Sengupta, M. and Dalwani, R. (Editors). 2008.
Proceedings of Taal2007: The 12th World Lake Conference: 292-299

Water Quality Assessment of Katraj Lake, Pune (Maharashtra, India): A Case Study

K.C.Khare and M.S. Jadhav
Sinhgad College of Engineering, Pune- 411041,Maharashtra
Department of Civil Engineering, Sou. Venutai Chavan Polytechnic, Pune, 411041, Maharashtra,
E mail : khare.kanchan@gmail.com, mrunaljadhav@gmail.com

ABSTRACT:

Katraj lake is one of the prime lake of Pune (Maharashtra) which has; a historical significance, is situated in south Pune covering about 82 hectares .In 1749 the water supply system which was commissioned from "Ambil Odha" that flows down to Katraj -Dive ghat. The system consists of an intricate system of two lakes, dams and canals. The first lake acts as a sedimentation tank and the water from the first lake then seeps into the Katraj Lake. It is checked by a 1000 feet long stone dam. Katraj is also serviced by many natural springs. Both dams have small gates at the base that were used as sluice gates to release excess waters back into the Ambil Odha canal. In 19th century the Katraj Lake water used to supply water through a underground canal to the heart of the city. Several fountains, tanks, baths and wells were constructed to supply water from the Katraj Lake to the local residents. In 1879, the Pune municipality took over the city's water supply system and from then began a gradual decline in the use of the Katraj system.

As recently as 1970, the Katraj lake waters were being supplied to residents living in near by vicinity of the lake. Presently the surface water quality of the Katraj Lake is severely degraded due to the pollution from surrounding areas directly entering the waters.

Water analysis was done for the parameters like pH, Dissolved oxygen (DO), Biochemical oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total dissolved solids(TDS),Chloride, SulpHate, Nitrate, Calcium and Magnesium and Hardness for testing the suitability for drinking, agricultural purposes.

The study report discusses about the analysis of the water quality and suggests the means to improve through eco remediation measures.

Keywords : Water pollution, PHysico- chemical characteristic, MorpHometric data, Sampling

INTRODUCTION:

Water is the most abundant and most useful compound in the world and hence it is called "Jeevan" in Sanskrit. or Life. Life is not possible without water, the 2/3 rd mass of our body is water and 70% surface of the earth is covered by water. The contamination and pollution of water is of great concern in the world for the developing countries like India. Water of good quality is required for living organisms. Basically the quality of water is described according to its pHysical, chemical and biological parameter. The biological study of water is helpful in problems like pollution control, the construction and renovation of dams or lakes, fish and aquatic life. The pHysico-chemical methods are used to detect the effects of pollution on the water quality. Changes in the water quality are reflected in the biotic community structure. Water pollution occurs when water body is adversely affected due to the addition of undesirable materials to the water. When it is unfit for its intended use, water is considered polluted. Lakes serve as an important life support system by helping in recharging of aquifers and regulating hydrological regimes. Restoration and recharge of water table is possible due to the lakes, so the lakes play important role in our life. The lakes also act as natural traps for sediments and nutrients thereby helps to regulate water quality and sedimentation of the river systems from the catchments area. The degradation of lake is due to encroachment and eutropHication loads and silt. The main causes for the water pollution of lake are due to pollutant entering from fixed point sources and pollutants entering from non point sources.

Present study deals with a Katraj Lake which is situated in Pune in western Maharashtra. Pune is historic place in Maharashtra (Fig. 1). Katraj Lake is also a historic manmade lake situated at the bottom of hill ranges of Katraj Ghat in south west part of the city (Fig. 2). It was built during 1750's, which consist of a intricate system of two lakes dams and canal. The first lake (Fig. 4 to 6) act as a sedimentation tank and the water from the first lake then seeps into the second

lake. Second lake has natural springs as its main source of water.

