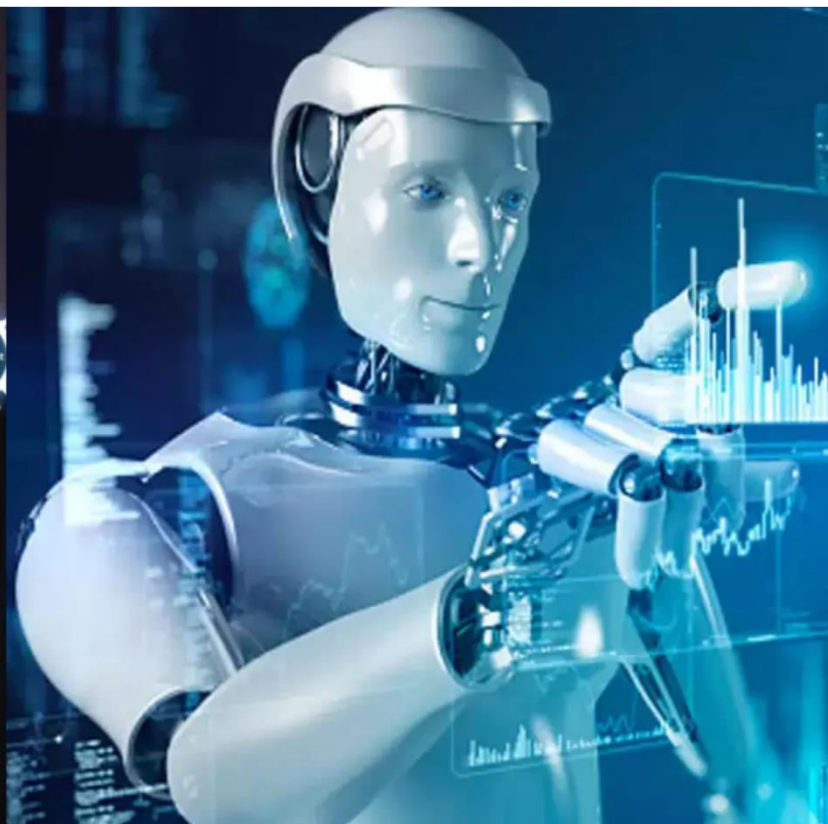




International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 10, October 2025

Seasonal Variation of Physico-Chemical Parameters in Manakondur Lake, Karimnagar District, Telangana: Implications for Water Quality and Aquatic Health

V.Rajani

Department of Zoology, Kakatiya University, Warangal, Telangana State, India

Email: vrphd.zoology@gmail.com

ABSTRACT: The present study was conducted to evaluate the physico-chemical characteristics of freshwater bodies in the Karimnagar district, with Manakondur Lake selected as the representative site after an initial survey. Lakes serve as vital freshwater resources and are utilized for various domestic and agricultural purposes. The water quality of such environments is assessed through physico-chemical and biological parameters. In this study, water samples were collected from four different sampling stations in Manakondur Lake over a period of one year, from June 2021 to May 2022, and analyzed using standard methods. The parameters analyzed included temperature, transparency, total dissolved solids (TDS), pH, dissolved oxygen (DO), carbon dioxide (CO₂), total hardness, total alkalinity, chloride, phosphate, nitrate, and biological oxygen demand (BOD). Water temperature showed seasonal variation, with the highest value recorded in summer ($29.75 \pm 2.10^\circ\text{C}$) and the lowest in winter ($24.80 \pm 3.19^\circ\text{C}$). Transparency was highest during winter (37.67 ± 8.40 cm) and lowest during the rainy season (20.95 ± 0.88 cm). TDS values were elevated in summer (412.50 ± 29.80 mg/L) and lowest during the rainy season (278.75 ± 13.76 mg/L). The pH ranged from a maximum of 8.20 ± 0.08 in the rainy season to a minimum of 7.70 ± 0.08 in summer. DO levels peaked during the rainy season (12.07 ± 2.17 mg/L) and were lowest in summer (7.05 ± 0.42 mg/L). CO₂ levels were highest in winter (10.75 ± 0.20 mg/L) and lowest in the rainy season (6.25 ± 1.89 mg/L). Total hardness was greatest in summer (225.00 ± 20.81 mg/L) and lowest in winter (148.75 ± 13.76 mg/L). Total alkalinity was highest in winter (368.75 ± 48.02 mg/L) and lowest in summer (195.26 ± 25.61 mg/L). Chloride concentrations peaked in summer (55.30 ± 7.19 mg/L) and were lowest in the rainy season (38.22 ± 2.28 mg/L). Phosphate levels were highest in summer (0.14 ± 0.05 mg/L) and lowest in winter (0.07 ± 0.01 mg/L), while nitrate levels followed a similar pattern, with the maximum in summer (0.15 ± 0.02 mg/L) and minimum in winter (0.05 ± 0.01 mg/L). BOD was highest in summer (9.12 ± 0.85 mg/L) and lowest during the rainy season (6.21 ± 0.54 mg/L). Overall, the results indicate that all the analyzed parameters were within the permissible limits, and the lake water is suitable for domestic and irrigation purposes.

