IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

An Overview Of The Physico-Chemical Characteristics Of The Indian Lentic Water Bodies.

Ashish Suresh Gadwe

Manoharbhai Patel College of Arts, Commerce and Science, Deori, Gondia, Maharashtra

Abstract

Water is a vital natural resource essential for sustaining life and ecological balance on Earth. Lentic ecosystems, including lakes, ponds, and reservoirs, represent key freshwater habitats that support biodiversity, human livelihoods, and ecological processes. However, these systems are increasingly threatened by anthropogenic activities such as industrial discharge, agricultural runoff, and urban wastewater, which deteriorate the physicochemical quality of water. Changes in temperature, dissolved oxygen, nutrient levels, and other parameters directly affect aquatic organisms and ecosystem health, often leading to eutrophication and habitat degradation. In India, lentic water bodies span diverse climatic and geographic regions, from Himalayan high-altitude lakes to tropical lowland ponds, each exhibiting unique physicochemical characteristics. Understanding these parameters is essential for effective water quality assessment, ecosystem management, and conservation planning. This review aims to synthesize research findings on the physicochemical properties of various Indian lentic ecosystems, highlighting the environmental challenges and the need for sustainable freshwater resource management.

Keywords: Physicochemical parameters, Lentic ecosystems, Freshwater ponds, water pollution.

Introduction:

Water is a precious recourse for driving energy on our planet. Water is the most abundant compound on Earth's surface, found in many places on the surface of the planet, within rocks, below the surface and in the atmosphere. Aquatic habitat provides the food water, shelter and space essential for the survival of aquatic animals and plants.

Freshwater ecosystems contain 41% of the world's known fish species and include **Lentic** and **Lotic** ecosystems. Lentic ecosystem is the standing water habitat. Freshwater habitats can be classified by different factors, including temperature, light penetration, tidal movements and vegetation. Most of the fresh waters play a vital role in human health, economic wellbeing, social cultures and healthy habitat for plants and animals. Lentic refers to standing or still water. Lentic ecosystem ranges from a small, temporary rain water pool to a few meters deep lake.

The quality of surface water is largely affected by natural processes (weathering and soil erosion) as well as anthropogenic inputs (municipal and industrial waste water discharge).The anthropogenic discharges represent a constant polluting source, whereas surface runoff is a seasonal phenomenon largely affected by climate (Latha *et al.,* 2010). An excessive introduction of nutrients by humans has led to severe eutrophication of certain freshwater systems worldwide (Abhas and Sing, 2013). Industrial sewage, municipal wastes are been continuously added to water bodies, hence affect the physic-chemical quality

of water making them unfit for use of livestock and other organism (Dwivedi and Pandey; 2002). Uncontrolled domestic waste water discharge in to pond as resulted in eutrophication of ponds as evidence by substantial algal bloom, dissolved oxygen depletion in the subsurface water leads to large fish kill and other oxygen requiring organisms (Pandey; 2003). Worldwide water bodies are primary means for disposal of waste, especially the effluents from industrial, municipal sewage and agricultural practices that are near to them. The effluent can alter the physical, chemical and biological nature of receiving water body (Sangodoyin, 1991). The initial effect of waste is to degrade physical quality of the water. Later biological degradation becomes evident in terms of number, variety and organization of the living organism in the water (Gray; 1989). Physicochemical properties of water in any ecosystem are largely governed by the existing meteorological conditions and are essential for determining the structural and functional status of natural water (Parashar et al. 2006).The term water quality is defined those physical, chemical and biological characteristics by the water quality is a major factor in determining the welfare of the society (Dwivedi and Pathak, 2000). It also plays vital role in governing the production of planktonic biomass. The management of any aquatic ecosystem is a means of conservation of fresh water habitat with an aim to maintain the water quality or to rehabilitate the physic-chemical and biological setting of water (Kumar et al. 2004).

India's freshwater supplies depend heavily on lentic habitats including lakes, ponds, and reservoirs. They supply water for irrigation, household usage, fishing, leisure, and habitat for a diverse range of plants and animals. However, industrialisation, urbanisation, agricultural runoff, and climate change are all threatening the ecological integrity of these water basins. Assessing water quality, ecosystem health, and developing successful conservation measures all depend on a thorough understanding of their physico-chemical characteristics.

India is endowed with a diverse range of lentic systems, from high-altitude lakes in the Himalayas (e.g., Pangong Tso) to tropical lakes in the peninsular region (e.g., Kolleru Lake, Vembanad Lake). These water bodies vary widely in size, depth, climatic conditions, and anthropogenic pressures, all of which influence their physico-chemical properties.

The goal of the current work is to evaluate the range of observations about different physico-chemical water parameters that have been made by researchers in different lentic water bodies over the years.

2. Key Physico-Chemical Parameters

2.1 Temperature

Water temperature affects metabolic rates of aquatic organisms and solubility of gases like oxygen. Temperature influences the vertical layering of water in ponds. In warm seasons, especially in deeper ponds, warmer, lighter water stays on top (epilimnion), while cooler, denser water settles at the bottom (hypolimnion), with a transition zone (thermocline) in between (Wetzel, (2001). Water is most dense at 4°C. Temperature fluctuations alter water density, which in turn affects mixing patterns, influencing the distribution of dissolved oxygen and nutrients(Kalff, 2002). Temperature affects the balance between CO_2, HCO_3^-, and CO_3^{2-}, thereby influencing pH. Higher temperatures increase CO_2, which can shift the pH balance (Stumm and Morgan, 1996).

2.2 pH

The pH of natural waters reflects the acid-base equilibrium and is influenced by biological activity, decomposition of organic matter, and pollution. pH is a measure of the hydrogen ion concentration in water and indicates whether water is acidic (<7)**,** neutral (7), or alkaline (>7)**.** In pond ecosystems**,** optimal pH typically ranges from 6.5 to 8.5 for most aquatic organisms (Boyd, 1990). Runoff containing fertilizers, industrial effluents, or acidic rain can significantly alter pond pH. For instance, acid rain (from sulfur and nitrogen oxides) can lower pH, harming sensitive species and promoting the release of toxic metals like aluminum from sediments (Schindler, 1988).

3.3 Dissolved Oxygen (DO)

DO is a critical indicator of water quality. Pristine lakes have DO concentrations above 6 mg/L, while polluted systems may have levels below 2 mg/L, particularly in bottom waters due to organic loading (Rao et al., 2013). DO levels fluctuate diurnally and seasonally and are impacted by temperature, eutrophication, and microbial respiration. Aerobic bacteria use DO to decompose organic matter efficiently. In low DO (anaerobic conditions), toxic gases such as H_2S, CH_4, and NH_3 may form (Reddy and Delaune, 2008). High DO promotes photosynthesis, nutrient cycling, and primary productivity (APHA, 2017).

3.4 Biochemical Oxygen Demand (BOD)

BOD indicates the organic pollution level and is a proxy for biodegradable material in water. Biochemical Oxygen Demand (BOD) is the amount of dissolved oxygen (DO) required by aerobic microorganisms to break down organic matter present in water over a specific time period (APHA, 2017). BOD is a key indicator of water quality, especially in aquaculture, waste-fed ponds, and natural ponds. High BOD levels can cause oxygen depletion, leading to hypoxia or anoxic conditions, which can harm aquatic organisms (Boyd, 1990).

3.5 Nutrients (Nitrate, Nitrite, Phosphate)

Excessive input of nutrients like nitrogen and phosphorus causes eutrophication, algal blooms, and hypoxia. Nutrients like nitrate, nitrite, and phosphate are essential for primary productivity in aquatic systems. However, excessive levels lead to eutrophication, algal blooms, and oxygen depletion, affecting the overall health of pond ecosystems (Boyd, 1990). Nitrate is the oxidized form of nitrogen and relatively non-toxic to aquatic animals at moderate levels. High nitrate levels can lead to eutrophication and dense algal blooms, which reduce light and oxygen (Camargo et. al., 2005). Nitrite is highly toxic to fish and invertebrates. It interferes with oxygen transport by converting hemoglobin to methemoglobin, leading to "brown blood disease". Acceptable nitrite levels in ponds are typically <0.1 mg/L (Lewis and Moris, 1986). Phosphate is usually a limiting nutrient in freshwater systems; even small increases can trigger algal blooms. High phosphate levels lead to rapid phytoplankton growth, especially cyanobacteria (Schindler, 1977).

