Study of Physico-chemical Parameters of Killa Lake Water of Belgaum, Karnataka, India

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ABSTRACT

The present study has been undertaken to evaluate Physico-chemical parameters. Water samples were collected from Killa Lake, Belgaum at two places and analyzed. The results reveal that the lake water is polluted due to the entry of sewage. The lake has an area of 66 acres of land and 43 acres of the land is water spread. Catchment's area is of 2.27 sq.km and the command area is of 573 acres.

The district authorities have taken measures to rehabilitate the lake by cleaning it up with the help of MoEF, New Delhi, City Corporation Belgaum, Dept of Tourism and Urban Development Authority and Karnataka State Pollution Control Board Belgaum, during the year 2005, under the National Lake Conservation Programme. Since then the lake's aesthetic beauty has been enhanced.

In this project, they have desilted the basin of the lake and bypassed all the city sewage entering into the lake through underground drainage. They have taken measures to see that only storm water enters into the lake. They have stopped public usage of water for washing of clothes, cattle and vehicles. In addition to this, the border of the lake has been fenced and a good garden has been brought up all along the border of the road. With these developments, it has been found that the physico-chemical parameter of the lake has improved.

INTRODUCTION

Everything originated in the water and water sustains everything. All life on earth depends on water. Water is a significant source of habitat for plants, animals and is found in every section of ecosphere. Sources of water are atmospheric, with surface water; stored water and ground water. Stored water present in ponds, reservoirs, lakes or ocean are important features of the earth's landscape. Humans have constructed lakes to stop runoff water for various uses like drinking, irrigation and recreation during the dry periods. Due to rapid population growth, urbanization, industrial, technological development, urbanization and injudicious planning without due regard to sustainable development around the lakes, it reduces the catchments area, which ultimately leads to gradual deterioration of these lakes. Due to urbanization around the lakes naturally,

there will be an entry of domestic waste, which leads to eutrophication and declines the quality of water leading to loss of biodiversity, siltation and consequent shallowing and shrinking of lakes.

STUDY AREA

The present study has been undertaken to evaluate the quality of Killa Lake water (Fig-1-2), with respect to its suitability for potability, irrigation and aquatic life, which is situated in Belgaum City. Located in the Northwest part of Karnataka State, Southwest of India. It is located between 74°. 37'. 3.35" East Longitude and 15°. 53'. 45" North Lattitude. Geographically it lies in the east of magnificent "Western Ghats". Belgaum receives an average annual rainfall of about 800 mm and is situated at 747.47m Mean Sea Level. The temperature of the city is moderate and it varies from a maximum of 38.0°C to a minimum of 8.0°C. It comes under Krishna basin and Ghataprabha sub-basin.

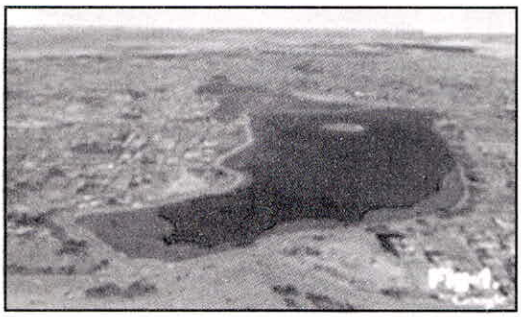

Fig. 1 : Satellite Image of the Killa Lake.

Fig. 2 : View of the Killa Lake before desiltation

As the lake is situated in front of the Historic Killa it has got the name Killa Lake. Due to the vast development of the city simultaneous increase in population and the over crowding of the vehicles, the lake has lost its purity.

STATUS OF KILLA LAKE SYSTEM

Earlier three major sewage entry points drained this lake. viz 1. Drain from circuit house corner 2. Drain from Shivaji nagar area and 3. Masonry channel near BUDA corner and through pipe culvert into the lake. The total discharge is 7764 cum/day (Fig-3-8). The storm water is the major source of inflow into the lake. The total runoff into the lake is thus estimated at 3037 ml. From these inlets both waste water and storm water enters the lake. Thus through the inlets the sludge has been accumulated and it measures about 85000 m^3 at an over all average depth of 0.31m. There is no continuous outflow of water from the lake. The outlet is operated only when the water level exceeds the sill level during the monsoon season around June to September (3-4 months) of the year. Based on the meteorological department's information the water loss by evaporation is about 626 ml annually. Historically the lake

