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Seasonal variation in the physico-chemical characteristics of lake Gyakar Sinyik (Ganga Lake): A wetland of eastern Himalayas, India

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Abstract
Lake *Gyakar Syinik* popularly known as Ganga Lake located in Itanagar wildlife sanctuaries, Eastern Himalaya was studied for a period of one year (Jan-Dec 2023). Physico-chemical characters like Temperature, pH, Electrical conductivity, Total dissolved solid, Salinity, Oxygen redux potential, Transparency and Dissolved oxygen content were recorded on monthly basis. Most of the parameters were within the range of Indian standards with variation between monsoon and non-monsoon season. However, with the oxygen reduction potential and less dissolved oxygen it gives a warning signals the deteriorating condition of wetland with a threat to the future of the biota living in.

Keywords: Wetland, physico-chemical, seasonal variation, Ganga Lake

Introduction
Wetlands are one of the productive ecosystems of biosphere as it receives precipitation water as well as surface runoff which brings different types of nutrients into it. These lentic ecosystems are rich in biological diversity and are very often influenced by environmental factors [1-4]. *Gyakar Sinyik* is one such high altitude lentic water body located in the Itanagar wild life sanctuaries of Eastern Himalaya [5]. It is surrounded by hills and located at altitude of 350 msl. Distribution and diversity of planktons are influenced by the abiotic factors [6-7]. Few research works are reported on the limnology aspects from Arunachal Pradesh with no specific works on the physico-chemical characteristics of wetland waters. Keeping this in view, the present piece of research was designed to study the physico-chemical characteristics of lake *Gyakar syinik.*

Materials and Methods
The Lake *GYAKAR SINYIK* is a natural, freshwater lake located in Itanagar wildlife sanctuaries (93° 34' 04.58'E longitude and 27° 04' 28.52"N) at an altitude of 330-350 m above sea level (Fig.1). It has an area of about 70,000 m^2 though located close to Pachin and Pam watersheds. Transparency was measured by a 20 cm diameter Sacchi disc fitted to a long-calibrated thread. The transparencies of the water are observed visually by immersing the disc in the water until it just disappeared and reappeared. Transparency (cm) = A+B/2, where A= depth of disappearance, B= depth of reappearance. The water sample was collected in BOD bottle was fixed on the spot and carefully brought to the laboratory for the determination of dissolved oxygen content by Winkler's method. Other parameters like pH, temperature, oxidation redux potential (ORP), turbidity, conductivity and salinity were determined with the help of probe following standard procedures prescribed by American Public Health Association [8]. Statistical analyses were done with n=10 in case of physico-chemical characteristics and expressed as mean $\pm$ standard deviation. Correlation coefficient (r) was calculated and expressed as positive and negative range.

