*IOSR Journal of Applied Chemistry (IOSR-JAC)*
*e-ISSN: 2278-5736.Volume 17, Issue 3 Ser. 1 (March 2024), PP 61-69 www.iosrjournals.org*

# Study of the Seasonal Variations in Water Quality of Nundkol Lake in Ganderbal, Jammu and Kashmir, India

**Meenakshi Sharma*[1] and Prof. (Dr.)Manjul Mishra[2]**

Meenakshi Sharma*[1] and Prof. (Dr.) Manjul Mishra[2]

*Meenakshi Sharma*[1], Research Scholar, Department of Chemistry, Apex University, Jaipur Rajasthan, India, E-mail: meenakshikjpr@gmail.com*
*Dr.Manjul Mishra[2], Professor, Department of Chemistry, Apex University, Jaipur, India, E-mail: manjulmishra7@gmail.com*

***Abstract***
*Water is a vital resource crucial for sustaining life and supporting ecosystems. Lakes, characterized as standing bodies of water, offer various benefits such as fisheries, potable water sources, scenic beauty, and ecological diversity. This study focuses on Nundkol Lake, a sacred alpine water body in the Kashmir Valley, India. Physicochemical parameters including temperature, pH, conductivity, turbidity, and total dissolved solids (TDS) were monitored monthly from January to December 2023. The data analysis revealed seasonal fluctuations in water temperature, with the coldest temperatures (-27°C) observed in January and the warmest temperatures (24°C) recorded in August. Turbidity levels ranged from 1.5 to 1.6 NTU, indicating relatively clear water conditions throughout the year. Electrical conductivity (EC) ranged from 155 to 188 µS/cm, showing variations influenced by temperature and mineral content. pH levels remained slightly alkaline, ranging from 7.99 to 8.33, with higher values observed in summer months. TDS concentrations ranged from 41.76 to 43.65 mg/l, indicating stable water quality. This comprehensive assessment underscores the importance of continuous monitoring to preserve the ecological health and sustainability of Nundkol Lake and similar freshwater ecosystems.*

***Keywords: -** Nundkol Lake, Water quality, Kashmir Valley, Physicochemical parameters, Environmental monitoring*

## I. Introduction: -

Water is an essential requirement for the survival of many animals and is regarded as a key natural asset. Lakes, as defined by Forel in 1892, are bodies of standing water situated in a basin or lacking connection to the sea. Regardless of their size, lakes offer a multitude of benefits such as fisheries, potable water sources, scenic beauty, power generation, property value enhancement, and serve as valuable ecological study sites. They constitute an integral aspect of the natural environment, shaping landscapes and influencing ecological processes. Over recent decades, lakes worldwide have garnered attention for environmental scrutiny due to their immense diversity stemming from factors such as their origins, geographical locations, hydrological patterns, and substrate compositions. Water quality is determined by various abiotic and biotic factors inherent to the ecosystem. The preservation of a healthy ecosystem relies heavily on maintaining optimal water quality[1].

Physical characteristics such as temperature, light intensity, transparency, pressure, conductivity, and water current, along with chemical properties like levels of dissolved oxygen, free carbon dioxide, pH, alkalinity, hardness, phosphate, and nitrate levels, significantly govern the aquatic life and determine the trophic status of the water body. Abiotic factors typically serve as the governing forces of the environment and influence the well-being, distribution of organisms, and functioning of the ecosystem[2].

Nundkol Lake, also known as Nandi Kund or Kalodaka Lake, is a sacred alpine water body nestled in the Ganderbal district of the Kashmir Valley in Jammu and Kashmir, India. Its name, derived from "Nandi," the bull vahana of the Hindu god Shiva, reflects its cultural significance. This oligotrophic lake, situated near the slopes of Mount Haramukh at an elevation of 5,142 meters (16,870 feet), is fed by glacial runoff from Gangabal Lake and Mount Haramukh's glaciers. It serves as the source of Wangath Nallah, a significant tributary of the Sindh River[3].

The surroundings of Nundkol Lake are adorned with verdant meadows, making it a popular camping spot during the summer months. Alpine flowers blanket the lake's basin in summer, including gentian, geum, blue poppy, and potentilla, while late spring sees the area adorned with hedysarum flowers. The lake is home to brown trout, attracting licensed fishermen. Water quality in Nundkol Lake is crucial for its ecological health and sustainability. Continuous monitoring of physicochemical parameters such as turbidity, pH, dissolved solids, nutrients, and heavy metals is essential to understand the lake's response to environmental stressors. The unique geographical and climatic characteristics of the Ganderbal region emphasize the importance of studying Nundkol Lake's water quality trends. Insights from this research can inform resource management strategies, conservation efforts, and policy interventions, contributing to the preservation of lake ecosystems in fragile Himalayan regions[4].

**Research Area:**

- Lake Name: Nundkol Lake (also known as Nandi Kund or Kalodaka Lake)
- Location: Ganderbal district, Kashmir Valley, Jammu and Kashmir, India

## II. Material And Methods:

**Sampling Sites**

A comprehensive study was conducted over the course of one year (January to December, 2023) at Nundkol Lake.