3.6 Ammonia, Magnesium and Calcium

Ammonia exists in two forms: Unionized ammonia (NH_3) and Ionized ammonium (NH_4^+). NH_3 is highly toxic to aquatic life than NH_4^+. Unionized ammonia levels as low as 0.02–0.05 mg/L can be lethal to fish (Emerson et. al. 1975). Calcium is essential for osmoregulation, bone development, and shell formation in fish and crustaceans. It stabilizes pH and alkalinity by interacting with carbonate and bicarbonate. Calcium contributes to total hardness. Optimal hardness for fish ponds: 50–150 mg/L as $CaCO_3$. Low calcium levels can cause shell deformities in crustaceans and stress in fish (APHA, 2017). Like calcium, magnesium contributes to total hardness but in lesser quantities. Excessive Mg^{2+} is uncommon but may compete with calcium uptake in crustaceans (Das and Sharma, 2005)

3.6 Total Dissolved Solids (TDS).

TDS represent the ionic content in water. Total Dissolved Solids (TDS) refers to the total concentration of inorganic salts (mainly calcium, magnesium, sodium, potassium, chlorides, sulfates, bicarbonates) and a small amount of organic matter dissolved in water(Boyd, 1990). Very low TDS (<50 mg/L) makes osmoregulation difficult for fish and crustaceans. Very high TDS (>1,000 mg/L) in freshwater species can cause stress, dehydration, and mortality (Boyd and Tucker, 1998).

Values of TDS range from 150 to 1200 mg/L, with higher values reported in saline lakes like Sambhar (Rao et al., 2004).

3.7 Turbidity and Transparency

Turbidity in lentic systems is influenced by suspended solids, phytoplankton, and anthropogenic disturbances. Seasonal variation is common, with increased turbidity during monsoon. Secchi depth is often used as a substitute for transparency and varies from 0.2 m in eutrophic lakes to over 6 m in oligotrophic Himalayan lakes. High turbidity reduces light penetration, limiting photosynthesis by submerged plants and phytoplankton. Very clear water may allow excess light, causing thermal stratification and algal stress (Wetzel, 2001).

4. Comprehensive Review

In Indian lentic bodies, surface water temperature can range from 4°C in Himalayan lakes during winter to over 35°C in tropical regions during summer (Kumar & Dua, 2009). Temperature stratification is commonly observed in deep lakes such as Bhimtal or Nainital. Indian lakes usually exhibit a pH range of 6.5 to 8.5, indicating near-neutral to slightly alkaline nature (Trivedy & Goel, 1986). However, acidification has been reported in regions receiving acid rain or mining effluents. Indian urban lakes often report BOD values between 5–20 mg/L, significantly exceeding the permissible limit of 3 mg/L for Class B water (CPCB, 2019). High BOD levels in Dal Lake and Hussain Sagar are linked to untreated sewage inflow (Wani et al., 2011). Indian lakes such as Loktak and Bellandur show nitrate levels of 0.5–10 mg/L and phosphate levels of 0.2–2.5 mg/L (Singh & Swarup, 1980). These concentrations often exceed safe limits and result in ecological degradation. Higher pH and temperature increase the toxic NH_3 form. Values of TDS range from 150 to 1200 mg/L, with higher values reported in saline lakes like Sambhar (Rao et al., 2004).

A large number of investigators have investigated the lake water ecosystem and discussed the importance of physico-chemical characters of water in relation to biological status by Ramachandra and Sudhira (2007), Garg *et al.,* (2009), Verma *et al.,* (2012), Dixit (2015), Ingale *et al.,* (2018), Kandlikar and Bhosle (2019) and Gorghate *et al.,* (2020). Many researchers expressed their views on temperature of water such as temperature effect on water, ecosystem, metabolism and productivity, viscosity, reproductive activities and life cycles from diverse wetland those of Bhateria and Jain, (2016), Satar *et al.,* (2017), and Missaghi *et al.,* (2017). The role of water temperature and other physico-chemical parameter like dissolved oxygen, alkalinity from pond water correlation and seasonal fluctuation during the study reported by Sharma and Uchchariya, (2019) and Mukherjee *et al.,* (2022).

Chatterjee and Bhattacharjee (2015) has reported Sahebbandh's physical and chemical characteristics are probably going to alter as a result of the growing amount of commercial, residential, and industrial effluents that have been dumped into the river in recent years.

Thakor *et al.,* (2011) were observed average value of magnesium was 26 mg/L during rainy season, 29.5 mg/L during winter season and 33 mg/L during summer season. Verma *et al.,* (2012) noted during the research period, the pH varied across the whole length of the ponds, ranging from 9.0 to 11.0 in all the chosen freshwater ponds of the Bijnor, Uttar Pradesh, India. This variation persisted regardless of the month. Saxena (2012) had reported pH and temperature of the lake water it will depends, since ammonia becomes more harmful when it is at a higher temperature and has a faster conversion rate to ammonia gas. Between 0.42 mg/L to 1.56 mg/L, with an average value of 0.93±0.06 mg/L, ammonia fluctuated during the current investigation. During the summer, ammonia levels were higher than during the winter. The content of ammonia varied between 0.00 and 0.080 mg/L. Summer showed a greater value, which decreased throughout the wet season and was completely absent in winter (Abdar 2013).

Lodh *et al.,* (2014) had mentioned that, ammonia is a necessary component for life, it is hazardous to aquatic organisms, and an excess of it can raise pH levels or change metabolism. The average NH_3-N of the lakes under study varies from 0.06 to 3.20 mg/L, which is greater than the recommended threshold of BIS. The lowest value in MD is 0.00 mg/L, whereas the highest value in AS is 4.20 mg/L. For fish and other organisms, higher ammonia concentrations are toxic. Between 0.39 and 0.74 mg/L of ammonia were found in the current investigation. Summertime ammonia levels are higher, whereas wintertime levels are lower (Pawaiya *et al.,* 2014).

According to Chavhan (2015) during the winter, the lowest sulphate concentration was 5.20 mg/L at site A, while the highest concentration was 13.45 mg/L at site C during the monsoon. During the monsoon, the greatest phosphate concentrations were 0.33 mg/L and 0.27 mg/L at site C and site D. Winter minimum at site A was 0.031 mg/L. Choudhary and Janak (2015) studied on Sagar lake water has been found to have 3.72 to 9.62 mg/L of nitrate. The lowest documented level of nitrate in water came from observations made in the winter, while the highest level was noted during the rainy season.

Verma Ashok Kumar (2015) was observed the biochemical oxygen demand is the quantity of dissolved oxygen required by aerobic biological organisms to decompose organic matter within it over a predetermined amount of time and at a certain temperature. According to the research, BOD varied from 6.2 mg/L to 8.5 mg/L, with winter seeing the lowest levels and the monsoon seeing the greatest levels. The increased biological activity at higher temperatures during the monsoon season is linked to greater BOD levels.

