



## Physicochemical Analytical Assessment of Nandkol Lake Water in Ganderbal, Jammu and Kashmir, India

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### KEYWORDS

*Ganderbal, Industrialization, Nandkollak, Physico-Chemical Parameters, Water borne diseases.*

### ABSTRACT

Undesirable alterations in the physical, chemical, and biological properties of the atmosphere, water, and soil pose a significant risk to humanity. Due to the expanding human population, industrialization, the use of fertilizers, and various human activities, water has become extensively polluted with hazardous substances. Natural water pollution can be attributed to factors like the natural breakdown of rocks, soil seepage, mining operations, and so on. Given that the human population is susceptible to a range of waterborne diseases from consuming contaminated drinking water, it is crucial to regularly assess water quality. Access to clean water is essential for preventing infections and improving overall quality of life. This study primarily focuses on the physical and chemical characteristics of the water in Nundkol Lake, which is situated in the breathtaking alpine setting at the base of Harmukh Mountain in Ganderbal, Jammu and Kashmir. Nundkol Lake is renowned for its crystal-clear water, and it is located just over a kilometre away from the well-known Gangabal Lake. The journey to these lakes commences from Naranag, a popular tourist destination in Ganderbal. The renowned "Great Lakes Trek," which connects Naranag and Sonmarg, includes both of these lakes. Through out the current research, various parameters such as water temperature, colour, taste, odour, pH at 25°C, total dissolved solids, conductivity at 25°C, total hardness (expressed as CaCO<sub>3</sub>), chlorides (as Cl), sulfates, fluorides (as F), total acidity, total alkalinity (as CaCO<sub>3</sub>), and residual chlorine were comprehensively examined.

### INTRODUCTION: -

Water is a fundamental and irreplaceable element that defines our planet, Earth. It is a dynamic resource that not only shapes our landscapes but also sustains life and preserves the delicate balance of ecosystems. Covering about 71% of the Earth's surface, water takes on various forms, from expansive oceans and flowing rivers to underground aquifers and frozen glaciers, playing a critical role in our planet's climate and biodiversity. The presence of liquid water on Earth is a unique and rare feature in the universe, making our planet an oasis teeming with diverse life forms and standing out amidst the cosmic vastness. Water, from the tiniest microorganisms to magnificent marine creatures, serves as the cradle of life, nurturing and sustaining a complex

web of interconnected living organisms. Lakes, with a total surface area of 2.67 million square kilometers (occupying 1.8% of the world's land area) and a total volume of 181.9 thousand cubic kilometers (constituting 0.8% of all non-frozen terrestrial water reserves), are the most significant accessible water resources on Earth's surface<sup>1</sup>. A lake's characteristics, including its terrain, soil, geology, and surrounding vegetation, influence the types of substances that enter it, thereby affecting its water quality. In essence, a lake reflects the condition of its watershed and the landscape surrounding it. To understand the seasonal variations in water quality, the current study investigates how the physicochemical properties of water change across the four seasons at six different sample locations within Manasbal Lake. Water



is undeniably one of the most crucial and abundant elements in our environment. It is essential for the survival and growth of every living organism on Earth. Currently, our planet boasts an impressive 70% of its surface covered by water. In nature, water is one of the most ubiquitous substances, accounting for roughly three fourths of the Earth's surface<sup>2</sup>. Lakes, in particular, represent a substantial portion of this resource, holding approximately 50.01% of the Earth's surface water. This invaluable resource, in the form of lakes, offers numerous advantages. Lake water plays a pivotal role in supporting a balanced aquatic ecosystem, replenishing groundwater, preserving soil nutrients, and meeting various socioeconomic needs. Presently, humans rely on lake water for various purposes, such as drinking, residential use, agriculture, and fisheries. However, it's important to recognize that human activities and interventions are impacting the quality of lake water, which in turn affects the socioeconomic development of the regions they serve<sup>3</sup>.

Unfortunately, due to human activities such as industrialization, the use of fertilizers in agriculture, and the growing global population, our environment is facing severe contamination. Contaminated drinking water is a significant concern as it can lead to waterborne diseases affecting the human population. Therefore, it is crucial to regularly monitor the quality of drinking water to prevent these diseases. Comprehending biological

processes fully is a challenging task because the chemistry of water provides valuable insights into the metabolism of ecosystems and the broader hydro-biological connections within them. Access to clean water is essential for preventing infections and improving the quality of life<sup>4</sup>. Natural water sources contain various impurities that enter the aquatic system through processes like the weathering of rocks and soils, soil leaching, the dissolution of aerosol particles from the atmosphere, and various human activities, including the use of metal-based materials, processing, and mining<sup>5</sup>.

The government's increasing use of metal-based fertilizers in the agricultural sector may contribute to the continued rise of metal contamination levels in freshwater reservoirs due to water runoff. Additionally, faecal contamination of drinking water is a significant concern, leading to waterborne illnesses that have claimed the lives of millions of people.<sup>6</sup>

Undesirable alterations in the physical, chemical, and biological characteristics of air, water, and soil pose a substantial threat to humanity. These changes are interconnected with plants and animals and have far-reaching consequences. Industrial expansion, whether in the form of new industries or the expansion of existing ones, generates industrial effluents that, when left untreated, can contaminate water, sediments and soil<sup>7</sup>.