KEYWORDS: Physico-chemical parameters, Freshwater Lake, Water quality, Seasonal variation, Manakondur Lake, Karimnagar district.

I. INTRODUCTION

Water plays a crucial role in sustaining human life but the ramifications of urbanization and industrialization result in the contamination of water sources, rendering them unsuitable for drinking and agricultural purpose. Fresh water is one of the most important natural resources crucial for the survival of all living beings. It is even more important for human beings as they depend on it for food production, industrial and waste disposal, as well as cultural requirements (S.Abdullah, et al.,2010). Ponds have been used since time immemorial as traditional source of water supply in India. The water is said as the liquid of life and it is the essence of all living processes. A healthy aquatic environment is largely governed by its physicochemical characteristics and its stability. Biological production in any aquatic body is directly correlated with its physico-chemical status (Sharma et. al., 2013). The physical and chemical properties of freshwater bodies are characterized by the climatic, geochemical, geomorphological and pollution, it is very important to study the physico-chemical factors influencing the biological productivity in the water bodies (Sahni and Yadav, 2012). The quality of water affects the species composition, abundance, productivity and physiological conditions especially, the indigenous population of aquatic organisms.(Wetzel,2001). The alteration in physicochemical

parameters leading to eutrophication has become a widely recognized the problem of water quality deterioration. In recent years increase in human population, demand for food, land degradation of many freshwater resources. (Ray et al.,2000). Eutrophication is a global phenomenon associated with nutrient enrichment of aquatic ecosystem. Several studies have been made so far to understand the physico-chemical properties of lakes, ponds, and reservoirs in India. (Jain et al.,1996, Mohanraj et al.,2000, Thorat and Masarrat 2000).

Freshwater lakes play a critical role in maintaining regional biodiversity, supporting livelihoods, and supplying water for domestic, agricultural, and industrial uses. In semi-arid regions such as Telangana, India, the quality of lake water is especially sensitive to seasonal fluctuations, which can profoundly influence its physico-chemical characteristics and, in turn, the health and diversity of aquatic communities. Manakondur Lake, situated in the Karimnagar district, is a key water resource for surrounding villages yet remains understudied with respect to how monsoon, post-monsoon, winter and summer seasons drive changes in water chemistry.

Seasonal rains, evaporation rates, and agricultural runoff combine to produce marked shifts in parameters such as pH, dissolved oxygen (DO), electrical conductivity (EC), turbidity, nutrient concentrations (nitrate, phosphate), and temperature. Elevated nutrient loads during and after the monsoon, for instance, can lead to eutrophication, algal blooms, and oxygen depletion, stressing fish and invertebrate populations. Conversely, high temperatures and evaporation in the dry summer months often concentrate dissolved salts, alter pH, and further reduce oxygen solubility, exacerbating stress on aquatic fauna.

