Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 7, July 2021: 14423-14435

# Wular Lake and Pollution Status: A Major Concern

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**Abstract:**

In order to attain the sustainability of water bodies in Kashmir Valley their protection is very urgent. Water is the precious environmental component among all other components and should be managed so as to agricultural, industrial and domestic needs of water can be fulfilled. But unfortunately the water bodies are at risk due to the waste generated in their catchment area was not properly treated and makes these water bodies unfit for all purposes. In Kashmir Valley, Wular Lake is India's largest freshwater lake, located 34 kilometers from Srinagar at an elevation of 1580 meters between 74°29′E and 74°40′E longitudes and 34°16′N and 34°25′N latitudes. With a surface area of 112.77 km2, a maximum length of 16 km, and a maximum width of 9.6 km, it is elliptical in shape. The study has been undertaken on the Wular Lake of Srinagar, Kashmir on randomly selected sampling sites by simple random selection. The samples were collected in prewashed clean plastic bottles. After that samples were promptly brought to scientific laboratory and further investigation began immediately. These samples were investigated with respect to turbidity, temperature, pH and dissolved oxygen. Methods used for these parameters were Turbidometer, pH Meter, Thermometer and Wrinkler'sIodometric Method. The findings of the study that the overall conditions of Lake Wular are critical from pollution point of view. The main sources of pollution came from agricultural activities, domestic waste water and agricultural runoff. Various mitigation measures for lake conservation have been proposed, including increasing forest cover in the direct catchment area, removing excess weeds from the lake on a regular basis, reducing area under degraded pastures and improving the quality of existing pasture lands, reducing degraded area under agriculture/horticulture in the catchment area, and enhancing current water storage capacity, proving an opportunity to accommodate high flows, which are forced in the absence of adequate storage. As a result of these actions, Lake Wular's overall pollution will be reduced.

**Key Words:** Sustainability, Wular Lake, Temperature, pH, Turbidity, DO, Domestic Waste, Catchment Area.

## 1. Introduction

Our earth is enriched with a numerous number of Fresh water ecosystems like pond, lake, river streams etc are considered as lolistic units as they bring together the environment, biological organisms and man within a single framework. The overall quality both

biologically and physically of fresh water ecosystem depends upon the biological diversity and physico-chemical properties. The sustainable development can be achieved by adequate quantity and quality of fresh water ecosystems.Invertebrates, bugs, microorganisms, fishes, and plants all thrive in freshwater aquatic ecosystems.Water contamination refers to the pollution of all water bodies (such as lakes, rivers, seas, springs, and groundwater) that occurs when contaminants are released directly or indirectly into the water bodies without adequate treatment to remove harmful substances. It is a major global issue that necessitates a thorough review and revision of the water assets strategy at all levels (international down to individual aquifers and wells). It is estimated that it is the leading cause of death and disease in the world, with more than 15000 people dying every day. Water quality continued to deteriorate as new challenges of environmental problems arose. Other resources on the planet, such as air, soil, and water, are becoming increasingly polluted. When toxic, harmful, or undesirable substances contaminate a water body such as a lake, river, stream, ocean, or aquifer, the water quality degrades and becomes toxic to humans or the environment. Agricultural, domestic, and municipal wastes continue to pollute lake ecosystems. Nonpoint sources, such as runoff from land or direct sewage discharges from residential areas, are frequently used to introduce pollutants and wastes into lakes. Heavy metals, organic and inorganic compounds, and organic substances such as herbicides and pesticides are all harmful substances associated with these wastes, all of which have a negative impact on aquatic organisms and ecosystem function.Pathogenic microorganisms, putrescible natural waste, plant supplements, harmful synthetic compounds, residue, heat (oil), and radioactive substances are all examples of contaminants that can contaminate water bodies. Water contamination can even deliver the water unfit for modern or agrarian purposes not to discuss drinking. Infringements formed on the water bodies have lead to exceptional contracting of the all out region. An illustration of this is the Nilnag Lake in Budgam. Anchar Lake in Srinagar that has transformed into swamp. River Jhelum has been transformed into a channel because of strong waste and effluent going into it. Its fish population is decreased.Water pollution is a significant threat to India, despite the fact that the country's constitutional framework and international commitments recognize the need for protection and conservation. The Water Prevention and Control of Pollution Act of 1974 (the "Water Act") was enacted to provide for the prevention and control of water pollution, as well as the maintenance or restoration of water wholesomeness in the country. The Water Act makes it illegal to discharge domestic sewage and agricultural runoff into bodies of water that exceed a certain standard and it imposes penalties for non-compliance.