Fig. 3 : Sewage inlet of South Eastern side of the Killa Lake

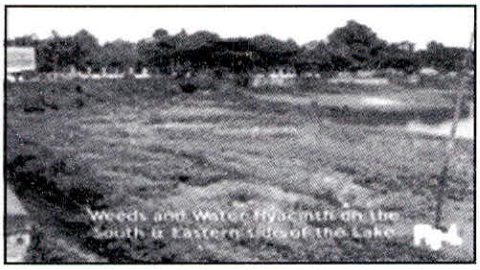

Fig. 4 : Weeds on South and Eastern side of the Killa Lake

Fig. 5 : Entry of sewage into the Killa Lake

Fig. 6 : Killa Lake desiltation work under progress

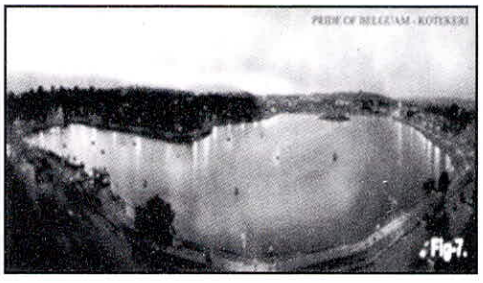

Fig. 7 : Lake view after completion of the work

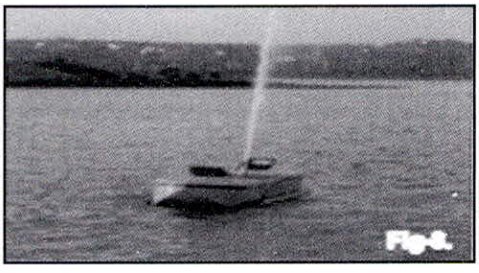

Fig. 8 : Aeration Fountain to increase the oxygen level in the Killa Lake

has acted as a buffer to high floods in Belgaum area and as a source of irrigation water to the nearby villages. Earlier 570 acres of land was irrigated from this lake now it has been reduced to 340 acres due to the rapid urbanization (Infrastructure & Technology Consultants). Presently the lake is used for providing recreational facilities to the citizens of Belgaum and surrounding villages.

MATERIALS AND METHOD

Water samples from Killa Lake were collected and brought to the Laboratory and tested. The physico-chemical parameters were analyzed as per the Standard Methods described in APHA (1998) and Ramteke & Moghe (1988).

RESULTS AND DISCUSSION

The present study deals with the analysis of the physico-chemical characteristics of the Killa Lake, Belgaum. Fifteen water quality parameters were analysed and significant variations in these parameters were observed. The physico-chemical parameters of the lake are given in the Table 1 and 2. The color of the lake water before desiltation was light ash during the rainy season and greenish colour during winter and summer season. Light ash colour was absent because there was no sewage runoff into the lake after desiltation and it appeared dusky in colour. Light ash colour was due to the influx of rainwater along with sewage, which brought a lot of silt and organic particles and greenish colour is due to the occurrence of algal blooms. Dusky colour is due to the runoff of rainwater along with soil and inorganic particles into the lake.

The pH value ranged from 7.5 to 8.16 and 7.23 to 8.56 before and after desiltation respectively, which is the desirable limit for primary water quality criteria for various uses as per the CPCB. The pH constantly remained above 7 indicating the alkaline nature of the water body, which shows the high buffering capacity of the system.

The BOD and DO ranges from 20.2 to 7.5 mg/l and 4.0 to 6.0 mg/l respectively before desiltation and after desiltation the BOD and DO value ranges from 8.8 to 2.94 mg/l and 5.0 to 8.7 mg/l respectively. High values of BOD and low values of DO indicated the level of organic pollution (Pinaki Ranjan Chatterjee and M. Raziuddin 2003). The BOD varied in a narrow range of 20.2 to 8.8 mg/l indicating that the lake water is polluted but there is an improvement in water quality consequent to the implementation of the rejuvenation measures (Fig. 9) (Reddy et al., 2002). Oxygen is an important parameter of water quality in pond and reservoirs. It is essential for the metabolic activity of aquatic organisms. The presence of oxygen is due to the direct diffusion from air and photosynthetic activity of autotrophs. The DO value of the pond was suitable for potability after proper conventional treatment and aquaculture (Yogesh and Pedse 2001). The DO was found to be more after desiltation when compared to before desiltation of the lake.

The Hardness of Killa Lake water was found to be high due to the concentration of calcium and magnesium salts (Bagade and Verma 1985). Water can be classified on the basis of hardness in the following manner; 0-60 mg/l as soft, 61-120 mg/l as moderately hard, 121-160 mg/l as hard and greater than 160 mg/l as very hard. On the basis of this the lake water before desiltation can be included in the very hard category due to long time deposition of salts in the lake and after desiltation the lake water can be included in the moderate category, because of the fresh storm water added to the lake.

