

## Trophic status of Dal Lake: A review

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### Abstract

This review study focuses on the ecology of Dal Lake, including its water quality assessment, pollution sources, anthropogenic pressure, and land conversion of the globally recognised Dal Lake, variety of Macroinvertebrates, Zooplankton, and weed development. The water quality has drastically changed, particularly in the vicinity of populated areas, suggesting significant organic contamination of the body of water. The water quality further declined as a result of frequent floods and water lodgement. Furthermore, the many aquatic species found in Dal Lake are unable to thrive due to the abrupt and unexpected rise in temperature in the valley, which might even be lethal for fish growth and zooplanktons.

**Keywords:** Zooplanktons, macro-invertebrates, anthropogenic pollution, land conversion

### Introduction

Dal Lake is known as the "liquid jewel" is an urban lake in Srinagar, the summer capital of Jammu and Kashmir, India. It is one of the most breath taking places on earth, measuring 4.62 miles (7.44 km) in length and 2.2 miles (3.5 km) in width. It is situated at an altitude of 1584 metres above sea level, between latitude 34° 05' and 34° 09'N and longitude 74° 49' and 74° 53' E. At the very foot of Zabarwan Mountain is Dal Lake. Takht-i-Suliman lies to the left of the Lake, while the Hill of Hari-Parbat is to the right. Dal Lake receives water from a variety of subterranean springs and streams, but the Dachigam stream (Telbal-Nalla), which empties into the lake on its northern side, is the primary source (Marsar Lake). In addition to these, the Hazratbal Basin of the Lake receives a large number of inflows, including (Pishpav, Meerakshah, and man-made Boutkol). In addition, a number of springs emerge from the Lake bed. There are four basins, with the Nigeen being the smallest and the Hazratbal Basin being the largest. The basins vary in terms of size, mean depth, and volume. The lake is deepest at Nigeen basin (6 m), whereas Gagribal basin is the shallowest (2 m). The extra water leaves the Gagribal basin at Dal Gate via Tsunt-Kol and goes into the Jhelum River. Water surplus from the Nigeen basin travels to the Khushalsar Lake via Nalla Amir Khan. Dal Lake being a well-known travel attraction, majority of its inhabitants makes a living from farming, tourism, and fishing. The fact that the area is the birthplace of Kashmiri civilization has substantially boosted the region's economy. But throughout the last two decades, Dal Lake's situation has gotten worse every day. The most apparent causes are unplanned urbanisation, enormous deforestation, and harsh grazing. Other major problems include excessive sedimentation, undesired weed growth, high input of nutrients from point & non-point sources. The result of this has been decreased depth, high sedimentation, and low transparency values (AHEC, 2000). According to Solim and Wanganeo (2008), the carrying capacity of Dal Lake is severely strained by large-scale summer influx.

### Dal Lake flora and Fauna

Dal Lake has an abundance of macrophytes (both floating and submerged), phytoplanktons, Zooplankton and Macrozoobenthos. The aquatic and marshland habitat of the lake is home to 117 species of macrophyte plants, which are organised into 42 groups and 69 genera. The macrophytes of the lake are particularly well-known for its *Nelumbo nucifera*, or lotus blossoms. In the eutrophic zones, *Ceratophyllum demersum* is growing rapidly, while *Myriophyllum spicatum* and *Potamogeton lucens* are also cited as the prominent species, based on the distribution of fauna the Dal lake is home to Zooplanktons and Macrozoobenthos (but mostly pollution tolerant species have been found so far) as well as fishes i.e *Schizothorax species*, Reports indicate that *Cyprinus species*, which are economically significant fish species which were introduced in the early 1960s, are dominant, while the native *Schizothorax species* is declining.

### Land Transformation within the Dal Lake

The Dal Lake is a significant lake for Srinagar City in terms of ecology, economy, and society. There are five major land use/cover classes that occur in and around the Dal Lake. i.e the lakeshore region, marshy terrain, residential area (home to Dal dwellers), and the area around plantations and orchards. Over the past 20 years, there has been a sharp growth in the conversion of marshy terrain and lake areas to built-up land and floating gardens, also known as "Radh" in the local language. Weeds, particularly the recently developed *Azolla sp.* are growing rapidly as a result of land changes and activities including sedimentation, chemical inflow, and grey water. Lake water has become a thick marsh as a result of this, over time, the concentration of chemicals in Dal Lake has increased, with higher levels of pH value (alkaline), chloride, calcium hardness, alkalinity, and phosphorous concentration in the water of the lake, has put the Lake under a hyper eutrophic condition. Each year, 15 major drains charged with an estimated 18.17 tonnes of

phosphorous and 25 tonnes of inorganic nitrogen nutrients and chemicals are discharged into the lake water.

### Sanitation and Drainage Problems

The sample survey calculates that the estimated waste generation in the Lokut and Bud Dal wards is about 97,000 kg/day. The capacity and efforts of the Srinagar Municipal Corporation were found to be inadequate, resulting in heaps of garbage and clogged sewage. This becomes alarming because it eventually spills into the Dal Lake, contaminating the lake water. The Hanji localities (around the Dal Lake) are also subject to sanitation and drainage problems due to the limited infrastructure. The government and NGO's efforts to maintain cleanliness are egregiously inadequate.

### Occurrence of Floods and Water Logging

Floods and water logging have also become more common as a result of the reduction and compression of water bodies and marshy areas of Srinagar's Dal Lake, particularly during and after the rainy season. formerly again, the primary cause is the alteration of the soil; these wetlands and marshlands were formerly like sponges, absorbing water and keeping it from seeping into the city's low-lying neighbourhoods. The flood threat is now a common occurrence due to the removal of marsh and water bodies as well as sedimentation in the lake.

