

Water Quality assessments of Dal Lake, Jammu & Kashmir

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Abstract: *Due to urbanization, modernization and increase in population growth the problems of sewage disposal and contamination of surface waters in lakes are expanding at high rate. In the last four decades the water quality of Dal Lake has undergone enormous changes and which in turn had make it useless for domestic use and aesthetic view. Extension of land use in lake could increase the use of fertilizers which could cause the problem of eutrophication. The paper is an attempt to present condition of water quality in lake. Water quality can be assessed by different parameters like BOD, pH, nitrate, phosphorus turbidity etc. From the test results and data we observed that the maximum surface of lake water is covered by weeds which is the result of higher concentration of nitrate and phosphorous which directly results into siltation of lake water. Due to the higher values of BOD, COD it results the less amount of dissolved oxygen present in the lake water which causes the direct threat to Lake Ecosystem. Heavy metals such as Pb, Cr, Fe, Hg, etc. are of special concern because they produce water or chronic poisoning in aquatic animals. Harmful algal blooms are becoming increasingly common in freshwater ecosystems globally. Pollution by plastic scrap is an increasing environmental concern in water bodies, which affects open-water, shoreline and environments.*

.Keywords: *Dal lake, BOD, COD, coliform, plastic debris, Urbanization, sewage*

I. Introduction

After air, water can be stated as the second most important resource which is important to sustain life and a simply put it's the absolute necessity for life. Water is the most abundant as well as a critical resource in nature and covers approximately 3/4th of the earth's surface, although being so abundant many factors have contributed for its limitation. The desirable characteristics of water vary with endeavor use. Human's excessive interests related with water for their particular use, which may involve many uses like commercial, industrial or recreational insights. Water treasured used is for drinking purpose, which must be essentially clear, free from turbidity, bacteria, foul odor and color. The emergence of civilization and subsequent industrialization by

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humans has caused a great damage to our ecosystem and disturbed the environment. Wastes occur in the form of solid, liquid and gaseous emissions are being continuously discharged in water. Pollutants contact into waterways from various types of sources like point sources (especially discharges of wastewater), non-points sources and diffuse sources and also from atmospheric deposition. Lakes and ponds also affected, as most of the lakes in major cities have been polluted. Water pollution has posed a serious challenge due to its effect on economic activities. The problem of water pollution holds greater relevance in the context of a developing country like "India". While the intensity of the problem is huge and widely spread, the losses due to its impact are quite gigantic due to its straight and direct impact on the human health and livelihood which we rather termed as "survival". The rising and never-ending demand and the limited resource of clean and pure water as a result of the growth in population, droughts and industrialization is an issue that has gained a lot of hue and cry in the world today. Various modern practices, as a result have been developed and adopted to gain usage into better and pure water resources. Dal Lake is situated in Srinagar, Jammu and Kashmir and a lot people draw their employment from the lake in terms of agriculture, fisheries, tourism etc. It connects a lot of people through the various activities and can be stated as source of cultural heritage which holds a lot of importance in itself. But the same activities that provide revenue, employment, residence, food and recreation to the people become a threat to the lake. With increasing industrialization, urbanization and technological advance in all fields, sources of water are getting more and more seriously polluted. The Lake survival will be threatened if the present rate of pollution continues unabatedly. Natural waters are affected with a wide variety of inorganic, organic, and biological pollutants. For example, biodegradable organic matter in water is often not toxic, but the consumption of oxygen during its degradation prevents the water from supporting fish life (Trivedi, 1992). pH, BOD, COD, Turbidity and other physical chemical properties must be controlled within a range favorable to the particular aquatic organisms, involved to save Dal lake from its near death.

II. Study area

The word Dal means "still" which comes from a Tibetan word. Dal lake is situated in the heart of Kashmir Srinagar (Lat long 34°5'-34°6'N and 74°8'-74°9'E surrounded with mountains. The inflow of Dal Lake is from the "Arrah" river which flows in a northerly edge through a dark and deep channel called Tel Bal. The total water surface of dal lake is 11.45 km² in which floating gardens has covered 4.1 km², Land area and marshy area are 1.51 km² and 2.25 km² respectively.