Figure 1. Pune Location

Figure 2. Location of lakes

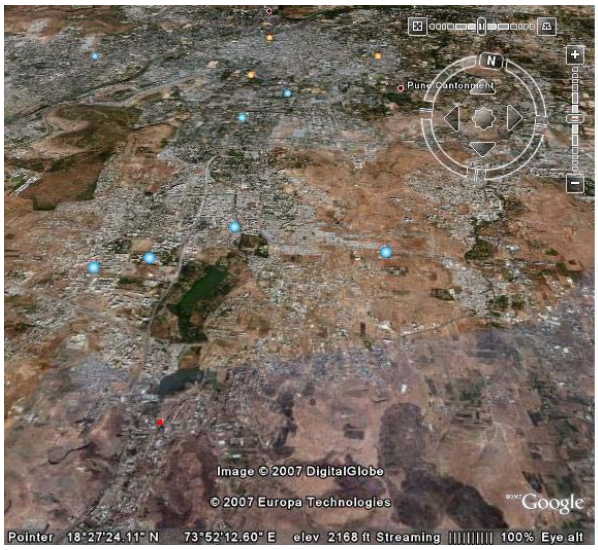

Figure 3.

Figure 4.

Figure 5.

Figure 6. First lake

These two lakes are 600m away from each other (Fig. 3). Dam has small gates at the base which were used as sluice gates to release excess water back into the canal. The Katraj Lake and the adjoining dam is an architectural wonder of Maratha Engineering in stone masonry. The water level of the lake is controlled by a unique Persian water control system. The entire system works under the action of gravity. In ancient time the lake water was used for drinking purposes. The water from the lake was supplied to the heart of the city and to the 'Shaniwarwada' a famous historic place in Pune. Conveyance system from Katraj Lake to the historic place 'Shaniwarwada' supplied water for all the fountains in the fort. Even today, several old Wadas and tanks in the city get water through an under ground earthen pipeline. Now the water of the second lake is used only for recreation purposes and plantations (Fig. 7 to 13). The lake does not seem to have received care and attention during last few years as a result, the lake as well as its catchment is facing serious threats from encroachment and pollution. In this connection Pune Municipal corporation is should undertake the lake improvement project which includes desiltation, beautification and removing of aquatic weeds and its disposal with the help of government and NGOs.

In the present study water quality analysis was done for pre monsoon and post monsoon season for the second lake.

Figure 7. Second katraj lake

Figure 8.

Figure 9.

Figure 10.

Figure 11.

Figure 12.

Figure 13.

MATERIAL AND MATHODS

MorpHometric Data of Katraj Lake

Area of the Lake : 3002 x 10^2 m^2
Volume of the Lake : 3002000 m^3
Maximum length : 790 m
Depth : 8-10 m
Shape : Sub rectangular

CLASSIFICATION:

Based on the TropHic status: EutropHic
Based on presence of outlet: Open lake
Based on the nature of inflow: Seepage lake
Based on morpHometry : Sub rectangular lake

Lake Water Sampling:

The choice of sampling stations was influenced by the various uses of the water and their location, relative magnitude and importance. Number of water sampling stations was equal to the log of the area of lake in square kilometer. Lake sampling is normally carried out from a boat. The station is usually identified from a combination of landmarks on the shore and depth profiles with echo sounding. Precise identification of the station each time is not easy but this is usually immaterial because of the good lateral mixing. Number of samples will be needed to be taken at vertical intervals. The following minimum programme is recommended. Two depths (surface and bottom) if lake depth does not exceed 10 m, Three depths (surface, thermocline and bottom) for lakes not deeper than 30 m, Four depths (surface, thermocline upper hypolimnion, bottom) for lakes of at least 30 m depth

in lakes deeper than 100 m additional depths may be considered.

The water samples of the present lake were collected from two different stations of the lake for pHysico-chemical analysis before and after monsoon in the year 2006-07. The samples for analysis were collected in sterilized bottles using standard procedure in accordance with the standard method of American Public Health Association (1995), In this study surface water samples are collected. The parameters selected for the said examination are detailed in (Table 1). Water analysis for second Katraj Lake was carried out for the month of December 2006 and August 2007 and the results were tabulated in (Table 2 and Table 3) respectively.