**Sample Collection**

Surface water samples were meticulously collected using clean glass stoppered sampling bottles. For water quality analysis, sampling was carried out using sterile plastic bottles that had been thoroughly cleaned and rinsed with distilled water, following the guidelines outlined in the APHA (2005) standards[5]. While some limnological parameters were analyzed on-site, samples for select water quality parameters were carefully transported to the laboratory under ideal conditions.

**Sample Analysis**

The physico-chemical analysis of lake water involved the estimation of major parameters including temperature, pH, specific conductivity, secchi transparency, dissolved oxygen, free $CO_2$, alkalinity, $PO^{3-}{}_4$, and $NO_3^-N$[6]. Surface water temperature was recorded using a mercury thermometer, secchi transparency was measured utilizing a standard Secchi disc, and turbidity was analyzed employing a Turbidity meter (2100 PT HACH)[7]. Additionally, a Biogen pH-temperature-conductivity meter was utilized to determine conductivity in mhos and pH levels.

**Study site:**

- The study site is located at a latitude of 34.41774° or 34 degrees, 25 minutes, and 4 seconds north.
- Its longitude is 74.93581° or 74 degrees, 56 minutes, and 9 seconds east.
- Elevation: 5,142 meters (16,870 feet) above sea level.
- Source of Water: Glacial runoff from Gangabal Lake and Mount Haramukh's glaciers
- Tributary: Wangath Nallah, a significant tributary of the Sindh River
- Floral Diversity: Alpine flowers including gentian, geum, blue poppy, potentilla, and hedysarum flowers
- Fish Species: Brown trout
- Access: Accessible via a 65-kilometer motorable route from Srinagar to the Naranag hiking camp
- Seasonal Accessibility: Accessible only during the summer due to heavy snowfall in winter
- Importance of Water Quality Monitoring: Continuous monitoring of physicochemical parameters is essential for understanding the lake's response to environmental stressors and ensuring its ecological health and sustainability.

**Data from January 2023 to December 2023 Water Temperature**

The provided monthly data table represents the water temperature fluctuations in Nundkol Lake over the course of a year. Understanding these variations is crucial for assessing the lake's seasonal dynamics and its impact on the surrounding ecosystem.

In January, Nundkol Lake experiences its coldest temperatures, with water temperatures dropping to 27°C. This extreme cold is typical of winter months in alpine regions like Kashmir. As winter progresses into February, temperatures begin to rise slightly, but the lake remains bitterly cold, averaging around -21°C.

March marks the transition from winter to spring, with temperatures gradually warming up. However, Nundkol Lake still experiences cold conditions, with water temperatures averaging around -13°C. As April arrives, the lake begins to thaw, and temperatures rise to around -1°C, signaling the onset of spring.

May brings further warming, with water temperatures reaching around 4°C. This increase in temperature triggers biological activity in the lake, with aquatic life becoming more active. By June, the lake experiences a significant temperature rise, reaching an average of 14°C. This warmer water encourages plant growth and supports a diverse range of aquatic organisms.

July and August are the warmest months, with water temperatures peaking at around 15°C and 24°C, respectively. These warmer temperatures create favorable conditions for recreational activities such as swimming and boating, attracting tourists to the lake.

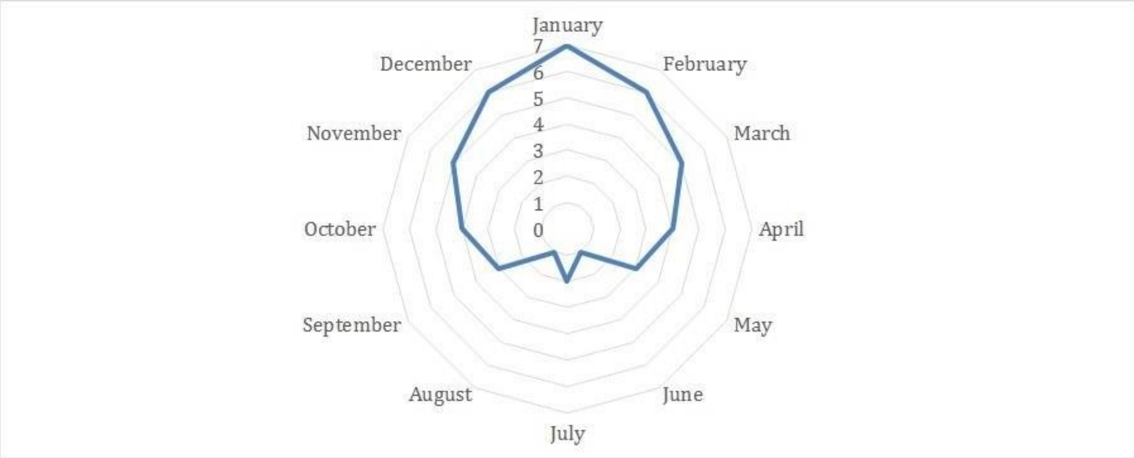
As September approaches, temperatures begin to decline gradually, but the water remains relatively warm, averaging around 20°C. By October, autumn sets in, and temperatures drop further to around 11°C. This cooling trend continues into November, with water temperatures averaging around 3°C.

