

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 2, February 2015

Limnological Study of Water Quality Parameters of Dal Lake, India

J.N.Sharma¹, Raj Shailesh Kanakiya², Dr.S.K.Singh³

Superintendent Engineer, J&K pollution Control Board, J&K, India

Research Scholar, Department of Environmental Engineering, Delhi Technological University, Delhi, India

Professor & Head, Department of Environmental Engineering, Delhi Technological University, Delhi, India

ABSTRACT: Water quality is a general term that refers to a general description about the properties of a water body. Lakes that have a high water quality possess properties that make it a high valued resource to society and nature. Temporal analysis is done for and correlation analysis is carried out between physico-chemical characteristics for determining water of the Dal lake. The organic and inorganic pollutant load in the Dal have accelerated the macrophytic growth which in turn has reduced the water quality and biological oxygen demand (BOD) of the lake and hence have reduced the recreational and aesthetic appeal of the lake. The condition of Dal Lake has reached a critical stage from the ecological angles and if proper conservation measures are not taken in future, the lake will likely deteriorate further and will soon turn into eutrophic condition.

KEYWORDS: Dal Lake, Physico chemical characteristics, Common Physical Indicator

I. INTRODUCTION

All life on this planet totally depends on the 'Water' which exist in nature in various forms such as Ocean, river, lakes, clouds, rain and snow etc. As far as **Lakes** are concerned, they are the most fertile, diverse, productive and interactive ecosystem in the world. The word "Lake" is used loosely to describe many types of water bodies – natural, manmade and ephemeral including wetlands(2). Lakes are traditionally under-valued resources to human society. They provide a multitude of uses and are prime regions for human settlement and habitation. Uses include drinking and municipal water supply; industrial and cooling water supply; power generation; navigation; commercial and recreational fisheries; body contact recreation, boating, and other aesthetic recreational uses(3)

Dal lake is a warm monomictic lake occur in temperate latitudes in subtropical mountains and in areas strongly influenced by oceanic climates. In the same way as their cold water counterparts, they mix only once during the year with temperatures that never fall below 4°C.(4)

Dal Lake ecosystem (Lat. 34° – 6' N, 74°- 45' E, alt. 1583m) situated in the heart of Srinagar, the summer capital of Jammu & Kashmir State is under tremendous anthropogenic pressure for the last three decades. More than 50,000 people live within the lake itself in various hamlets besides living in houseboats. People use this lake, for personal purposes generating huge businesses out of it but producing numerous pollutant generating substances for it in the form of floating gardens and using fertilizers at large in the nearby paddy fields therefore these activities have deteriorated the lake ecosystem in diverse ways. These stresses have caused significant impairment to the lake quality(5).