Table 1. Parameters and methods employed in the chemical examination of water samples:

Sr.No.	Parameter of water analysis	Methods
1	pH	Potentiometric
2.	DO	Azide modification
3.	BOD	Azide modification
4.	COD	Dichromate reflux
5.	Chloride	Gravimetric
6.	Calcium	Titrimetric
7.	Magnesium	Titrimetric
8.	Hardness	Titrimetric

Table 2. Physico-Chemical Characteristics of Lower Katraj Lake:

Sr No	Parameters	Unit	Observed values December 2006 (S1)	Observed values December 2006 (S2)
1.	Temperature	°C	28	27.3
2.	PH	--	7.3	7.1
3.	D.O.	Mg/l	5.4	4.3
4.	B.O.D.	Mg/l	70.00	78.00
5.	C.O.D.	Mg/l	180.00	120.00
6.	Chloride	Mg/l	76.01	80.01
7.	Total hardness	Mg/l	162.00	182.00
8.	Total Alkalinity	Mg/l	170.00	186.00
9.	Total dissolved solids	Mg/l	435.00	465.00
10.	Turbidity	NTU	36	42

S1 – At the center of the lake S2: weed encroachment

Table 3. Physico-Chemical Characteristics of Lower Katraj Lake:

Sr No	Parameters	Unit	Observed values August 2007 (S1)	Observed values August 2007 (S2)
11.	Temperature	°C	24.2	24
12.	PH	--	8.45	9.05
13.	D.O.	Mg/l	5.8	4.8
14.	B.O.D.	Mg/l	68.00	74.00
15.	C.O.D.	Mg/l	126.00	136.00
16.	Chloride	Mg/l	79.01	82.3
17.	Total hardness	Mg/l	260.00	298.00
18.	Total Alkalinity	Mg/l	189.00	239.00
19.	Total dissolved solids	Mg/l	390.00	456.00
20.	Turbidity	NTU	28	32

S1 – At the center of the lake S2: weed encroachment

RESULT AND DISCUSSION:

The temperature of water was found to be in the range between 24°C to 28°C in pre-monsoon and post-monsoon respectively. The temperature of water is one important parameter which directly influences some chemical reaction in aquatic ecosystem. The significant correlation between ambient temperature and water temperature was studied by (Ganpati 1943,1962 and Verma 1967). pH of water is important for the biotic compound because most of the plant and animal species can survive in a narrow range of pH from slightly acidic to slightly alkaline condition. pH was recorded 7.3 to 8.45. (Fig 14). The high value pH during rainy season may be due to the dilution of alkaline substances or dissolution of atmospHeric carbon dioxide (Sheikh Nisar and Yeragi 2003).

The dissolved oxygen varied from 4.8 to 5.7 mg/l during the study. (Fig.14) The dissolved oxygen was found to be maximum at post monsoon and minimum at pre monsoon. The dissolved oxygen in water is temperature dependent. As it is required to all the plants and animals for respiration, the high temperature and low dissolved oxygen during summer create favorable condition for the development of green algae (Prakash C.1982).

The biochemical oxygen demand was recorded in the range 68to 78 mg/l (fig 14). These two parameters are also temperature dependent

The chloride ranged from 76.01 to82.03 mg/l (Fig 15). Chlorides in urban areas are indicators of large amount of non point source pollution by pesticides, grease, oil, metals and other toxic materials.

The total hardness ranged from 160.00 to 298.00 mg/l.(Fig 15) minimum during pre-monsoon and maximum during post monsoon which is higher as per the permissible limit. Basically calcium, magnesium, barium strontium etc are responsible for the total hardness of water. The calcium is one of the alkaline earth metals, not known to produce any hazardous effect on human health. The magnesium has ten times the solubility of calcium and being bivalent, too produces hardness. The calcium and magnesium hardness are the two elements, which form the most abundant ions in fresh water, WHO (1984).