## 2. Objectives of the Study

- To perceive the pollution status of Wular Lake.
- To find out mitigate measures of lake water pollution.

### Causes of Water Pollution

**Natural causes:** Large amounts of biodegraded plants and animals mix with water and pollute it. Siltation was caused by riverbank erosion, and this silt suffocates aquatic life from

time to time. Many different types of natural salts and other materials mix with rainwater and eventually end up in rivers and ponds.

**Causes caused by humans:** Anthropogenic activities are responsible for the majority of the water pollution in Wular Lake. Man-made pollutants include industrial wastes, agricultural wastes, household wastes, excessive use of chemical fertilizers and pesticides, and many others. Water is severely polluted as a result of these pollutants. Water that has been contaminated by such pollutants is extremely hazardous to both human and aquatic life.

**Figure 1: Waste Sites Which Pollute The Lake Wular.**

## 3. Methods and Materials

### 3.1 Description of Study Area

Wular Lake, located on the lower slopes of Haramuk Mountain, is Asia's second largest freshwater lake. It covers an area of 200 square kilometers, with a length of nearly 24 kilometers and a width of 10 kilometers. The lake is located in Sangrama, close to the Baramula Road, between the towns of Sopur and Bandippore.

The River Jhelum is Wular Lake's primary source of water. This lake also has a small island in the middle known as the 'Zaina Lank.' King Zainul-Abi-Din developed this island. Wular Lake is also thought to be a relic of Satisar Lake, which existed in the past. This lake's grounds are a well-known sunset spot.

Wular Lake plays an important role in the hydrography of the Kashmir Valley, serving as a massive assimilation basin for yearly floodwater. The lake and its surrounding broad swamps are home to a diverse range of wildlife. The mountains' Bohnar, Madamati, and Erin rivers, as well as the south's Vetasta (Jhelum) and Ningal rivers, consistently dump massive amounts of sediment into the lake. The lake is being ravaged by a combination of natural siltation and human encroachment.

Wular Lake is also an important fish habitat, accounting for roughly 60% of the Kashmir Valley's total fish yield. Cyprinuscarpio, Barbusconchonius, Gambusiaaffinis, Nemacheilus sp., Crossocheiluslatius, Schizothoraxcurvifrons, S. esocinus, S. planifrons, S. micropogon, S. longipinus, and S. niger are the most common fish species found in the lake. Wular Lake supports the livelihoods of over 8,000 fishermen.

The beauty of Kashmir is completely reliable on these water bodies and the tourists are coming all over the world to enjoy here. Be that as it may, because of infringement and contamination by some regular and anthropogenic activities transform these lakes into dustbins, so there is earnest need to address such issues related the declining the water bodiesConsidering the importance of this well-known body of water to Kashmir's human development and economy. For that purpose such study was carried out on WularLake. The study of water body Wular Lake and all other water bodies in Kashmir like Dal Lake, Nigeen Lake, Nilnag Lake etc) are facing a severe threat of pollution. To guarantee fresh water accessibility from the local water sources has become a major challenge. Since Wular Lake is predominantly polluted because of addition of major plant nutrients especially nitrogen and phosphorus, derived from human waste, detergents and agricultural practices. The organic and inorganic toxic substance load in Wular Lake has accelerated macrophytic growth, lowering water quality and biological oxygen demand (BOD) and, as a result, lowering the lake's recreational and aesthetic appeal. Wular Lake's environmental situation has reached a critical point, and if proper conservation measures are not taken in the near future, the lake will become extinct. Wular Lake's water quality continues to deteriorate, and it will soon be thrown out.