Understanding the seasonal dynamics of these physico-chemical variables is therefore essential for assessing water quality status, identifying periods of ecological vulnerability, and informing management interventions aimed at preserving the lake's ecological integrity. Despite its local importance, few studies have systematically tracked how Manakondur Lake's water quality parameters respond to seasonal change and what the implications are for aquatic health and sustainable use.

By elucidating these seasonal patterns, this study provides a baseline for resource managers and local stakeholders to safeguard water quality and promote the long-term resilience of Manakondur Lake's aquatic ecosystem.

II. MATERIAL AND METHODS

Water samples for physico-chemical analysis were collected from Manakondur Lake in Karimnagar District. Sampling was conducted monthly during the morning hours to ensure consistency. While some of the physical parameters were measured onsite, the majority of the analyses were performed in the laboratory using standard methods as outlined by the American Public Health Association (APHA, 1985).

III. STUDY AREA

Manakondur Lake, located in Manakondur Mandal of Karimnagar District, Telangana, is a significant freshwater ecosystem positioned at 18.4036° N and 79.2062° E. The lake lies at an elevation of 265 meters and is mainly rain-fed, forming part of the Lower Godavari river basin. The region receives 900–1100 mm of annual rainfall and has a tropical climate. The lake is ecologically important, supporting diverse fish species and aquatic vegetation. Socio-economically, it sustains local agriculture and fisheries. However, challenges such as water pollution, overfishing, and climate variability threaten its sustainability.

Sampling procedure:

Water samples for physico-chemical analysis were collected from four predetermined stations. At each station:

1. In-situ measurements

- **Temperature and pH** were recorded on-site using a calibrated thermometer and pH meter, respectively.
- **Transparency** was measured with a Secchi disc, lowered slowly until just obscured and the depth recorded.

2. Dissolved oxygen (DO)

- Samples for DO determination were collected in 250 mL BOD bottles by submerging the bottle just below the surface and filling it slowly to avoid entraining air bubbles.

○ Immediately upon collection, each sample was fixed in the field with Winkler's A (manganous sulfate) and Winkler's B (alkaline iodide) reagents.

3. Laboratory analyses

- Bulk water samples for other chemical parameters were transferred to pre-cleaned plastic cans, preserved as required, and transported on ice to the laboratory.
- Physico-chemical analyses were performed following the standard methods outlined in APHA (1985) and Trivedy & Goel (1984).

IV. RESULTS AND DISCUSSION

The physico-chemical characteristics of Manakondur Lake between June 2021 and May 2022 reveal clear seasonal patterns that are largely consistent with other Indian tropical and subtropical freshwater bodies. These parameters not only reflect natural climatic influences but also hint at anthropogenic inputs and their implications for aquatic life and water quality management.