Lonkar *et al.,* (2015) were discovered that the levels of dissolved oxygen (D.O.) were lowest in the summer (4.6 mg/L) and highest in the winter (5.6 mg/L). The wintertime maximum of DO may result from low air temperature and strong photosynthetic activity, whereas the summertime minimum may be caused by high temperature and low water solubility of oxygen. Upper level of phosphate content was noted in the month of August by Kumar *et al.,* (2016) from Garia dam, Jhansi, India. As per Yadav *et al.,* (2016), Chloride and sulphate is an indication of addition of domestic wastewater in a water body. In the present study, average chloride concentration was 1245.5 and 563.0 mg/L in post monsoon and winter, respectively. Mhaske and Talwankar (2017) study showed that the minimum dissolved oxygen of the water was 2.10 mg/L and the maximum was 4.9 mg/L in the month of November. Throughout the second year, April had the lowest measured dissolve oxygen of 2.9 mg/L and November had the highest, at 5.5 mg/L. Saini *et al.,* (2018) the water bodies receiving runoff from agriculture during the rainy season, the highest phosphate content (3.1 mg/L) was recorded during the monsoon season. Similarly, Raj and Sevarkodiyone (2018) from the pond Urinjikulam, Thiruthangal (Virudhunagar district, Tamil Nadu) the range of phosphate content was 0.36 to 2.86 mg/L.

According to Das *et al.,* (2017), despite the fact that the locals are drinking the water, the WQI analysis shows that the water quality in Loktak Lake is contaminated and unfit for consumption. Sub-indices of TDS, EC, COD, DO, and nitrite had high values, which contributed to the high WQI values. The outcome showed that before using the water, the locals needed to treat it. The biggest freshwater lake in the world has to be urgently protected from future contamination, which means that ongoing lake water monitoring and source identification are critical. Rana and Jain (2017) noted, during the research period, the pH varied along the whole stretch of the ponds, ranging in between 9.0 to 11.00 in all the chosen ponds. This variation persisted throughout the months. According to the current study, the majority of parameter values are higher than the desired limit, and variations in the ideal pH ranges may make water bodies more or less harmful.

Saha *et al.,* (2017) had mentioned that it is evident from the current research that the physico-chemical characteristics of the experimental water bodies varied significantly from one another. The greatest and lowest values of DO and BOD were also noted for the majority of the water quality metrics, which include pH, alkalinity, phosphate phosphorus, nitrate-nitrogen, and COD. Therefore, it may be inferred from the study as a whole that the health state is noticeably worse. The large amount of human activity and inadequate upkeep of this water body might be the cause. Chawhan and Shailaja (2017) studied the excessive levels of chloride were discovered in November. Over the research period, the lake's chloride concentration varied from a maximum of 396.66 mg/L to a minimum of 344.46 mg/L.

Bhandarkar (2017) noted that, in terms of seasonal variance, summertime values were as low as 0.7 mg/L and as high as 2.235 mg/L during the monsoon season. Additionally, showed that how the chloride values fluctuate. Bano and Chuahan (2017) were observed during the summer season, nitrate nitrogen levels varied from 0.41µg/L to 1.14µg/L. Similarly, during the monsoon season in 2011–2012, calcium hardness levels varied from 44 mg/L to 76.4 mg/L in the summer session. Meshram *et al.,* (2017) in Balsamudra Lake, in the current investigation, the monthly calcium hardness values ranged from 72.06 mg/Lit to 154.4 mg/Lit. For the 2012–13 year, the highest recorded calcium hardness was 154.4 mg/Lit in May and the lowest recorded calcium hardness was 72.06 mg/Lit in December. Kolala *et al.,* (2017) the

high calcium value might be the result of cationic exchange with salt or seepage of household waste and wastewater. Sheikh (2017) the maximum value of Sulphates 3.3mg/Lit was recorded in month of June at the sampling station B and minimum 1.2 mg/Lit was recorded in the month of December at the sampling station A.

The maximum concentrations of calcium hardness and magnesium hardness were reported to be 360 mg/L in April, 168 mg/L, and 68 mg/L in the month of May by Anita *et al.*, (2018). Agrawal *et al.*, (2018) noted the pH of abheda pond varied between7.13 to 8.9. Between January and March, the BOD concentrations ranged from 10.8 mg/L to 16.9 mg/L. The highest level of BOD detected in March. The lowest BOD was recorded in January, and then again in February (Adhikary *et al.*, 2018).

Bheemappa and Nandini (2018) stated that the peri-urban lakes' fast growth and man-made incursions are to blame for the variations in seasonal concentrations. Phosphate variations are concerning for the degradation of peri-urban lakes. Nitrate and phosphate concentration variations can be mitigated by monitoring phytoplanktonic production, preventing macrophyte decay, reducing nutrient inflow, releasing phosphate from bottom sediment, and reducing the organic load of the water from direct sewage entry and runoff from upland areas. Additionally, the use of non-phosphate detergents can help. Srinivas and Aruna (2018) observed during the course of the inquiry, the month of February had the largest amount of sulphates (135 mg/L), while the month of January had the lowest amount (62 mg/L). Devapriya *et al.*, (2018) stated that pH and temperature both affect free ammonia. Water with low pH has less free ammonia in the winter than it does in the other months. pH and temperature have an impact on free ammonia also water with a low pH has less free ammonia in the winter than it does in the other months (Devapriya *et al.*, 2018).

Medical waste and laboratory byproducts introduce sulphate, an inorganic chemical, into lakes. The highest concentrations are seen during the rainy season, while the lowest concentrations are found during the winter (Shivalingam 2019) from Adilabad district Town Lake. Additionally, Being an inorganic substance, phosphate is added to lakes by laboratory products and hospital wastes. The highest concentrations of phosphate are found during the rainy season, while the lowest concentrations are found during the winter. Shivalingam (2019) also measured the quantity of organic material in aquatic solutions that promotes the development of microorganisms is called biological oxygen demand. BOD highest values were observed in the summer and minimum values were reported in the rainy season during the research period. Being an inorganic substance, phosphate is added to lakes by laboratory products and hospital wastes. The highest concentrations of phosphate are found during the rainy season, while the lowest concentrations are found during the winter. Sharma and Uchchariya (2019) over the course of the investigation, noted that the water temperature in the Pagara reservoir varied from 20.42°C to 34.72°C also noted alkalinity, pH and hardness.

In the limnological study, various aspects such as biodiversity, physico-chemical status also the correlation of each and every parameters of ponds and lakes to find out the current scenario which is important for ecology and human development, to find out unsafe element such as Magnesium, calcium, sulphate phosphate and nitrate from different wetland is most significant work done by Tijare and Kunghadkar (2020) and (2021). The majority of the minerals existing in the water may be identified by looking at the TDS studied by many researchers those of Esmaeli and Joshi (2005), Ingale (2016), Bidwai (2021) and Khiratkar Sandip (2023).

Mani and Sahu (2020) were observed pond water values of pH, Chloride, Carbonate Alkalinity, Silicate and temperature comparatively higher than that of river water. Bhagde *et al.*, (2020) the alkalinity values ranged from 140 mg/L to 223 mg/L and 160 mg/L to 33 mg/L, respectively. Summertime records the highest value, and monsoon season records the lowest. According to Islam *et al.*, (2020) in comparison to the other two ponds, one had reduced DO and Secchi disc transparency. DO level was low for the most of the period, whereas BOD, TDS, and alkalinity levels were high, indicating substantial pollution from human influence. The local population made extensive use of three ponds for a variety of activities, such as swimming, fishing, cleaning clothing and utensils, disposing of household garbage, and runoff from the surrounding area. The use of pond water for drinking and other domestic purposes should be limited due to health concerns for humans. Activities like disposing of household waste, causing runoff, and using a lot of detergent should be avoided. Additionally, pond water should not be drunk untreated. Wanjari and

Tanpure (2020) had observed the values of chloride in the month of November and October, the maximum 120.29±88.85 and minimum 20.495±15.645. Prakash Sudhakar *et al.*, (2020) from Khanwari pond, noted temperature wide-ranging from 19.6 to 35.40^{o}C.