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 2, February 2015

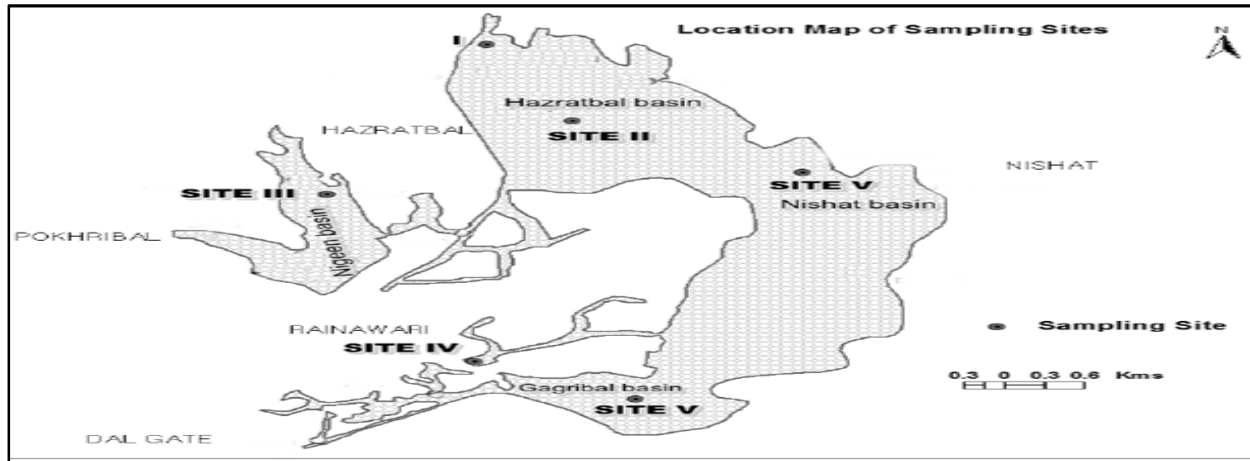


Fig. 1 :Sampling Sites in Dal Lake

The sampling of lakes for the purpose of assessing water quality is a complex process, as is the interpretation of the data obtained. Consequently, these activities must be based on a relatively complete understanding of basic limnology. The strategies employed for sampling and data interpretation are also controlled by lake use, the issue or lake problem being addressed, and the availability of resources for undertaking an assessment programme(6).

It is important to analyse water to determine its suitability for drinking, domestic use industrial use, agricultural use etc. It is also important in water quality studies to know the amount of organic matter present in the system and the quantity of oxygen required for stabilization of the water. The impact of organic pollutants on water quality in this work is expressed in terms of the Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Biological Oxygen Demand BOD, Calcium, Magnesium, Iron, Chloride, Ammonical Nitrogen and Total Dissolved Solids (TDS). The Dal lake can be subdivided into four parts as per its basins. The Water Quality Index is calculated for four sites Char Chinari, Nageen Central, Hazratbal STP, i.e., are 102.66, 120.33, 109.35, 101.3 respectively. Which is high with respect to the limits and hence is unfit for consumption.(2)

An ecological study of the Dal lake was conducted during 2005 – 2007 so as to gain insight into the flaws of the conservation endeavors. It was revealed that ecologically unsound management practices are the major cause for the plight of the lake. In response to the inshore dredging, skimming of free floating macrophytes and unplanned mechanical dewatering undertaken during the past several years, some previously sparsely distributed aquatic plants in the lake have reached nuisance levels, while hitherto unknown invasive *Azolla pinnata* has got widely distributed throughout the water body. A thorough study encompassing all environmental aspects, including socioeconomics, needs to be undertaken so as to frame an ecologically well balanced conservation strategy for this important aquatic ecosystem of the region(6).

Direct discharge of untreated human wastes from houseboats and settlements adjoining the lake has further aggravated the nature and extent of pollution. Human encroachments and siltation have combined with natural processes to reduce the area of open water within the lake.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 2, February 2015

Common Physical Indicators used to Assessing Water Quality

Sr.No	Colour	Cause
1	Muddy Tan to Light Brown	Suspended sediments common after rainfall Runoff from construction, roads, agricultural/range land, oil erosion caused by vegetation removal from riparian zone, rangeland/overgrazing, agriculture, and logging
2	Pea Green, Bright Green Yellow, Brown, Brown Green, Brown-Yellow, Blue Green	Water with these colours generally indicate a plankton bloom (Key indicator of a plankton bloom, elevated DO and pH) Water colour dependent on dominant plankton type present.
3	Tea/Coffee	Dissolved humus matter (organic portion of soil) Usually associated with woodlands or swampy areas.
4	Milky White	Paint (construction), milk (food processing)
5	Dark Red, Purple, Blue or Black	Fabric dyes, inks from paper and cardboard manufacturers
6	Milky Grey/Black	Raw sewage discharge or other oxygen-demanding waste, a rotten egg or hydrogen sulphide odour may be present. It may also be sewage fungus.
7	Clear Black	Turnover of oxygen depleted bottom waters or sulphuric acid spill
8	Orange-Red	Deposits on streambeds associated with oil production areas but not always. Check for petroleum odour. Colour can be due to iron and an oily sheen or residue may be present which can occur naturally (not oil or petroleum). No petroleum odour.
9	White Crusty Deposits	Common in dry/arid areas where the evaporation of water leaves behind salt deposits (for example, chloride or sulphate) Also found in association with brine water discharge (from oil production areas). A petroleum odour and an oily sheen may be present along the banks.

Table.No 1- Colour used as Indicator Assessing Water Quality

The Colour of Dal lake is more inclined towards Blue-Green which indicates a plankton bloom (Key indicator of a plankton bloom, elevated DO and pH). This Water colour is due to dominant plankton type present.