Water temperature in Manakondur Lake fluctuated between 21.0 °C (winter minimum) and 32.5 °C (summer maximum). Such variation is typical of shallow Indian lakes, where intense solar radiation and high ambient air temperatures during summer months raise water temperatures substantially, while cooler winter nights depress them. These values fall within the optimal thermal range for most tropical freshwater fish species (Boyd, 1982), and mirror observations from Sehgal (1980), Krishnamurthy (1990), and Jayabhai (2013), among others. Temperature not only regulates metabolic and reproductive rates in fish but also influences the solubility of gases and the rate of chemical reactions in the water column. Secchi depth transparency ranged from 20.0 cm in the peak of the monsoon (August) to 45.5 cm in winter (January). The inverse relationship between turbidity and rainfall—where runoff during monsoon brings suspended solids and reduces clarity—aligns with findings by Sharma and Durve (1991), Raut (2006), and V. Rajani (2020). Higher transparency in winter promotes deeper light penetration, supporting benthic algal growth, while reduced clarity during monsoon can limit photosynthesis and alter primary productivity dynamics. TDS values spanned 260 mg/L (December minimum) to 450 mg/L (March maximum). Elevated TDS in late dry season months likely reflects concentration of ions through evaporation, whereas dilution from early monsoon rains reduces TDS (V. Rajani, 2021). These levels are within tolerable limits for freshwater biota but indicate an increasing ionic load preceding the monsoon, possibly exacerbated by agricultural runoff or domestic effluents in the catchment. The lake's pH was relatively stable, varying narrowly from 7.6 to 8.3. Such alkaline conditions are characteristic of many Indian lakes and suggest robust buffering capacity, likely due to carbonate and bicarbonate ions. The negligible seasonal shift agrees with Angadi et al. (2005) and V. Rajani (2024), indicating that there were no major episodic acid-base disturbances during the study year. DO concentrations ranged from 6.5 mg/L to 14.0 mg/L. Higher values in cooler months reflect increased gas solubility at lower temperatures, whereas warm-season hypoxia can occur at night due to elevated respiration by plankton and microbes. The observed range surpasses the critical threshold for supporting diverse aerobic aquatic life (Panigrahi et al., 2005; Barclay, 1966), aligning with Srikanth (2009) and V. Rajani (2020). These results underscore the lake's generally good oxygenation, though periodic monitoring is needed to detect potential eutrophication-driven oxygen dips. CO₂ concentrations varied between 5.0 mg/L (August minimum) and 11.0 mg/L (October maximum). Fluctuations in free CO₂ often reflect seasonal patterns in photosynthesis and respiration: lower levels during summer and monsoon when phytoplankton uptake peaks, and higher levels post-monsoon as organic matter decomposition intensifies. These dynamics influence buffering capacity and pH stability. Total hardness (Ca²⁺ + Mg²⁺) ranged from 135 mg/L to 250 mg/L, with highest values in summer, moderate in monsoon, and lowest in winter—mirroring Kataria et al. (1996). Alkalinity values (170–410 mg/L) follow similar seasonal trends, reflecting dissolution of CO₂ and carbonate equilibria (Wetzel, 1983; Vijaykumar, 2009). Both parameters indicate moderately hard, well-buffered water suitable for aquatic life but also suggest potential scaling or taste issues if considered for drinking without treatment. Chloride concentrations fluctuated between 35.0 mg/L and 60.2 mg/L, peaking in summer. These levels are within BIS permissible limits for drinking water, and variations are consistent with patterns noted by Pejavar et al. (2004) and Kumar et al. (2011). Seasonal spikes likely result from evaporation concentrating salts and possibly from anthropogenic sources such as detergents and sewage discharges. Orthophosphate levels (0.05–0.19 mg/L) and nitrates (0.04–0.18 mg/L) remained relatively low but showed slight elevations during post-monsoon months, corresponding to increased runoff of agricultural fertilizers and domestic sewage (Kaushik and Saxena, 1999; Naseema et al., 2013; V. Rajani, 2021). While not currently indicative of severe eutrophication, these nutrient loads warrant continued monitoring, as sustained input could trigger algal blooms and associated oxygen depletion. BOD

values ranged from 5.5 mg/L to 10.0 mg/L, with higher values indicating greater loads of oxidizable organic matter post-monsoon (Abida, 2008; V. Rajani, 2021). Although within permissible limits for surface waters, periodic increases emphasize the need for controlling organic effluent discharge to safeguard the lake's self-purification capacity.