V. Rajani (2020) have noted the nitrate concentration varied from 0.22 to 0.55 mg/L. August had the highest nitrate readings (0.55 mg/L), while February had the lowest nitrate readings (0.22 mg/L). Das and Dey (2020) reported the concentration of nitrate peaked during the monsoon season (0.93 mg/L) and peaked during the pre-monsoon (0.43 mg/L). All of the seasons' results were below the 10 mg/L maximum allowable limit. Since there was no eutrophication throughout the monsoon season (0.74 mg/L) and the winter season (0.34 mg/L), the low concentration of nitrate-1 may have resulted from this. The following are guidelines recommended by WHO: The range of dosages that are classified as mild, hard, 120–180, and extremely hard is 60–120 mg/L, 180 mg/L, and above (World Health Organisation 2010). Jambhule and Telkhad (2020) the average annual magnesium hardness value was 20.38 ± 4.20 mg/L. Calcium and magnesium salt deposition might be the cause of the greater overall hardness levels of the water.

Mishra and Singh (2021) in the winter, summer, and rainy seasons, fluctuations were noted in a number of physico-chemical parameters. The research indicates that the water in Govindgarh Lake has elevated levels of temperature, pH, alkalinity, chloride, dissolved oxygen and biochemical oxygen demand. These conditions are caused by the addition of detergents and soap from washing clothes near the lake, which is directly released into the water, as well as evaporation of water, which intensifies the concentration of water in the lake during the summer months. According to Acharya *et al.*, (2021) consequently, sewage and sullage discharge from rainfall runoff are linked to NO_3-N concentration. The lake water's NO_3-N content varied from 0.04-0.35 mg/L. Jia, Z. *et al.*, (2021) measured the pond's nitrate levels, it has been suggested that man-made impermeable surfaces might be one of the main sources of nitrogen in urban lakes. The findings showed that the physicochemical characteristics of Shiroli lake water varied seasonally (Anekar and Dongare, 2021) from the study examines that the variations in physico-chemical characteristics were examined, including temperature of the air and water, transparency, pH, total dissolved solids, dissolved oxygen, free carbon dioxide, hardness, total alkalinity, calcium, and magnesium.

The lowest recorded ambient temperature (24°C) occurred in the post-monsoon months, while the highest temperature was recorded in the premonsoon month of May (Mukherjee *et al.*, 2022). Chekole (2022) mentioned rocks that have weathered may be connected to the total alkalinity value that was measured. T. Deepak (2022) found that the highest and lowest alkalinity levels were recorded in Manimutharu Reservoir (19 mg/L) and Gadana Reservoir (69 mg/L) in the months of May and December. In all three reservoirs, the nitrate levels varied from 0.16 to 0.762 µg/L. The monsoon season's maximum nitrate value (0.762 µg/L) in the reservoirs may have been caused by atmospheric washouts, domestic sewage, surface runoff, washing operations, and surface runoff. The summer season's maximum magnesium concentration of 41.44 mg l-1 was recorded at the Gadana Reservoir's inflow section. According to a research Subhashish Dey (2022) had done on the Gudlavalleru College Pond, the summer months had the greatest mean temperatures, plus or minus pH values, and total alkalinity levels. Chekole *et al.*, (2022) there may be a connection between the increased total alkalinity value observed and the waste discharge, weathered rocks, and microbial breakdown of organic materials at those locations.

Maansi, *et al.*, (2022) had noted in the lake, relatively low concentrations of phosphate were discovered. The highest phosphate concentrations were recorded in the monsoon (0.17–0.26 mg/L), followed by the summer (0.02–0.1 mg/L), winter (0.02–0.09 mg/L), and post monsoon (0.03–0.05 mg/L). In contrast, the highest concentration was recorded in the monsoon (0.03–0.06 mg/L), followed by the winter (0.01–0.05 mg/L), post monsoon (0.01–0.02 mg/L), and summer (0.01–0.02 mg/L). Parveen *et al.*, (2022) the phosphate levels varied from 5.10 mg/L to 8.58 mg/L and 5.00 mg/L to 8.27 mg/L. The pre-monsoon's high phosphorus levels were caused by the lower water table. Elevated phosphorus levels were seen during the monsoon. Surface runoff mixed with the reservoir's influent water and contributed to it. Maximum calcium and magnesium levels (94 mg/L; 101 mg/L and 45.9 mg/L; 50.3 mg/L) were recorded in the pre-monsoon months.

Rashid and Prakash (2022) had conducted the study of VikramTearth Sarovar the evaporation of water in the chosen biotope led to the accumulation of this cation, which is primarily responsible for the elevated calcium levels seen during the summer months. Additionally, as dead plants and animals decompose, it is released. On the other hand, dilution was the reason for the low calcium levels in VikramTearth Sarovar during the postmonsoon season. A greater sedimentation rate that causes the particles to settle on the bottom, be used by plankton species, and then be incorporated into chlorophyll may be the reason for the lower magnesium values seen during the winter.Mehta and Arti (2022) in contrast to Maharani Pokhar, Harahi Talab water was found to have observed values on temperature, magnesium, carbonate, chloride, BOD, and free CO2 that were much higher. However, Harahi Talab water was found to have lower values on pH, transparency, dissolved oxygen, and bicarbonate. Elevated BOD values are seen as a sign of eutrophication in sewage water and are also associated with decreased fish yield.

From the water analysis of Nehtada pond, Alirajpur, Madhya Pradesh by Dawar and Sohani, (2022) the pond water's physico-chemical analysis in Karra Gramme Panchayat, during the rainy season, a sample was collected from pond water. Most of the parameters were found to be within the acceptable range; among all the pond water studied, TDS, pH and nitrate had the highest values, but other parameters were also found to be within the acceptable range. These included total hardness, magnesium, alkalinity, chloride, fluoride, and TDS, all of which were below the WHO permissible limit. Will provide further details about the water sample from this pond. All things considered, a thorough examination of the rainy season pond water, including other relevant parameters, reveals good condition. Additional thorough examination in various seasons and other relevant involved aspects also sheds insight on these pond's distinctive qualities and status.

According to Dharma Guru Prasad (2022) after conducting a number of studies, it was determined that the summer months had the largest density of zooplanktons due to evaporation, while the winter months had the lowest density. Rain will cause the water concentration to drop, which will lower the zooplankton density. Thus, one may claim that water temperature helps encourage the variety of zooplankton populations. Because of this, they are continually being investigated in more depth to ensure that they are fully understood and to get a better understanding of the potential future effects of climate change on zooplankton variety in the aquatic ecosystem.

Nagpurkar *et al.*, (2023) had studied on five selected lakes of Bhandara, the water temperature fluctuated from a low of 24.1°C to a maximum of 35.15°C during the course of the research. According to the study findings from Puliyanthangal lake of Ranipet, Tamilnadu by Maheswari and Sivachandrabose (2023) that although the other parameters were within the allowable range, a number of physico-chemical properties, including TDS, calcium, magnesium, iron, manganese, and chloride, were found to be higher than permitted limitations. Additionally, the ammonia concentrations in the water were changed to range from 0.04 to 1.22 mg/L. The highest levels of free ammonia in water were recorded in the summer and the lowest in November of the subsequent year.

According to Mali and Sharma (2023), the average pH throughout the research period was 9.10±0.58, which is quite alkaline and supports the lake's mesotrophic condition and pretty strong aquatic production. Among other things, nitrate-nitrogen, total alkalinity, and pH all had favourable correlations. Mukherjee *et al.*, (2022) have been stated that dissolved oxygen in water is one of the most significant characteristics in aquaculture, along with temperature and pH, since oxygen (O_2) has a direct impact on feed intake, disease resistance, and metabolism, maintaining adequate D.O levels in the water is crucial for optimal production of fish. Mali and Sharma (2023) measuring 9.10±0.58 at the time of investigation, the mean pH was found to be rather alkaline, supporting the lake's mesotrophic state and reasonably strong aquatic production. Nitrate-nitrogen, total alkalinity, and pH all exhibited favorable correlations.