Fig.1:Nundkol Lake, Ganderbal



Heavy metals originating from industrial processes and elevated concentrations of heavy metals like Pb (lead), Cr (chromium), and Fe (iron) are of particular concern because they can either contaminate water or lead to chronic poisoning in aquatic organisms. This poses a significant ecological threat<sup>8</sup>.

In river water with high levels of contaminants, various parameters such as total dissolved solids, total suspended solids, biological oxygen demand, and faecal coli form levels tend to increase, primarily due to the presence of organic materials. Such water becomes unsuitable for consumption, irrigation, or any other use, emphasizing the importance of monitoring and maintaining water quality.

Nundkol Lake is an oligotrophic alpine lake located in the Ganderbal district of Jammu and Kashmir, within the picturesque Kashmir Valley. Situated in the vicinity of Mount Haramukh, which rises to 5,142 meters, the lake is positioned just 1.5 kilometers north of the larger and higher- altitude Gangabal Lake. The lush meadows surrounding Nundkol Lake's banks provide an ideal camping location during the summer months. The nearby town of Naranag serves as a base camp for those embarking on hikes to the lake<sup>9</sup>.

Nundkol Lake is fed by glaciers, both from Gangabal Lake and Mount Haramukh, and it is the source of Wangath Nallah, the principal right tributary of the Sindh River.

During the winter, Nundkol Lake freezes over and is blanketed in heavy snowfall. In the summer, the lake's basin is adorned with a carpet of alpine flowers, including gentians, geums, blue poppies, and potentillas. Late spring sees the region around the lake covered in hedsarum flowers. The brown trout is among the fish species found in Nundkol Lake, and licensed fishermen are allowed to fish in the lake<sup>10</sup>.

Most visitors to Nundkol Lake explore the Trunakhul and Badpathri alpine meadows, which are located midway during the two- day journey to the lake. There is also an alternative route through the Mahlish meadows, starting from the Chattergul hamlet, located 10 kilometers west of Naranag. This five-day trek can begin at Arin, and it is also possible to reach the lake via Bandipora. Travellers who wish to explore several of the region's alpine lakes often opt to trek from Naranag and return through Gadsar Lake, Vishansar Lake, and the Sonamarg region of Jammu and Kashmir<sup>11</sup>.

## Significance of the study

The study on the physicochemical analytical assessment of Nandkol Lake water in Ganderbal, Jammu and Kashmir, India holds several significances. Here are some of the key points:

- **Environmental Monitoring:** The study contributes to the ongoing monitoring of the water quality in Nandkol Lake. Understanding the lake's physicochemical characteristics is crucial for assessing its overall health and identifying potential environmental concerns.
- **Water Resource Management:** Nandkol Lake serves as a valuable water resource in the region. By conducting a thorough analysis of the lake's physicochemical parameters, the study aids in evaluating the water's suitability for various purposes such as drinking, irrigation, and recreational activities. It provides essential information for effective water resource management and decision making.
- **Ecological Preservation:** Lakes are intricate ecosystems supporting diverse flora and fauna. The physicochemical assessment of Nandkol Lake helps in determining the water's impact on the lake's ecology. It identifies potential threats to aquatic life and highlights any deviations from the natural balance, enabling targeted conservation efforts.
- **Human Health Concerns:** The quality of water in Nandkol Lake directly affects the health and well-being of the local population. Analyzing the physicochemical parameters helps to identify any contaminants or pollutants that may pose risks to human health. This information can guide the implementation of appropriate water treatment and purification measures to safeguard public health<sup>12</sup>.
- **Baseline Data:** The study establishes a baseline dataset for Nandkol Lake water quality. This baseline serves as a reference point for future comparative analyses, allowing researchers and authorities to monitor changes over time. It enables the detection of long-term trends, impacts of anthropogenic activities, and effectiveness of any interventions undertaken.
- **Policy Formulation:** The findings of the study can contribute to the formulation of policies and regulations pertaining to the conservation and management of Nandkol Lake. Government agencies and local





authorities can utilize the scientific data to develop strategies for sustainable water use, pollution control, and preservation of the lake's ecological integrity<sup>13</sup>.

- The study on the physicochemical analytical assessment of Nandkol Lake water in Ganderbal, Jammu

