

An assessment of water quality parameters in Dal Lake Dharamshala: A case study

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Abstract

The organic and inorganic pollutant load in the Dal Lake has accelerated macrophytic development, lowering the water quality and biological oxygen demand (BOD) of the lake and as a result, lowering the recreational and aesthetic appeal of the lake, resulting in its degradation. A Water Quality Assessment is a helpful method for simplifying, monitoring, and analyzing the data collected from any given water source. A basic measure of water quality can be extracted from a water quality assessment based on a few main parameters. In general, water quality data derived from various water quality parameters would appear to indicate a water body's health status. This paper details the changes in the water quality of Dal Lake over the recent past. The paper analyses the strategies that can be implemented to manage the lake and restore its quality if appropriately implemented.

Keywords: - Dal lake pollution, physio-chemical parameters, geographical land use, QGIS.

1. Introduction

Dal Lake is seen as a huge expanse of water in a beautiful landscape of Baladhar range of mountains where people go to relax and have fun. Boating, camping, fishing, swimming, bird watching, and other outdoor activities are available there. Dal Lake is an 'Urban Lake'. When the phrase "urban lakes" is used, however, the image is quickly dispelled. Although urban lakes are not the same as lakes in general, they do have importance and functions, including both ecological and social functions.

The term "lake" is used loosely to refer to a variety of water bodies, including wetlands, which are natural, man-made, or ephemeral. A number of human disturbances are currently threatening the biodiversity of lake and pond habitats, the most serious of which include increased nutrient load, contamination, acidification and invasive species invasion. Water quality has declined, and biological productivity has improved, suggesting the system's ecological stress.

The most noticeable effect of urbanization is hydrologic transition. Runoff peak flows and overall flow volumes are usually increased as a result of urbanization, resulting in poor water quality and aesthetics. Pollutants predominantly enter wetlands by runoff. Large amounts of pollutants, such as eroded soil from construction sites, toxic metals and petroleum from roadways, industrial and commercial areas, and nutrients and bacteria from residential areas, are produced in urbanized watersheds. Sedimentation is the most significant non-point pollutant in terms of volume. Urbanization creates vast amounts of contaminants while also reducing water infiltration potential, resulting in more surface runoff. As a result, pollutants from urban land uses are more susceptible to surface runoff transport than pollutants from other land uses.

Lake water and sediment chemistry is a product of catchment geology, weathering and erosion cycles, as well as anthropogenic inputs. Dissolution, hydrolysis, oxidation, and reduction are some of the chemical processes that degrade silicate and carbonate minerals. The basic chemical reactions that occur between silicates, carbonates, and rainwater produce various ions and clay minerals, either congruently or incongruently.

Dal Lake's surface water composition has been altered by municipal and domestic effluents, resulting in increased eutrophication. Furthermore, excessive sedimentation rates, caused by widespread soil erosion as a consequence of deforestation and encroachment by the local population, have resulted in a substantial reduction in lake volume. The lake provides drinking water, irrigation, fisheries, recreation, and tourism, among other things.

2. Location and Extent

Dal Lake is situated in Dharamshala, Himachal Pradesh ($32^{\circ}14'47.6''\text{N}$ $76^{\circ}18'38.9''\text{E}$ 32.246562, 76.310794, 1,775 m above sea level). (Dal Lake.Pdf, n.d.) Dal Lake is a small mid-altitude lake near Tota Rani Village in Kangra district (Himachal Pradesh). The name 'Dal Lake' arises from the Dal Lake in Kashmir. (Kumar et al., 2020)

The lake, which is surrounded by rugged mountains and towering deodar trees, is a wonderful place to visit. This quiet and calm lake with greenish water is home to several different species of fish. According to many well-known stories and myths, these fish are never caught or eaten because of a curse that the lake is said to bear. Surprisingly, many people regard the lake as a holy site, as there is a small temple dedicated to Lord Shiva on the lake's shore. If you're trekking up to Naddi, which is also known as the Sunset Point, the Dal Lake is a great place to rest and relax. The lake, with its lush greenery and blossoming flowers, is an ideal place for relaxing with loved ones and enjoying a carefree day in nature. This is why the Dal Lake is considered one of Mcleodganj's most important and beautiful tourist attractions.