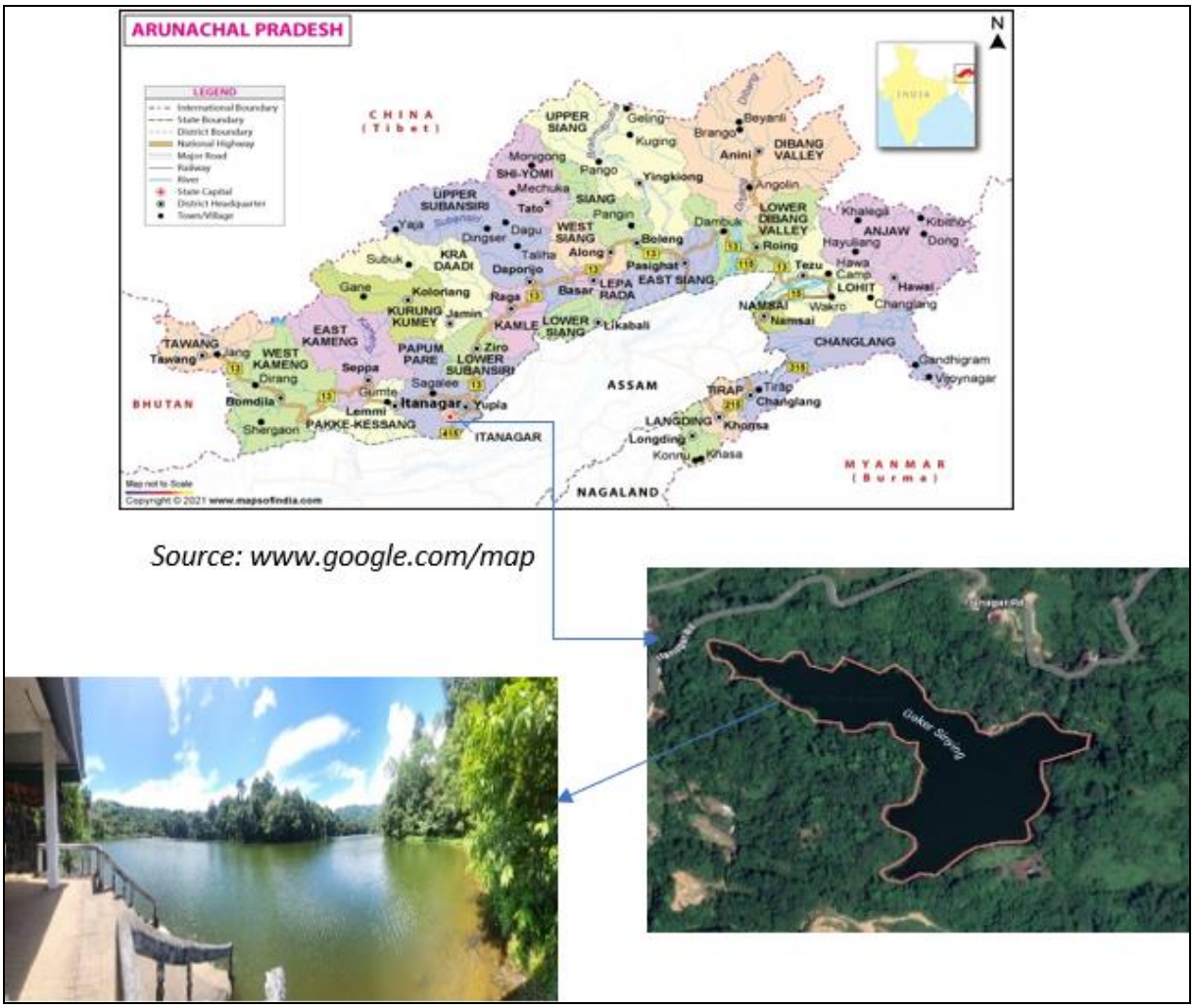

Photo 1: Sampling site of *Gyakar Syinik*

Results

The results obtained are presented in table-1. The physico-chemical characteristics of lake water is presented as data range observed throughout the year with minimum and maximum (Table-1). The average data of the year of physico-chemical characteristics of lake water is presented as mean with standard deviations. The data is expressed in the form of graph (Fig.1-8).

Temperature: Water temperature is an important physical parameter. The intensity variations of water temperature directly affect the productivity of wetland. The fluctuation in wetland water temperature depends on the seasons and geographical area, sampling time. Water temperature regulates the density and diversity of plankton population in fresh water. Water temperature has some positive and negative effects for plants as well as planktonic growth. Most of the aquatic plants grow with a suitable temperature of 20-35 ºC. The temperature range was found to be 22-32 ℃ which is well within the range for the aquatic organisms.

pH: The Hydrogen ion Concentration or pH of water determined the intensity of the acid or alkaline condition. The biological activities and acidity of the bottom sediments influence the pH of water. The high range of pH may result from high photosynthetic rate by dense phytoplankton blooms. Aquatic organisms are sensitive to pH change and biological treatment requires pH control or monitoring. The pH of the aquatic system is an important indicator of water quality and the level of pollution. Due to the presence of carbonates and bicarbonates, most of the water is alkaline. It also influences some factors like conductivity, bicarbonates, chloride, salinity, phosphate, hardness. Range of the p^H were found to be with a range of 6.66-9.31. The permissible limit of pH recommended by WHO is from 6.5 to 9.2. The pH of the Lake being within the range is suitable for sustaining aquatic life in it. The pH is positively correlated (r=+0.71) with temperature. The pH of the Lake is suitable for sustaining aquatic life in it.

Transparency: The transparency of any wetland is dependent upon the TDS, as well as the presence of algal bloom which prevents the sun light penetration. It also influences the dissolved oxygen content. The normal range of transparency is 150ppm. The transparency during the period of study was recorded with an annual range of 95-118cm. However, seasonal fluctuation with insignificant differences was observed during the study. The transparency level is positively correlated (r=+0.49) with dissolved oxygen content of the wetland

Total Dissolved Solid (TDS): The amount of dissolved or soluble materials in water is termed as total dissolved solid (TDS) and is generally measured in (mg/L). Total Dissolved Solid (TDS) is a measurement of inorganic salts, organic matter, and other dissolved materials in water. Total dissolved solids cause toxicity through increases in salinity and changes in the ionic composition of the water. The range of the TDS

was found to be 19-137 ppm. The total dissolved solid (TDS) was within the permissible limit.

Dissolved Oxygen (DO): Dissolve oxygen is important parameters of aquatic ecosystem and effects on the physical and biological process of water and is very important because it is directly affecting the survival and distribution of flora and fauna in an ecosystem. The oxygen acts as indicators of planktonic development and plays a significant role in proper growth of aquatic life like fishes. The principal sources of dissolved oxygen in water are either directly from the atmosphere through the exposed surface or from the photosynthesis of chlorophyll-bearing plants. The principal causes of oxygen decrease in water are respiration of animals and plants. This is a continuous activity day and night. Decomposition of organic matter is another reason for the depletion of oxygen. Dissolved oxygen is used up in decomposition of the mucky bottom materials and the suspended organic matter. Range of the DO were found to be 5.2-7.8 ppm. However, the oxygen stress was quite evident from the results.

Oxidation-reduction potential (ORP): The oxygen stress was quite evident not only from dissolved oxygen content but also from ORP with a negative oxidation reduction potential (-68to 2µv). ORP is measured in millivolts (mV). Oxidation-reduction potential (ORP) measures the ability of a lake or river to cleanse itself. The higher the ORP value, the healthier the lake ORP depends on the amount of dissolved oxygen that is in the water. When ORP is low, dissolved oxygen is low, toxicity of certain metals and contaminants can increase, and there is lots of dead and decaying material in the water that cannot be cleared or decomposed. The ORP is negatively correlated(R=-0.23) with pH.