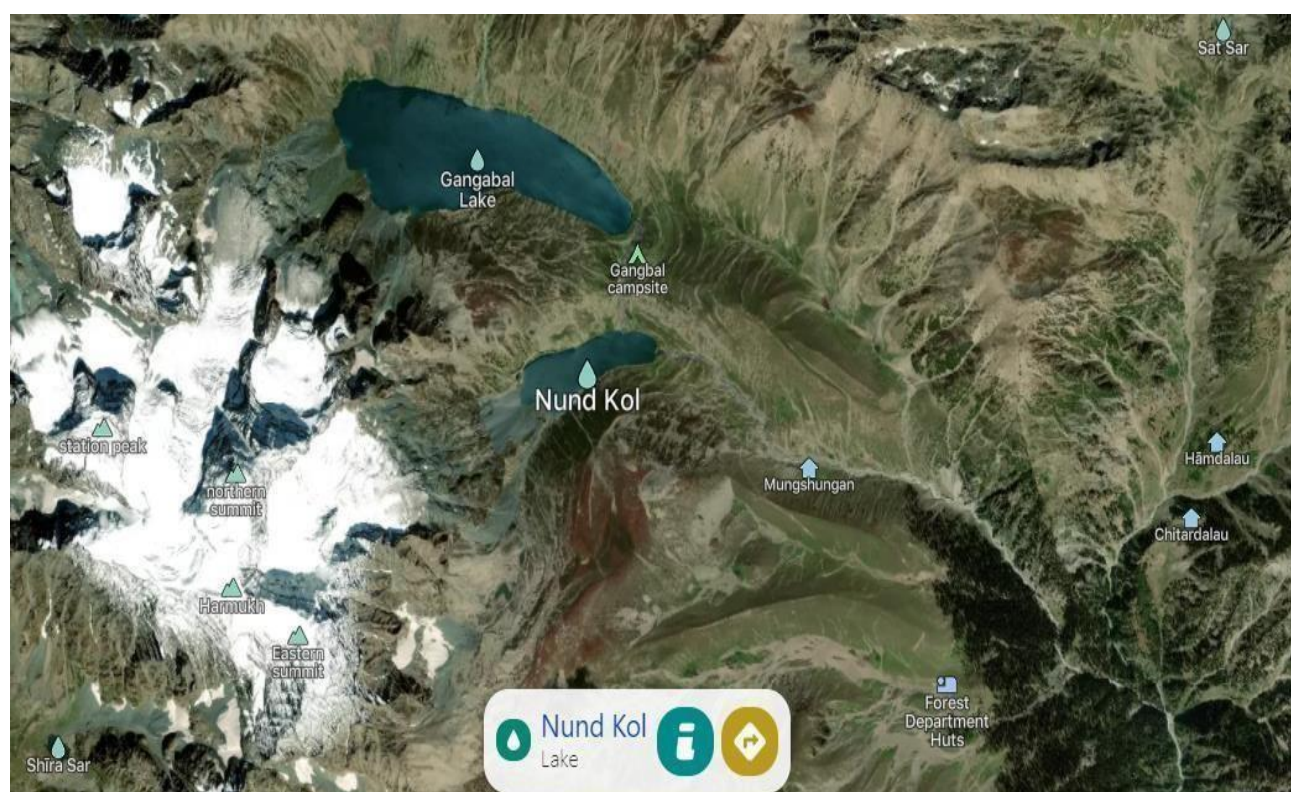
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## Material And Methods:

### Study site:

- **Latitude** 34.41774° or 34°25'4" north
- **Longitude** 74.93581° or 74°56'9" east
- **Elevation** 3,504 meters (11,496 feet)

and Kashmir, India holds immense significance in terms of environmental monitoring, water resource management, ecological preservation, human health concerns, establishing baseline data, and policy formulation<sup>14</sup>.



**Fig.2: Study Site of Nundkol Lake**



Nundkol Lake is only accessible in the summer, and due to the significant snowfall during the winter, no excursions are permitted there. A 65 km motorable route that passes through the Ganderbal District and Wayil on the way to the Naranag hiking camp connects Srinagar with Nundkol Lake.

Whether directly or indirectly, daily processes that impair water quality have an effect on aquatic life. Hence, it is essential to continuously monitor the

**Study Area:** Various physico-chemical parameters of lake water, analyzed with the help of Standard methods are illustrated in Table 1.

physical, chemical, and biological characteristics of water in order to preserve the health of lakes.

- Source: NandKol Ganderbal Jammu
- Water Testing Lab: Handwara
- Status: Raw water
- Date of collection: 14 June 2022
- Date of examination: 15 June 2022