**Figure 2: Map of Jammu And Kashmir And Location Of Lake Wular**.

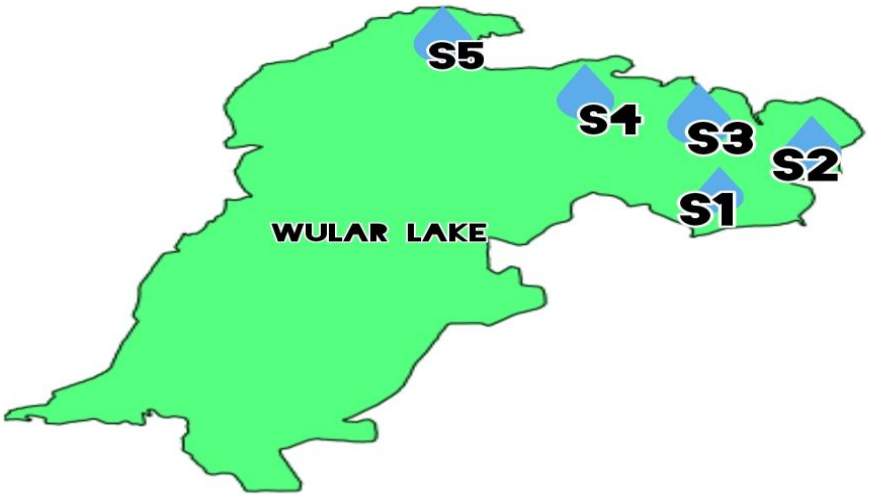



**Figure 3: Location of Study Sites**

**Figure 4: Study Site (Wular Lake)**

**FIGURE 5: Discuss about the Study Site with Locals (Irfan Ahmad Ganai and GhQadir)**

**Site Details**

The study has been undertaken on the Wular Lake of Kashmir on Five randomly selected sampling sites by simple random selection as under:

| S NO. | Sampling Site | Name of Water Sampling Site |
|---|---|---|
| 1 | Site 1 | Sadeerkoot Payeen |
| 2 | Site 2 | Sadeerkoot Bala |
| 3 | Site 3 | Lahrapur Ghat |
| 4 | Site 4 | Zormanz |
| 5 | Site 5 | Kanibathu |

The consent for inspecting and testing of water was taken from the concerned department i.e Lake and Waterways Development Authority Srinager (LAWDA). The overall subject and objectives of the study was discussed with them. The laboratory tests are likewise examined with concerned staff and coordinator of laboratory.

## 4. Sample Collection

Open water samples were collected by using the clean polythene bottles on monthly basis for the analysis of pollution with respect to pH, temperature, turbidity, dissolved oxygen from Dec 2018 to Jan 2019. The parameter like temperature was measured on spot by using mercury thermometer. The other various parameters were analyzed in the laboratory as per standard methods of APHA (2005). The samples were collected from 5 selected sites of Wular Lake as referenced above. The testing sites were chosen by simple random sampling. The aim of analysis was to monitor the changes due to pollution in the chemical and physical properties of Lake Water. Sample testing was conducted by following strategies to get the best results and the results were recorded on predesigned, standardization proforma.

The methodology adopted for assessment of 04 parameters and their change due to pollution coming from the vicinity of WularLake water are as under.

| **S No.** | **Parameters** | **Methods Adopted** |
|---|---|---|
| **1** | **Temperature** | **Mercury Thermometer** |
| **2** | **Turbidity** | **Turbidometer** |
| **3** | **Ph** | **Ph Meter** |
| **4** | **Dissolved Oxygen** | **Wrinkler's Method** |

**Result**

## 5. Tables and Graphs

**Table 1: Monthly Variation of Different Parameters At Site 1 (Sadeerkoot Payeen)**

| S No. | Parametrs | Months(2018-2019) | | | | | | | | | | | | Mean Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | |
| 1 | Temperatur | 3.8 | 4 | 4.9 | 7.1 | 11.2 | 16 | 16 | 17 | 13 | 12 | 10 | 6.7 | 10.1 |
| 2 | Turbidity | 10.3 | 15 | 13.2 | 12.4 | 16 | 16.3 | 16 | 15.4 | 13 | 12.2 | 13.4 | 16.7 | 14.1 |
| 3 | Ph | 7.1 | 7.2 | 7.2 | 7.8 | 7.5 | 8.1 | 7.9 | 7.9 | 7.9 | 7.5 | 7.8 | 8.2 | 7.6 |
| 4 | DO | 9.5 | 9.2 | 9.4 | 9.1 | 8.9 | 8.3 | 8.1 | 7.3 | 6.2 | 8.7 | 8.3 | 9.4 | 8.5 |