Electrical conductivity (EC): Electrical conductivity (EC) is the ability of current conduction and in the case of water it is also an estimator of the amount of total dissolved salts or ions in water. The results are presented in table 1. The range of EC was found to be 20-166(µs/cm). It also influences the oxidation reduction potential and was found to be negatively correlated (r= -0.71). Dissolved salts from the surrounding catchments were trapped by vegetation and transpired or evaporated. The salt that washed into wetlands became concentrated in the waterbodies and biota is very sensitive to it. Wetlands which are no longer flushed, the continual input of salt increases concentration of salt in the sediments and this will influence the aquatic plants and benthic animals.

Salinity: Range of the Salinity were found to be 11-81ppm. Again, the lake water conductivity may be controlled by various factors like geology, the lake size, runoff from non-point sources, atmospheric inputs, evaporation rates, some types of bacterial metabolism etc. Variations in conductivity are affected by average temperature. The more chemical ions or dissolved salts a body of water contains, the higher the conductivity will be change in conductivity may be due to either natural flooding, evaporation or man-made pollution and can be detrimental to water quality and the biota therein. Moreover, less electrical conductivity and salinity makes the quality of water fit for aquatic life.

Physico-chemical factors like pH, temperature, TDS regulate the growth of plankton in the wetlands. They also vary in accordance with season which in turn influences the distribution of plankton in the wetlands. Temperature in the wet land varies with season with lowest (22.3±0.6) recorded in the month of November and highest in August (31.98±1.22). All life processes, such as including distribution of organisms are influenced by water temperature. Wetlands are in general alkaline in nature due to the presence of carbonates and bicarbonates. The pH influenced due to their presence. The higher phytoplankton correlated with photosynthetic activity which in turn increases in pH. The higher pH is also attributed to different anthropogenic activities. Here results observed depicts a range of 6.66-9.31 with high during monsoon than pre and post monsoon. The dissolved oxygen content is one of the limiting factors of any wetland. It is also dependent upon photosynthesis, temperature and salinity of the water and vary in accordance with different seasons. The DO level was observed highest during September (7.8 ppm) whereas lowest in February (5.24 ppm). The availability of oxygen decreased with the decrease in temperature. The minimum DO record in post monsoon (winter)was due to its utilization for decomposition of organic matter and respiration of zooplankton. The variation in the ORP level also positively correlated with the dissolved oxygen content. Salinity interacts with factors like temperature, oxygen and ionic compounds and affects the biology of any wetland. During investigation, the salinity of wetland was found to be 81ppm in September whereas 9.45 in June. The variation is due to the rainwater and evaporation in response to seasonal variation. Electrical conductivity and TDS also varied seasonal, and both the parameters also correlated with each other. The increase of TDS is mainly due to inflow of drainage water containing large quantity of silt from the surrounding hills which nis very often facing landslides during rainy season. An increase in TDS always corresponds to EC increase.

Table 1: Physico-chemical characteristics of Lake *Gyakar Syinik* Lake

Month	Temp^{0}C	pH	ORP (µv)	EC (µs/cm)	TDS (ppm)	Salinity (ppm)	Transparency (cm)	DO (ppm)
JAN	22.5+1.2	7.5+0.3	-12.1+4.5	128.3+6.2	98.4+8.5	69.2+3.5	102.1+8.4	5.5+0.16
FEB	23.16±2.37	7.89±0.65	-33.5±6.8	127±23.4	98.5±15.7	70.3±14.3	97.98± 11.3	5.24±0.58
MAR	23.7±1.8	8.10±0.7	-36.1±5.2	30.2±1.2	19.7±2.1	14.6±2.3	95.2±9.7	5.8±0.20
APR	25.82±0.35	7.47+0.32	-20.02+2.2	73.5+5.19	53.36+4.8	34.2+3.86	98.3±2.5	5.3±0.31
MAY	27.4±0.21	9.01±0.12	-30.35±9.4	33.47±4.4	22.82±6.1	15.39±2.17	96.96±1.35	6.1±0.2
JUN	31.07±0.71	9.31±0.07	-49.9±3.2	19.91±1.2	13.31±0.61	9.45±0.67	118.5±4.3	7.6±0.5
JUL	31.95±0.45	8.25±0.15	-42.6±4.8	23.84±3.1	16.22±1.1	11.38±0.5	96.2±6.7	7.2±0.3
AUG	31.98±1.22	8.31±0.21	-62.9±3.4	36.2±3.4	24.1±1.2	19.2±0.2	97.3±3.5	7.5±0.1
SEP	29.88±0.35	8.01± 0.11	-25.8± 3.1	166.5±12.5	137.3±8.6	81.0±5.4	108.1± 4.2	7.8±0.3
OCT	31.86±0.45	8.82±0.15	-67.94±2.24	121.2±5.8	78.6±4.3	53.6±3.5	103.6±1.2	7.7±0.1
NOV	22.3±0.6	6.66±0.2	-23.2±0.01	110±5.2	70.0±3.5	48.0±2.6	97.6±2.4	6.2±0.2
DEC	23.8+0.23	7.4+0.2	-15.3+2.5	34+2.1	21.0+1.6	18.0+1.1	97.3±2.5	6.9±0.3