On the banks of the Dal Lake, a grand fair is also held. This grand festival, which takes place in September, is held to commemorate Lord Shiva's presence and is attended by a large number of Gaddi Tribe members. The different ways that people use the lake as well as the various pollutant-producing practices have put a strain on the lake environment in a variety of ways. The lake is primarily fed by Telbal nala, a large perennial inflow channel that drains the largest sub catchment area of about 145 square kilometers and contributes around 80% of the total inflow to the lake along with a number of small streams along the shore line, such as Peshpaw nala, Shalimar nala, Merakhs. There are a number of springs within the lake basin that serve as a permanent water supply for the lake. The Gagribal basin is the shallowest, while the Nageen basin is the deepest. 4.1 km² of the lake's total area is under floating garden or agriculture, 1.51 km² is submerged land, and 2.25 km² is marshy.

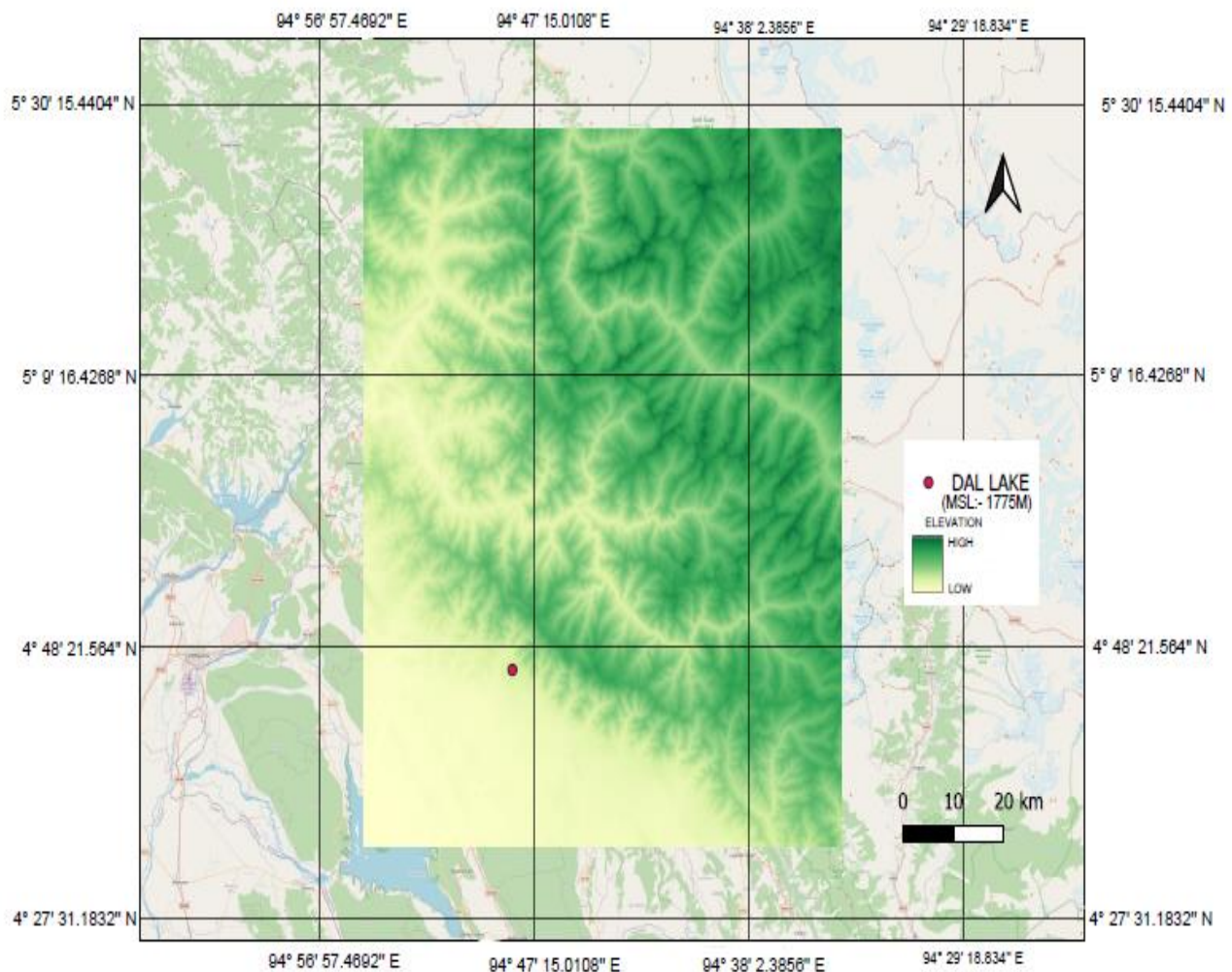


Figure-1 Location of Dal lake Dharamshala (Priyanka et al., 2020)

3. Research Significance and Objectives

Research has been conducted to achieve following objectives:

1. To study the geographical land use pattern by using QGIS.
2. To study the physio-chemical water quality parameters in the lake.