**TABLE 2: Monthly Variation of Different Parameters at Site 2 (SADEERKOOT BALA)**

| S.No | Parametrs | Months(2018-2019) | | | | | | | | | | | | Mean Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | |
| 1 | Temperature | 3 | 3.2 | 3.1 | 6.2 | 10.1 | 13.2 | 14 | 20 | 14 | 13 | 10.1 | 8 | 9.8 |
| 2 | Turbidity | 13.8 | 13 | 14 | 16 | 16.1 | 12 | 14.2 | 14.3 | 16.1 | 14 | 16.4 | 18.2 | 14.8 |
| 3 | Ph | 7.4 | 7.6 | 7.4 | 7.7 | 7.3 | 8.4 | 8.1 | 7.5 | 7.8 | 7.6 | 7.9 | 8.3 | 7.7 |
| 4 | Do | 9.1 | 8.9 | 9.2 | 8.9 | 9.1 | 8.7 | 8.5 | 7.6 | 6.4 | 8.4 | 9.1 | 9.2 | 8.5 |

**TABLE 3: Monthly Variation of Different Parameters at Site 3 (LARHWAPUR GHAT)**

| S.No | Parametrs | Months(2018-2019) | | | | | | | | | | | | Mean Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | |
| 1 | Temperature | 3.5 | 3.3 | 3.8 | 5.7 | 11 | 14 | 15.2 | 19 | 13 | 14 | 10.9 | 7.7 | 10.0 |
| 2 | Turbidity | 12.4 | 15.6 | 18.3 | 17.3 | 16 | 15 | 14.8 | 25.3 | 17 | 15.9 | 17.2 | 14.2 | 16.5 |
| 3 | Ph | 7.4 | 7.3 | 7.1 | 7.9 | 7.5 | 8.3 | 8.4 | 7.5 | 8.1 | 7.9 | 7.4 | 8.3 | 7.7 |
| 4 | Do | 9 | 9.1 | 9.5 | 9.1 | 9.1 | 8.9 | 8.3 | 7.5 | 6.8 | 8.6 | 9.3 | 9.4 | 8.7 |

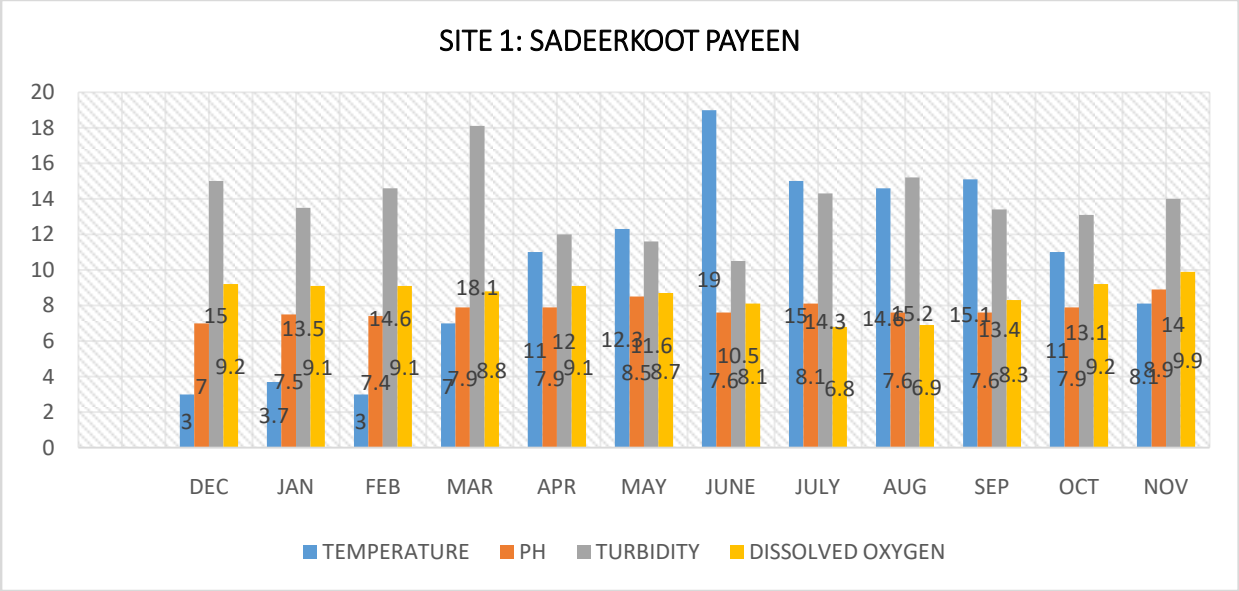
**TABLE 4: Monthly Variation of Different Parameters at Site 4 (ZORMANZ)**