The lake is divided into four basins namely Nigeen, Hazratbal, Bod Dal. The deepest and the shallowest basins are Nigeen and Gagribal with depth around 6m and 2.25 m respectively. Dal Lake was counted in one of the most beautiful lakes in the world. “Perhaps in the whole world there is no corner as pleasant as the Dal Lake” quoted by Sir Walter Lawrence his book. But if we now a days see the Dal has come to adisastrousstate, which may contradict the statement. However, lake is still the main attraction of the Srinagar and also providing water to the city for domestic use. Dal lake has very high social and economic service, but still lake has come to its end stage. The detoration of encroachments of Dal Lake has mainly brought by the Hanji community which in turn degrade the lake environment. Fazal and Amin states that the hanji community economically depended on the lake have triggered the social transformation which in turn led to conversion of land use classes in and around the lake. They also states that the increased tourist flow to the Lake has resulted in that the increase in tourist flow to the lake has resulted in city residents acquiring space to establish and run their business in the form of hotels and restaurants in and around the lake and which in turn have led to the land transformation of the lake. One of the major drawback is the marshy areas around the lake that have been converted into build land and floating vegetable gardens. Plantation/orchards has also recorded increase in land from marshy area, lake area. During the study it has been recorded that Land under agriculture is also gaining land from lake water and plantation/orchard. It is also reported that 1200 house boats inside the Dal Lake generates approximately 9000 metric tons of waste annually which is dumped into Dal Lake, Including this waste, 15 major drains are also emptied into the lake which withdrew 18.17 tons of phosphorous and 25 tons of inorganic nitrogen nutrients. The waste generation in the Lokut and Bod Dal wards is about 97000 Kg/day. Obstruction and blockade of inner water Channels which circulate and distribute the waste which causes diseases and epidemics like malaria, dengue as well as cholera, which results the rise in mean temperature of Srinagar city. All that being said about the deterioration of the lake, it is very important to continuously monitor the condition of such water bodies.

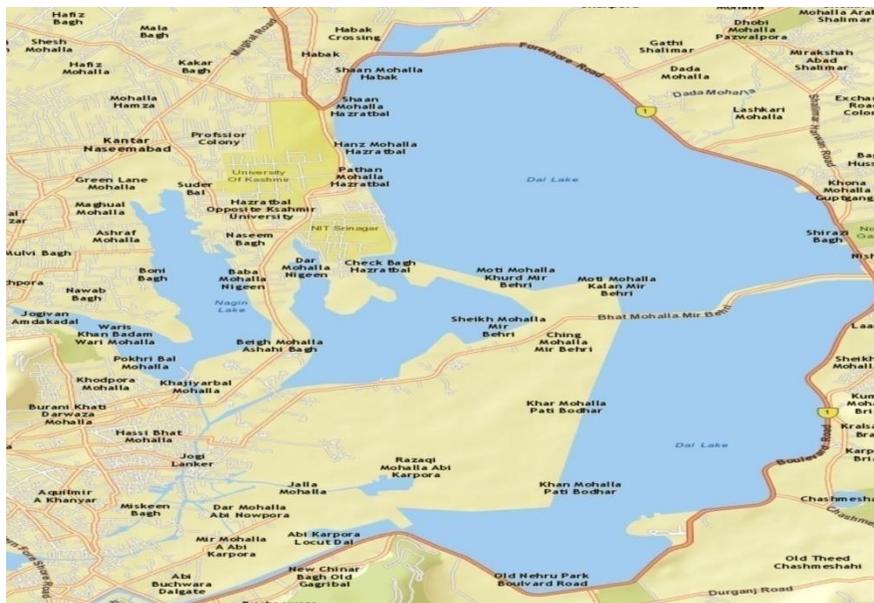


Figure-1 blue area represents the Dal catchment area & study site

III. Methodology

Six sites in the four basins were analysed from which samples were collected in 2 litre plastic cans. The B.O.D samples were collected in separate 300 mL bottles and care was taken to protect them from sunlight by immediately covering them & and send all the collecting samples to PHED Zanikote Srinagar laboratory. A total number of 22 parameters were analyzed and observed with standard values. The results were analysed also in Gis to analyse the effect of important parameters observed. The following are the various parameters checked with their corresponding methods adopted.