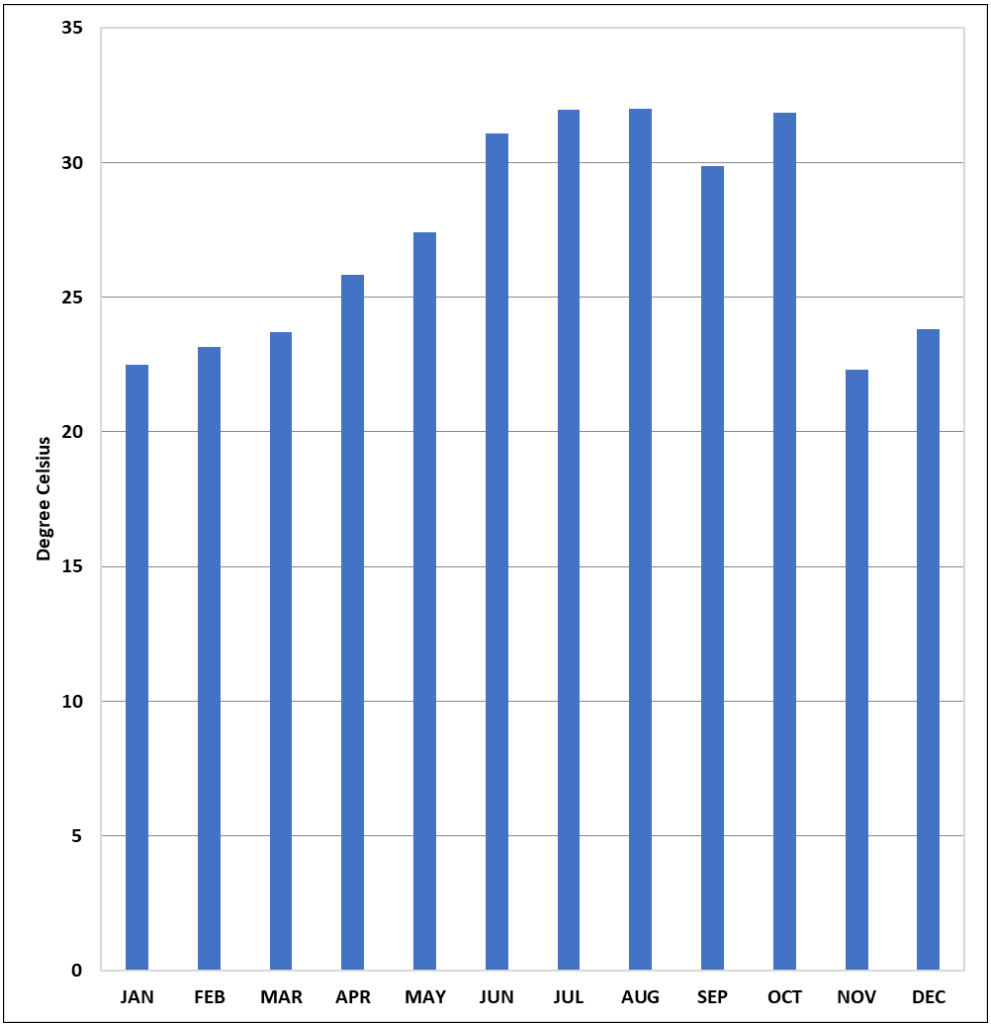

Fig 1: Temperature of Water of *Gyakar syinik* Lake

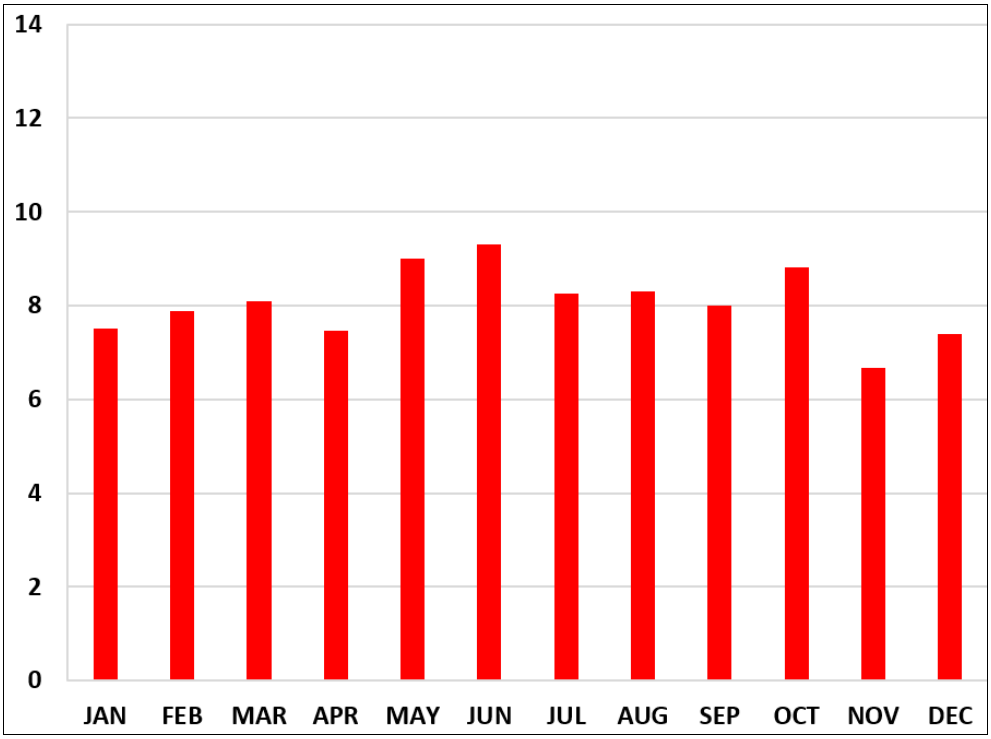

Fig 2: pH of Water of *Gyakar syinik* Lake

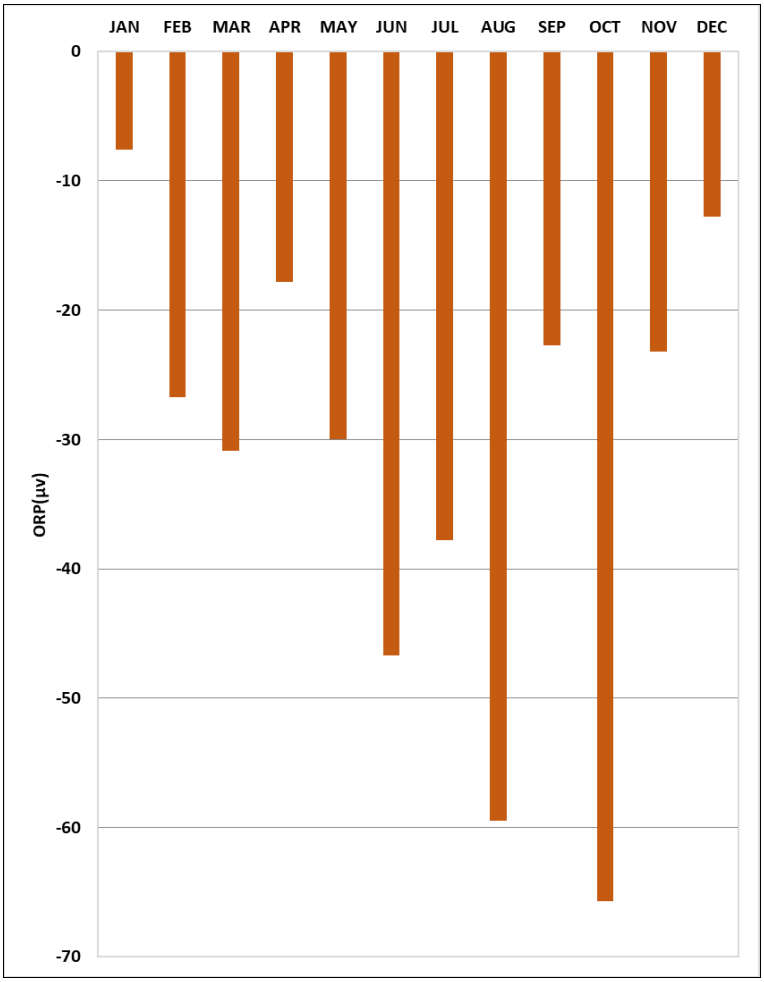

Fig 3: ORP of Water of *Gyakar syinik* Lake

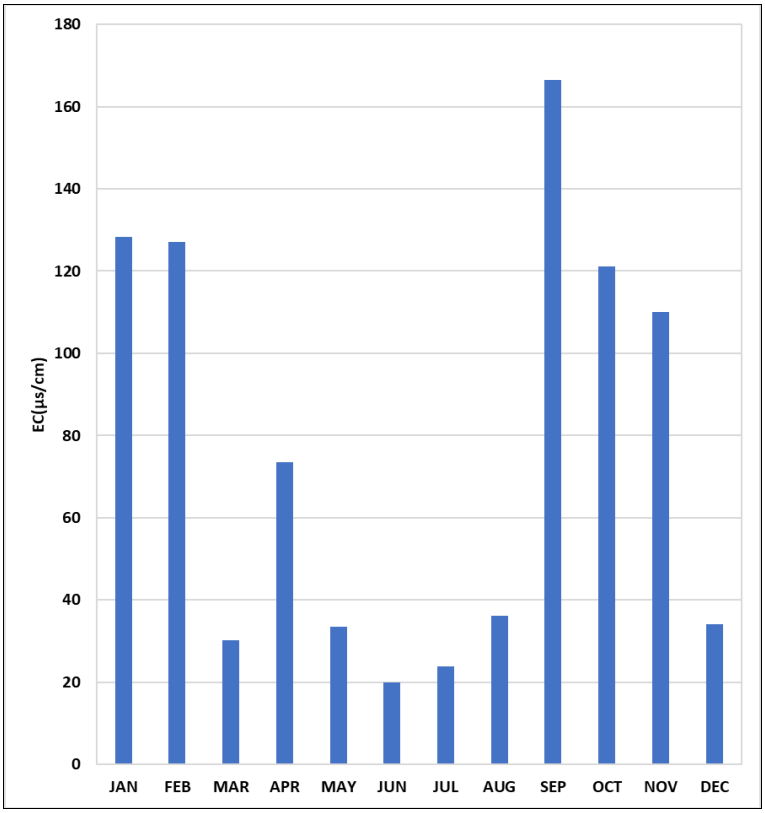

Fig 4: EC of Water of *Gyakar syinik* Lake

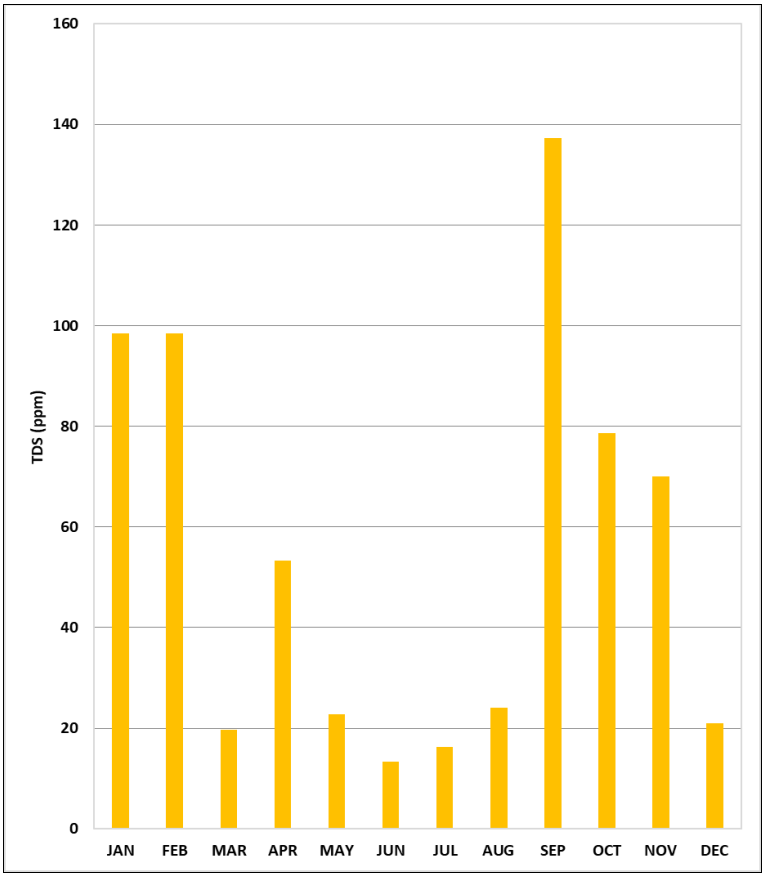

Fig 5: TDS of Water of *Gyakar syinik* Lake

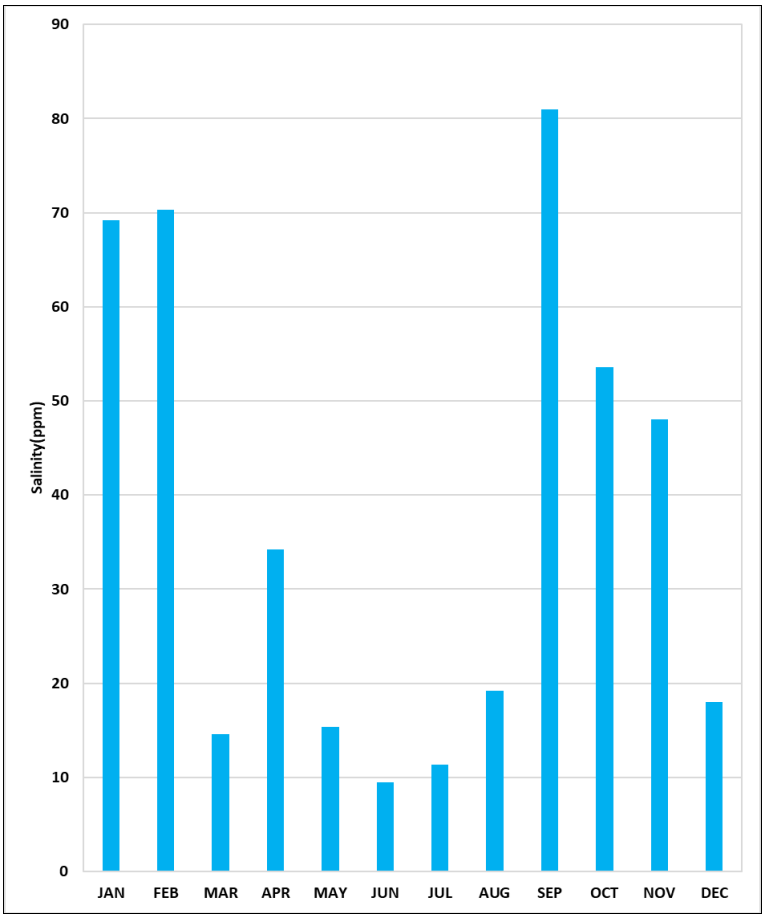

Fig 6: Salinity of Water of *Gyakar syinik* Lake

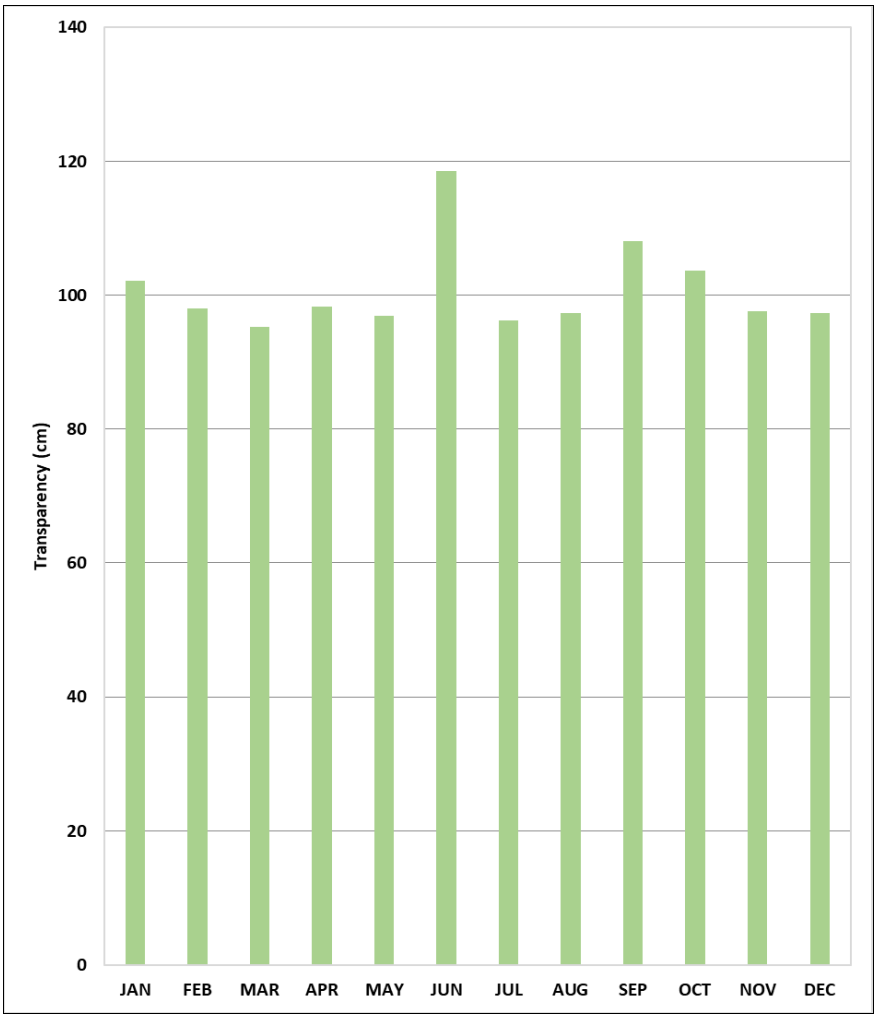

Fig 7: Transparency of Water of *Gyakar syinik* Lake

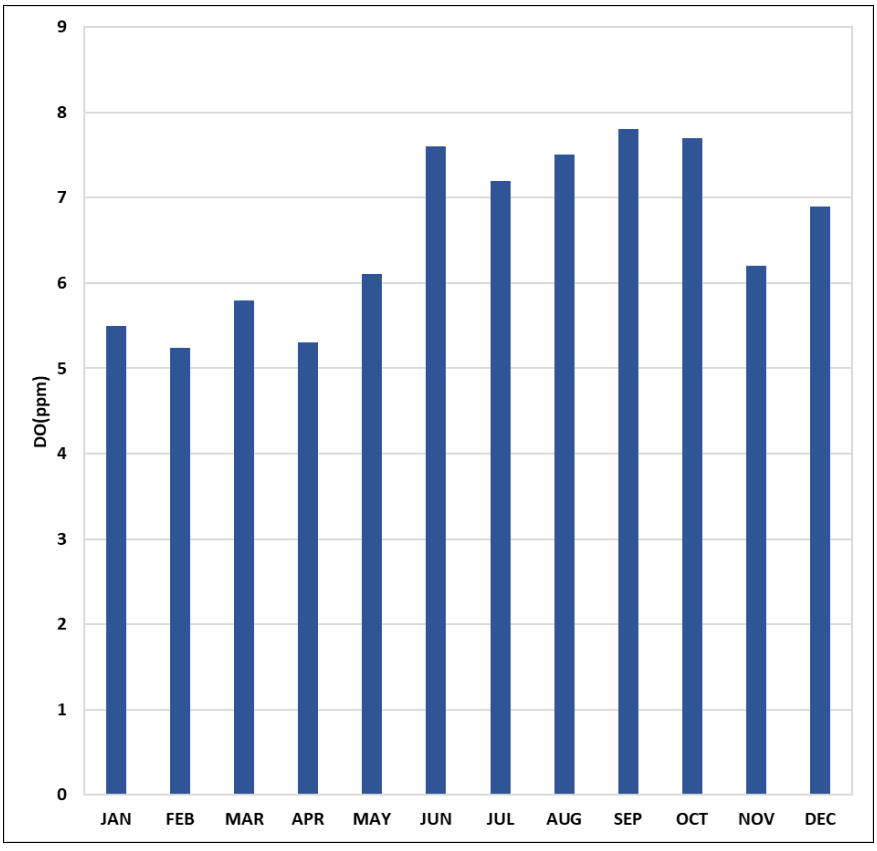

Fig 8: Dissolved Oxygen of Water of *Gyakar syinik* Lake

Discussion and Conclusion

There is an intrinsic connection between physico-chemical parameters and plankton diversity as parameters such as temperature, pH, EC, DO, BOD, COD, free carbon dioxide, total alkalinity, hardness, chloride, phosphate, sulphate, and nitrate, does have an impact on distribution on plankton in wetlands which also coincide with rainwater influx and seasonal variations [9]. A comprehensive assessment of the water quality