Table 1. Showing the Physico-Chemical Characteristics of Killa Lake water Before Desiltation during the year 2004

Sl No	PARAMETERS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Colour	BG	BG	BG	BG	BG	Light ash	Light ash	Light ash	Light ash	Light ash	BG	BG
2	pH	8.16	8.07	7.7	7.61	7.82	7.91	7.71	7.87	7.5	8.06	8.04	8.13
3	BOD	13.25	18.1	12.85	14.65	16.3	17.4	20.2	10.5	9.45	14.5	15.4	7.5
4	Dissolved Oxygen	4.5	4.15	4.95	4.5	3.95	4.5	4.8	5.35	6.05	4.65	4.2	4.3
5	Dissolved Solids	365	550	425	440	450	406	390	320	370	400	570	680
6	Conductivity	580	765	730	720	745	640	620	465	590	710	865	780
7	Chloride as Cl	113	122	143	133	126	138	136	80	100	115	148	103
8	Sulphate as SO_4	12.32	13.97	11	13.25	14.9	15.88	15.65	17.26	10.89	13.8	23.6	17.07
9	Hardness as $CaCO_3$	97	174	99	110	142	109	115	136	153	161	170	130
10	Calcium as Ca	31	36.8	19.6	22.2	29	22	24.2	37.2	36.4	34.5	33.8	25.2
11	Magnesium as Mg	4.38	19.93	12.17	14.5	17.45	12.64	13.65	10.4	15.06	15.55	22.26	16.28
12	Nitrate as NO_3	4.06	BDL	BDL	4.52	5.3	1.73	2.32	2.75	5.38	5.54	7.44	1.13
13	Iron as Fe	BDL	BDL	5.16	4.45	4.15	3.2	4.11	1.6	5.56	5.4	3.7	BDL
14	Fluoride as F	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
15	Chromium as Cr^{+6}	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
All the values are in mg/l except pH, and conductivity is expressed in µmhos/cm. BG- Blue Green.													

Table 1 : Showing the Physico-Chemical Characteristics of Killa Lake water Before Desiltation during the year 2006

Sl No	PARAMETERS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Colour	BG	BG	BG	BG	BG	Dusky	Dusky	Dusky	Dusky	BG	BG	BG
2	pH	7.85	8.08	7.2	6.61	8.09	8.56	7.23	8.04	7.97	8.15	8.21	8.18
3	BOD	6.6	8.8	6.9	8.1	6.05	6.8	2.94	2.8	7.72	3.48	4.65	4.6
4	Dissolved Oxygen	6.1	4.9	6.75	6.85	5.8	6.8	6.8	5.85	5.8	5.05	5.55	8.7
5	Dissolved Solids	228	270	460	310	310	360	330	260	220	270	250	250
6	Conductivity	425	435	645	605	515	550	590	385	350	410	420	365
7	Chloride as Cl	58	76	88	78	81	76	50	60	52	41	28	46
8	Sulphate as SO_4	17.91	29.43	23.21	27.33	39.27	9.64	24.7	19.3	24.35	19.23	23.43	28.59
9	Hardness as $CaCO_3$	148	136	110	73	109	120	148	100	90	111	44	93
10	Calcium as Ca	29.7	36.8	24	18.4	27.2	36	36	26.4	20.8	28	11.6	18.4
11	Magnesium as Mg	17.98	10.69	12.11	6.55	9.95	7.29	14.1	8.26	9.23	9.96	3.65	11.38
12	Nitrate as NO_3	3.42	4.08	BDL	4.99	5.39	9.64	4.75	4.84	2.75	2.62	1.73	1.17
13	Iron as Fe	2.88	2.9	7.56	3.2	3.32	1.92	2.6	2.15	2.68	8.2	10	10.11
14	Fluoride as F	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
15	Chromium as Cr^{+6}	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