Table-1 shows the various parameters checked and corresponding method

Parameters	Methods Adopted
Total iron	Iron MR
Nitrate	Phenol disulfonic method
Fluorides	Ion selective electrode method
Chlorides	Argentometric method
T.D.S	Gravimetric method
Total Alkanity	Titrimetric method
Calcium	EDTA Titrimetric method
Aluminum	Spectorphometric Method
Magnesium	EDTA Titrimetric method
Resd.chlorine	Iodometric titration method
Sulphate	Spectorphometric Method
Ph	Ph meter
Turbidity	Turbidimetric test
Total Hardness	EDTA Titrimetric method
Total Coliform	Membrane filtration
Conductivity	Conductivity meter
Total Acidity	Titration Method
Phosphate	Stannous Chloride Method
Ammonia	Nesslerization Method
Carbon Dioxide	Gas Sensing Electrode
COD	Titrimetric ,mid level
BOD	Standard method 5210 b(5 day BOD test)

IV. Results and Discussions

IV.I. Results

Twenty two parameters were checked for Dal lake in the PHED laboratory Zainkote Srinagar j&k and the water samples for BOD, COD were put under incubation for 6 days. The results getting after testing are given below in table no 2.

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Table-2 water testing results of Dal Lake

Sr. No	Parameter	Units	Sample D1	Sample D2	Sample D3	Sample D4	Sample D5	Sample D6	MEAN
1	Total Iron	mg/l	0.05	0.1	0.12	0.05	0.1	0.12	0.09±0.03
2	Nitrate	mg/l	25	30	32	25	30	32	29±3.22
3	Fluorides	mg/l	0.1	0.12	0.1	0.1	0.12	0.1	0.11±0.01
4	Chlorides	mg/l	10	12	12	10	12	12	11.33±1.03
5	T.D.S	mg/l	65.3	81.6	99	65.3	81.6	99	81.97±15.07
6	Total alkalinity	mg/l	180	172	162	180	172	162	171.33±8.07
7	Calcium	mg/l	32.8	31.6	32.8	32.8	31.6	32.6	32.37±0.60
8	Aluminum	mg/l	ND	ND	ND	ND	ND	ND	
9	Magnesium	mg/l	9.76	10	10.24	9.76	10	10.24	10±0.21
10	Resd Chlorine	mg/l	RAW WATER						
11	Sulphate	mg/l	ND	ND	ND	ND	ND	ND	
12	Ph		7.69	7.47	7.31	7.69	7.47	7.31	7.49±0.17
13	Turbidity	N.T.U	8.26	31	11.35	8.26	31	11.35	16.87±11.03
14	Total Hardness	mg/l	122	120	124	122	120	124	122±1.79
15	Total coliform	MPN	POSITIVE	POSITIVE	POSITIVE	POSITIVE	POSITIVE	POSITIVE	
16	Conductivity	µs/cm	132.8	166	202	132.8	166	202	166.93±30.96
17	Total Acidity	mg/l	1	1.2	1.2	1	1.2	1.2	1.13±0.10
18	Phosphate	mg/l	0.02	0.015	0.01	0.02	0.015	0.01	0.02±0.0
19	Ammonia	mg/l	0.5	0.4	0.35	0.5	0.4	0.35	0.42±0.07
20	Carbon Dioxide	mg/l	1.2	1.1	1.25	1.2	1.1	1.25	1.18±0.07
21	COD	mg/l	271	283	288	298	304	283	287.83±11.79
22	BOD	mg/l	176.73	187.06	188.35	199.66	206.72	186.3	190.80±10.68

I. Discussions

The five most important parameters were observed and analyzed in Gis. As per our observations and conclusion, the Dal catchment is now fully loaded with nitrate and phosphorous load. Every year tons of nitrate and phosphate from the inflows channels and 15 major drains of the city were drained into the lake which causes serious ill effects to dal ecosystem and water quality. Due to the excessive presence of nitrate an phosphate the unwanted weeds like azolla have covered the maximum area of dal lake water which leads to eutrophication of lake.

Bio-Chemical oxygen demand is a parameter to assess the organic load in a waterbody. Many researchers have recorded higher BOD values in polluted water. The BOD concentration ranged between 28 mg/l to 33 mg/l indicating that the water body is eutrophic. The test results gives the indication that dal lake water is having higher value of BOD which directly hamper the aquatic life.