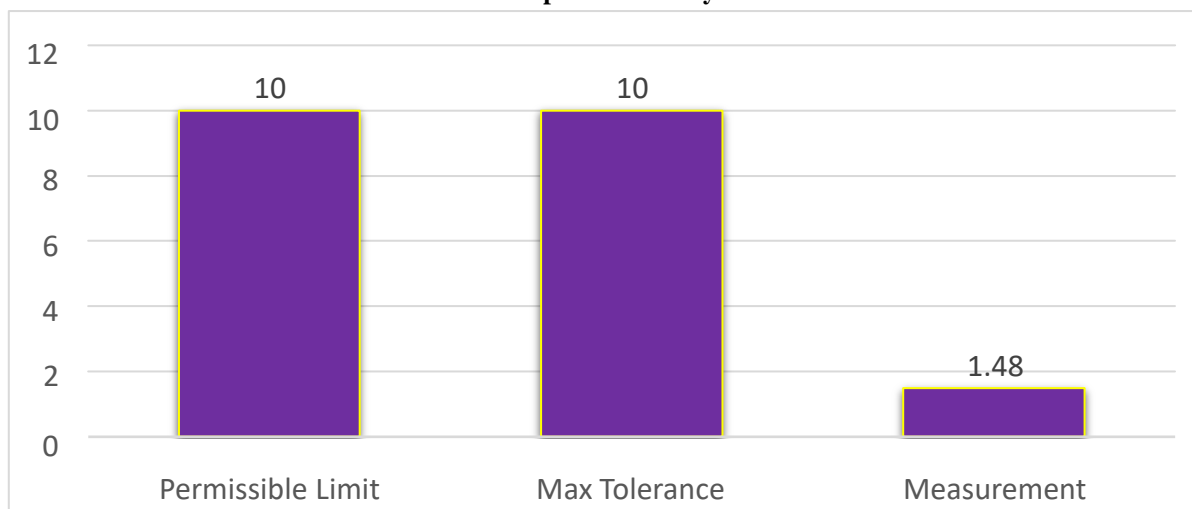
S.No.	Parameters	Units	Results	Permissible Limits	Max Tolerance Limits
1.	Turbidity	N.T.U	1.48	<10	10
2.	Colour	Hazens	-	5.0	25
3.	Taste & Odour	-	-	Non-projectable	
4.	pH at 25°C	-	8.87	6.5-8.5	8.5
5.	Total Dissolved Solid	mg/l	31.07	500	2000
6.	Conductivity at 25°C	µs/cm	39.28	-	-
7.	Total hardness (As CaCO <sub>3</sub> )	mg/l	0.60	200	500
8.	Chlorides (as CL)	mg/l	80	200	1000
9.	Sulphates	mg/l	200	200	400
10.	Fluorides (as F)	mg/l	0.0	1.0	1.5
11.	Total Acidity	mg/l	-	-	-
12.	Total Alkalinity (as CaCO <sub>3</sub> )	mg/l	-	200	600
13.	Residual Chlorine	mg/l	0.0	0.2	1.0
14.	Total iron (as Fe)	mg/l	0.0	0.3	1.0
15.	Nitrites (as NO <sub>2</sub> )	mg/l	-	None	Traces
16.	Ammonical Nitrogen (NH <sub>3</sub> -N)	mg/l	-	-	-
17.	Nitrate Nitrogen (NO <sub>3</sub> -N)	mg/l	0.0	45	100

(Source: Primary Data).

**Table 1.: Physico-chemical parameters of Nundkol lake water**

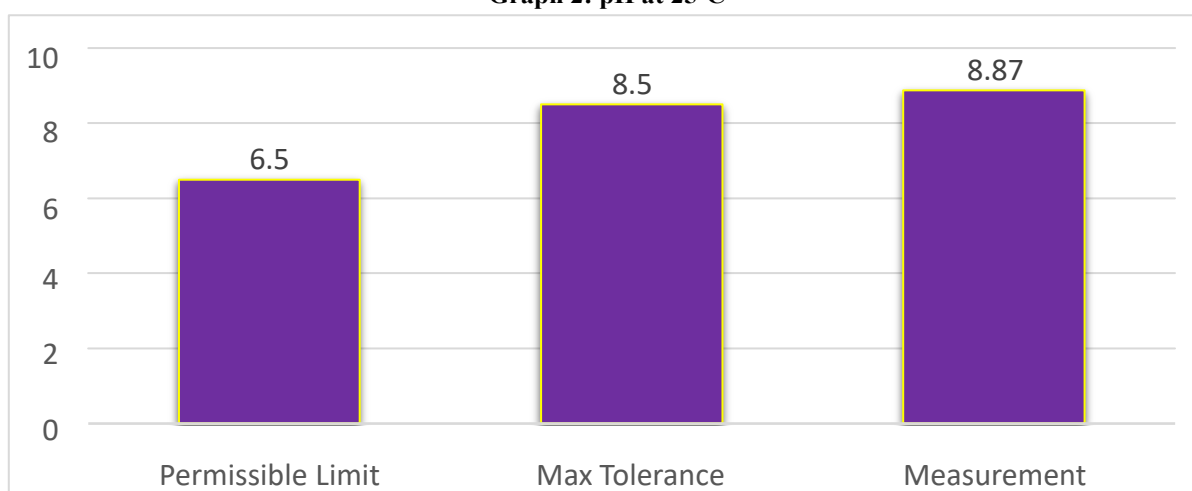


Graph 1: Turbidity



- **Turbidity:** The permissible limit of turbidity should be less than 10 and maximum limit must be 10. The turbidity of Nandkol lake water is 1.48 which is under the limit prescribed by the government.

Graph 2: pH at 25°C



- **pH at 25°C:** The pH level of lake water is above tolerance level. pH level ranges between 6.5 to 8.5 and the result of the study indicates 8.87 which above the maximum tolerance limit.