4. Methodology

Water samples for physico- chemical Characteristics were collected on monthly basis from February 2020 to February 2021 at four sampling sites known as zone1, zone2, zone3, zone4. The readings were taken with the help of multi parameter U-50 series. Temperature and Transparency were measured in the field. Dissolved oxygen sample was fixed at the spot in accordance with Winkler's method. The depth, pH, Oxidation Reduction Potential (rpmb) Water Conductivity (ms/cm), Turbidity (ntu), Total Dissolved Solids (g/l), Salinity (ppt) were measured with the help of multi parameter. The average (mean) for each parameter per month was computed, considering the values from four zones.



Figure-2 Various sampling zones in Dal lake Dharamshala

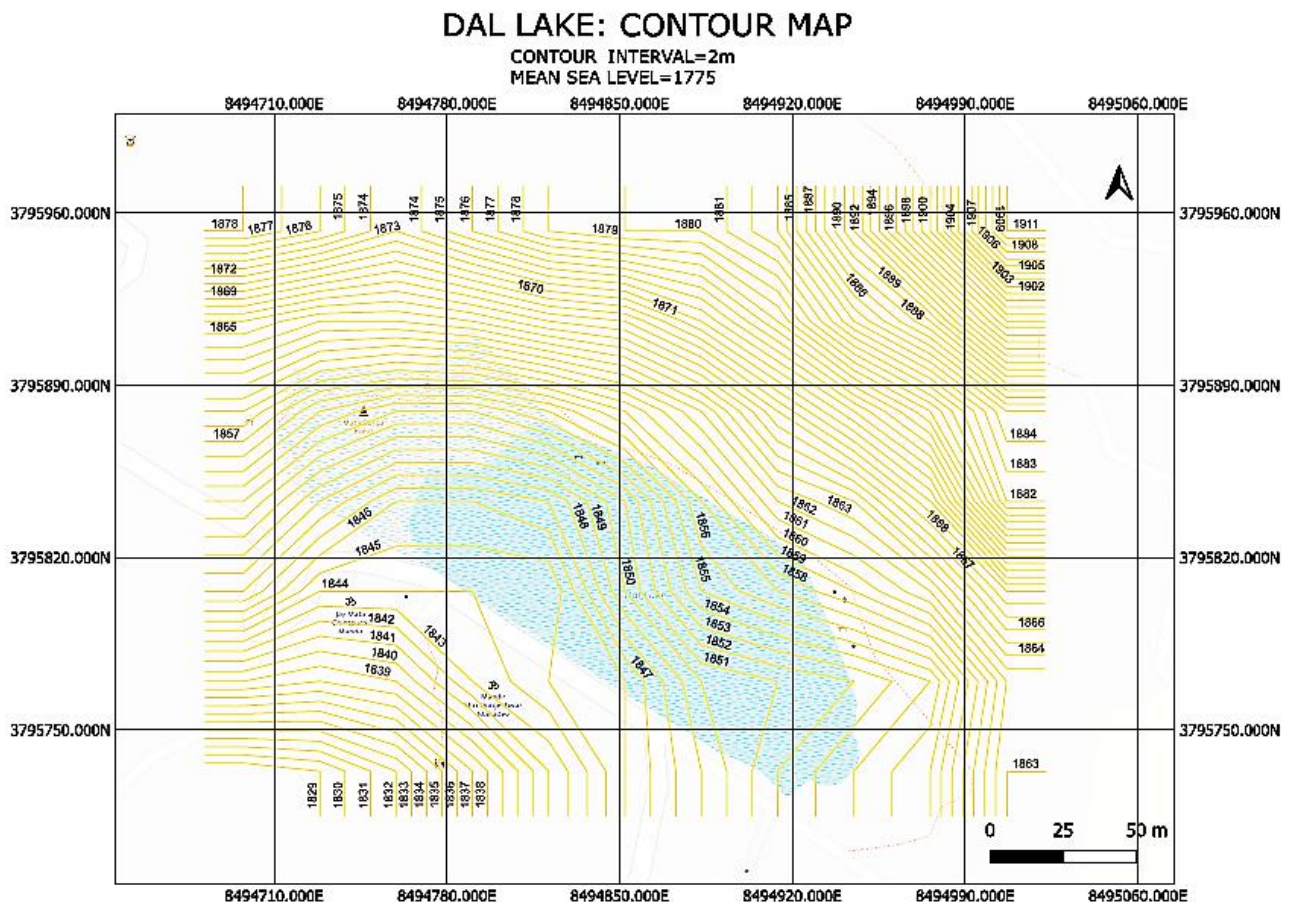


Figure-3 Contour map of Dal lake Dharamshala

5. Results

Range of variation of various Physico-chemical characteristics of water of Dal lake, Dharamshala has been given below: -

