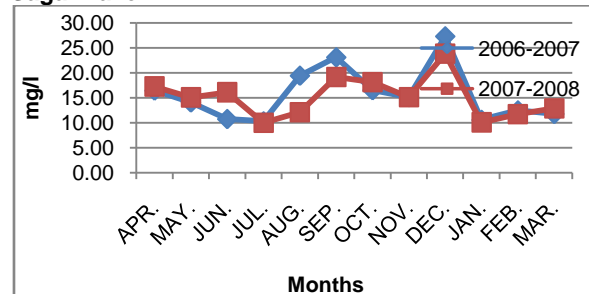**Fig. 14 : Monthly Variation of Chloride of Sakhya Sagar Lake**

Fig. 15: Monthly Variation of Calcium of Sakhya Sagar Lake
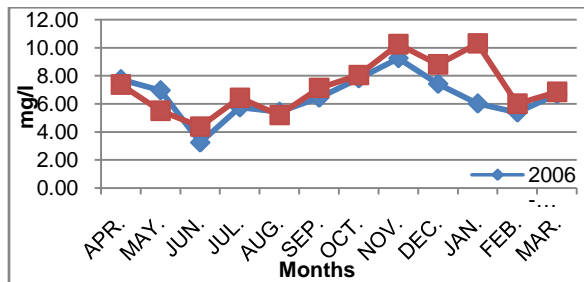
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Fig. 16: Monthly Variation of Sulphate of Sakhya Sagar Lake
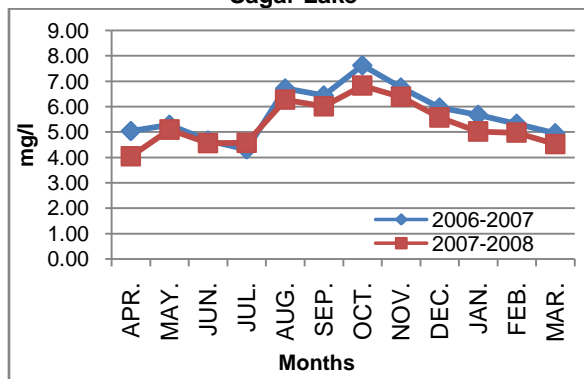

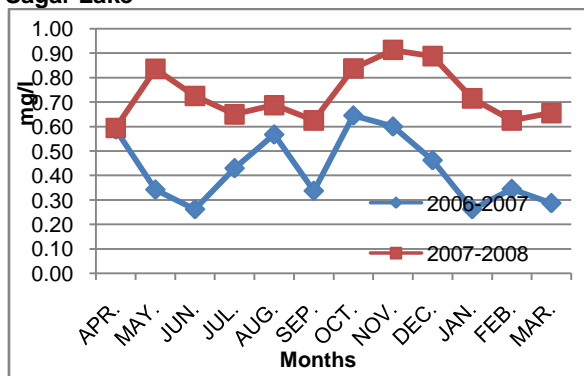**Fig. 17: Monthly Variation of Nitrate of Sakhya Sagar Lake**

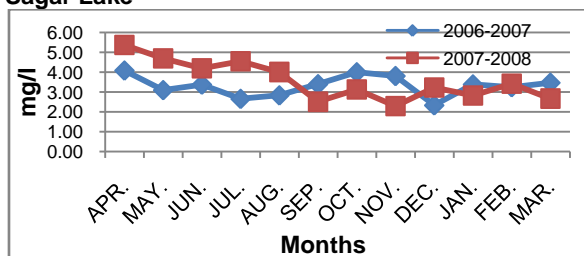**Fig. 18: Monthly Variation of Phosphate of Sakhya Sagar Lake**

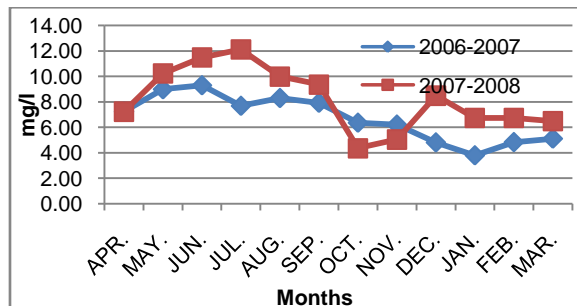**Fig. 19: Monthly Variation of Biochemical Oxygen Demand of Sakhya Sagar Lake**

Fig. 20: Monthly Variation of Chemical Oxygen Demand of Sakhya Sagar Lake

Conclusion

From the results obtained, it can be concluded that the Sakhya Sagar Lake ispolluted freshwater body due to the continuous discharge of municipal sewage and runoff. Higher amount of nutrients leads to eutrophication. More nutrients in the water body makes the water unfit for human consumption. It is recommended that periodical survey is essential to find out the water quality and carryout abatement programmes.For sustainable upkeep of the water bodies it is important that the forest department should take all necessary measures like diverting of any sewage, waste water that coming to the Sakhya Sagar Lake, creation of more green belt around the lakes, involving local people and tourists and sensitize them about the role of the, water bodies in the Madhav National Park for wild life as well as for drinking and agriculture use. The forest department should take measures to control siltation, pollution and weed infestation in the lakes to provide suitable habitat for avifauna and other vertebrates.