| S.No. | Parametrs | Months(2018-2019) | | | | | | | | | | | | Mean Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | |
| 1 | Temperature | 4.1 | 3 | 3.5 | 6.7 | 9 | 12.5 | 16 | 18.2 | 15.2 | 15.3 | 10.8 | 7.9 | 10.1 |
| 2 | Turbidity | 13.4 | 15 | 14.8 | 16.4 | 16.7 | 16 | 14 | 12 | 16 | 12 | 14.2 | 16.2 | 14.7 |
| 3 | Ph | 7.1 | 7.2 | 7.5 | 7.6 | 7.8 | 8.4 | 7.9 | 7.9 | 7.3 | 7.7 | 7.8 | 8.6 | 7.7 |
| 4 | Do | 9.9 | 9.7 | 9.4 | 9 | 9.3 | 9.1 | 8.5 | 6.5 | 6.8 | 8.9 | 8.9 | 9.1 | 8.0 |

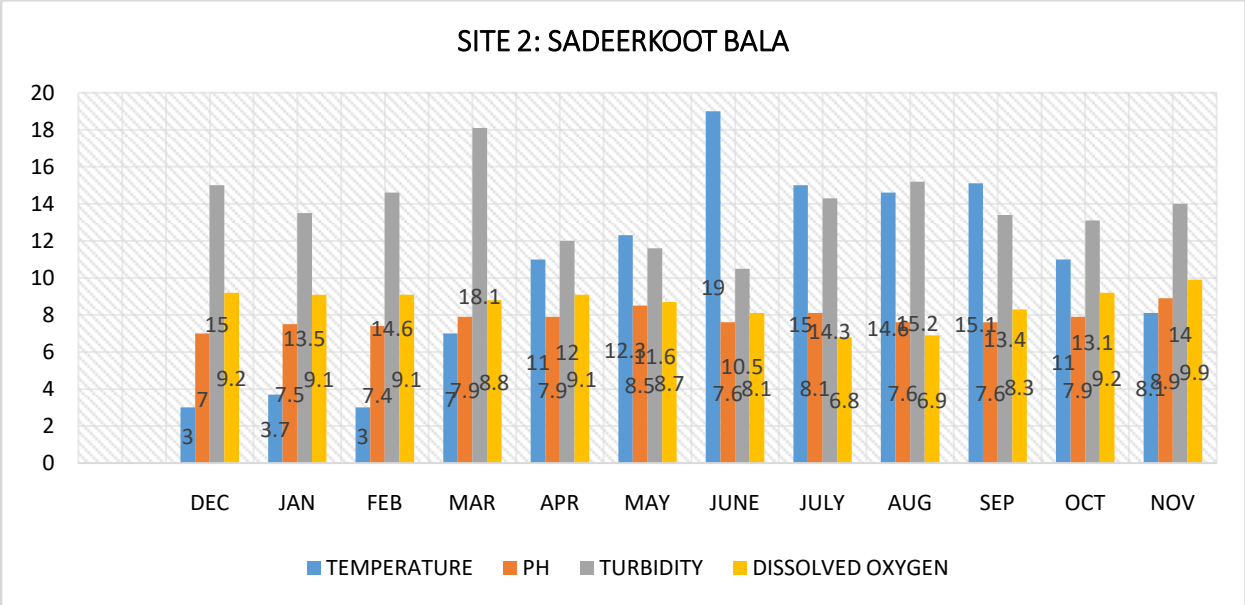
**TABLE 5: Monthly Variation of Different Parameters at Site 5 (KANIBATHU)**

| S.No | Parametrs | Months(2018-2019) | | | | | | | | | | | | Mean Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | |