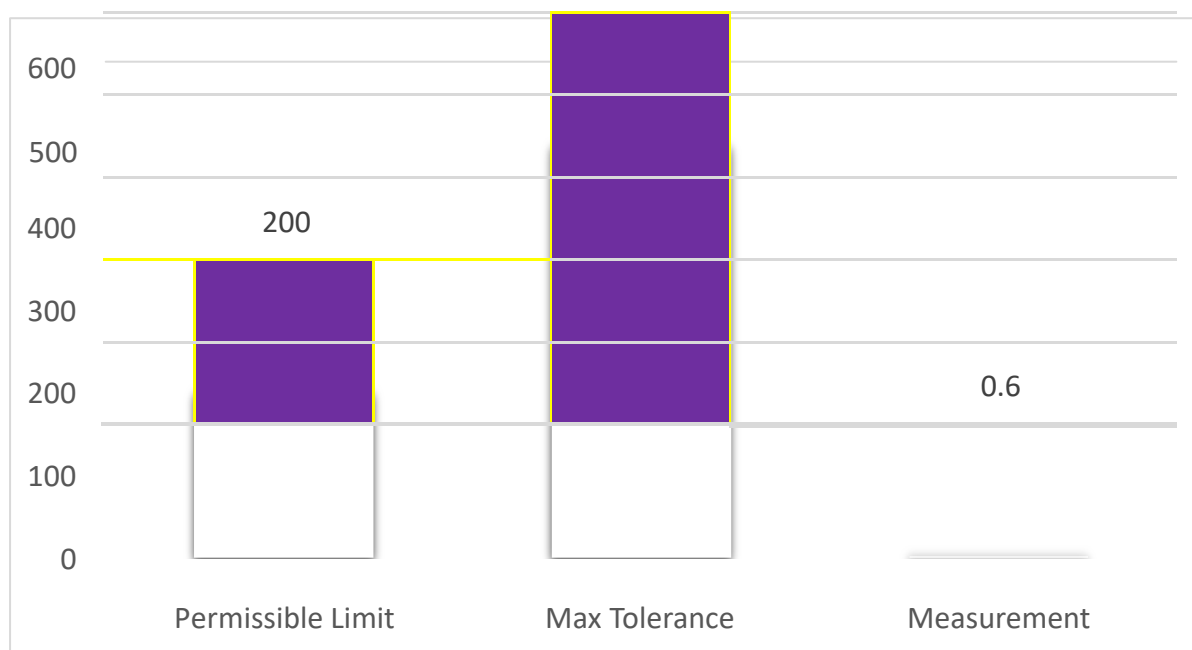


Graph 3: Total Dissolved Solid



- **Total Dissolved Solid:** The dissolved solid ranges between 500 to 2000 and level of dissolved solid in lake water is 31.07 mg/l.
- **Conductivity at 25°C:** Conductivity of lake water is 39.28 $\mu$ s/cm.

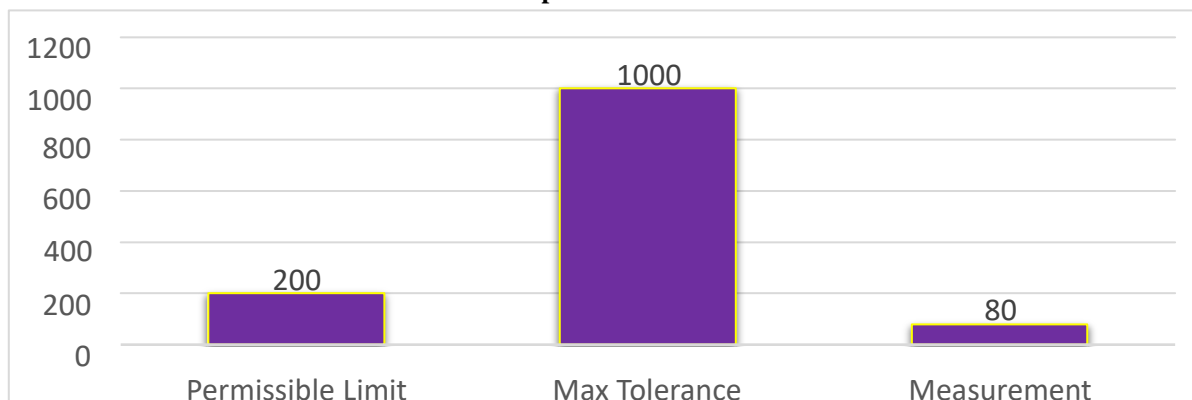
Graph 4: Total hardness



- **Total hardness (As  $\text{CaCO}_3$ ):** Total hardness of lake water ranges between 200 to 600 mg/l and the hardness level of lake water is under permissible limit which is 0.60 mg/l.