Figure 2 Bluish green colour of Dal Lake(7)

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 2, February 2015

Sr.No	Odours	General Causes
1	Rotten Eggs/Hydrogen Sulphide (septic)	Raw sewage
2	Chlorine	Wastewater treatment plant discharges; swimming pool overflow; industrial discharges
3	Sharp, Pungent Odour	Chemicals or pesticides
4	Musty Odour	Presence of raw or partially treated sewage, livestock waste or algae

Table No.2 Odour used as Indicator Assessing Water Quality

The Odour of Dal Lake is dominated by Hydrogen Sulphide indicating the presence of Raw Sewage, Nageen area of Dal Lake had a more of Musty odour implying presence of raw or partially treated sewage, livestock waste or algae.

Sr.No	Surface Scum	General Causes
1	Tan Foam	Usually associated with high flow or wave action; wind action plus flow churns water containing organic materials (increased with rainfall runoff) creating harmless foam; produces small patches to very large clumps.
2	White Foam	Covering wide area around wastewater outfall; thin or billowy; mostly due to soap
3	Yellow, Brown, Black Film	Pine, cedar and oak pollens form film on surface, especially in ponds, backwater areas or slow moving water of streams
4	Rainbow Film	Oil or other fuel type. Sheens are common after rains. Oil/gas residue wash off streets after rain. Other sources include spills, pipelines, and oil/gas production areas.

Table No.3 Surface Scum used as Indicator Assessing Water Quality

Nearby the House-boat area, Foam was been found to be White in colour indicating presence of soap and Rainbow film was found near Hazratbal basin.

II.METHODOLOGY

Data of water quality of Dal lake for 4 sites were collected from Dal Lake development authority. It comprises of 3 years data in year 2010, 2011, 2012. The method used by them are for analysis pH (Digital pH meter DPH 504), Electrical conductivity (EC) (Digital EC meter DEM900). Total dissolved solid (TDS) was determined by oven dry method. Biological Oxygen Demand (BOD) was estimated by Azide modification of Winkler method. Total Alkalinity (TA) as HCO_3^- , Calcium (Ca^{2+}), Magnesium (Mg^{2+}) total hardness (TH), Chloride (Cl), was estimated by standard titrimetry. Sulphate (SO_4^{2-}) by turbidometry, Nitrate (NO_3^{2-}) by Brucine method all using HITACHI UV-VIS spectrophotometer.

III.RESULTS & DISCUSSION

Various parameters of water quality of Dal lake at four locations Hazratbal are given in table 1 (a) Nishat Garden are given in table 1 (b), Grand Palace are given in table 1 (c), Nishat Garden are given in table 1 (d) respectively. Various characteristics are as below

Table 4 (a): Water Quality of Dal Lake at Hazratbal

Year	pH	EC	T.D.S	COD	BOD	Phosphate	$\text{NH}_3\text{-N}$	Iron	S	Hardness	Ca	Mg	Alk	Cl	K
2010	7.5	298	165	24.9	2	0.057	0.604	0.421	35.7	180	40	19.4	26	16	2
2011	7.9	311	184	24.58	7	0.232	0.124	0.17	77.2	366	76.15	42.7	42	20	5
2012	8	701	456	48	5	0.96	5.97	0.481	96.3	300	108.2	30.6	181	26	6

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 2, February 2015

Table 4 (b) Water Quality of Dal Lake at Nishat Garden

Year	pH	EC	T.D.S	COD	BOD	Phosphate	NH ₃ -N	Iron	S	Hardness	Ca	Mg	Alk	Cl	K
2010	7.8	208	167	16.6	1	0.109	0.439	0.252	10.2	130	34.4	18.6	62	18	2
2011	8.6	130	87	40	2	0.18	0.15	0.07	11.2	100	23.2	10.2	66	13	1
2012	8.2	254	115	72.7	4	0.75	0.66	0.471	25.7	220	64.9	17.1	158	17	3

Table 4 (c) Water Quality of Dal Lake at Grand Palace

Year	pH	EC	T.D.S	COD	BOD	Phosphate	NH ₃ -N	Iron	S	Hardness	Ca	Mg	Alk	Cl	K
2010	7.2	155	85	24.9	2	0.064	0.252	0.87	12.5	120	24	14.5	55	12	2
2011	7.9	138	92	40	2	0.14	0.13	0.15	13.65	76	18.4	7.2	72	17	2
2012	8.1	230	110	35.4	3	0.3	0.62	0.51	18.5	176	42.5	19.9	94	26	3