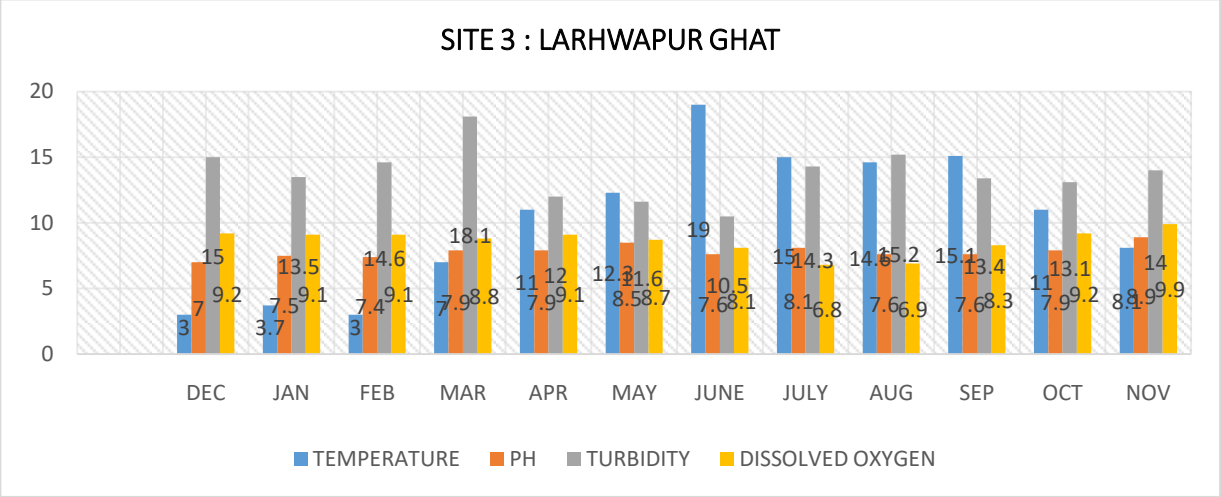
| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Temperature | 3 | 3.7 | 3 | 7 | 11 | 12.3 | 19 | 15 | 14.6 | 15.1 | 11 | 8.1 | 10.2 |
| 2 | Turbidity | 15 | 13.5 | 14.6 | 18.1 | 12 | 11.6 | 10.5 | 14.3 | 15.2 | 13.4 | 13.1 | 14 | 13.7 |
| 3 | Ph | 7 | 7.5 | 7.4 | 7.9 | 7.9 | 8.5 | 7.6 | 8.1 | 7.6 | 7.6 | 7.9 | 8.9 | 7.2 |
| 4 | Do | 9.2 | 9.1 | 9.1 | 8.8 | 9.1 | 8.7 | 8.1 | 6.8 | 6.9 | 8.3 | 9.2 | 9.9 | 8.6 |