in ten ancient lakes located in Guwahati city, Northeast India, utilizing the Water Quality Index (WQI) and multivariate statistical methods. underscores the urgent need for remedial actions to address the deteriorating water quality in these ancient lakes, emphasizing the critical role of pH, DO, and BOD in shaping the overall water quality and highlighting potential risks to both human consumption and aquatic ecosystems [10]. Growth of phytoplankton in freshwater lakes are due to long duration of sunshine, pH, and trophic activities [11]. Diversity of phytoplankton are also reduced because of heavy rainfall, high turbidity, reduced salinity, temperature, pH, along with overcast skies [12]. Some authors also highlighted the role of various water quality parameters like p H, EC and TDS on the compositions of phytoplankton and periphyton species among some lakes of Kashmir Himalayas [13]. Sometimes surface runoff brings excess of nutrient load to the wetland during monsoon there by leading to the growth of macrophytes [14]. Here in this piece of research there was clear indication of oxygen stress observed in the wetland as evident from less dissolved oxygen. This is also complemented by a negative ORP which indicates that the lake leading towards a reduced state of chemical reaction which may be due to nitrate reduction. Reduction of transparency (around 100 cm) is also leading the towards eutrophication. This wetland a tourist destination which leads to anthropogenic disturbance requires scientific intervention. With getting less sunlight due to shades from the periphery of forest as well as hills the productivity of the wetland is affected which is visible from the results obtained from the results. A comprehensive approach by the department of forest, environment, fishery and tourism will lead to the conservation of this old wetland which is culturally associated with people of Arunachal Pradesh specially the *Nyishi* tribe.

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References

1. Lodh R, Paul R, Karmakar B, Das MK. Physico-chemical studies of water quality with special reference to ancient lakes of Udaipur City, Tripura, India. Int J Sci Res Publ. 2014;4(6):1-9.
2. Laishram J, Dey M. Water quality status of Loktak lake, Manipur, Northeast India and need for Conservation measures: A study of five selected villages. Int J Sci Res Publ. 2014;4(6):2250-3153.