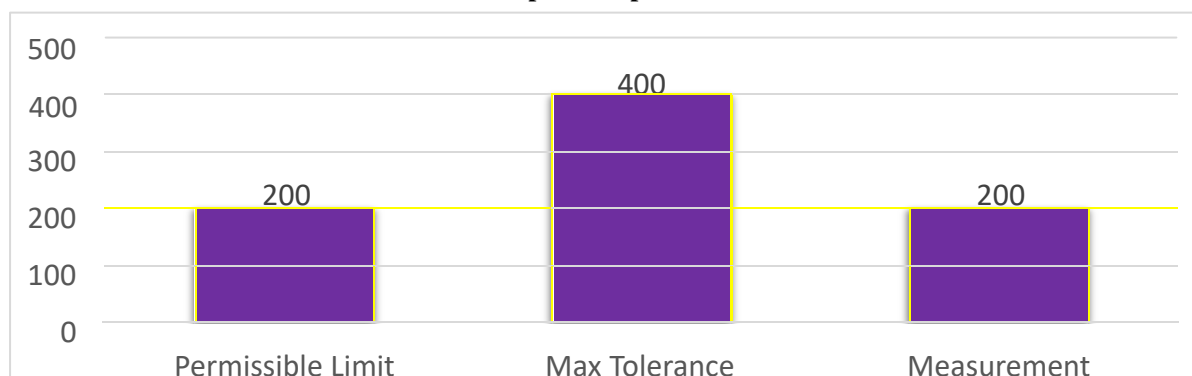


Graph 5: Chlorides



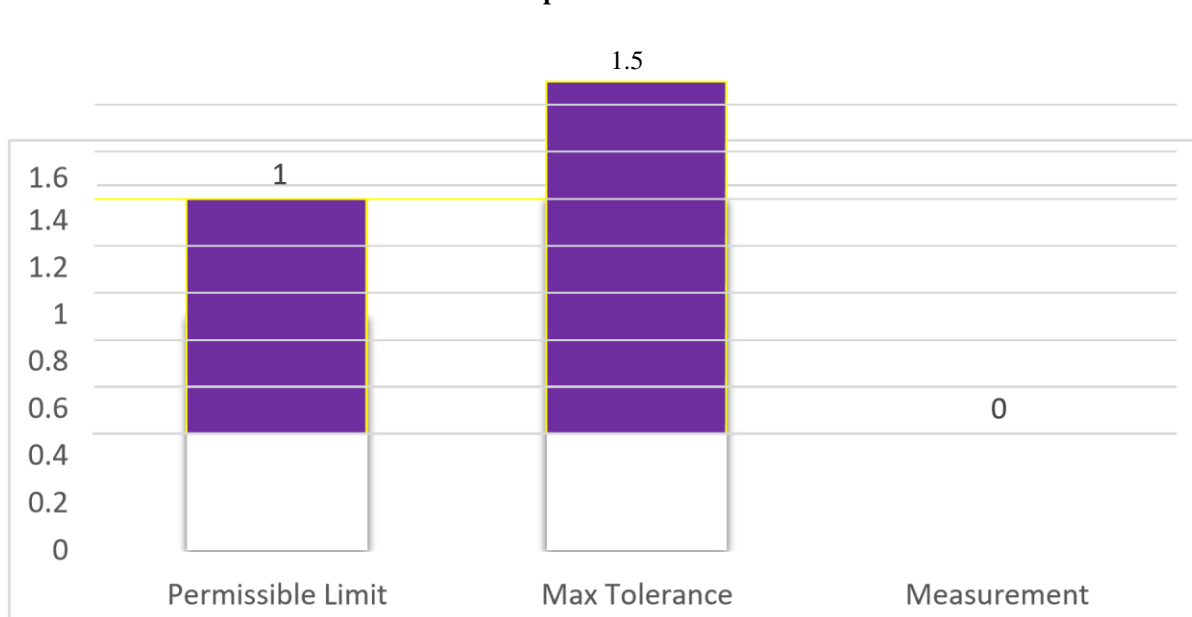
- **Chlorides (as CL):** Chloride limit of water ranges between 200 mg/l to 1000 mg/l and the result of lab test shows 80 mg/l level of chloride in Nandkol lake water which under permissible limit.

Graph 6: Sulphates



- **Sulphates:** The level of sulphate in dissolved water should range between 200 mg/l to 400 mg/land reading shows 200 mg/l which is permissible limit.