December marks the onset of winter once again, with temperatures plummeting to around -13°C. The lake begins to freeze over, signaling the start of another cold winter season.

Overall, the monthly fluctuations in water temperature in Nundkol Lake reflect the seasonal changes typical of alpine regions, influencing the lake's ecosystem dynamics and recreational activities throughout the year.

**Water Transparency level**

The values provided represent the turbidity levels in the lake, measured in Nephelometric Turbidity Units (NTU), across different months of the year. Turbidity refers to the cloudiness or haziness of a fluid caused by suspended particles that scatter light. It is an essential parameter in water quality assessment as it can affect the aquatic ecosystem and indicate potential environmental changes or pollution sources. In this dataset, the turbidity levels show a seasonal trend, with fluctuations observed throughout the year. The lowest turbidity levels are recorded during the summer months, particularly in June and August, where values drop to 1 NTU. This period coincides with reduced rainfall and potentially lower levels of runoff carrying sediment into the lake, resulting in clearer water.

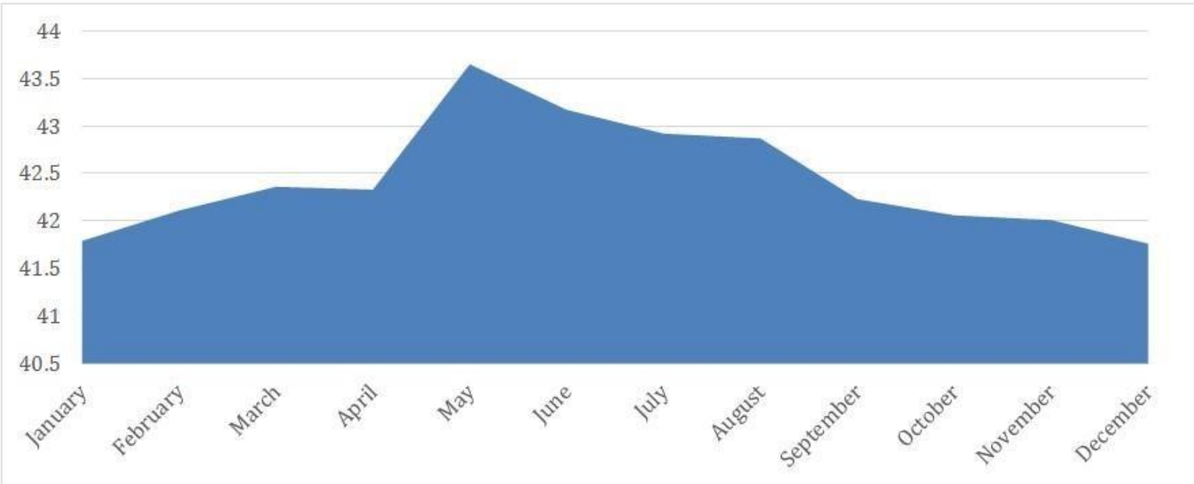



Conversely, turbidity levels tend to increase during the winter and early spring months, reaching their peak in January with a value of 7 NTU. This increase may be attributed to factors such as increased precipitation, snowmelt, and higher levels of organic and inorganic particles entering the lake from surrounding areas.

The intermediate months, such as September, October, November, and December, show moderate turbidity levels ranging from 3 to 6 NTU. These months may experience varying weather conditions and environmental factors, influencing the turbidity of the lake water. Overall, monitoring turbidity levels in the lake provides valuable insights into the water's clarity and quality, helping to assess its suitability for various uses such as drinking water supply, recreation, and supporting aquatic life. Additionally, understanding the seasonal variations in turbidity aids in identifying potential sources of pollution and implementing appropriate management strategies to protect and preserve the lake ecosystem[8].

**Electrical Conductivity (EC)**

The provided data represents the Electrical Conductivity (EC) levels in the lake water measured in micro siemens per centimeter (µS/cm) across different months of the year. EC is a key indicator of water quality, reflecting the concentration of dissolved salts and ions in the water. It provides insights into the water's ability to conduct electricity, which is influenced by factors such as mineral content, temperature, and pollution levels[9].




In this dataset, the EC values exhibit variations throughout the year, reflecting seasonal changes and potential environmental influences. The highest EC values are observed during the summer months, particularly in June, with a peak value of 188 µS/cm. This increase in conductivity during summer can be attributed to factors such as higher temperatures, increased evaporation, and reduced water volume, leading to higher concentrations of dissolved salts and minerals in the water[10].

Conversely, EC levels tend to decrease during the winter and early spring months, reaching their lowest point in December with a value of 155 µS/cm. This decrease may be associated with factors such as lower temperatures, reduced evaporation, and increased precipitation, which dilute the concentration of dissolved salts in the water.