From the foregoing observations of the physicochemical parameters, it can be concluded that the waterbody shows the characters of eutrophication. Low dissolved oxygen, high bio-chemical oxygen demand and high nitrate concentrations indicate the eutrophic status of the water body

The results also shows the higher values of Turbidity ranges from (8-31 NTU) which is higher than the permissible limit(<5 NTU). Due to the high turbidity in lake which causes colour changes ,odour, resistance to light penetration inside lake for photosynthesis to produce more dissolved oxygen. Directly or indirectly it leads to threat to lake ecosystem.

The results were explained using GIS to represent the data results of important parameters focused.

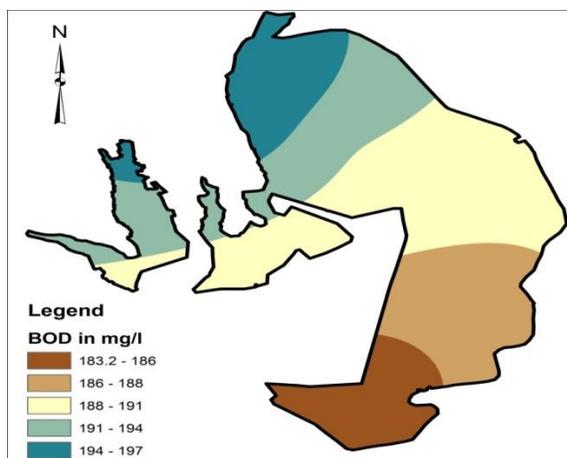


Figure -2 BOD variations across dal catchment

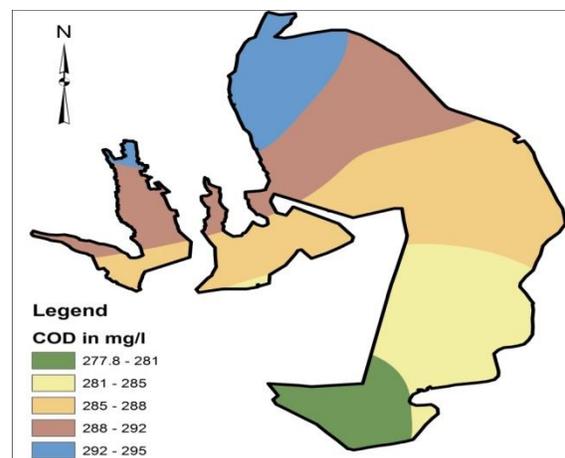


Figure -3 COD variation across dal lake

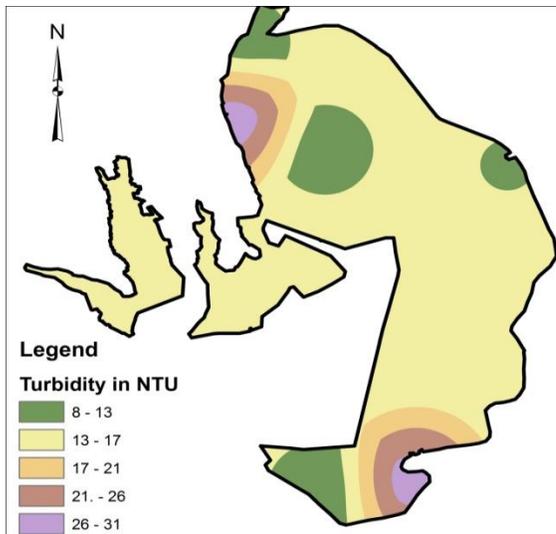


Figure-4 Turbidity variation across dal Lake

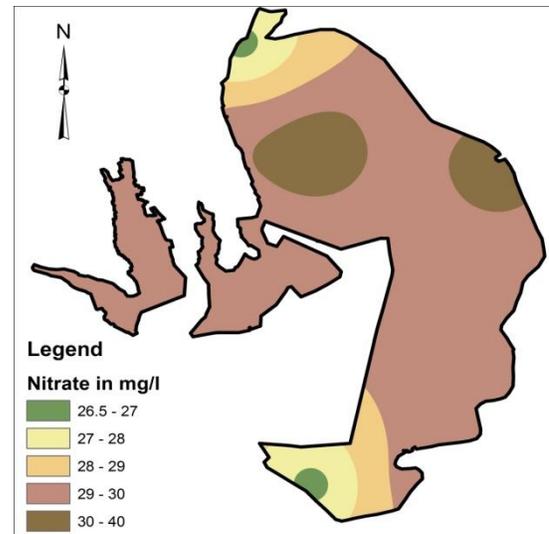


Figure-5 Nitrate content across Dal lake

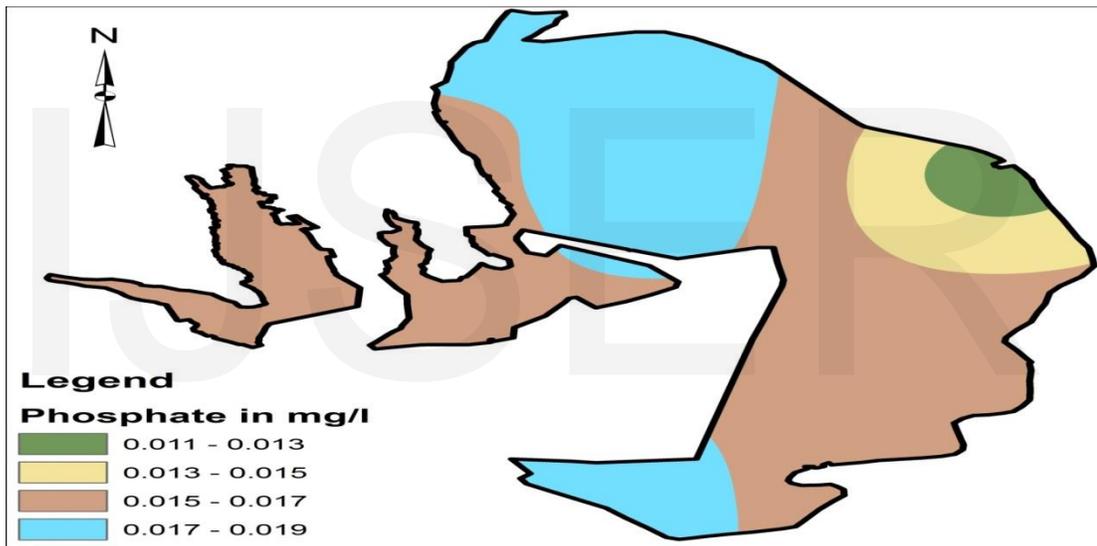


Figure-6 shows the phosphate content across Dal Lake

Use of GIS simply helps us to visualize the effects of various parameters and their concentration effects across catchment very simply. It's very simpler than graphical methods. Almost all the basins of Dal Lake show same character and from above figures it indicates that every basin is highly polluted with nitrate and phosphate. every year BOD is increasing very fast rate .the water surface is almost covered with azolla weeds which hampers the lake ecosystem. The increase of nitrate and phosphate load in the lake causes siltation hence depth of lake every year affected. the 15 major drains of city are the main culprit behind the dal lake pollution. The coliform shows MPN (most probable value) positive which means the lake is highly contaminated with organic matter or sewage. So the present report reveals that nutrient loading and maximum weed cover across the whole lake has exceeded the eutrophic condition leading to a hyper eutrophic status.

V. Conclusion

The study in this report indicates clearly the degradation of water quality and quantity of Dal Lake. Lake parameters have been identified in our project which shows the variation in the ecological behavior of the lake. Due to higher turbidity content, the color of the lake has changed from bluish green to Hazel color which has caused the declined in tourist attraction as per the aesthetic view. The study also reveals that the increase in impurities due to pollution, which also accelerates the value of BOD and COD as tested in the certain location which reduces the dissolved oxygen present in water and due to this kind of changes would affect the aquatic environment as an increase in nitrogen content would result in eutrophication that stimulates aquatic plants and also affect aquatic life because of depletion of oxygen demand in water it creates difficulty to survive. The lake water is unfit from the purpose of drinking and the general water quality is not even "GOOD". So all in all the conclusion is quite straightforward that the lake is about to see it's near death unless and until government, local bodies and most importantly the people who live in and around the lake do something for its savior.

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