V. CONCLUSION

The comprehensive assessment of physico-chemical parameters in Manakondur Lake from June 2021 to May 2022 reveals that the lake's water quality is largely within permissible limits for sustaining aquatic life and potential domestic usage after treatment. Seasonal variations in parameters such as temperature, transparency, dissolved oxygen, and nutrient concentrations reflect the combined influence of climatic conditions and anthropogenic activities, including agricultural runoff and localized sewage input. The observed temperature and DO levels are conducive for aquatic biodiversity, while the pH, TDS, and alkalinity indicate a well-buffered, moderately hard water system. However, slight elevations in BOD, phosphate, and nitrate values during the post-monsoon period highlight the onset of nutrient enrichment, which, if left unchecked, could lead to eutrophic conditions in the future. This study underscores the need for regular monitoring and the implementation of sustainable watershed management practices, particularly to control nutrient and organic matter input. Public awareness campaigns, strict regulation of agricultural runoff, and improved sewage treatment infrastructure will be essential for preserving the ecological balance and water quality of Manakondur Lake in the long term.

Implications for Water Quality and Aquatic Health:

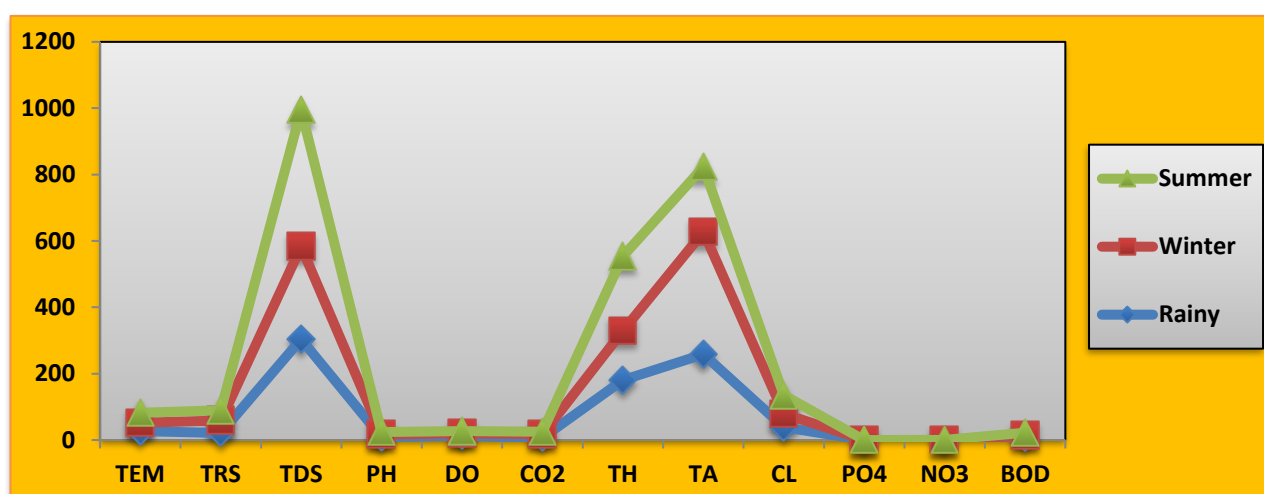
Overall, Manakondur Lake exhibits seasonal water quality oscillations driven by monsoonal inputs, temperature-induced evaporation, and biogeochemical cycling. The elevated summer turbidity, TDS, BOD, and nutrient concentrations, coupled with lower DO, suggest potential stress on fish and invertebrate communities during the pre-monsoon period. Conversely, the high DO in winter and dilute conditions during the rainy season likely support more favorable habitat conditions. These findings underscore the need for continuous monitoring and management, particularly targeting nutrient and organic load reductions during the dry season, to sustain the lake's ecological integrity and its role in regional aquaculture and fisheries.

Table 1. Monthly & Seasonal Physico-Chemical Parameter Variations in Manakondur Freshwater Lake (June 2021–May 2022)