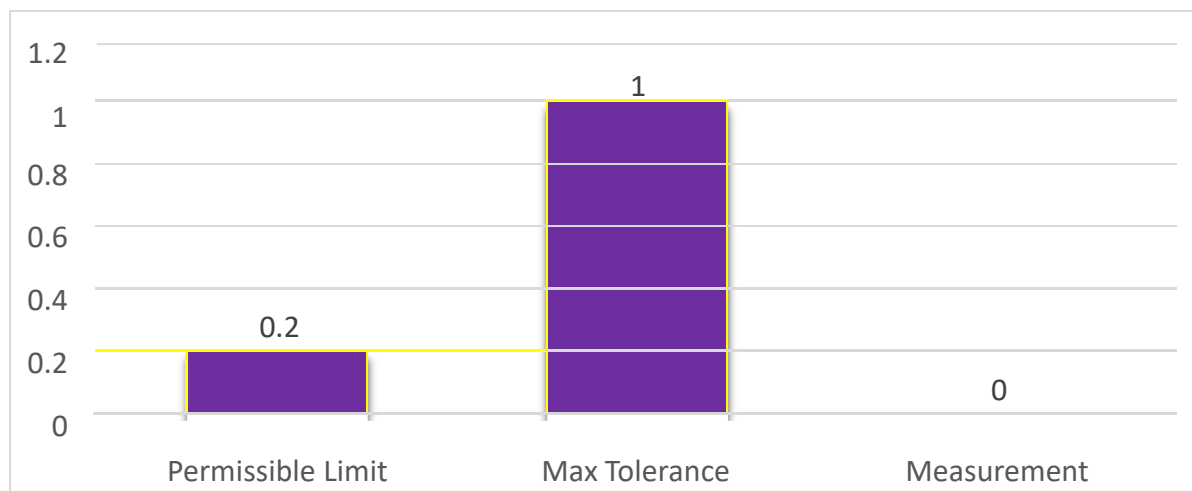
Graph 7: Fluorides



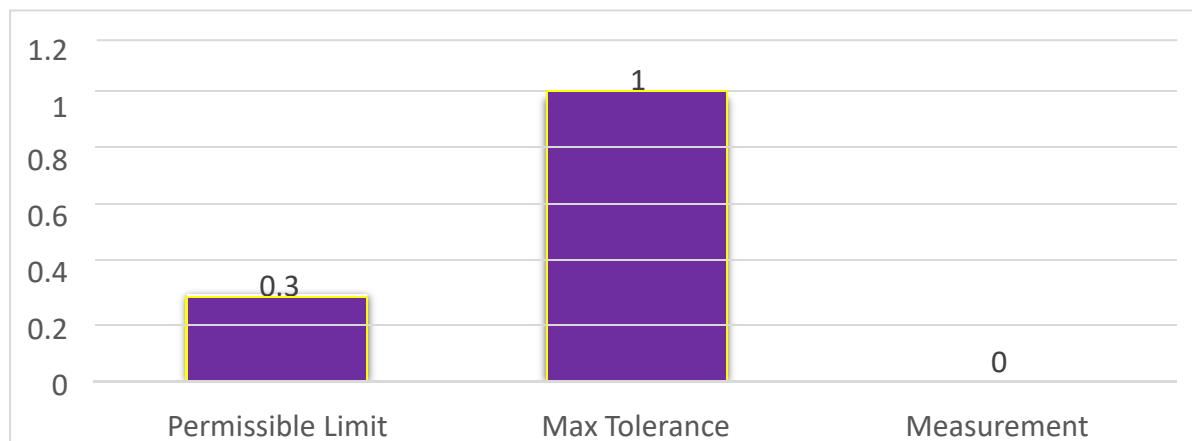




- **Fluorides (as F):** The level of fluorides in dissolved water should range between 1.0mg/l to mg/ land reading shows 0.0mg/l which is permissible limit.

**Graph 8:Residual Chlorine**

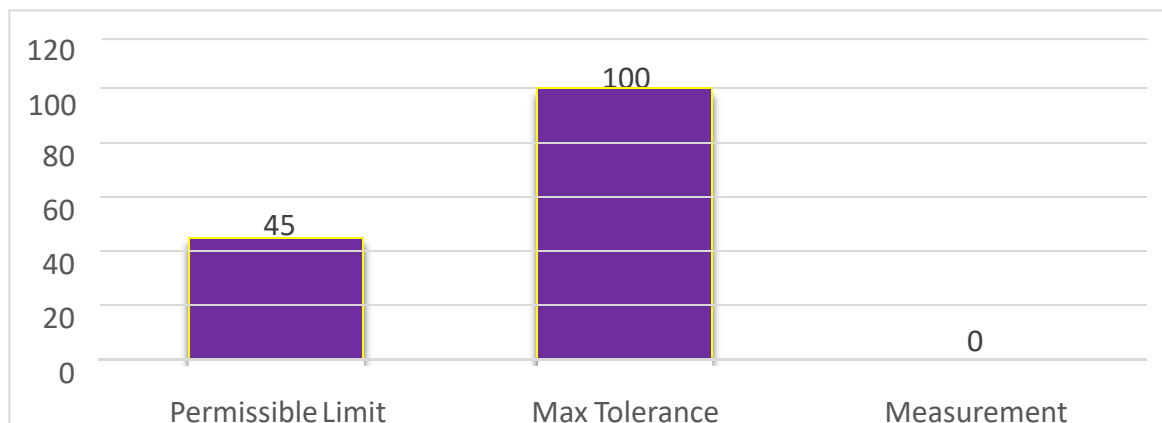
- **Residual Chlorine:** The level of residual chlorine in dissolved water should range between 0.2mg /l to 1.0mg/l and reading shows 0.0mg/l which is permissible limit.

**Graph 9 : Total Iron**

- **Total Iron (as Fe):** The level of total iron in dissolved water should range between 0.3mg/l to 1.0mg/l and reading shows 0.0mg/l which is permissible limit.



Graph 10 : Nitrate –Nitrogen



- **Nitrate Nitrogen ( $\text{NO}_3\text{-N}$ ):** The level of nitrate nitrogen in dissolved water should range between 45 mg/l to 100 mg/l and reading shows 00 mg/l which is permissible limit.

#### Conclusion: -

The physicochemical analytical assessment of Nandkol Lake water in Ganderbal, Jammu and Kashmir, India provides valuable insights into the quality and health of this important water resource. Through the comprehensive analysis of various physicochemical parameters, we have gained a deeper understanding of the lake's characteristics and their implications for both the environment and human health<sup>15</sup>.

The findings of this study indicate that Nandkol Lake water exhibits certain variations in its physicochemical properties. Parameters such as pH, dissolved oxygen, turbidity, conductivity, and nutrient levels have been measured and analyzed. These results serve as a baseline for assessing the lake's current condition and tracking changes over time.