The total alkalinity ranged from 170.00 to 239.00 mg/l. The alkalinity might be due to high pH. The high pH may be due to the hydroxide, carbonates and bicarbonates. The greater alkalinity values may be due to the large scale use of its bank as open latrine and consequent washing of the excreta in and near by the water body. (Narasimha Rao and Jaya Raju 2001)

The total dissolved solids ranged from 390.00 to 465 mg/l.(fig 15) The excessive total dissolved solids generally affects the potability.

The turbidity of the lake water ranged from 28 to 42 NTU which is higher as per the permissible limit <5 NTU APHA (1992) (fig 15)

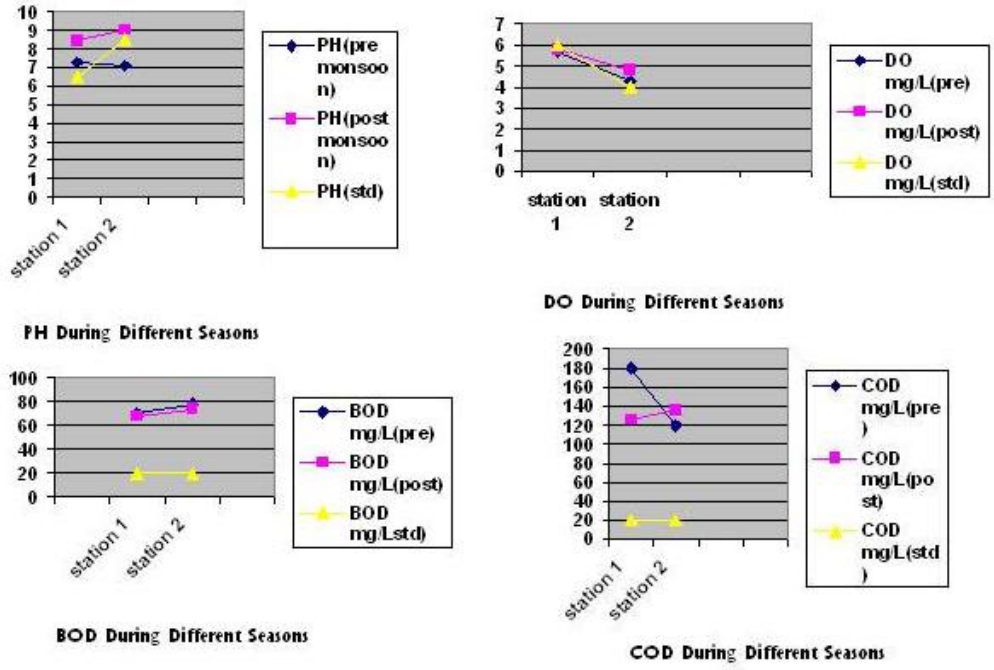

Figure 14.