	MONT H	TEM	TRS	TDS	PH	DO	Co ₂	TH	TA	CL	Po ₄	No ₃	BOD
Rainy season	JUN-21	28.00	21.30	340	8.3	9.00	5.00	190	230	39.70	0.12	0.10	5.50
	JUL-21	27.00	20.50	315	8.2	14.00	6.00	170	255	40.00	0.10	0.11	6.50
	AUG-21	26.00	20.00	300	8.1	13.10	5.00	175	270	38.20	0.13	0.12	6.10
	SEP-21	27.00	22.00	265	8.2	12.20	9.00	185	280	35.00	0.14	0.09	6.75
	MEAN ±SD	27.00 ±0.81	20.95 ±0.88	303.75 ±33.50	8.20± 0.08	12.07 ±2.17	6.25 ±1.89	180.00 ±9.12	258.75 ±12.74	38.22 ±2.28	0.12 ±0.01	0.10 ±0.01	6.21 ±0.54
Winter season SEASON	OCT-21	28.20	26.20	285	8.0	8.00	11.00	165	410	40.80	0.05	0.07	6.80
	NOV-21	26.50	37.00	270	7.9	8.20	10.70	155	390	41.00	0.07	0.05	7.60
	DEC-21	21.00	42.00	260	8.0	8.00	10.80	140	375	41.20	0.08	0.04	7.00
	JAN-22	23.50	45.50	295	7.8	8.10	10.50	135	300	41.60	0.09	0.06	6.90
	MEAN ±SD	24.80 ±3.19	37.67 ±8.40	278.75 ±13.76	7.92 ±0.09	8.07 ±0.09	10.75 ±0.20	148.75 ±13.76	368.75 ±48.02	41.15 ±0.34	0.07 ±0.01	0.05 ±0.01	7.07 ±0.35
Summer	FEB-22	27.5	33.10	400	7.7	7.50	8.00	200	225	45.00	0.15	0.13	9.50
	MAR-22	29.00	31.10	450	7.6	7.20	7.70	220	210	55.70	0.06	0.15	9.00
	APR-22	30.00	30.00	420	7.7	7.00	7.50	230	180	60.50	0.18	0.17	10.00

MAY-22	32.50	29.20	380	7.7	6.50	7.00	250	170	60.00	0.19	0.18	8.00
MEAN ±SD	29.75 ±2.10	30.85 ±1.69	412.50 ±29.80	7.70 ±0.08	7.05 ±0.42	7.55 ±0.42	225.00 ±20.81	195.26 ±25.61	55.30 ±7.19	0.14± 0.05	0.15± 0.02	9.12± 0.85
MIN	21.00	20.00	260	7.6	6.50	5.00	135	170	35.00	0.05	0.04	5.50
MAX	32.50	45.50	450	8.3	14.00	11.00	250	410	60.50	0.19	0.18	10.00

Fig-2: Seasonal variation of physico-chemical parameters of Manakondur Freshwater Lake from June 2021 to May 2022.



REFERENCES

1. Abdar, M.R. (2013). Physico-chemical characteristics and phytoplankton of Morna Lake, Shirala (M.S), India. *An International Quarterly of Biology and Life Sciences*, 1(2): 1–7.
2. Abdullah, S., Iqbal, M.A., & Fazil, M.I. (2010). Physico-chemical analysis of the freshwater at Kundalika Dam, Upli Dist. Beed, (M.S.) India. *Global Journal of Environmental Research*, 4(1): 1–5.
3. Angadi, S.B., Shiddamallayya, N., & Patil, P.C. (2005). Limnological studies of Papnash pond, Bidar, Karnataka. *Journal of Environmental Biology*, 26(2): 213–216.
4. APHA (1985). *Standard Methods for the Examination of Water and Wastewater*, 17th ed. American Public Health Association, Washington, D.C.
5. Boyd, C.E. (1982). *Water Quality Management for Pond Fish Culture*. Elsevier Scientific Publ. Co., New York, pp. 318.
6. Chouhan, C.S., & Sharma, K.C. (2007). Limnobiological status of a religious lake Budha Pushkar near Ajmer, Rajasthan. In: *N.S.L. Jaipur, Rajasthan*, pp. 227–230.
7. David, H., & Austin, D. (2012). Multiyear desertification study of an urban, temperate climate, eutrophic lake. *Lake & Reservoir Management*, 28: 107–119.
8. Hulyal, S.B., & Kaliwal, B.B. (2011). Seasonal variations in physico-chemical characteristics of Almatti Reservoir of Bijapur district, Karnataka State. *International Journal of Environmental Protection*, 1(1): 58–67.
9. Jain, S.M., Sharma, M., & Thakur, R. (1996). Seasonal variations in physico-chemical parameters of Halali reservoir, Vidisha District, India. *Journal of Ecobiology*, 8(3): 181–188.
10. Jhingran, V.G. (1991). *Fish and Fisheries of India*, 3rd ed. Hindustan Publishing Corporation, Delhi, 727 pp.
11. Kant, S., & Kachroo, P. (1971). Limnological studies on Kashmir lakes. IV. Seasonal distribution of phytoplankton in Dal and Nagin Lake. *Proceedings of the Indian National Science Academy*, 40B: 77–79.
12. Kataria, H.C., Iqbal, S.A., & Chandilya, C.B. (1996). Limnochemical studies of Tawa reservoir. *Indian Journal of Environmental Protection*, 16(11): 841–846.
13. Kaushik, S., & Saxena, D.N. (1999). Physico-chemical limnology of certain water bodies of Central India. In: K. Vismayan (Ed.), *Fresh Water Ecosystem in India*. Daya Publishing House, Delhi, p. 336.