The intermediate months, such as March to October, exhibit moderate EC values ranging from 157 to 177 μS/cm. These months may experience varying weather conditions and environmental factors, influencing the conductivity of the lake water.

Monitoring EC levels in the lake is essential for assessing water quality, identifying potential sources of contamination, and understanding the impact of human activities on the aquatic ecosystem. By tracking seasonal variations in EC, authorities can implement appropriate management strategies to protect and preserve the lake's water resources for both ecological and human uses.

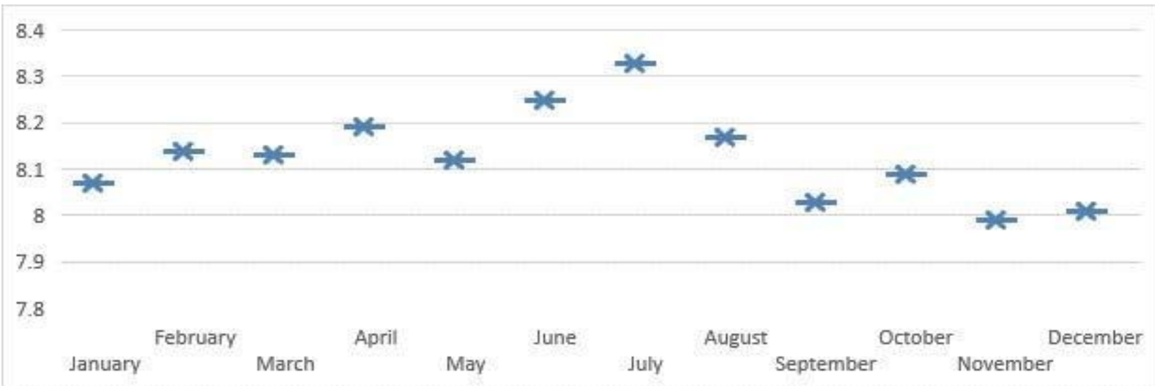
**Water Turbidity**

The provided data represents the water turbidity levels in the lake across different months of the year. Turbidity is a measure of the cloudiness or haziness of water caused by suspended particles, which can include sediment, organic matter, and plankton. It is an important indicator of water quality, affecting light penetration, aquatic habitat, and overall ecosystem health[11].

In this dataset, the turbidity levels show slight variations throughout the year, with values ranging from 1.5 to 1.6 NTU (Nephelometric Turbidity Units). Generally, the turbidity remains relatively low, indicating clear water conditions with minimal suspended particles.

The lowest turbidity levels are observed during the winter months, particularly in January, February, and December, where values range from 1.5 to 1.53 NTU. This period may experience lower levels of runoff and sedimentation due to reduced precipitation and colder temperatures, resulting in clearer water.

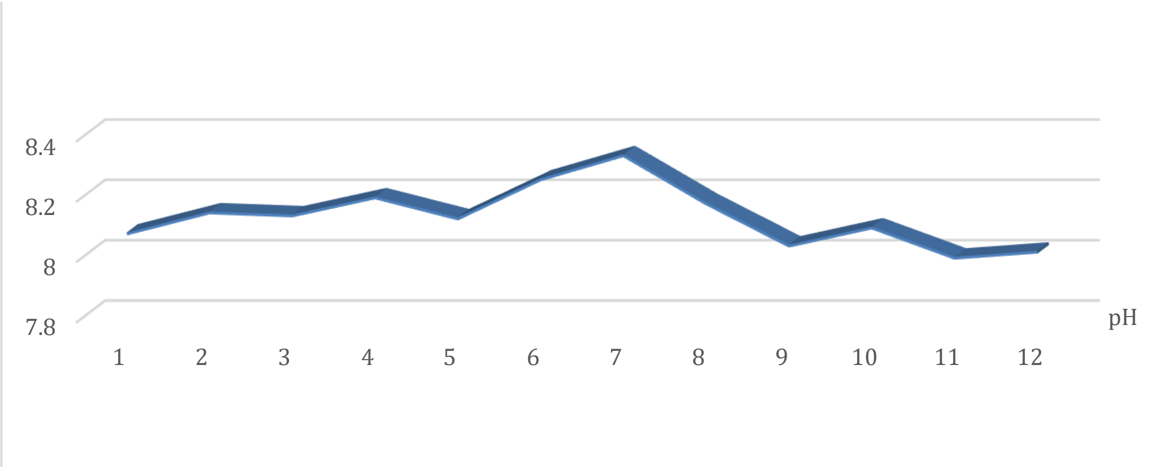
Turbidity levels tend to increase slightly during the spring and summer months, reaching their peak in July with a value of 1.6 NTU. This increase may be attributed to factors such as higher temperatures, increased biological activity, and potential runoff from agricultural or urban areas.




