Exploration into the Limnology of Dal Lake, Srinagar, Jammu and Kashmir

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***Abstract*— Limnology is the scientific study of inland waterways and the populations connected with them. Lakes are divided into three distinct zones according to limnology: the littoral zone, the photic zone, and the benthic zone. The problems of sewage disposal and contamination of surface waters in lakes are growing at a rapid rate as a result of urbanization, modernization, and an increase in the overall number of people living in the world. The water quality of Dal Lake has seen huge changes over the course of the past four decades, which has resulted in the lake becoming unusable for both aesthetic purposes and for residential usage. The expansion of land usage in the lake could lead to an increase in the application of fertilizers, which could contribute to the eutrophication problem. In this document, we make an attempt to illustrate the current state of the lake's water quality. Several different measures, such as biological oxygen demand (BOD), pH, nitrate, phosphorus, and turbidity, can be used to evaluate water quality. According to the findings of the tests and the collected data, we found that the majority of the water surface of the lake is covered by weeds. This is because the lake contains a higher percentage of phosphorus, which directly results in the siltation of the lake water. Because of the high levels of BOD, there is a lower quantity of dissolved oxygen available in the water of the lake. This is the primary reason of the harm that is posed to the lake ecosystem. Around the world, freshwater environments are seeing an increase in the frequency of harmful algal blooms. Plastic scrap pollution is a growing environmental hazard in water bodies, especially impacts open water as well as shorelines and habitats. This pollution comes from plastic waste.**

***Index Terms*— Limnology, Eutrophication, Turbidity, pH, Alkalinity, Chloride, Sediments, Hardness, Dissolved Oxygen, BOD, Phosphorus, Temperature.**

I.INTRODUCTION

The science of inland waterways and the communities that are associated with them is known as limnology. Limnology classifies lakes into three distinct zones: the littoral zone, which is a sloping area close to land; the photic zone, also known as the open-water zone, which is where the majority of the sunlight is; and the deep-water profundal zone, also known as the benthic zone, which is where only a small amount of solar energy can penetrate. The turbidity of lakes, which is defined by the quantity and size of the particles that are suspended in the water, affects the maximum depth that light can penetrate. If a particle's weight is smaller than the arbitrary turbidity forces acting upon it, then the particle is said to be in suspension. The hue of the water is caused by a variety of particles, some of which have a biological origin while others have a sedimentary one. For example, decomposing plant materials can be to blame for a yellowish or brownish hue, but algae might be to blame for a greenish tint to the water.

The bottom sediments of Dal Lake represent contamination from both point sources and nonpoint sources; biochemical responses are largely chemical degradation of silicate and carbonate minerals. The concentration of a molecular constituent in water depends on its parent material and solubility in water. The concentration and abundance of chemical components in lake sediments reflect their presence in catchment rocks and anthropogenic sources. Both lakes operate as sinks for agricultural runoff, urban, and industrial waste water discharges, enriching them in nutrients, sediments, and heavy metals. The lake's water quality is degrading due to a rise in nearby construction and low dispersion and mobilisation rates. Dal Lake is an urban lake, therefore municipal and domestic effluents have modified its surface

water composition, causing eutrophication. High sedimentation rates, soil erosion caused by deforestation, and encroachment by the neighboring population have all reduced the lake's capacity. Lakes supply drinking water, irrigation, fishing, recreation, and tourism. No complete water quality investigation has been done. This research considers lakes and their geographies. We must also analyze the lake's effluent chemistry based on physicochemical factors to provide a baseline for future evaluations. Dal is a Himalayan tourist lake. Fishing isn't important. The lake has five basins connected by canals. It's one among India's most beautiful lakes and Jammu and Kashmir's second largest. Encircling the lake are mountains. Gardens and orchards cover the shores. Dal Lake contains hundreds of house boats where guests can stay peacefully. Smaller, more elaborately designed shikaras service the boats. On the lake's shores, you'll also find the University of Kashmir's campus. Shankaracharya and Hari Parbat temples overlook the lake. 80% of the lake's water comes from a north-flowing canal. On the southwest side, the lake drains into the River Jehlum. A stone-lined canal connects the lake and tributary along this outlet. This channel lets boats enter and exit the lake and prevents floating garden flooding. Over 500 Mughal gardens once surrounded the lake, but only a few remain. Lake's origin is unknown. Geologists believe Dal Lake is the last remnant of an oligotrophic Pleistocene lake that formerly covered Kashmir. Geologists call Dal a floodplain lake. Expanding vegetable farms use lake water to irrigate. The lake is 6m deep (Nagin basin). Aquatic flora is food, fodder, and compost. Dal Lake's water quality has degraded in the past two decades. Large swathes of land around the edge are floating gardens. As tourism has increased, residential buildings, restaurants, and hotels have sprouted along the lakeside. Also rising: houseboats. Increasing and unplanned urbanisation dumps large amounts of raw sewage into lakes, causing future health problems. Environmental problems include excessive weed growth, water clarity loss, water enrichment, and high microbial activity. In 1978, Jammu & Kashmir's state government created the Dal Development Project.