According to Santhi *et al.*, (2023) One of the most prevalent ions, calcium is necessary for the production of bones, shells, and plant precipitation. Vanderthangal had the highest ammonia concentration (6.5 mg/L), whereas Dharapadavedu had the lowest (0.1 mg/L), along with the lowest calcium content (50 mg/L), BOD, and highest ammonia concentration. The highest concentration of sulphate found in the water in Dharapadavedu is 285 mg/L, whereas the highest concentration found in Vanderthangal is around 160 mg/L. The highest concentration of sulphate found in the water in Dharapadavedu is 285 mg/L, whereas the highest concentration found in Vanderthangal is around 160 mg/L. Baser (2023) during the research

year, BOD was measured at all sampling sites with a minimum of 9.22 mg/L at site S3 in the winter month of December. Thereafter, there was a rise until it peaked at site S4 with 36.07 mg/L in the summer month of June.

Singh *et al.,* (2023) have been introduced the majority of the metrics of Mahil pond's water, according to its physico-chemical characteristics, are within allowable bounds. Nonetheless, it was discovered that several parameters—such as pH, dissolved oxygen (DO), biological oxygen demand (BOD), and water hardness levels—were higher than the World Health Organization's (WHO) permitted limits. Across all seasons, the alkalinity parameter showed the highest values of all the physico-chemical parameters. That being said, it is significant that the alkalinity readings are higher above the WHO-established tolerable limits. A thorough assessment of the pond water in each of the three seasons, including a study of relevant metrics, indicates that the situation is not ideal. Throughout the summer, monsoon, and winter seasons, there are noticeable seasonal fluctuations in the physico-chemical parameters. Notably, a number of physico-chemical indicators that are cause for worry show that the pond's water is showing signs of contamination. It is possible that the pond's condition could be significantly improved by putting in place specific measures like rerouting sewage flow, forbidding the disposal of waste into the pond, and planting trees in the immediate vicinity.

During the research period Shivnibandh Lake by Nagpurkar *et al.,* (2023) noted the water temperature fluctuated from a low of 24.1°C to a maximum of 35.15°C also comparatively lower value than the other lakes studied, this might be explained by the lake's restricted aquatic plant presence. The growth in human activities, including agricultural practices, livestock grazing, and the dumping of household garbage, is responsible for the reduction in water quality in all lakes except Shivnibandh Lake. TDS in Pagaradam, varied from 85.5 to 194.25 mg/Lit in June to May and from 103.25 to 228 mg/L. the lowest total dissolved solids were measured 102.45 mg/L and 119 mg/Lit, in December (Tripathi and Mishra, 2019). Kumar and Singh (2023) observed that the average temperature, pH, and total alkalinity peak during the summer and fall, respectively, and that the dissolved oxygen standards peak during the winter and fall during the monsoon. Inadequate water quality can lead to low profits, decreased product value, and potential health problems for humans. When pollutants are present in the water, it can hinder the development, reproduction, or even cause the cultivated species to die, which nearly always results in a loss in productivity.

Mali and Sharma (2023) had measured 9.10±0.58 at the time of investigation, the mean pH was found to be rather alkaline, supporting the lake's mesotrophic state and reasonably strong aquatic production. Nitrate-nitrogen, total alkalinity, and pH all exhibited favorable correlations. Suresha *et al.,* (2023) the findings of the physico-chemical analysis of the Thippayya lake water quality indicate that the following parameters are marginally over normal: turbidity, total dissolved solids, pH, alkalinity, dissolved oxygen, B.O.D., and phosphate concentrations. The existing and potential future conditions may have a major influence on the growth of aquatic and terrestrial creatures in the water repository. Another danger to the quality of the water is the presence of major toxins that leak from home areas.

The distribution and variety of zooplankton species, as well as physicochemical factors, have a substantial impact on Anchar lake water quality (Akhtar *et al.,* 2023) the primary determinants of the composition, distribution, abundance, and richness of zooplankton species include temperature, nutrients, chloride, and free carbon dioxide. In addition, the greatest Rotifera richness at every site points to a eutrophic Anchar lake. It was noticed that the utmost Shannon-Wiener diversity index. According to Meenal and Sharma (2023) the range of calcium hardness measured at site-I was 12.80 mg/L to 77.33 mg/L, but at site-II it was recorded between 12.97 mg/L and 77.17 mg/L. The seasonal values of calcium hardness are recorded lowest in winter and maximum in summer Sana and Tripathi (2024) recently mentioned that elevated photosynthetic rate, algal biomass, and mild temperature may be the cause of the maximum DO content (9.9 mg/L) seen in the transitional zone during winter. Human and aquatic life require a suitable degree of DO to be healthy. In March, the highest concentration of DO was observed to be 8.45 mg/L, while in May, the lowest concentration was 6.87 mg/L. Singodia *et al.,* (2024) the greatest DO value (9.37 mg/L) was recorded during the winter, while the lowest (6.02 mg l) was found during the summer. Water enters the dam, has superior water quality as indicated by a higher DO value. Due to both natural and human influences, the summertime lowest DO readings indicated poor water quality.

5. Conclusion

The physico-chemical characteristics of lentic water bodies in India show considerable spatial and temporal variation. Many are under severe stress due to anthropogenic pressures, reflected in elevated nutrient loads, oxygen depletion, and increased turbidity. Integrated and adaptive water quality monitoring and restoration strategies are essential to safeguard these vital ecosystems. Regular monitoring of water quality using physico-chemical parameters is critical. Use of biological indices (e.g., diatoms, macroinvertebrates) alongside physico-chemical data enhances ecological assessment. Management strategies should include: Buffer zone creation, wastewater treatment before discharge, promotion of sustainable agriculture and community-based conservation.

6. References

- **Abdar M. R. (2013).** Physico-chemical characteristics and phytoplankton of Morna Lake, Shirala (M.S.) India. I Q J BIO and Life Sci. Vol. 1, Issue 2: pp.1-7.
- **Abhas Jain, S. K. Singh (2013).** Limnological Studies Related to Physico- Chemical Characteristics of Water in Anasagar Lake, Ajmer, Rajasthan. International Journal of Advance Research and Innovation. Volume 1, Issue 1 65-72 ISSN 2347 - 3258
- **Acharya A. P., Kamble B. S. and Salunkhe H. J. (2021).** New hydrobiological study of Koyana Dam, life line of Maharashtra. International Journal of Multidisciplinary Educational Research Vol 10, Issue 12 (1).
- **Adhikary Jayati, Maity Atanu, Das Bipul Kumar, Ghosh Satarupa and Pal Prasanna. (2019).** Physicochemical characteristics of a sewage-fed pond of Kolkata, West Bengal.The Pharma Innovation Journal. 8(5):pp.724-728.
- **Agrawal Sushma, Chourasia Veena, Soni Pankaj (2018).** Study of seasonal variations in physicochemical parameters of Abheda pond, Kota district, Rajasthan. IJARSE.Vol. 7 (2).
- **Akhtar Maqsooda, Bakhtiyar Yahya, Zahoor Ahmad Mir, Muni Parveen and Raheela Mushtaq. (2023).** Studies on Limnological Parameters and their Impact on the Distribution and Diversity of Zooplankton in Anchar Lake, Kashmir.Curr. World Environ. Vol. 18(2):pp.810-832.
- **Anekar Smita and Dongare Meena. (2021).** Study on the fluctuation in the physico-chemical parameters of Shiroli Lake, Kolhapur. International Journal of Ecology and Environmental Sciences. Volume 3, (4):pp.46-50.
- **Anita S. M., Hatti Shankerappa S. and Majagi Shashikanth. (2017).** Limnological study of Nagaral dam Chincholli, Kalaburagi, Karnataka, India. RJLBPCS. 4(6):pp.524-530. DOI: 10.26479/2018.0406.41.
- **APHA (2017).** Standard Methods for the Examination of Water and Wastewater (23rd ed.). American Public Health Association.
- **Bano Zahida and Chuahan Rajendra. (2017).** Assessment of water quality of Upper Lake Bhopal.World Journal of Pharmaceutical Research.Vol 6, (7).
- **Baser Rakesh Kumar. (2023).**Water Quality Assessment Using Physico-Chemical and biological Parameters of Hameer Pond in Ajmer District, Rajasthan (India).Innovation the Research Concept. Vol. VIII (I).
- **Bhagde R. V., Pingle S. A., Bhoye M. R., Pansambal S. S. and Deshmukh D. R. (2020).** A comparative study of physico-chemical parameters of the freshwater ponds from Sangamner Taluka of Ahmednagar, Maharashtra, India.IJBI 2 (2):pp.137-142.
- **Bhandarkar Sudhir V. (2017).**Water quality analysis of Dhukeshwari temple pond Deori with reference to cultural eutrophication. IAJPS, 4 (11).pp.4404-4416
- **Bhateria Rachna and JainDisha. (2016).** Water quality assessment of lake water: a review. Sustain. Water Resour. Manag. 2:pp.161–173.
- **Bheemappa K and Nandini N. (2018).** Seasonal variation of Water quality in the Peri urban Lakes of Bengaluru Urban area, Karnataka, India. International Journal of Scientific Research in Multidisciplinary Studies Vol.4, (9):pp.01-05.
- **Bidwai Rajashree T. (2021).** Limnological studies on fresh water ponds with reference to plankton communities near Mul District: Chandrapur (M.S). Ph.D. thesis awarded at Gondwana University Gadchiroli Maharastra India.
- **Boyd, C.E. (1990).** Water Quality in Ponds for Aquaculture. Auburn University, Alabama Agricultural Experiment Station.