Overall, the consistent and relatively low turbidity levels suggest good water clarity in the lake throughout the year. However, monitoring turbidity remains important for detecting any changes in water quality, identifying sources of pollution, and ensuring the health and sustainability of the aquatic ecosystem. Regular monitoring and management efforts are essential to maintain clear and healthy water conditions in the lake for both ecological and recreational purposes[12].

**pH**

The pH levels of Nundkol Lake water were investigated over a span of one year, January 2023 to December 2023, with measurements taken at 25°C. The provided data presents the pH levels of the lake water recorded across different months of the year. pH is a measure of the acidity or alkalinity of a solution, with values ranging from 0 to 14. A pH of 7 is considered neutral, while values below 7 indicate acidity and values above 7 indicate alkalinity[13].




In this dataset, the pH levels show some fluctuations over the year, but they generally remain within a relatively narrow range. The pH values range from 7.99 to 8.33, indicating slightly alkaline conditions in the lake water. During the summer months, particularly from June to August, the pH levels tend to be higher, with values ranging from 8.17 to 8.33. This increase in pH may be influenced by factors such as increased photosynthesis by aquatic plants, which can raise pH levels through the absorption of carbon dioxide[14].

Conversely, pH levels are slightly lower during the winter months, particularly in November and December, where values range from 7.99 to 8.01. This decrease in pH may be associated with factors such as reduced biological activity and increased rainfall, which can introduce acidic compounds into the water.

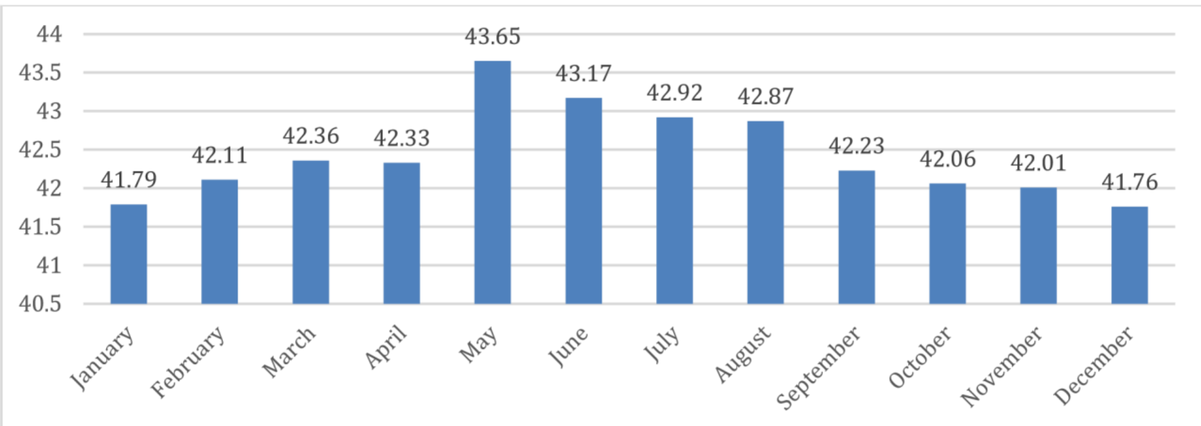
Overall, the pH levels observed in the lake water indicate relatively stable and alkaline conditions throughout the year. Monitoring pH is important for assessing water quality, as fluctuations outside the normal range can impact aquatic life and ecosystem health. Maintaining pH within acceptable limits is essential for preserving the ecological balance of the lake and ensuring its suitability for various uses, including drinking water supply, recreation, and supporting aquatic biodiversity[15].

**Total Dissolved Solid (mg/l)**

The concentration of Total Dissolved Solids (TDS) in Nundkol Lake water was examined over a one year from January 2023 to December 2023.

The provided data showcases the Total Dissolved Solid (TDS) levels in the lake water measured in milligrams per liter (mg/l) across different months of the year. TDS refers to the total concentration of dissolved inorganic and organic substances present in water, including salts, minerals, and organic compounds. It serves as a crucial indicator of water quality, with elevated TDS levels potentially indicating pollution or high mineral content[16].

In this dataset, the TDS levels exhibit minor variations throughout the year, with values ranging from 41.76 to 43.65 mg/l. These variations suggest relatively stable water quality conditions in the lake over the observed period.