### Literature on Dal Lake

#### a. Physicochemical parameters

##### 1. 2013

Basharat Mushtaq, Rajni Raina, and Tabasum Yaseen examined changes in the physico-chemical parameters of Dal Lake. They came to the conclusion that the lake's water quality was declining due to direct sewage, runoff from neighbouring residential areas, especially houseboats, dredging and dewatering operations, farming activities in floating gardens, etc.

##### 2. 2014

Saima Parvaiz and Sami Ullah Bhat conducted a study to enhance the water quality of Dal Lake. They compared the data from the previous year to their findings, which showed that anthropogenic activities had worsened the water quality. High amounts of nitrate and ortho-phosphorus had been observed.

##### 3. 2015

Muzzafar u Zaman Khan, Ishtiyak Majeed Ganaie, and Kawser Hussian Bhat conducted limnological study of Dal Lake in Srinagar showed that the excessive use of nitrogenous fertilisers in the floating gardens of the lake and the surrounding agricultural fields was the cause of the higher nitrogen values in the water body. Phosphate levels are also greater, indicating that Dal Lake is eutrophic, and alkalinity test findings showed that the water falls into the hard water category.

##### 4. 2016

Sajad Hussian Dar and Asrar Amin Khan conducted an evaluation of the physical and chemical characteristics of Dal Lake and came to the conclusion that urbanisation, savagery, and human activity are the primary causes of the declining water quality, which is ultimately what sustains life and property.

##### 5. 2018

Basharat Mushtaq and Humaira Qadri, who conducted a comparative assessment of various water quality parameters to evaluate changes over time and concluded that water quality of Dal Lake has significantly declined, several water quality parameters including dissolved oxygen, chloride, NH<sub>4</sub>-N, NO<sub>3</sub>-N, and total phosphorus, showed notable variations from previous results, this is due to Dal Lake's high nutrient load, which must be maintained for the preservation of lake ecology.

#### b. Macroinvertebrates

##### 1. 2012

Arif Yaqoob Malik and Mudasir Ali revealed that macrozoobenthos in Dal lake was made up of nine species of benthic invertebrates that belonged to the three main phyla's i.e Annelida, Arthropoda and Mollusca. The most common Annelida species were *chironomous sp.* (insect) and *Limnodrillus sp.* (Oligochaeta).

##### 2. 2016

Mohammed Yaseen Gudoo, Mohammad Farooq Mir, and Anuja Gupta identified Thirty-one Macroinvertebrate species in the technical report on the ecological assessment of Macroinvertebrate diversity, distribution, and abundance in the Dal Lake. However, changes in the Macroinvertebrate fauna of the lake can be caused by anthropogenic pressure, pollution levels, and other factors.

##### 3. 2017

According to Aubid Bashir, Anuja Gupta, and Riyes un Aziz, there are 31 species, 6 classes, 13 orders, and 22 families of Macroinvertebrates that fall into the three main phyla of mollusks, arthropoda, and annelids. The overall population density of this fauna is 8305 md/m<sup>2</sup>. Due to the species' vulnerability to pollution, population density plays a crucial role in determining species dominance and the trophic state of Dal Lake, leading to the conclusion that eutrophication is occurring there

##### 4. 2018

Imadiya Javaid, Inam Sabha, Umara Qayoom, and Sami ullah Bhat found that Macrophytes, such as *Ceratophyllum demersum*, *potamogeton natans*, and *Hydrilla vorticella*, provide a conducive substrate for Macroinvertebrate growth and development. In comparison to other macrophytes, such as *Myriophyllum spicatum*, *Utricularia sp.*, and *Chara sp.*, *Ceratophyllum demersum* harboured higher Macroinvertebrate density.

#### c. Zooplanktons

##### 1. 2014

M. Jeelani in her comparative study of the zooplanktons in Dal Lake, Kashmir, India, identified 40 taxa of zooplanktons, including 12 crustaceans and 23 rotifers. However, over time, the use of mechanical de-weeders has also led to a loss of species diversity in the lake's zooplankton population.

### Conclusion

Important Physico-Chemical factors (such as Phosphorus, Ammoniacal Nitrogen, and Calcium Hardness, Dissolved Oxygen, Biological Oxygen Demand) were found to have changed significantly, which in turn had an impact on the

Zooplankton and Macroinvertebrate Community, there overall diversity has been significantly affected by fluctuations in the values of Total Alkalinity, Total Hardness, Electrical Conductivity, Magnesium Hardness, and Transparency and also transition of organism's from sensitive taxa to pollution tolerant taxa. Various Physico-Chemical characteristics of Dal Lake such as pH, Total Alkalinity, Hardness, Phosphorus and Calcium have been compared with the categories of trophic status of Lakes and it has been seen that, in present Dal Lake falls under the category of "Hyper-Eutrophic Lake" as it is fed by too many nutrients especially due to higher levels of pH, Alkalinity, Calcium, Total Hardness.

### Suggestion

Preservation of Dal Lake is need of an hour, in order to improve the quality of water and increase the diversity of aquatic fauna following suggestions may be put forth for conservation strategies of Dal Lake which will form the base line for the upcoming research on the Dal Lake. (1). Need of repair/replacement/treatment/installation of sewerage passing along the Dal Lake. (2). On-going evaluation of the Lake's water quality. (3). The water of the Lake should be used for agricultural purposes on scientific grounds. (4). Proper treatment of water before its use for drinking purposes. (5). Awareness of public regarding the ecological significance of the Dal Lake. (6). Time bound fencing of Lake from all sides to stop encroachments. (7). Dredging of dry land patches present inside the Lake. (8) Provide proper garbage collection systems to prevent citizens from dumping the same into Lake. (9). Provide lavatories to Dal dwellers to prevent open defecation.

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