II. PLACE OF WORK

1. Dal Lake Srinagar, Jammu And Kashmir.
2. NIT Srinagar
3. Kashmir University
4. IUST Awantipora
5. Govt Degree College Anantnag

III. OBJECTIVES

1. Physico chemical analysis of Dal lake.
2. Comparison Properties of Dal lake Kashmir.
3. Check whether the water is acidic or basic.
4. To study the physical properties of Dal lake .
5. To study the chemical and biological characteristic of Dal lake.
6. To check the sediment concentration in the water.
7. To check the aquatic life like fishes and algae in water.

IV. METHODOLOGY

The methodologies for study are almost done in laboratory but for the collection of literature of lake background and other related aspects, to collect authentic literature I have to go through various departments and agencies government as well as non government. the studies are mostly conducted on the basis of primary survey supported by ground survey marking point source and non point source of pollution by visiting all corners of the lake were it was assessable and have taken snapshots/photographs also.. Secondly the laboratory tests were done and analyzed in university of Kashmir laboratory, by using standard methods for testing purposes. Thirdly interviews with Dal dwellers and catchment area residents and other people within the catchment area, the interviews were almost related to domestic water discharge and the problems they are facing from the present polluted lakes.fourthlly, secondary data were collected from newspapers, websites, journals, magazines, published by LCMA Kashmir.

Three water samples were collected at three locations from the three basins of the Dal Lake and Bellandur Lake respectively. An analysis was carried out according to standard methods (APHA 1992 American public health association) pH and conductivity (EC) of water samples were determined by portable digital pH meter and conductivity meter, respectively. DO, CO2, chloride, and phosphate have been estimated by WINKLER method, TITRATION method (sodium carbonate), TITRATION method (AgNO3) and STANNOUS CHLORIDE method respectively.

PHYSICAL PARAMETERS

1. Turbidity: The amount of turbidity present in the representative sample of water drawn from Dal Lake is 11.4 NTU.
2. Dissolved sediments: The estimation of dissolved solids can provide some insight into the processes that lead to the creation of scales, which are accountable for foaming in boilers, accelerating corrosion, and distorting with the texture and flavor of numerous finishing products.
   Result: The concentration of dissolved sediments in the water sample is 84.3 mg/l .
3. Suspended sediments: he quantity of suspended sediments found was 91.7 mg/l .
4. Colour: Water in its purest form has no color, however environmental contaminants can cause natural water to take on a variety of hues. The coloring components, most of which are carbonaceous compounds, decrease when waters come into touch with organic detritus.
   Result: Color of the given sample of water = 4.7 TCU .
5. Temperature: The average water temperature found is 18.27 °C

CHEMICAL PARAMETERS

1. pH: The negative log of hydrogen ion concentration in water and wastewater is defined as pH. pH levels ranging from 0 to a little less than 7 are considered acidic, while pH values ranging from 7 to 14 are considered basic. Neutral pH is defined as the concentration of H+ and OH- ions being equal.
   Results: The pH value of given water sample is 8.5
2. Alkalinity: Alkalinity is a measurement of the water's ability to neutralize acid. To put it another way, its pH stability.

S. No.	Volume of sample (ml)	Burette reading		Vol of titrant used (A)	Alkalinity (mg/l)
		Initial (ml)	Final (ml)		
1	30	0	5.25	5.25	175
2	30	5.5	10.8	5.3	176.67
3	30	12	17.1	5.1	170
4	30	18	23.2	5.2	173.33

Result: Average Alkalinity of the given water sample is 173.7 mg/l .

3. Acidity: The amount of base necessary to neutralise a given sample to a specified pH is known as acidity. Acidity can be caused by strong mineral acids, weak acids like carbonic and acetic acids, and hydrolyzing salts like ferric and aluminium sulphates. Acid adds to corrosivity and regulates various chemical and biological processes, hence it's crucial.