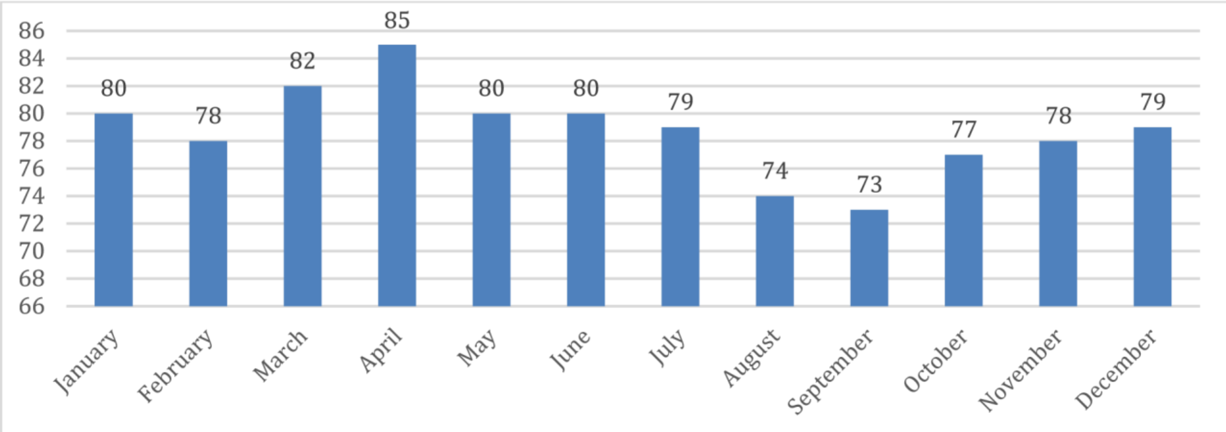


The highest TDS levels are recorded in May, with a value of 43.65 mg/l, while the lowest levels are observed in December, with a value of 41.76 mg/l. This pattern may reflect seasonal influences such as changes in precipitation, evaporation, and runoff, which can affect the concentration of dissolved substances in the water. Overall, the TDS levels observed in the lake water fall within the acceptable range for freshwater bodies, indicating good water quality. However, regular monitoring of TDS levels is essential to detect any significant changes over time and to ensure the long-term health and sustainability of the lake ecosystem. Maintaining appropriate TDS levels is crucial for supporting aquatic life, preserving water resources, and safeguarding the ecosystem against pollution and degradation[17].

**Total hardness (As $CaCo_3$)**

The total hardness of Nundkol Lake water, expressed as calcium carbonate ($CaCO_3$) concentration, was examined over a one year from January 2023 to December 2023.

Total hardness, expressed as $CaCO_3$ (calcium carbonate), is a critical parameter in assessing water quality and understanding the chemical composition of a water body. The values provided represent the concentration of various dissolved minerals, primarily calcium and magnesium ions, which contribute to water hardness. In the context of the dataset for Nundkol Lake, the total hardness values range from 73 to 85 mg/L (milligrams per liter) over the course of the year[18].




The variations in total hardness levels throughout the year reflect seasonal changes and potential environmental influences on the lake's chemistry. In January, the total hardness is recorded at 80 mg/L, indicating relatively hard water. This hardness persists through the winter months, with slight fluctuations observed in February and March. As spring arrives in April and May, total hardness remains relatively stable, suggesting consistent mineral concentrations in the lake water.

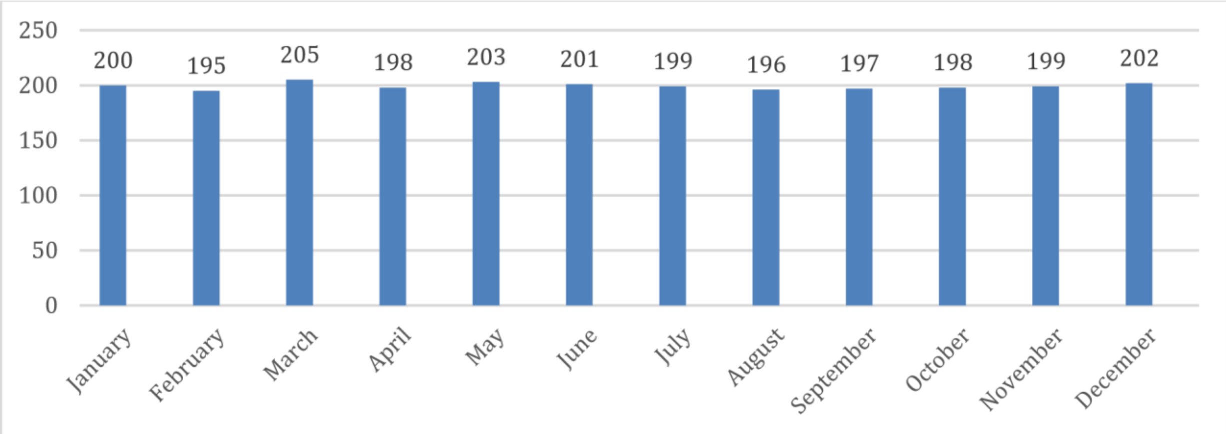
During the summer months, from June to August, a slight decrease in total hardness is observed, with values ranging from 74 to 80 mg/L. This reduction may be attributed to factors such as increased precipitation, which can dilute the mineral content of the lake water. However, total hardness levels remain within a relatively narrow range, indicating the resilience of the lake's chemistry to seasonal changes.

As autumn approaches in September and October, total hardness shows a slight decrease, reaching a minimum of 73 mg/L in September. This trend may be influenced by factors such as decreased evaporation and lower mineral inputs from surrounding areas. Total hardness levels remain relatively stable through November and December, suggesting consistent water chemistry as the lake transitions into winter.

