

# Variation in physio-chemical Parameters of Dal Lake, Jammu and Kashmir

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**Abstract**—Physio-chemical analysis was carried out for the hydrological year 2017. This study was undertaken to evaluate the rate of change of physio-chemical parameters in the Dal Lake. The lake water is alkaline in nature (pH: 7.1–8.7) characterized by medium total dissolved solids of 80.8–230.7 mg L<sup>-1</sup> and electrical conductivity of 126.3–384.6  $\mu$ s cm<sup>-1</sup>. Comparative results indicate that NO<sub>3</sub><sup>-</sup> N (>1.7 times) have increased from 1997 to 2017. NO<sub>3</sub><sup>-</sup> N has increased in the lake particularly in Nigeen basin, while as Nishat basin has remained slightly unaffected from all types of anthropogenic pressures. The order of major ions is Ca<sup>2+</sup> > Mg<sup>2+</sup> > Na<sup>+</sup> > Cl<sup>-</sup> > NO<sub>3</sub><sup>-</sup>. The geochemical processes suggested that the lake water composition is mostly influenced by the lithology of the catchment. This study reflects that Dal Lake is undergoing through hyper-eutrophication due to increase in anthropogenic activities in catchment area. The health of Dal Lake has reached to an alarming stage and if proper remedial measures are not taken, quality of lake water will worsen further and will reach to a hyper-eutrophic condition.

**Keywords:** Dal Lake, Total Phosphorous, Chemical oxygen demand, Eutrophication

## Introduction

Lakes are sensitive ecosystems that contribute to regional hydrology [1,2] and pristine biodiversity [3,4] and play an important role in sustaining the socio-economy of the dependent populations [5]. The valley of Kashmir is well known for its huge freshwater resources like lakes, glaciers, rivers, ponds, springs etc. The Dal lake of Kashmir, situated in the north-east of Srinagar has been a great tourist attraction in the past. Due to the ecological stress from human activities, the lake system is not only shrinking in surface area but its water quality has also deteriorated and the aquatic life is also badly affected [6,7]. The consideration of physico-chemical factors in the study of limnology is basis for understanding of trophic dynamics of water body. In the present study physical and chemical parameters were analyzed to understand the current chemical quality of lake.

## Study area :

Dal Lake (Figure 1) is situated between 34°04' - 34°11' N, 74°48' - 74°53' E in the north-east township of Srinagar in the

heart of Kashmir Valley in western Himalayas (1583 m amsl). The lake has a total area of above 23 km<sup>2</sup> of which approximately 12 km<sup>2</sup> is the total open water spread area. Total area of its catchment is about 314 km<sup>2</sup> and it is divided into 4 sub-catchments namely: i) Tailbal Dachigam, ii) Lake Hillside, iii) Srinagar north sub-catchment, and iv) Srinagar center sub-catchment.

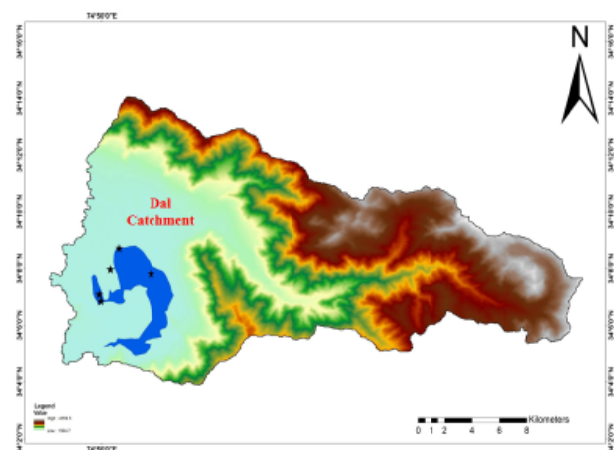


Figure 1: Study area map

## Methodology

The water samples were collected in the polyethylene bottles. Initially, the prewashed bottles were rinsed with sample water. The closed bottle was dipped in the lake at the depth of 0.5 m, and then a bottle was opened inside and was closed again to bring it out at the surface. The samples collected in three replicates from five different points were mixed together to prepare an integrated sample. Samples were collected during morning hours in between 8.00 to 10.00 a.m. using one litre container. Parameters including pH, electrical conductivity, total dissolved solid, calcium, magnesium, chloride, sodium, nitrate and were analysed. We adopted standard guidelines of water sampling and physico-chemical parameters evaluation. Parameters such as pH, electrical conductivity, total dissolved

solids were directly evaluated in the study area whereas other parameters were analysed in laboratory.