Table 4 (d) Water Quality of Dal Lake at Nehru Park

Year	pH	EC	T.D.S	COD	BOD	Phosphate	NH ₃ -N	Iron	S	Hardness	Ca	Mg	Alk	Cl	K
2010	7.2	299	128	16.6	1	0.175	0.46	0.43	9.8	124	30.46	11.6	60	12	1.2
2011	8	128	85	40	2	0.13	0.51	0.09	11.7	82	22.4	6.3	76	16	2
2012	8	286	110	48.8	4	0.75	0.64	0.52	19.5	176	40.9	20.9	98	17	3

Table 5 : Statistical Analysis of Water Quality Characteristics of Dal lake

	pH	EC	T.D.S	COD	BOD	P	NH ₃ -N	Iron	S	H	Ca	Mg	Alk	Cl	K
Max	8.6	701.0	456.0	72.7	7.0	1.0	6.0	0.9	96.3	366.0	108.2	42.8	181.0	26	6.0
Min	7.2	128.0	85.0	16.6	1.0	0.1	0.1	0.1	9.8	76.0	18.4	6.3	26.0	12.0	1.0
Avg	7.9	261.5	148.7	36.0	2.9	0.3	0.9	0.4	28.5	170.8	43.8	18.3	82.5	17.5	2.7

Physico-chemical Characteristics of Dal lake

1. pH

pH is an important parameter which determines the suitability of water for various purposes. Range of pH is range of 7.2 to 8.6 and the average being 7.886, which is within drinking water limits as per (7).

2. Conductivity

Low Conductivity (0 to 200 $\mu\text{mho/cm}$) is an indicator of pristine or background conditions. Midrange conductivity (200 to 1000 $\mu\text{mho/cm}$) is the normal background for most major freshwater lakes. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or bugs. High conductivity (1000 to 10,000 $\mu\text{mho/cm}$) is an indicator of saline conditions. Waters that have been heavily impacted by industry can fall into this range. Average being in the second range for the Dal lake.(8)

3. TDS

TDS values in lakes and streams are typically found to be in the range of 50 to 250 mg/L. In areas of especially hard water or high salinity, TDS values may be as high as 500 mg/L. Drinking water will tend to be 25 to 500 mg/L TDS. BIS Water Standards include a recommendation that TDS in drinking water should not exceed 500 mg/L TDS(9). Maximum TDS of the study period is 456mg/l so it is well below the BIS limits.

4. Ammonical Nitrogen

NH₄-N is oxidized rapidly to nitrate in aerobic waters of rivers and streams. However, in lakes, NO₃-N is rapidly reduced into organic compounds within organisms and liberated as ammonia during the metabolism of these organism(10).

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 2, February 2015

5. BOD

Average BOD for Dal lake is 2.916 mg/l which is below the established standard limit. If BOD exceeds 3 mg/l, it affects coagulation and rapid sand filtration processes, conventional plants require expensive advance water treatments.

6. COD

COD is an indicator of inorganic pollution average is 36mg/l which is greater than the standard BIS limit. Possible cause of this high value could be the illegal untreated discharge of sewage into Dal lake.

7. Hardness

Hardness in Dal Lake is higher than permissible Hardness concentration of freshwater bodies of Kashmir Valley has been associated with thick population of plankton, especially Cyanophyceae(12).

8. Total Alkalinity

According to BIS(13) the maximum permissible limit is 120 mg/L. The observed average value of total alkalinity was in greater in range of 26- 160mg/l. Total alkalinity values in the study indicates that the water was very hard. Higher values of alkalinity registered during summer might be due to the presence of excess of free CO₂ product as a result of decomposition process coupled with the mixing of sewage and domestic waste.

9. Calcium and Magnesium

The observed average value of calcium was in range of 18 to 108 mg/l, which when standard permissible limit of 75 mg/l prescribed by BIS is above at certain region and below at certain with average being 43.66 mg/l. The quantities of calcium in natural water due to prevalence of lime rocks in the catchment. The observed average value of magnesium was in range of 6 to 42 mg/l.

10. Chloride

Chloride, a component of salt, is one of the common anions found in freshwater and thus chloride levels are directly related to conductivity. Chloride levels in Dal lake have ranged from 12.0 mg/l to 26 mg/l with an average of 17.5 mg/l.