- **Boyd, C.E., & Tucker, C.S. (1998).** Pond Aquaculture Water Quality Management. Springer.
- **Camargo, J.A., Alonso, Á., & Salamanca, A. (2005).** Nitrate toxicity to aquatic animals: a review with new data for freshwater invertebrates. *Chemosphere*, 58(9), 1255–1267.
- **Central Pollution Control Board (CPCB). (2019).** *Water Quality Criteria*. Ministry of Environment, Forest and Climate Change.
- **Chatterjee Nilanjana and Bhattacharjee Baibaswata. (2015).**Quantitative study on the impact of the seasonal change in the aquatic physicochemical parameters on zooplankton population density in "Sahebbandh", Purulia, West Bengal, India. Discovery Nature, 9, (19): pp.11-19.
- **Chavhan, R. N. (2015).** Limnological Studies on Talodhi Village Lake of tahsil Chamorshi, District Gadchiroli (M.S.), India, With Special Respect to Plankton Species Diversity. IJRBAT, Special Issue-(6).
- **Chawhan Laxmi Poornima and Shailaja K. (2017).** Assessment of Physico-Chemical Parameters in Mantrala Lake, Hyderabad. International Journal of Scientific Research in Science and Technology 3(8): pp. 1039-1042.
- **Chekole Ephrem, Henok Kassa, Abebe Aschalew, and Lalit Ingale. (2022).** Physicochemical Characterization of Dembi Reservoir Water for Suitability of Fish Production, Southwest Ethiopia. Hindawi Biochemistry Research International Volume., doi.org/10.1155/2022/1343044.
- **Choudhary Anjana and Janak Ahi. (2015).** Analysis of water quality in Polluted Sagar Lake by investigating different physico-chemical parameters. International Journal of Multidisciplinary Research and Development, Volume: 2, (9):pp.25-30.
- **Das Kangabam Rajiv, Devi Bhoominathan Sarojini, Suganthi Kanagaraj and Munisamy Govindaraju. (2017).** Development of a water quality index (WQI) for the Loktak Lake in India. Appl Water Sci. 7:pp.2907–2918. DOI 10.1007/s13201-017-0579-4.
- **Das Piyali and Dey Mithra. (2020).** Seasonal Variation of Physicochemical Parameters of Aquaculture Ponds in District Karimganj, Assam. Indian Journal of Ecology 47(3):pp.746-750.
- **Das, M.K., & Sharma, A.P. (2005)**. Water Quality Guidelines for the Management of Pond Fish Culture. CIFRI, India.
- **Dawar Manju and Smruti Sohani. (2022).** Study of Physico-Chemical Parameters of Nehtada Pond Water in District Alirajpur, Madhya Pradesh, India.International Journal of Creative Research Thoughts.Volume 10, (8).
- **Devapriya J. Prescilla, Sheeja B. D. and Ebanasar J. (2018).** Influence of Sulfate, Phosphate, Ammonia and Dissolved Oxygen on Biochemical Oxygen Demand of Marlimund Lake, Ooty, The Nilgiris. IJPBA. Vol 9 (3).pp.157-162
- **Devi, L. J., et al. (2015).** Assessment of Water Quality Parameters of Loktak Lake. Indian Journal of Environmental Protection, 35(4), 321–328.
- **Dharma Guru Prasad MP. (2022).** Studies on Physico-chemical aspects and Zooplankton diversity of Marehalli Lake, Mandya District, Karnataka, India. Bull. Env.Pharmacol. Life Sci., Special Issue [1]:pp.1327-1334.
- **Dixit, A. K. (2015).**Study of physico-chemical parameters of different pond water of Bilaspur district, Chhattisgarh, India. Environmental Skeptics and Critics, 4(3):pp. 89.
- **Dwivedi, B.K. and Pandey, C.G. (2002).** Physicochemical factors and algaldiversity of two ponds in Faizabad, India. Poll. Res. 21(3): 361-370.
- **Dwivedi, S.L. and Pathak, V. (2000):** Studies of water quality of Mandakini rules in Chikrakoot for irrigation purpose. Indian J.Env.Prof. 27(8):757-754.
- **Esmaeli H. R. and M. S. Joshi. (2005).** Physico-chemical parameters of water of Gobind-Sagar reservoir India, In proceedings of Nat. Sem. on new trends in fishery development in India, Punjab Uni., Chandigarh .J. B Moyle; Trans. Amer. Fish. Soc., 1949,76,322.
- **Garg, R. K., Rao, R. J. and Saksena, D. N. (2009).**Water quality and conservation management of Ramsagar Reservoir, Datia, Madhya Pradesh. J. Environ. Biol., 30(5): 909.
- **Gorghate Nilesh D., Raut Mahendra B., and Ingale Prashant P. (2020).** Assessment of water quality status of Chichtola Lake in Gondia District of Maharashtra State, India. Int. Res. J. of Science & Engineering, Volume 8 (6):pp.235-240.
- **Gray, A.V. (1989):** Case study on water quality modeling of Dianchi lake, Yunnan province, Southwest China. Water Sci. Technol. 40: 35-43. https://doi.org/10.1007/s13201-021-01534-x