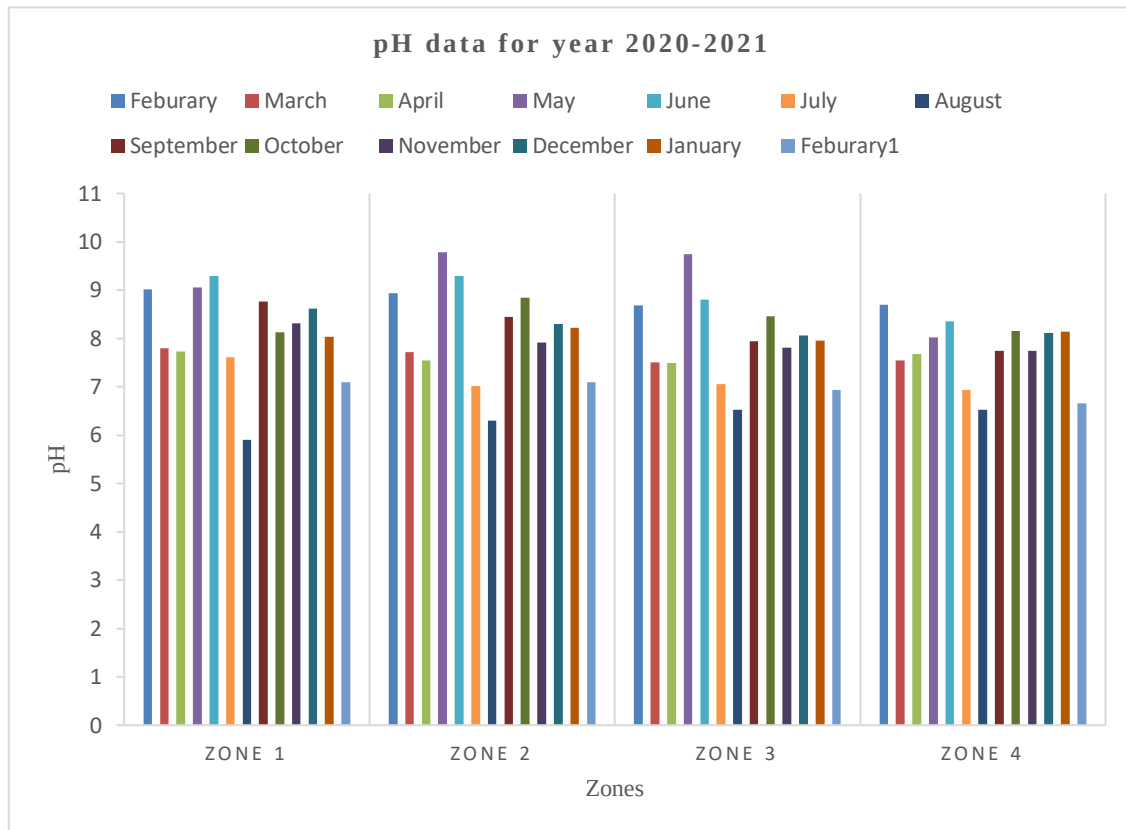


Figure-4 Month wise pH data of Dal lake Dharamshala

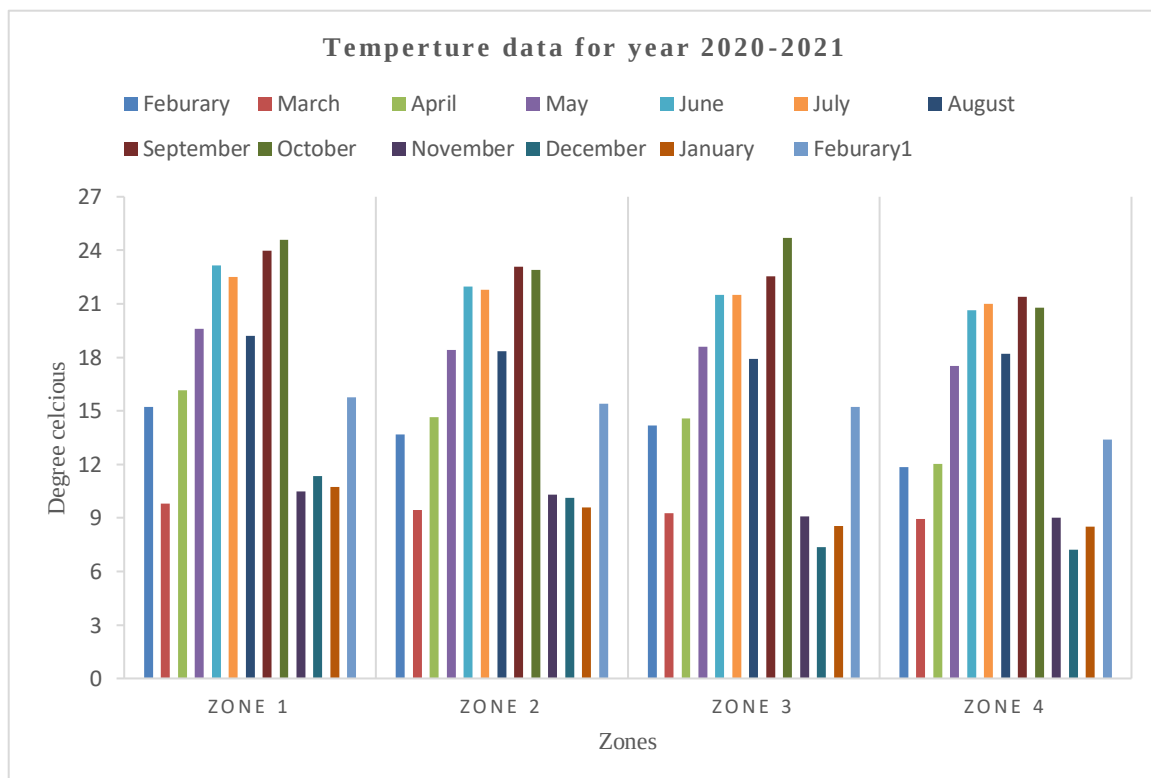


Figure-5 Month wise Temperature data of Dal lake Dharamshala

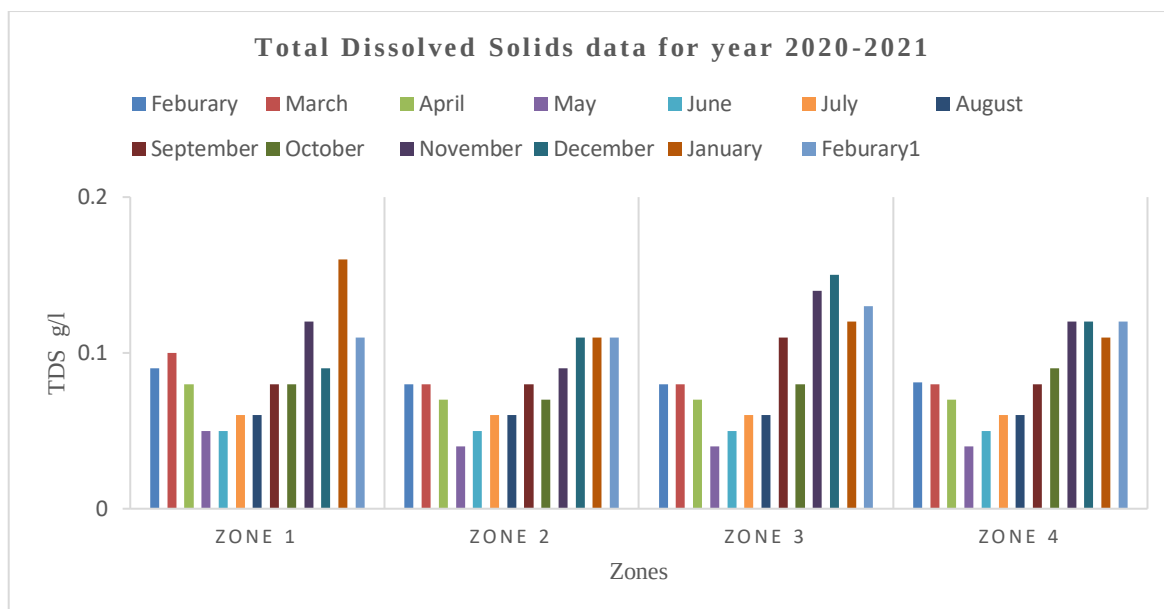


Figure-6 Month wise TDS data of Dal lake Dharamshala

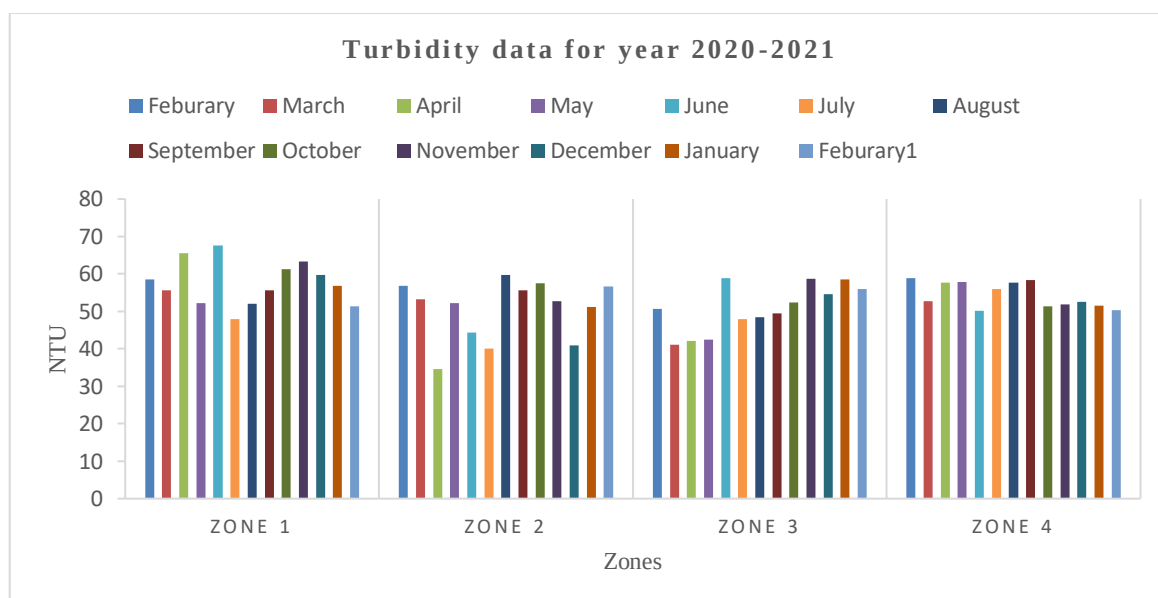


Figure-7 Month wise Turbidity data of Dal lake Dharamshala

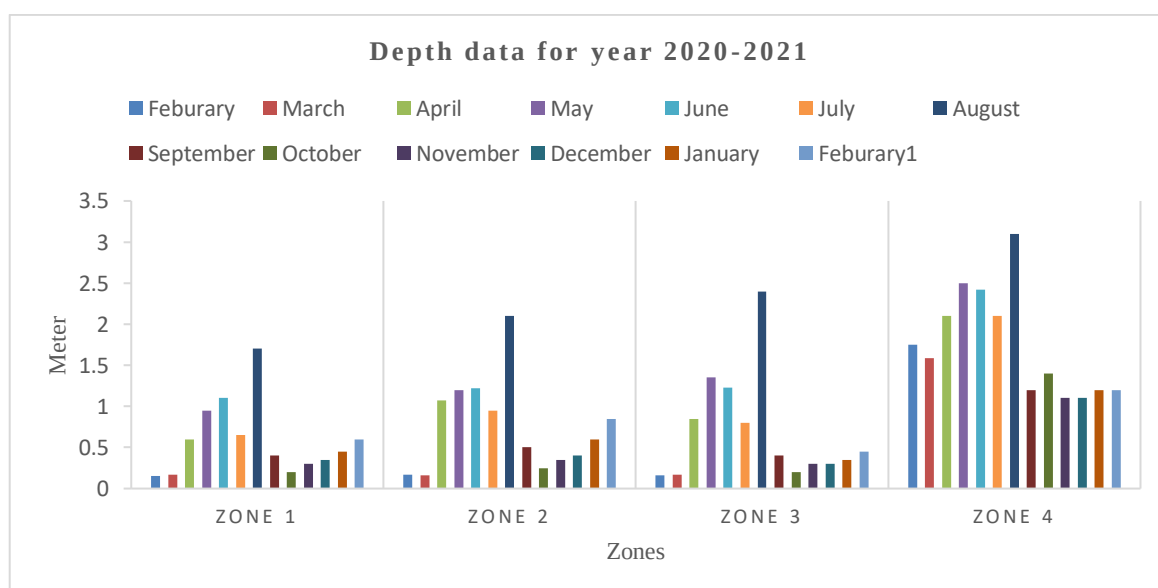