11. Potassium

Reason for Excess potassium in the lake can be either from soap used as softener or fertilizer. The average potassium is 2.7 mg/l which is well below the limits as per WHO guidelines(19)

IV.CONCLUSION

The limnological study is very useful to get fairly accurate idea of quality of the ground water by determining a few parameters experimentally. The control of lake water quality is based on sound management practice in relation to the required water uses and a reasonable, preferably detailed, knowledge of the limnological characteristics and processes of the water body of interest. An effective monitoring mechanism for monitoring the Dal lake conservation Programme which should comprise of eminent Limnologists, researchers, experts who have been associated closely with Dal lake studies during the Lake execution Programme to some international agency/organization well – known for Lake Conservation and management practices

REFERENCES

- 1.Krantz, D.&Kifferstein, B. (2010) *Water Pollution and Society*. Retrieved February 26, 2010, from University of Michigan website: <http://www.umich.edu/~gs265/society/waterpollution.htm>.
- 2.Raj Shailesh Kanakiya, S.K.Singh, J.N.Sharma (2014) Determining the Water Quality Index of an Urban Water Body Dal Lake, Kashmir, India - IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) Volume 8, Issue 12 Ver. III (Dec. 2014), pp 64-71
- 3..Deborah Chapman Water Quality Assessments - A Guide to Use of Biota, Sediments and Water in Environmental Monitoring - Second Edition © 1992, 1996 UNESCO/WHO/UNEP
- 4.Wetzel, R.G. 1975 Limnology. Saunders, Philadelphia, pp 743 .
- 5..Ishaq M and Kaul V (1988) Distribution of minerals in Himalayan lake. Trop. Ecol. 29, pp 41–49.
- 6.Humaira Qadri and A. R. Yousuf “The 12th World Lake Conference: 1453-1457 Dal Lake Ecosystem: Conservation Strategies and Problems”.
- 7.1. <http://www.frontlinekashmir.org.pk/search?updated-max=2011-05-25T09:58:00-07:00&max-results=50&reverse-paginate=true>

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 2, February 2015

7. American Public Health Association. Standard methods for the examination of water and wastewater, 17th ed. Washington, DC, 1989
8. AbbasJain,S.K.Singh(2013)Limnological Studies Related to Physico-Chemical Characteristics of Water in Anasagar Lake, Ajmer, Rajasthan Volume 1 (2013) 65-72 ISSN 2347 – 3258 International Journal of Advance Research and Innovation
10. Rolando Quirós(2001)The relationship between nitrate and ammonia concentrations in the pelagic zone of lakes ,Area de Sistemas de ProducciónAcuática, Facultad de Agronomía, Universidad de Buenos Aires
- 12.Bhat SA, Pandit AK (2003) Phytoplankton Dynamics in Anchar Lake, Kashmir. J. Res. Dev. 3:71-96
13. BIS Standards for Water for Drinking and other purposes, Bureau of Indian Standards, New Delhi, 1983.
- 14.Patil, V. T., and Patil, P. R. (2011) “Groundwater quality of open wells and tube wells around Amalner town of Jalgaon, district, Maharashtra, India”, Electronic Journal of Chemistry, 8(1), pp 53-78.
- 17.Axel Lehmann and Michael Rode(2001)Long-Term Behaviour And Cross-CorrelationWater Quality Analysis Of The River Elbe, Germany Wat. Res. Vol. 35, No. 9, Elsevier Science Ltd pp. 2153–2160
- 18.F.Jorgensen, S.E. and Vollenweider, R.A.(1989) Guidelines of Lake Management. Volume 1 Principles of Lake Management.International Lake Environment Committee Foundation, Otsu, Japan and United Nations Environment Programme, Nairobi, 199 pp.
- 19.WHO/HSE/WSH/09.01/7 Potassium in drinking-water Background document for development of WHO Guidelines for Drinking-water Quality
9. http://www.ostrowskiness.com/sections/downloads/envirolabs/Test_12_TDS.html
11. http://www.emecs.or.jp/01cd-rom/section_3_e/sec3_a_ro_b_6_e.html
12. http://academic.pgccc.edu/~ssinex/excelets/TDS_comparison.xls