Overall, monitoring total hardness provides valuable insights into the chemical composition of Nundkol Lake and helps assess its suitability for various uses, including drinking water supply, aquatic habitat, and recreational activities. Understanding the seasonal variations in total hardness is essential for managing and preserving the water quality of the lake and ensuring its long-term health and sustainability[19].

**Sulphates (mg/1)**

The Sulphates mg/1 of Nundkol Lake water was examined over a one year from January 2023 to December 2023. Sulphates ($SO_4^{-2}$) are another significant parameter used to assess water quality, particularly in freshwater systems like Nundkol Lake. The provided dataset presents the concentration of sulphates in milligrams per liter (mg/L) over the course of a year. The sulphate levels in Nundkol Lake exhibit minor fluctuations throughout the year, ranging from 195 to 205 mg/L. These variations reflect changes in environmental conditions and potential anthropogenic influences on the lake's chemistry[20].




In January, the sulphate concentration is recorded at 200 mg/L, indicating a moderate level of sulphates in the lake water. This level remains relatively stable through the winter months, with slight fluctuations observed in February and March. As spring arrives in April and May, sulphate levels show minor variations, reaching a peak of 203 mg/L in May. These fluctuations may be influenced by factors such as changes in precipitation patterns and inputs from surrounding catchment areas.

During the summer months, from June to August, sulphate concentrations remain relatively consistent, ranging from 196 to 201 mg/L. This stability suggests a steady state of sulphate input and dissolution in the lake water during the warmer months. As autumn approaches in September and October, sulphate levels show slight decreases, with values ranging from 197 to 198 mg/L. These variations may be influenced by factors such as reduced biological activity and changes in water flow patterns.

In November and December, sulphate concentrations increase slightly, reaching a maximum of 202 mg/L in December. These fluctuations may be associated with changes in environmental conditions and inputs from surrounding land areas. Overall, monitoring sulphate levels in Nundkol Lake is crucial for assessing water quality and understanding potential sources of contamination. By tracking seasonal variations in sulphate concentrations, authorities can implement appropriate management strategies to protect and preserve the lake ecosystem for both ecological and human uses[21].

## III. Conclusion: -

In conclusion, Nundkol Lake stands as a vital natural asset in the picturesque landscapes of the Ganderbal district, Kashmir Valley, India. Throughout this comprehensive study spanning from January to December 2023, various physicochemical parameters were meticulously analyzed to gain insights into the lake's water quality dynamics and seasonal variations. The findings shed light on the intricate interplay between environmental factors and the lake's ecosystem, highlighting the importance of continuous monitoring and conservation efforts. The study revealed notable seasonal fluctuations in key parameters such as water temperature, turbidity, electrical conductivity (EC), pH, total dissolved solids (TDS), total hardness, and sulphate levels. These fluctuations, influenced by factors like temperature variations, precipitation patterns, runoff, and biological activity, underscore the dynamic nature of the lake ecosystem[22].

Water temperature exhibited characteristic seasonal changes, with frigid temperatures in winter giving way to warmer conditions in summer, influencing biological activity and ecosystem dynamics. Turbidity levels, indicative of water clarity, showed slight variations throughout the year, influenced by factors like precipitation and runoff. Electrical conductivity, pH, and total dissolved solids provided insights into the chemical composition of the lake water, reflecting variations in mineral content, dissolved salts, and alkalinity. These parameters are crucial for assessing water quality and ensuring the health of the aquatic ecosystem[23].

Total hardness, expressed as calcium carbonate concentration, demonstrated seasonal fluctuations, reflecting changes in mineral inputs and environmental conditions. Similarly, sulphate levels showed minor variations throughout the year, influenced by factors like precipitation and biological activity. Overall, the study underscores the significance of continuous monitoring and management strategies to preserve the ecological health and sustainability of Nundkol Lake. Insights gained from this research can inform conservation efforts, resource management strategies, and policy interventions aimed at protecting fragile Himalayan lake ecosystems. By understanding and addressing the environmental stressors affecting Nundkol Lake, stakeholders can work towards ensuring the long-term viability of this invaluable natural resource for future generations[24].

## Acknowledgement: -

The authors would like to extend their gratitude to the water testing lab in Handwara, Jammu and Kashmir. Additionally, Meenakshi Sharma would like to express her sincere appreciation to Prof. Dr. Manjul Mishra for the invaluable guidance, support, and assistance provided during the process of writing, compilation, and data analysis for this research work.


## References: -


[1]. Bhadula,S. and Joshi,B.D. A Comparative Study of Physico- Chemical Parameters of the Major and Minor Canals of the River Ganga within Haridwar. J. Environ. & Bio. Sci. 2011; 25 (2):285-290.

[2]. 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.

[3]. ASTM International, (2003), Annual Book of ASTM Standards, Water and Environmental Technologyv. 11.01, West Conshohocken, Pennsylvania, pp 6-7.

[4]. APHA. Standard methods for the examination of water & waste water. Port city press, Baltimore, Maryland, USA. Ed. 2001.

[5]. 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.