3. Sharma RC, Singh S. Water quality and phytoplankton diversity of high-altitude wetland, Dodi Tal of Garhwal Himalaya, India. Biodiversity Int J. 2018;2(6):484-493.
4. Sarmah P. Analysis of seasonal variations of some physico-chemical parameters of Manas River, North-East India, to assess its health. Indian J Nat Sci. 2023;14(79):57816-58999.
5. Nanda P, Sinha B, Muthu J, Sharma H. Study of zooplankton diversity of Ganga Lake (Gyakar Sinyik) of Itanagar, Eastern Himalayas, India, using Foldscope. Bull Pure Appl Sci. 2020;39A(2):516-523.
6. Nanda P, Arya OP, Choikey U, Rajkhowa R. Physico-chemical characteristics and plankton diversity of a thermal spring in Arunachal Himalaya, North East India. ENVIS Bull Himalayan Ecol. 2023;31:143-148.
7. Muthu J, Mitra J. Phytoplankton diversity of lake, Gyakar Sinyik (Ganga Lake), Eastern Himalayas, India. Int J Fish Aquat Stud. 2024;12(4):152-156.
8. American Public Health Association, American Water Works Association, Water Environment Federation. Standard Methods for the Examination of Water and Wastewater. 21st ed. Washington, DC: American Public Health Association; 2005.