S. No	Volume of sample (ml)	Burette reading		Vol of titrant used	Acidity (mg/l)
		Initial (ml)	Final (ml)		
1	100	0	0.1	0.1	1
2	100	0.2	0.35	0.15	1.5
3	100	0.5	0.6	0.1	1
4	100	0.7	0.8	0.1	1

Result: Methyl orange acidity = 1.2 mg/l .

4. Hardness: Water hardness varies greatly depending on where you live. Groundwater is generally softer than surface water. The nature of the geological formations with which water has come into contact is reflected in the hardness of the water. The sum of calcium and magnesium concentrations, both reported as calcium carbonate, in milligramms per litre, is the overall hardness of water.

S. No.	Volume of sample (ml)	Burette reading		Vol of titrant used (EDTA)	Results
		Initial (ml)	Final (ml)		
1	20	0	2.45	2.45	126.17
2	20	3	5.3	2.3	118.45
3	20	5.5	7.9	2.4	123.6
4	20	9	11.4	2.4	123.6

Result: Total Hardness in mg of CaCO3 is 122.95mg/L

5. Chloride Content: Chlorides are commonly found in municipal wastewater, and they are frequently coupled with the ion sodium. Whereas chlorides are not dangerous, concentrations greater than 250 mg/l give water a distinctive flavour, making it unfit for drinking. The presence of chlorides in water sources over the normal background concentration is also utilized as an indicator of sewage pollution.

S. No.	Volume of sample (ml)	Burette reading		Vol of titrant used ($AgNo_3$)	Results
		Initial (ml)	Final (ml)		
1	20	0	0.8	0.8	19.979
2	20	1	1.6	0.6	14.985
3	20	2	2.5	0.5	12.487
4	20	3	3.5	0.5	12.487

Result: Chloride content present in water sample is 14.98 mg/l .

6. Phosphorus content: Srinagar residents are complaining about high phosphorus levels in the dal lake water, which they allege are killing the fish. They believe that new golf course builders are attempting to jump-start their grass by applying high amounts of phosphorus, and that most of this phosphorus is being wasted.

Results: Phosphorus content in the given water sample is 0.43 mg/l

BIOLOGICAL PARAMETERS

1. Dissolved Oxygen: The amount of oxygen that is dissolved in water, which is often referred to as DO and is a very significant measure of water quality, is an index of the biogeochemical cycling that are taking place in the water.

S. No	Burrete readings		difference	Result	Average (mg/L)
	Initial	final			
1	0	1.8	1.8	7.2	6.8
2	3	4.6	1.6	6.4	
3	5	1.7	6.7	6.8	

Result: The dissolved oxygen content present in the water sample is 6.8 mg/L

2. Bio-chemical Oxygen Demand: BOD is the quantity of oxygen bacteria need to stabilise carbonaceous organic matter in aerobic water. The test measures wastewater pollutant load, pollution level, and wastewater treatment efficiency. 5-Day BOD test, a bioassay process (measuring oxygen required by bacteria for decomposing organic matter in aerobic circumstances), requires nutrition, standard pH, temperature, and absence of microbial growth inhibitory agent.

Results: The amount of BOD determined from the given sample is 194.26 mg/l.

Note: Due to the obvious high BOD concentration, it can be deduced that the body of water is eutrophic.

V. CONCLUSION

1. The survey indicates the decline in Dal Lake's water quality and quantity. Due to rising turbidity, the lake's colour has changed from bluish green to hazel, reducing the number of tourists attracted by its beauty.
2. The research also indicated that pollution increases pollutants, which increases BOD in a given location, which reduces dissolved oxygen in water and affects aquatic life.
3. The Environmental Management Plan (EMP) aims to increase flora, wildlife, and fisheries. The methods will also help regulate nearby floods. The watercourse will create a better climate and cleaner environment by reducing pollution.
4. Underground water will become drinkable. Implementing soil conservation measures will maximize land utilization. Diversifying economic growth will increase the area's level of living, while wetland regions will attract tourists.
5. The lake is under strain from its surrounds, according to recent study. Lake is urban and important to its city; our research shows that it needs a specific plan for revitalization, ecosystem survival, and ecological balance. Unplanned development in the watershed area is a major stressor for the lake.
6. The research shows that sewage is the principal source to this body of water's contamination, and that irrigation with sewage-contaminated water that contains heavy metals increases metal concentrations in soil and vegetation. Metal concentrations in vegetation will provide baseline data, and additional sampling will be needed to quantify study results. Monitoring soil, plant, and water quality and avoiding metals from penetrating plants are necessary to prevent health concerns from sewage-fed irrigation.

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