**Results and Discussions**

The physico-chemical parameters such as pH, electric conductivity, total dissolved solid, calcium, magnesium, sodium, chloride, and nitrate of water were analysed in the water samples taken from Da Lake. These parameters were taken seasonally at the five points of the lake.

**pH**

We recorded a high pH of lake water (8.7) (Figure 2) associated with the high decomposition activities of biotic and abiotic factors. The low pH of 7.1 was noticed during winter due to the production of CO<sub>2</sub> from biological oxidation process and may have ultimately contributed to the reduction of pH.

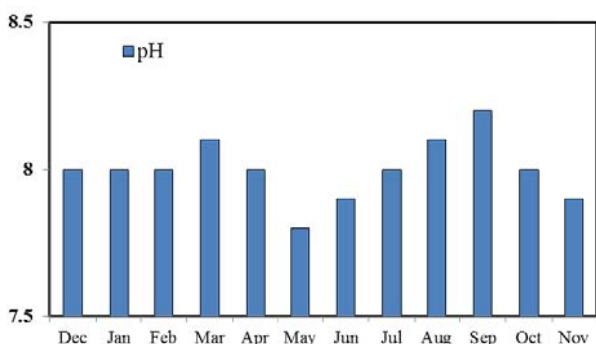


Figure 2: Monthly variation of pH

**Electrical Conductivity**

Water capability to transmit electric current is known as electrical conductivity and served as a tool to assess the purity of water the highest electrical conductivity reported during summer was 384 us/cm and lowest in winter observed was 126 us/cm (Figure 3) During summer, a high level of conductivity indicates the pollution status as well as trophic levels of the aquatic body.

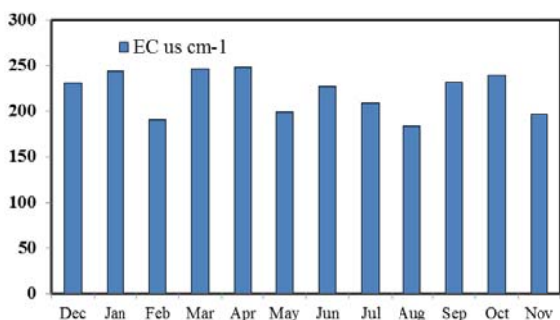


Figure 3: Monthly variation of Electrical Conductivity

**Total Dissolved Solids**

The highest total dissolved solids (TDS) in summer was observed as 230 mg/L (Figure 4) due to the addition of dead organic substances contributed by the decomposition of aquatic plants and animals which may be related to the water dilution caused by evaporation at high temperature during summer. The rain water may have decreased the TDS concentration to 80 mg/L (lowest TDS in the data) during monsoon

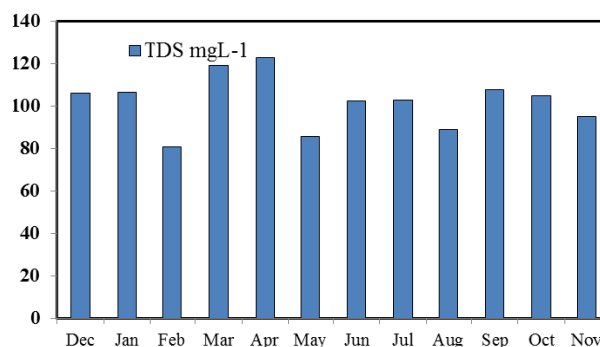


Figure 4: Monthly variation of Total dissolved solids

**Calcium**

The highest amount of calcium content in water was recorded during monsoon season as 48 mg/L by the addition of sewage waste which may be responsible for the increase in amount of calcium whereas the lowest amount of calcium was 19 mg/L (Figure 5) recorded during summer season due to calcium being absorbed by a large number of organisms.