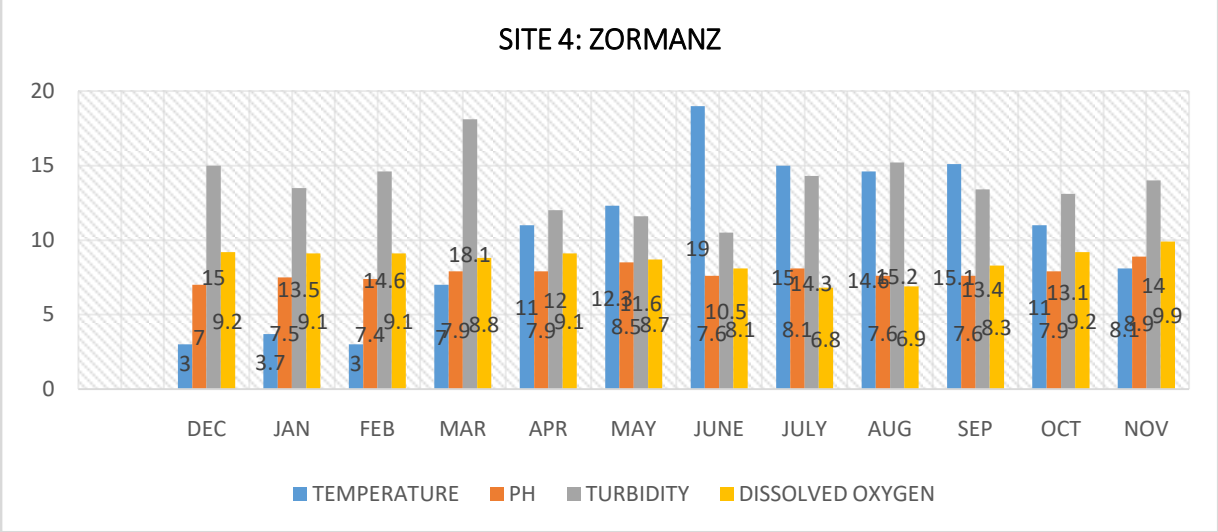

**Graph 1: Showing the Variation of Different Parameters of Lake Wular At Site 1**



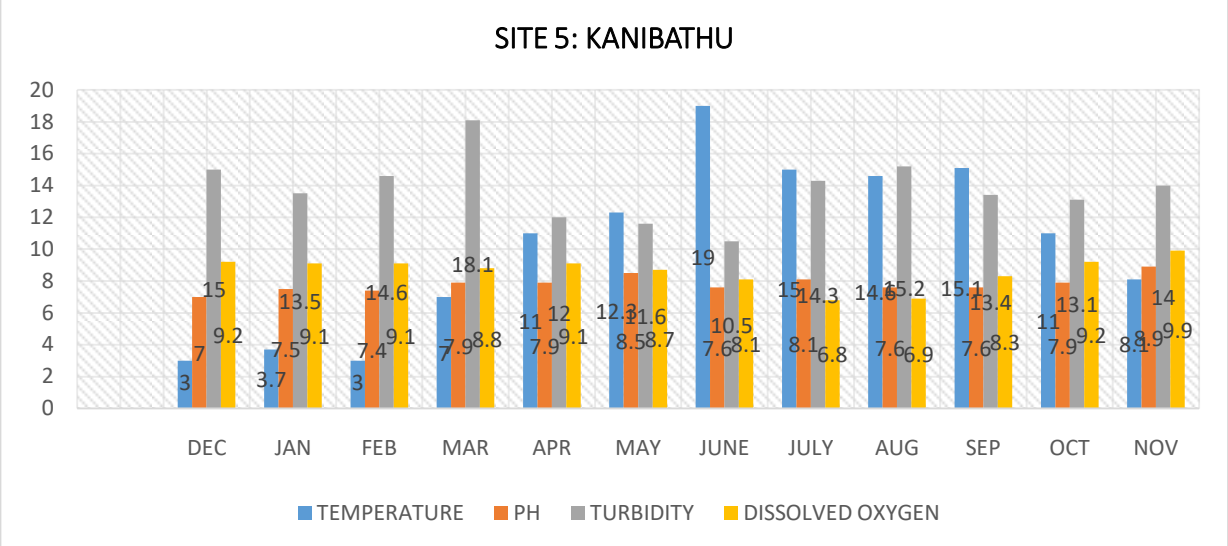

**Graph 2: Showing the Variation of Different Parameters of Lake Wular at Site 2**




**Graph 3: Showing The Variation Of Different Parameters Of Lake Wular At Site 3**




**Graph 4: Showing the Variation of Different Parameters of Lake Wular at Site 4**




**Graph 5: Showing the Variation of Different Parameters of Lake Wular at Site 5**

## 6. Research Findings

Physico-chemical indicators are the conventional 'water quality' indicators that the people know about. They incorporate dissolved oxygen, pH, temperature, saltiness and supplements (nitrogen and phosphorus). They likewise incorporate proportions of poisons like insecticides, herbicides and metals. Physico-chemical indicators give information on what is affecting on the system. Despite the fact that physico-chemical indicators can recognize the cause of the problem, they only give restricted data on the degree that pollutants are really affecting on fauna and flora

### pH

The pH recorded during the entire study (mean 7.2-7.7) indicates the nature of water quality is neutral to alkaline which may due to high temperature that causes reduction in $CO_2$ solubility. Our study shows the increase in pH at site 2 (SADEERKOOT BALA-7.7). Sudden change of pH can be harmful or even fatal to fishes.