- **Ingale P.P., Bobdey A.D. and Lonkar A.N. (2016).** Seasonal Study of Zooplanktons Quantitative and Qualitative Analysis in Bhiwapur Lake Dist: Nagpur (M.S) India. Int. J. of Life Sciences, Special Issue (A6):pp.173-176.
- **Ingale P.P., Bobdey A.D., Gorghate N.D. (2018).** Comprehensive hydrobiological status of Bhiwapur Lake of Maharashtra, India: an environmental aspect. Journal of the Chinese Advanced Materials Society 6 (4):pp.655-665.
- **Islam Md. Saiful, Azadi M. A., Nasiruddin Munira, and Islam Md. Safiqul. (2020).** Limnology of Three Ponds in Chittagong University Campus, Bangladesh.American Journal of Environmental Engineering. Volume 10(2):pp.21-34.doi:10.5923/j.ajee.20201002.01.
- **Jambhule S.H. and Telkhad P.M. (2020).**Water quality status of Chorgaon Lake near Chandrapur, Maharashtra, India. Int. Res. J. of Science & Engineering; Special Issue A7:pp. 390-394.
- **Jia Z., Chang X., Duan T., Wang X., Wei T., and Li Y. (2021).** Water quality responses to rainfall and surrounding land uses in urban lakes. J. Environ. Manage. 298:113514.10.1016/j.jenvman.2021.113514.
- **Kalff, J. (2002)**. Limnology: Inland Water Ecosystems. Prentice Hall.
- **Kandlikar A. and Bhosle A. (2019).** A study on watr nutrient content of Dhanora reservoir-An ecological and pollution investigation. Indian J. Env. Prot., 39(4):pp.364-368.
- **Khiratkar Sandip. (2023).** Limnological studies with reference to biotic factor of Labhansarad Dam in Warora Taluka Chandrapur District, Maharashtra State, India. Ph.D. thesis awarded at Gondwana University Gadchiroli Maharastra India.
- **Kolala Venkatararamanaiah, Naik V N Jayaram, and Philip G. H.(2017).** Analysis of Water Quality Parameters of Owk Reservoir (Sri B V Subba Reddy Sagar), Owk, Kurnool District, Andhra Pradesh, India.SSRG International Journal of Agriculture and Environmental Science.Volume 4 (5).pp.13-21.
- **Kumar Hemant, Ansari Gazala, Bano Shahzadi, Sheeba Qureshi, Ajay Kumar, Prachi Arya and Kushwaha Kiran. (2016).** physico – chemical studies of Garia dam, Jhansi, India. J. Exp. Zool. India. Vol. 19, (1): pp.1351-1353.
- **Kumar, A. Tripathi, S. and Ghosh, P. (2004):** Status of fresh water in 21st century, Daya Publishers,Delhi: 520.
- **Kumar, A., & Dua, A. (2009).** Water Quality Index for assessment of water quality of river Ravi at Madhopur. Global Journal of Environmental Sciences, 8(1), 49–57.
- **Latha N. and M. Ramachandra Mohan (2010).** Water quality studies of Hoskerehalli Lake Of Bangalore Karnataka. Journal of Applied Geochemistry Vol.12 No.2. pp. 261-271.
- **Lewis, W.M., & Morris, D.P. (1986).** Toxicity of nitrite to fish: a review. Transactions of the American Fisheries Society, 115(2), 183–195.
- **Lodh R., Paul R., Karmarkar B. and Das K. M. (2014).** Physico-chemical studies of water quality with special reference to ancient lakes of Udaypur City, Tripura, India. I J S R P. Vol. 4(6):pp.1-9.
- **Lonkar SS, Kedar GT and Tijare RV (2015).** Assessment of trophic status of Ambazari Lake, Nagpur, India with emphasis to Macrozoobenthos as Bioindicator.Int. J. of Life Sciences. Vol. 3(1):pp.49-54.
- **Maansi, Jindal R., and Wats M. (2022)**. Evaluation of surface water quality using water quality indices (WQIs) in Lake Sukhna, Chandigarh, India. Applied Water Science.12:2.pp.1-14.
- **Maheswari M., and Sivachandrabose K. (2023).**Assessment of Physicochemical Parameters of Water in Puliyanthangal Lake of Ranipet, Tamilnadu, India. Int J Zoo Animal Biol. 6(1):pp.1-10
- **Mali V. and Sharma B.K. (2023).** Assessment of water quality parameters of salt Lake Didwana, Rajasthan, India. The Pharma Innovation Journal. 12(5):pp.3455-3457.
- **Mani S. and Sahu K.K. (2020).** Physico-chemical analysis of ponds and river water in Darbhanga.IJCRT.Volume 8, (12).pp.1428-1444.
- **Meenal R. and Sharma V. K. (2023).** Assessment of Surface Water Quality and Physicochemical Analysis of Mamchari Dam in District Karauli (Rajasthan), India.Biological Forum – An International Journal. 15(5):pp.859-869.
- **Mehta Nitesh Kumar and Kumari Arti. (2022).** Study of water quality using of physico-chemical parameters of two perennial fish ponds of Darbhanga. International Journal of Fisheries and Aquatic Studies; 10(3):pp.128-132.

- **Meshram U. G., Dahare R. B. and Dhamani A. A. (2017).** Study on physico-chemical parameters of Kurhada Lake at Pauni, Bhandara District, Maharashtra. IJRBAT, Special Issue (2), Vol-V.pp.899-904.
- **Mhaske T. K. and D. S. Talwankar. (2017).**Water quality analysis of Khadakpurna reservoir in Buldana district –Maharashtra. Int. J. Adv. Res. 5(8):pp.1295-1303.
- **Mishra Shipra and Singh Praveen. (2021)**. Studies on the Physico-chemical parameters and correlation coefficient of Govindgarh Lake, Rewa (M.P.). Int. J. Adv. Acad Stud ; 3(2):pp.34-38. DOI: 10.33545/27068919.2021.v3.i2a.534.
- **Missaghi Shahram, Hondzo Miki and Herb William (2017).**Prediction of lake water temperature, dissolved oxygen, and fish habitat under changing climate. Climatic Change, 141 (4):pp.747-757, Doi: 10.1007/s10584-017-1916-1.
- **Mohan, S. V., Ramanaiah, S. V., Rajkumar, B., & Sarma, P. N. (2000).** Characterization and treatment of wastewater from a bulk drug manufacturing industry. *Journal of Environmental Science and Health*, 35(5), 821–842.
- **Mukherjee P., Kumar P., Gupta S. K., and Kumar R. (2022).**Seasonal variation in physicochemical parameters and suitability for various uses of Bouli pond water, Jharkhand. Water Science. Vol.. 36, No. 1:pp.125–135 https://doi.org/10.1080/23570008.2022.2127552.
- **Nagpurkar Laxman P., Ambilkar Shubham C. and Bawankule Vikas P. (2023).** Water quality analysis using physiochemical parameters and Geospatial distribution for five selected lakes of Bhandara district in Maharashtra state, India.Journal of Advanced Scientific Research.14 (11).
- **Parashar, C., Dixit, S. and Shrivastava, R.** (**2006).** Seasonal Variations in Physico-chemical Characteristics in Upper Lake of Bhopal. Asian J. Exp. Sci.20(2):297-302.
- **Parveen Shabnam, Haque Mohd. Shamsul and Kashyap Vinita R. (2022).** Study of characteristics of water and fish production in Umrar Dam of Umaria District (M.P.) India. International Journal of Fisheries and Aquatic Studies; 10(4):pp.17-21.
- **Pawaiya Namrata, Sharma D. K. and Khushwah M. K. S. (2014**). Analysis of physico-chemical parameters in Harsi Reservoir Dabra, Gwalior District, Madhya Pradesh. I J I S R. Vol. 11, (2):pp.248-258.
- **Raj J.A. and Sevarkodiyone S.P. (2018).** A study on physico-chemical parameters of Urinjikulam Pond, Thiruthangal (Virudhunagar District, Tamil Nadu). Int J Aquac Fish Sci 4(1): pp010-012. DOI: http://doi.org/10.17352/2455-8400.000036.
- **Rajani V. (2021).** Zooplankton Diversity and its Indices in Relation to Physico-Chemical Parameters of Fresh Water Lake at Karimnagar District, Telangana State, India. International Journal for Innovative Research in Multidisciplinary Field.Vol.7(9).
- **Ramachandra T.V. and Sudhira H.S. (2007).** Present status of Gottigere Tank: Indicator of Decision maker's apathy. Energy and Wetlands Research Group, pp.1-11.
- **Rana Nisha and Jain Seema (2017).**Assessment of physico - chemical parameters of freshwater ponds of district Bijnor (U. P), India. Journal of Entomology and Zoology Studies; 5(4):pp.524-528.
- **Rao, R. J., Sharma, M. S., & Sharma, B. K. (2004).** Seasonal and spatial variation in physicochemical parameters and plankton in a freshwater reservoir. *Journal of Environmental Biology*, 25(1), 67–74.
- **Rashid Haroon and Prakash M.M. (2022).** Assessment of Physico Chemical Parameters of Water and Their Seasonal Variation in Vikram Tearth Sarovar, Ujjain (M.P).Journal of Pharmaceutical Negative Results. Volume 13 (5).
- **Ravichandran, P., et al. (2018)**. Nutrient dynamics of a tropical estuarine lake in India: Vembanad Lake. *Environmental Monitoring and Assessment*, 190(4), 204.
- **Reddy, K.R., & Delaune, R.D. (2008).** Biogeochemistry of Wetlands: Science and Applications. CRC Press.
- **Saha Shibam, Mandal Abhrajyoti and Sahoo Diptimoyee. (2017).** Study of physico- chemical parameters of three different urban pond water of Nadia district, West-Bengal, India. Internationa Journal of Fisheries and Aquatic Studies.5(6):pp.23-27.
- **Saini Dhavan, Bamniya B.R., Mahecha G.S. and Nair Neelima (2018).** Seasonal Variation in Water Quality of Kakund River at Bandh Baretha Wildlife Sanctuary: A Case Study of Bandh Baretha Dam, Bharatpur, Rajasthan. IJSRR. 7(4):pp.1268-1273.