The water quality assessment reveals that, overall, Nandkol Lake water meets the established water quality standards for specific purposes, such as irrigation and recreational activities. However, certain parameters, such as nutrient levels and turbidity, indicate potential risks to the lake's ecosystem. These findings emphasize the need for ongoing monitoring and management efforts to ensure the lake's long-term health and sustainability<sup>16</sup>.

Moreover, the study identifies potential implications for human health. While the water generally meets the requirements for drinking purposes, specific contaminants or pollutants detected in trace amounts necessitate continued monitoring and mitigation measures. Public awareness campaigns and appropriate water treatment methods should be implemented to

safeguard the health of individuals reliant on Nandkol Lake as a water source.

The physicochemical analytical assessment of Nandkol Lake water provides crucial information for environmental management and human well-being. The findings underscore the importance of continued monitoring, sustainable water resource management, and conservation efforts.

By implementing appropriate strategies based on these findings, we can ensure the long-term preservation of Nandkol Lake, protect its diverse ecosystem, and safeguard the health of the communities relying on its waters.

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#### References:-

- [1] Adefemi S. O. and E. E. Awokunmi, (2010), Determination of physicochemical parameters and heavy metals in water samples from Itaogbolu area of Ondo-State, Nigeria, African Journal of Environmental Science and Technology, 4(3), pp 145148.
- [2] Adeyeye EI, (1994), Determination of heavy metals in Illisha Africana, associated Water, Soil



- Sediments from some fish ponds, *International Journal of Environmental Study*, 45, pp 231- 240.
- [3] Adnan, Amin, Taufeeq, Ahmad, Malik, Ehsanullah, Irfanullah, Muhammad, Masror, Khatakand Muhammad, Ayaz, Khan, (2010), Evaluation of industrial and city effluent quality using physicochemical and biological parameters, *Electronic Journal of Environmental, Agricultural and Food Chemistry*, 9(5), pp 931-939.
- [4] Aftab, Begum, S. Y, Noorjahan, C. M., Dawood, Sharif, S, (2005), Physico-chemical and fungal analysis of a fertilizer factory effluent, *Nature Environment & Pollution Technology*, 4(4), 529-531.
- [5] Agarwal, Animesh and Manish, Saxena, (2011), Assessment of pollution by Physicochemical Water Parameters Using Regression Analysis: A Case Study of Gagan River at Moradabad-India, *Advances in Applied Science Research*, 2(2), pp185-189.
- [6] APHA,(1985),Standard Methods For Examination of Water and Waste water, 20<sup>th</sup> Edition, American Public Health Association, Washington D.C.
- [7] APHA. Standard methods for the examination of water & waste water. Port city press, Baltimore, Maryland, USA. Ed. 2001.
- [8] ASTM International, (2003), Annual Book of ASTM Standards, Water and Environmental Technologyv. 11.01, West Conshohocken, Pennsylvania, pp6- 7.
- [9] Basavaraja, Simpi, S.M., Hiremath, K.N.S .Murthy,K.N. Chandrashekarappa, Anil N. Patel, E.T.Puttiiah, (2011), Analysis of Water Quality Using Physico-Chemical Parameters Hosahalli Tank in Shimoga District, Karnataka, India, *Global Journal of Science Frontier, Research*, 1(3), pp 31-34.
- [10] N. Patel, E.T.Puttiiah, (2011), Analysis of Water Quality Using Physico-Chemical Parameters Hosahalli Tank in Shimoga District, Karnataka, India, *Global Journal of Science Frontier, Research*, 1(3), pp 31-34.
- [11] Bhadula, S and Joshi, B.D. An Assessment Of the impact of sewer drains on the main canal of River Ganga, within Haridwar city, Uttarakhand, India. *Researcher*.2012;4(1):7-14.
- [12] Bhadula, Sand Joshi, B.D. Impact of religion touristic activities on the environmental condition with special reference to water quality and solid waste generation within Haridwar city, India. *International journal of plant, animal and Environmental Sciences*. 2014;4(4):309-315.
- [13] Chavan, R. P., Lokhande, R. S., Rajput, S. I., (2005),Monitoring of organic pollutants in Thane creek water, *Nature Environment and Pollution Technology*4(4)pp633-636.
- [14] Chisty. N. Studies on Biodiversity of Freshwater Zooplankton in Relation to Toxicity of selected Heavy Metals. Ph.D. Thesis submitted to M.L Sukhadia Univeristy, Udaipur 2002.
- [15] Colman, J., Lardinois, P., Rabelahatra A., Rafaliarison, J., van den Berg, F.Randriamiarana,H., and Johannes, J.Manuel pour le Développement de la Pisciculture à Madagascar, FI: DP/MAG/88/005. Document TechniqueN°4. PNUD/FAO-MAG/88/005. Antsirabe,Julliet 1992.
- [16] J.,van den Berg,F.Randriamiarana,H., and Johannes, J.Manuel pour le DéveloppementdelaPiscicultureà Madagascar, FI: DP/MAG/88/005. Document Technique N°4. PNUD/FAO-MAG/88/005. Antsirabe, Juillet 1992.