Figure-8 Month wise depth data of Dal lake Dharamshala

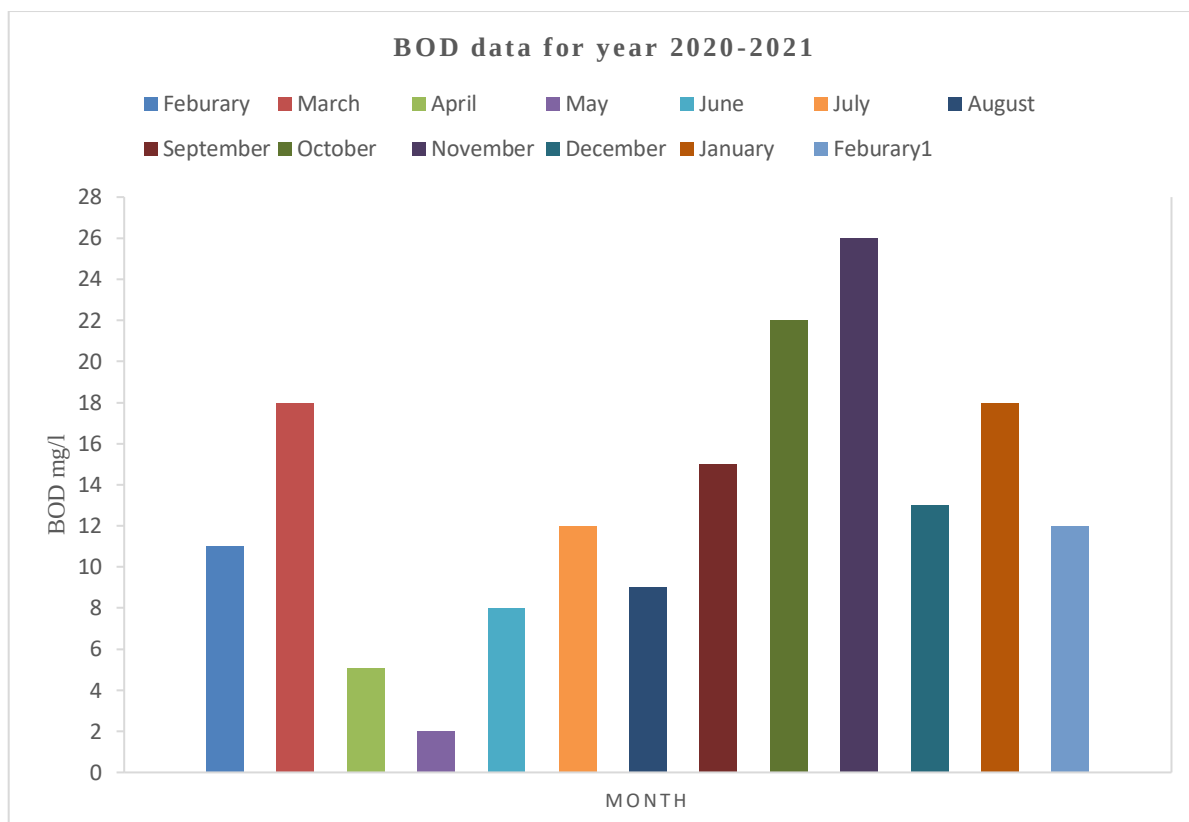


Figure-9 Month wise BOD data of Dal lake Dharamshala

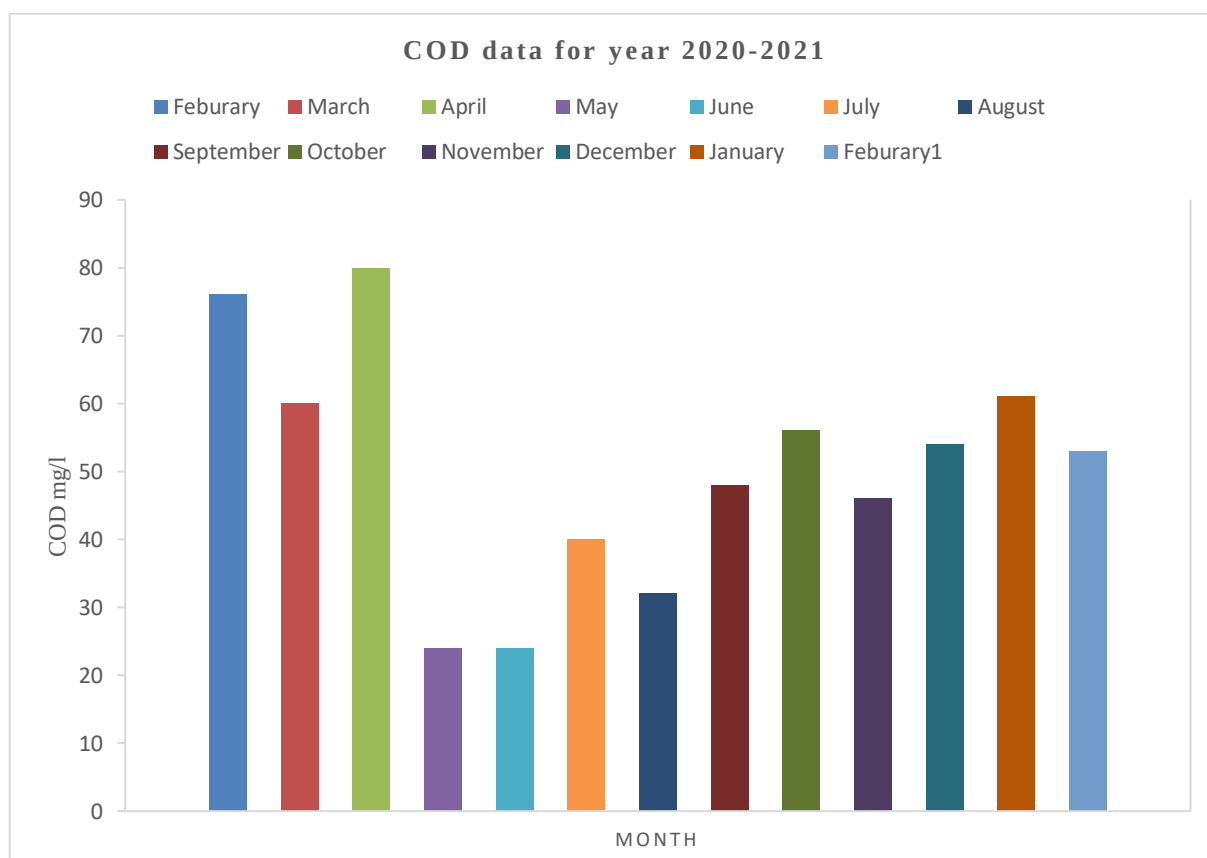


Figure-10 Month wise COD data of Dal lake Dharamshala

Table 1: Comparison of Results with BIS 10500:2012(BIS, 2012)

Properties	Obtained mean value	BIS limit (acceptable)
pH	7.91	6.5 – 8.5
Temperature (°C)	15.93	-
TDS (g/l)	0.083	500
Turbidity (NTU)	53.30	1
Depth (m)	0.95	-
BOD (mg/l 5 days)	13.16	1
COD (mg/l)	50.31	250 (as per CPCB)

*CPCB = Central Pollution Control Board

6. Conclusion

In this present study, an attempt was made to study the Dal Lake Dharamshala to assess quality of its water for drinking (animals and birds) and irrigation purpose by analysing different physio-chemical parameters of water. After analysing various factors, it can be concluded that pH balance and TDS content available in the water of the lake are within the permissible limits, but Turbidity and BOD are beyond permissible limits. Hence, proper filtration process or purification methods must be adopted to purify the water of the lake and to make it safe for animals and birds to drink water from this source. Some strict pollution control measures are required to be taken to reduce gradual degradation of the water in the lake. If left untreated, the water in the lake may pose some serious hazards to human beings and environment in its surroundings and will become threatening for various aquatic species available in the lake as well.

Conflict of Interest

In this manuscript the authors declare that there is no conflict of interest.

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