A study conducted by Rajiv Gangulyet. Al(Feb 2020) suggested that At low pH, salts and metals dissolve into ions, which are then ingested by humans and animals, causing negative health effects. The rate of other biological activities is also influenced by pH. The addition of carbonates and bicarbonates raises CO2 levels, affecting lake productivity.

### Temperature

The temperature of 5 selected study sites ranges from(9.8-10.2). Because the molecular forces of attraction between gas molecules decrease as the temperature rises, the amount of dissolved oxygen and other gases decreases. On the other hand, as the temperature drops, the amount of D.O. in the water rises, affecting water biodiversity as well as other chemical reactions.

### Turbidity

The overall study shows that all study sites have higher turbidity ranges (14.0-16.4 NTU), which is higher than the permissible limit (>5 NTU). Higher turbidity alters the colour, odour, and taste of the water, as well as obstructing light penetration into the lake, preventing photosynthesis from producing more dissolved oxygen. It puts the lake ecosystem in jeopardy, either directly or indirectly.

### Dissolved Oxygen

One of the most important a biotic factors influencing the Lake's aquatic environment is dissolved oxygen. Oxygen is a key regulator of metabolic activities in communities and organisms, as well as a good indicator of lake health. The DO in this study ranges from 8.0 to 8.7, which is very low at each site. The catchment area is subjected to large amounts of fertilizers, which are partially utilized and leached into the lake water, resulting in an increase in nutrients and eutrophication, which depletes oxygen in the water body. Hassan Zahoorul et al (2015).

The reduction in dissolved oxygen is due to the cumulative effect of human activities such as the dumping of organic wastes or other residential wastes into the lake. Dissolved oxygen depletion in water is probably the most important indicator of certain types of water pollution.

## 7. Discussion

According to a research of lake characteristics and trends in components, processes, and services, lake pollution is quite high. The lake's hydrological regimes have changed dramatically. Currently, the lake builds storages throughout the winter months, when the flows are already low. The capacity of the wetland to influence hydrological regimes has also been reduced due to the loss of marshes and catchment degradation. Over the last three decades, the lake's water-holding capacity has decreased by one-fifth. This is a major component contributing to excessive drainability and the wetlands' inability to manage flow regimes.

The lithology of the geological formations along the catchment of Jhelum, whose tributaries drain into the Wular Lake, is one of the major factors responsible for silt deposition in the Wular Lake in the current study. Extreme climatic variations (such as frost, heat, and humidity) and current-day environmental conditions (deforestation, land acquisition, farming practices, etc.).

The establishment of a willow plantation has significantly altered the wetland's hydrological approaches. These plantations act as barriers to the river Jhelum's silt-encrusted waters, forcing it to discharge the sediment load into the lake, resulting in a lack of water holding capacity

The wetlands of Kashmir Valley are under threat from encroachment. Because of the reclamation and expansion of arable fields for paddy cultivation, associated marshes across the Wular Lake have lost a significant amount of land. The area under encroachment in Wular Lake, according to records, is 35.00 hectares.

Solid wastes, organic and inorganic pollutants are the main sources of pollution in Wular Lake. The solid wastes comprise of non-biodegradable materials like polythene and plastics which are dumped into the lake by the local people. The majority of human settlements in and around Wular Lake are the epicentres of organic wastes, which dump all types and types of waste into it right away.

Furthermore, chemical fertilizers and pesticides produced on nearby agricultural lands run directly into Wular Lake, increasing its toxicity and degrading its quality.

## 8. Conclusion

In the present study I found that the overall conditions of Lake Wular is critical from pollution point of view. The main sources of pollution came from agricultural activities, domestic waste water and agricultural runoff. Various mitigation measures for lake conservation have been proposed, including increasing forest cover in the direct catchment

area, removing excess weeds from the lake on a regular basis, reducing area under degraded pastures and improving the quality of existing pasture lands, reducing degraded area under agriculture/horticulture in the catchment area, and enhancing current water storage capacity, proving an opportunity to accommodate high flows, which are forced in the absence of adequate storage. As a result of these actions, Lake Wular's overall pollution will be reduced.

## 9. Acknowledgement

Foremost, I would like to express my sincere gratitude to my **Supervisor Dr. Purneema Shrivastawa** for the consent support throughout the study and research, for her patience, motivation, enthusiasm and immense knowledge.

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