9. Jagadeeshappa KC, *et al*. Influence of physico-chemical parameters on the diversity of plankton species in wetlands of Tiptur taluk, Tumkur dist, Karnataka State, India. Caribb J Sci Tech. 2013;1:185-193.
10. Sharma P, Bora PJ. Water quality assessment using water quality index and principal component analysis: A case study of historically important lakes of Guwahati City, North-East India. Appl Ecol Environ Sci. 2020;8(5):207-217.
11. Chaturvedi RK, Sharma KP, Sharma K, Bharadwaj S, Sharma S. Plankton community of polluted water around Sanganer, Jaipur. J Environ Pollut. 1999;6:77-84.
12. Saravanakumar A, Rajkumar M, Thivakaran GA, Serebiah JS. Abundance and seasonal variations of phytoplankton in the creek waters of western mangrove of Kachchh-Gujarat. J Environ Biol. 2008;29:271-274.
13. Islam STS, Dar SA, Sofi MS, Bhat SU, Sabha I, Hamid A, Jehangir A, Bhat AA. Limnochemistry and plankton diversity in some high-altitude lakes of Kashmir Himalaya. Front Environ Sci. 2021. doi:10.3389/fenvs.681965.
14. Bhusal A, Devkota A. Physico-chemical characteristics of lakes of Chitwan National Park, Central Nepal. Biol Forum Int J. 2020;12(1):33-39.