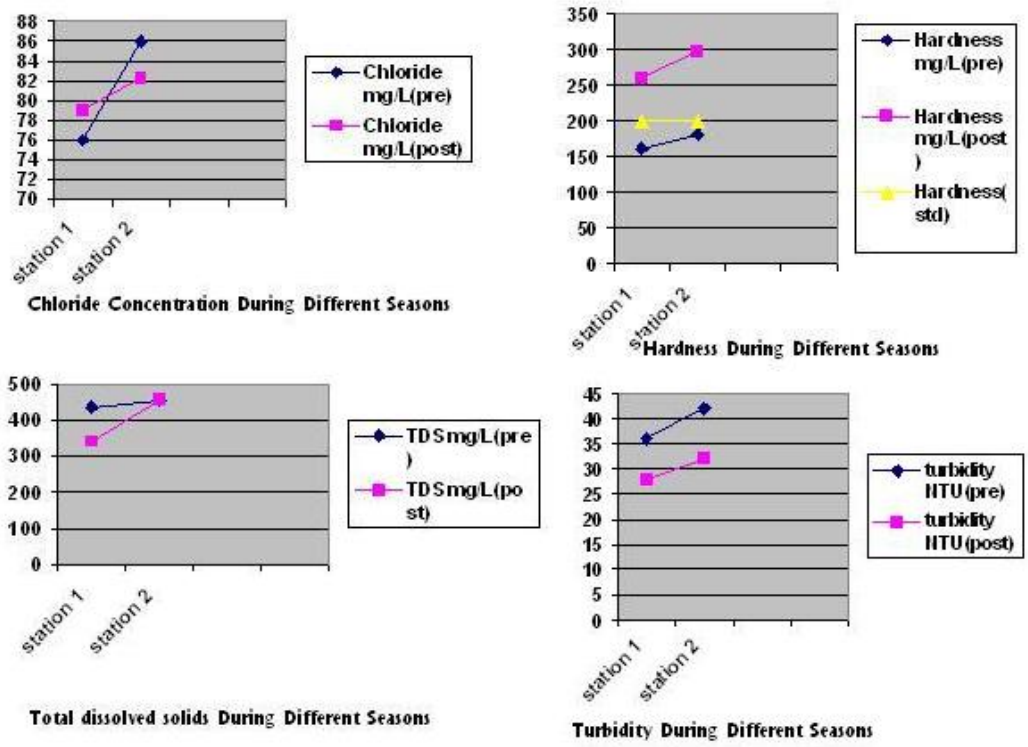

Figure 15.

Restoraion of Lake:

The lake restoration actions can be categorized under five broad heads, i) in- lake treatment ii) shore line treatment iii) source control iv) people's participation v) environmental awareness.

For Katraj Lakes following restoration techniques can be used.

1) Diversion of sewage line from the lake.
2) Dredging of silt and removal of weeds.
3) Planting native trees around the lake to control the erosion of soil
4) Introduction of composite fish culture to control mosquitoes

ACKNOWLEDGEMENT:

The authors are thankful to the Dr. M.R. Shiyekar, Head of Civil Engineering and Dr. A.S.Padalkar, Principal Sinhgad College of Engineering for constant encouragement and facilities provided

REFERENCES

Azhagesan R., NWA Water Quality parameters and water quality standards for different uses

Bhatia K.K.S., Omkar Singh, Water quality assessment for management of a typical lake in South India (NCEC-2006).

Bhatia K.K.S, Lake water quality monitoring and Modelling

Chaturvedi Samiksha; Dineshkumar and Sing R.V.(2003). Res *j*.chem.Environ. 7(3).

Draft proposal for Ecological restoration of Ambil odha watershed through negotiated IWRM approach September 2006.

Ganapati, S.V. (1943). Seasonal changes in the physical and chemical conditions of a garden pond containing abundant Aquatic vegetation.*J Madras Univ*. 13, 55-69.

Joshi Sandeep, Monitoring of Environmental factors and lake water quality

Narsimha Rao. P. and P.B. Jaya Raju (2001). Limnological investigations and diversity of plankton in sewage fed fish culture pond at Nambur near Gubtur. A.P. India.*J.Aqua. Biol.*, 16 (1 and 2), 11-14.

Pune Municipal Corporation Report, Renewal and management of sewage and drainage disposal in city of Pune under JNNURM

Prakash C. (1982). Water quality of Keetham lake (soor sarovar). J. *Envi. Bio*., 4 (4), 193-200

Reddy M.S. and N.V.V. char , Management of lakes in India

Sahastrabuddhe K., Patwardhan A., Changing status of urban water bodies and associated health concern in Pune India, International Conference on Environment and Health Chennai 2003.

Shaikh, Nisar and S.G. Yeragi (2003) Seasonal Temperature changes and their influence on free carbondioxide,

Dissolved (DO) and pH in Tansa river of Thane District, Maharashtra. *J.Aqua. Biol*., 18 (1), 73-75.

Standard Methods For Examination Of Water and Waste. 20th ed; American Public Health Association, Washingaton; D.C.(1998)

WHO; *Guidelines For Drinking Water Quality*,2nd Edition 1, 52-82, Geneva;(1993)