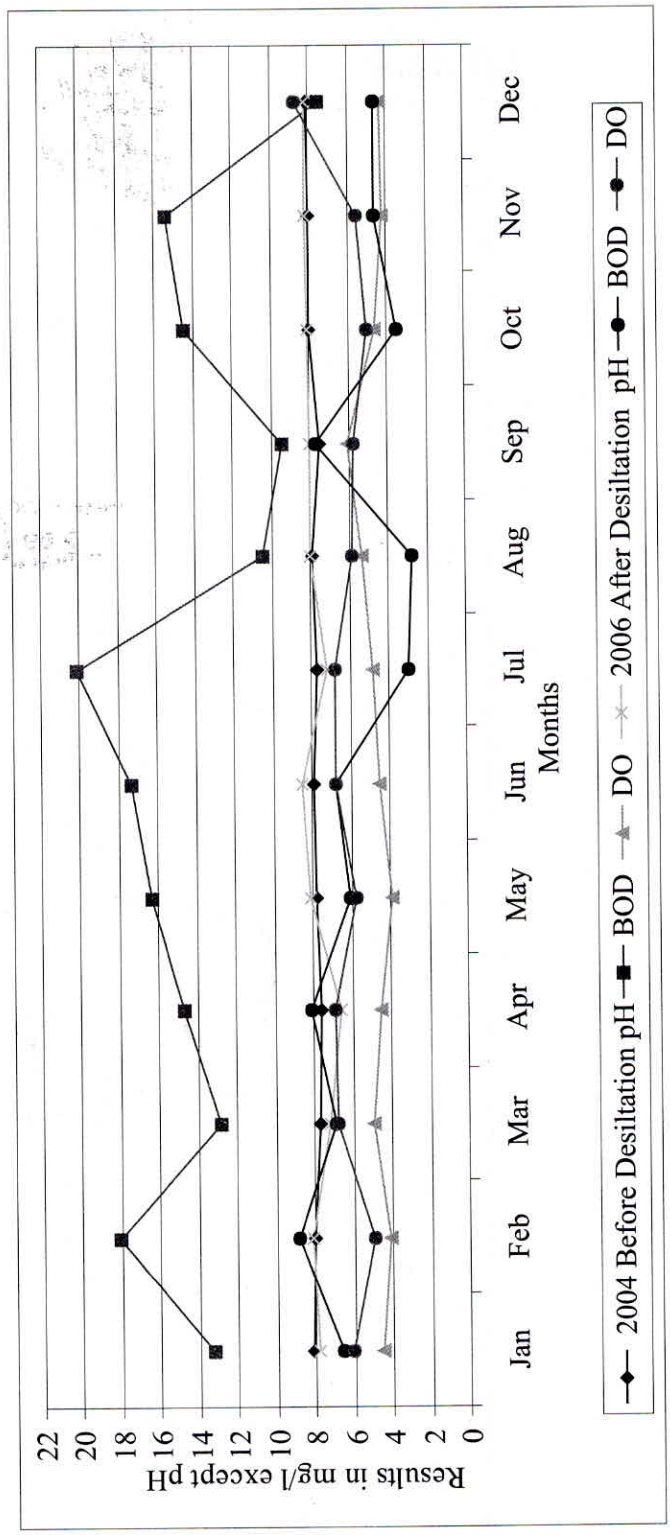

Fig. 9 Comparision of pH, BOD and DO of Killa Lake before and after desiltation

The total dissolved solids ranged from 320 to 680 mg/l before desiltation and after desiltaion it ranged from 220 to 460 mg/l. Electrical conductivity ranged from 465 to 865 uMhos/cm before desiltation and after desiltation this range is from 350 to 645 uMhos/cm. The inferior palatability results from high solids in water. The desired drinking water standard for dissolved solids is 500 mg/l as per BIS (IS 10500-91) standard. Electrical conductivity for primary water quality standard for irrigation is 2250 uMhos/cm.

Chloride concentration varied from 80 to 148 mg/l before desiltation and after desiltation 28 to 88 mg/l which is quite below the desirable limit for drinking water (250 mg/l) as per the BIS (IS 10500-91) standard. Before desiltation the chloride level is slightly higher when compared to the after desiltation level due to the mixing of organic wastes of animal origin. It is directly correlated to the pollution level (Munnavar 1970). The concentration of sulphate ranged from 10.89 to 23.6 mg/l before desiltation and from 9.64 to 39.27 mg/l after desiltation which is quite below the desirable limit for drinking water (200 mg/l) as per the BIS (IS 10500-91) standard and primary water quality criteria for various uses as per the CPCB standard. Nitrate is the most highly oxidized form of nitrogen compounds, as it is the product of the aerobic decomposition of organic nitrogenous matter. The present study showed that the level of nitrate is much below the BIS (IS 10500-91 standard (45 mg/l). The existence of iron in reduced conditions is observed when sulphate and carbonate concentration is low. It was observed that the Fluoride and Hexavalent chromium were below detection limit

CONCLUSIONS

- The control of eutrophication and treatment of lake water by way of permanent and temporary measures has helped to ensure acceptable water quality.
- By interception and treatment of sewage water inflows into the lake has helped to prevent further deterioration of the lake eco-system.
- The surrounding of the water body can be kept clean by controlling indiscriminate disposal of solid waste in and around the lake.
- The suitability of water for irrigation purposes is determined with respect to electrical conductance and Dissolved solids. The comparison of the water quality variables of the Killa Lake with different standards prescribed by CPCB and Environmental Protection Agency (EPA) revealed that the water is perfectly suitable for irrigation purpose.
- The presence of good number of fishes in the lake indicates that water is suitable for pisciculture.
- After desiltation of the lake and carrying out improvement activities like bypassing the sewage and with proper planning of the lake for recreation the lake have improved the water quality status.

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