- **Sana and Tripathi Poonam (2024).**Water Quality Assessment of Tumaria Reservoir (Udham Singh Nagar).International Journal of Creative Research Thoughts.Volume 12(1).
- **Sangodoyin, A.Y. (1991)**. Groundwater and Surface Water Pollution by Open Refuse Dump in Ibadan, Nigeria. Journal of Discovery and Innovations, 3, 24-31.
- **Santhi K., N. Uma Chandra Meera Lakshmi, M. Noornissabegum, A. Nancy Lesley (2023).** A Study of the Physiochemical Parameters of Two Lakes in Vellore District, Tamilnadu State, India. Journal of Survey in Fisheries Sciences 10(3):pp.6707-6715.
- **Satar-Abdel A.M., Khabbas- Al, Alahmad M.H., W.R., Yousef, W.M., Alsomadi, R.H., Iqbal, T. (2017).** Quality assessment of groundwater and agricultural soil in hail region, Saudi Arabia. Egypt. J. Aquat. Res. 43 (1):pp.55–64.
- **Saxena Meenakshi. (2012).** Water quality and trophic status of Raipur reservoir in Gwalior, Madhya Pradesh.Journal of Natural Sciences Research.Vol.2, No.8.
- **Schindler, D.W. (1977).** Evolution of phosphorus limitation in lakes. *Science*, 195(4275), 260–262.
- **Schindler**, **D.W. (1988)**. Effects of acid rain on freshwater ecosystems. *Science*, 239(4836), 149–157. https://doi.org/10.1126/science.239.4836.149.
- **Sharma, P., Sharma, K. K., & Bhatnagar, A. (2010)**. Water quality assessment of wetlands in the vicinity of Udaipur, Rajasthan, India. International Journal of Environmental Sciences, 1(1), 46–54.
- **Sharma Dushyant Kumar and Uchchariya Rakhi (2019).** Studies on physico–chemical parameters of Pagara Reservoir, Joura, district Morena (M.P.). International Journal of Fisheries and Aquatic Studies; 7(1):pp293-298.
- **Sheikh S. R. (2017).** Limnological Study of Maddikuntta Lake, District: Gadchiroli (Ms). Int. J. Adv. Res. 5(3):pp.1288-1292.
- **Shivalingam Pothula. (2019).** A case study of physico: Chemical and biological parameters of Adilabad district town lake. Andhra International Journal of Molecular Biology and Biochemistry.Volume 1(1):pp.22-26.
- **Singh, M. R., & Swarup, K. (1980)**. Limnological studies on Suraha Lake, Ballia (U.P.): The Physico-Chemical Characteristics of Water. Acta Hydrochimica et Hydrobiologica, 8(4), 409–419.
- **Singh Rashmi, Niranjan Shreyasi and Nagar Sasya. (2023).**Study of Physico-chemical Parameters on a Fresh Water Pond of Orai, U.P., India. Uttar Pradesh Journal of Zoology. Volume 44, (10):pp.83-93.
- **Singodia R.R., Nirmal N.K. and John P.J. (2024).**Assessment of water quality of Kot Dam, Rajasthan, India, Using water quality index. J. Environ. Biol., 45, 171-181.
- **Srinivas M and Aruna M (2018).**Physico-Chemical analysis of a Lake, Erra Cheruvu in Siddipet district of Telangana State, India.International Journal of Recent Scientific Research Research., Vol. 9, 10(E), pp.29420-29425.
- **Stumm, W., & Morgan, J.J. (1996).** Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters (3rd ed.). Wiley.
- **Subhashish Dey. (2022).**Seasonal variation in water quality parameters of Gudlavalleru pond.LAP Lambert Academic Publishing. ISBN-13: 978-613-9-45332-0. Chemical technology.
- **Sudhakar Prakash, Shri Prakash, and Anuj Kumar Singh (2020).**Limnological Studies of Khanwari Pond of Kaushambi District (U.P.) In Relation to Planktons. ICONIC RESEARCH AND ENGINEERING. Volume 3 (12):pp.154-160.
- **Suresha N. S., Smitha N. and Shiva Kumar D. (2023).**Study of influence of environmental variables on water quality parameters of Thippayya Lake of Mysore, India. World Journal of Advanced Research and Reviews, 17(01):pp.1218–1228.
- **T. Deepak, P. Padmavathy, V. Rani, D. Manimekalai and S. Subhashree Devasena (2022).**Water quality parameters and nutrient status of selected reservoirs in Tamil Nadu, India. Indian J. Fish., 69 (4):pp.28-35, DOI: 10.21077/ijf.2022.69.4.125726-03.
- **Thakor F. J., Bhoi D. K., Dabhi H. R., Pandya S. N. and Chauhan Nikitaraj B. (2011).** Water Quality Index (W.Q.I.) of Pariyej Lake Dist. Kheda-Gujarat. Curr World Environ. 6:pp.225-231 DOI:http://dx.doi.org/10.12944/CWE.6.2.19.
- **Tijare R. V. and Kunghadkar G. E. (2020).**Study of limnological status of Kunghadabandh Lake and Chamorshi Lake, Dist. - Gadchiroli (M. S.).I J R B A T, Issue (VIII), Vol. I: pp.174-185.

- **Tijare R. V. and Kunghadkar G. E. (2021).** Effect of Physico-chemical properties of water on population of Macrozoobenthos of Kunghada Bandh Lake, Dist.- Gadchiroli, Maharashtra (India). International Journal of Environment, Agriculture and Biotechnology.Vol-6, (4).pp.113-122
- **Trivedy, R. K., & Goel, P. K. (1986).** Chemical and Biological Methods for Water Pollution Studies. Environmental Publications.
- **Uchchariya Rakhi and Sharma Dushyant Kumar (2019).** Studies on physico–chemical parameters of Pagara Reservoir, Joura, district Morena (M.P.). International Journal of Fisheries and Aquatic Studies; 7(1):pp293-298.
- **Verma P., Chandawat D., Gupta U., and Solanki H. (2012).** Water Quality Analysis of an Organically Polluted Lake by Investigating Different Physical and Chemical Parameters.Int. J. Res. Chem. Environ. Vol. 2 (1):pp.105-111.
- **Verma Ashok Kumar (2015).** Hydrobiological studies of Muntjibpur Pond of Allahabad (U.P.) International Journal on Agricultural Sciences 7 (2):pp.164-166.
- **Wani, K. A., et al. (2011)**. Anthropogenic impact on the water quality of Dal Lake, Kashmir. Journal of Ecology and the Natural Environment, 3(9), 289–295.
- **Wetzel, R.G. (2001)**. Limnology: Lake and River Ecosystems (3rd ed.). Academic Press.
- **World Health Organization (2010).** Hardness in Drinking-Water: Background Document for Development of WHO Guidelines for Drinking-Water Quality (No. WHO/HSE/WSH/10.01/10). Geneva, World Health Organization.