[6]. 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), pp 633-636.

[7]. 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.

[8]. Colman, J., Lardinois, P., Rabelahatra A., Rafaliarison, J., van den Berg, F.Randriamiarana,H., and Johannes, J.Manuel pours le Développement de la Pisciculture à Madagascar, FI: DP/MAG/88/005. Document Technique N°4. PNUD/FAO-MAG/88/005. Antsirabe, Juillet 1992.

[9]. B. Banakar, B. R. Kiran, E.T. Puttaiah, R.Purushotham& S. Manjappa (2005), "Hydrochemical Characteristics Of Surfac e Water In Chandravalli Pond, Near Chitradurga".

[10]. Akshay R. Thorvat, N P Sonaje, M Mujumdar "Development of regression model for the Panchaganga River water quality in Kolhapur city" Engineering Research and Applications, 1(4), 2011, pp1723-1730.

[11]. Barghigiani, T. Ristori, R. Scerbo, C. Cini, R. Nottoli, L. Moschini and V. Giaconi; (2009), "Assessment of water Pollution and Suitability to Fish Life in Six Italian Rivers", Environmental Monitoring and Assessment, 66: 187 –205, Kluwer Academic Publishers.

[12]. Deepa P, Raveen R, Venkatesan P, Arivoli S and Samuel T Seasonal variations of physicochemical parameters of Korattur lake, Chennai, Tamil Nadu, India International Journal of Chemical Studies 2016; 4(3): 116-123 P-ISSN2349– 8528 E-ISSN 2321–4902 IJCS 2016; 4(3): 116-123

[13]. Hussien M EL- Shafei Assessment of some water quality characteristics as guide lines for the management of pond fish culture in Lake Manzala, Egypt International Journal of Fisheries and Aquatic Studies 2016; 4(2): 416-420 ISSN: 2347-5129 IJFAS 2016; 4(2): 416-420

[14]. Kumar Manoj, Pratap Kumar Padhy Multivariate statistical techniques and water quality assessment: Discourse and revie w on some analytical models INTERNATIONAL JOURNAL OF ENVIRONMENTAL SCIENCES Volume 5, No 3, 2014 Research article ISSN 0976 – 4402 doi: 10.6088/ijes.2014050100053

[15]. M. M. Khan, M. Admassu and H. R. Sharma; (2009), "Suitability Assessment of Water Quality of River Shinta and i ts Impacts on the Users: A Case Study from Gondar Town of Ethiopia", Indian Journal of Environmental Protection: Vol. 29, No. 2: IJEP 29 (2): 137-144.

[16]. N. Ramamurthy, J. Subhashini and S. Raju; (2005), "Physico-Chemical Properties of Palar River in Tamilnadu", Indian Journal of Environmental Protection: Vol. 25, No. 10: IJEP 25 (10): 925-928.

[17]. P. B. Lokhande, A. D. Gawas and H. A. Mujawar; (2005), "Study of Water Quality Parameters of River Water in Konkan Region", Indian Journal of Environmental Protection: Vol. 25, No. 3: IJEP 25 (3): 212-217.

[18]. P. Satheeshkumar & Anisa B. Khan Identification of mangrove water quality by multivariate statistical analysis methods in Pondicherry coast, India Received: 15 November 2010 / Accepted: 30 June 2011# Springer Science+Business Media B.V. 2011

[19]. R. K. Tiwary and Abhishek; (2005), "Impact of Coal Washeries on Water Quality of Damodar River in Jharia Coalfield", Indian Journal of Environmental Protection Vol. 25, No. 6: IJEP 25 (6): 518-522.

[20]. S. Harinath; "Water Quality Studies on Bommanahalli Lake", Journal of Industrial Pollution Control 25 (1) (2009) PP 33-36.

[21]. S. K. Deshmukh (2001), Theme paper on "Strategy for Techno-Economic Feasible Treatment".

[22]. S. Venkatramanan1, 2, S. Y. Chung1*, T. Ramkumar2, G. Gnanachandrasamy2, S. Vasudevan2 A multivariate statistical approa ches on physicochemical characteristics of ground water in and around Nagapattinam district, Cauvery deltaic region of Tamil Nadu, India Earth sci. res. j., Volume 17, Issue 2, 2013. eISSN 2339-3459. Print ISSN 1794-6190.

[23]. SalimAijaz Bhat,1 Gowhar Meraj,2 Sayar Yaseen,1 and Ashok K. Pandit1 Statistical Assessment of Water Quality Parameters for Pollution Source Identification in Sukhnag Stream: An Inflow Stream of Lake Wular (Ramsar Site), Kashmir Himalaya

[24]. Thorvat A. R., Sonaje, N. P., and Mujumdar, M. M. Regression Modeling and Impact Assessment of Panchaganga River Water Quality in Kolhapur City. International Journal of Advance Foundation And Research In Science and Engineerin g (IJAFRSE), TACE 2015. Impact Factor: 1.036, Science Central Value: 26.54, Vol. 2, 456-464.