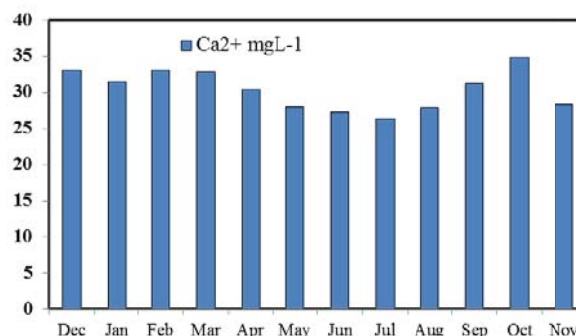


Figure 5: Monthly variation of Calcium

**Magnesium**

The highest amount of magnesium was 11 mg/L recorded during the winter season as the amount of magnesium is essential for chlorophyll bearing plant for photosynthesis and act as a limiting factor for the growth of phytoplankton. The

lowest value was 2.4 mg/L estimated during the summer season.

### Chloride

The highest chloride concentration of 24 mg/L was reported in summer due to frequent run-off loaded with contaminated water from the surrounding slum area and evaporation of water. (Figure 6) The high chloride concentrations indicates the presence of organic matter, presumably of animal origin. The lowest value of chloride was 01 mg/L during monsoon season and can be connected to the dilution of lake by rain water.

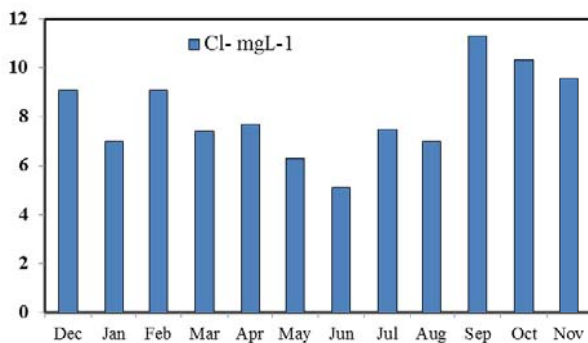


Figure 6: Monthly variation of Chloride

### Sodium

The highest amount of sodium was recorded during the summer season (13.9 mg/L) by the addition of waste water containing soap solution and detergent from the surrounding slum area. The highest volume of sodium content during summer is due to shrinkage of water volume. The lowest amount of 0.4 mg/L was recorded during winter season because of bioaccumulation by living organisms.

### Nitrate

The highest amount of nitrate was recorded during monsoon season (5 mg/L) (due to the possible influx of nitrogen rich flood water into the lake water from the large amount of contaminated sewage water (Figure 7)). The lowest amount of nitrate in water was recorded during summer was 0.3 mg/L and can be due to the utilization by plankton and aquatic plants for metabolic activities.

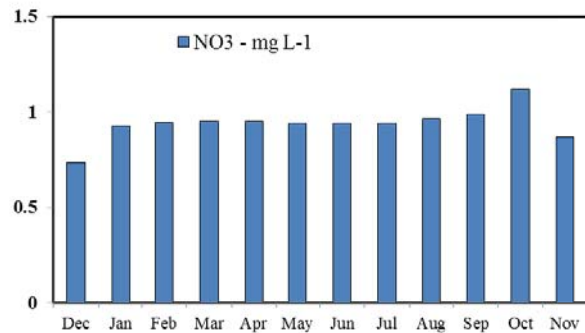


Figure 7: Monthly variation of Nitrate

### Conclusion

The statistics obtained from the physico-chemical analysis of the water quality in the Dal Lake clearly indicates that most of the important quantities such as pH, Electrical Conductivity, total dissolved solids, calcium, magnesium, chloride and nitrate are below WHO guidelines. However, this present situation may drastically affect the aquatic and terrestrial organism growth in the water repository and significant pollutants emerge from domestic sections pose an additional threat to the water quality in the near future.

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