References

1. Agarwal, S.S. (1980). Some aspects of limnology of Ramaua Dam with special reference to phytoplankton and zooplankton.Ph.D. thesis, Jiwaji University, Gwalior, India.
2. APHA (1985).Standard methods for examination of water and waste water analysis. American
3. Water Association and Water Pollution Center Federation, Washington, D.C.; 1268
4. Arya, M., Rao, R.J. andMishra, A.K. (2012).Ecology and Diversity of Fish Fauna in the Sakhya
5. Sagar Lake, Shivpuri, Madhya Pradesh, India". Journal of Environmental Research and Development. Vol.7, No.2A, pp. 973-978.
6. Dagaonkar, A. and Saksena, D.N. (1992) . Physico-chemical and biological characterization of a temple tank.Kailasagar, Gwalior, Madhya Pradesh. *J. Hydrobiol*, 8(1): 11-19.
7. Dixit, S.(1989).Studies on physico-chemical properties of Tighra Lake with special reference to plankton.Ph.D. thesis, Jiwaji University, Gwalior, India.
8. Garg, R.K. Seksena, D.N. and Rao, R.G. (2006).Assessment of physico-chemical water quality of Harsi Reservoir, District Gwalior, Madhya Pradesh.*J. Ecophysiol. Occup.Hlth.* 6 (2006) 33-40.

Asian Resonance

9. Kant, S. and Vohra, S. (1989).Lakes- their management and conservation.*In*: Management of aquatic ecosystem (Eds.: V.P. Agrawal, B.N. Desai and S.A.H. Abidi). *Society of Bioscience,* Muzaffarnagar: 155-168.

10. Kaushik, S. and Saksena, D. N. (1992). Water quality of a mesonary tank, Motijheel and method suggested for its management. Proceeding of SAARC Countries conference on environment management in developing countries, Firoz Gandhi College, Rai Baraili, India.

11. Kaushik, S., Agarkar, M. S. and Saksena, D. N. (1991).Water quality and Peridicity of Phytoplanktonic Algae in Chambal Tal, Gwalior, Madhya Pradesh. *Bionature.*, 11(2): 87-94.

12. Kaushik, S., Sharma, S. and Saxsena M. N. (1989). Aquatic insects population in relation to physico-chemical characterstics of Chandanpura pond, Gwalior (M.P.). In: Environment Risk Assesment. (Eds.: Y. N. Sahia, P. B. Deshmukh, T. A. Mathai and K. S. Pillai). Academy of Environmental Biology, India, Muzaffarnagar: 243-254.

13. Khuhawar, M.Y., Mirza, Aslam M., Leghari, S. M. and Arain, Rafee (2009).Limnological Study of Baghsar Lake, District Bhimber, Azad Kashmir. *Pak. J. Bot.*, 41(4): 1903-1915, 2009.

14. Mishra, A.K., Mathur, R., Gupta, R.B. and Arya, M. (2010).Limnological Study of Sakhya Sagar Lake, Shivpuri (M.P.), India. Journal of Environmental Research and Development. Vol.4, No.4, pp. 993-998.

15. Sakhre, V.B. and Joshi, P.K. (2002).Ecological of Palas-Nilegaon Reservoir in Osmanabad District, Maharashtra.*J. Aqua. Boil.*, 18(2): 17-22.

16. Sharma, Neeru and YadavIndu, (2007) Physico-chemical characteristics of Kayad Lake, Ajmer, Rajasthan, India.*Indian journal of Environmental Sciences. 11(2) pp 137-140.*

17. Trivedy, R.K. and Goel, P.K. (1986). Chemical and biological methods for water pollution studies, Environmental Publication Karad, Maharastra, India: 247.

18. Verma, M. N. (1969). Hydrobiologocal study of a tropical impoundment Tekanpur reservoir, Gwalior, India with special reference to the breeding of Indian Carps.*Hydrobiologia.*34: 358-368.