14. Kaur, H., Dhillon, Navkiran, & Bhat. (1995). Physico-chemical characteristics of freshwater ecosystem prevailing in and around Patiala (Punjab). *Environment and Ecology*, 13(3): 523–528.
15. Kumar, V., Arya, S., Dhaka, A., Minakshi, & Chanchal. (2011). A study on physico-chemical characteristics of Yamuna River around Hamirpur (U.P), Bundelkhand Region, Central India. *International Multidisciplinary Research Journal*, 1(5): 14–16.
16. Mohanraj, R., Kumar, S., Azee, P.A., & Kumar, S.R. (2000). Pollution status of wetlands in urban Coimbatore, Tamil Nadu, India. *Bulletin of Environmental Contamination and Toxicology*, 64: 638–643.
17. Naseema, K., Masihur, R., & Hussain, K.A. (2013). Study of seasonal variation in water quality among different ghats of river Ganga, Kanpur, India. *Journal of Environmental Research and Development*, 8(1): 1.
18. Panigrahi, S.N., Nayak, B.K., & Acharya, B.C. (2005). Effect of physico-chemical parameters on phytoplankton distribution of Maipura Estuary, Orissa, East Coast of India. *Ecology, Environment and Conservation*, 8(1): 137–144.
19. Pawar, R.S., & Panoskar, D.B. (2014). Characterization of groundwater in relation to domestic and agricultural purposes, Solapur Industrial belt, Maharashtra, India. *Journal of Environmental Research and Development*, 9(1): 102–112.
20. Pejavar, M., Somani, V., & Quadros, G. (2004). Physico-chemical parameters of two quarry lakes near Thane City, Maharashtra. *Journal of Aquatic Biology*, 19(1): 107–110.
21. Rajani, V., & Benarjee, G. (2018). The assessment of physico-chemical characteristics of a freshwater lake and its suitability for fish culture. *International Journal of Humanities and Applied Medical Sciences (IJHAMS)*, 6(7): 25–32.
22. Rajani, V. (2020). Water quality assessment of physico-chemical parameters of Wardhannapet freshwater lake of Warangal District, Telangana State. *International Journal of Scientific Research and Engineering Development (IJSRED)*, 3(6): 1–7.
23. Rajani, V. (2020). Preliminary studies on the physico-chemical characteristics of perennial freshwater lake of Warangal District, Telangana State, India. *International Journal for Research in Applied Science and Engineering Technology (IJRASET)*, 8(12): 1–6.
24. Rajani, V. (2021). Preliminary studies on water quality assessment of Pedda Cheruvu, Manakondur, Karimnagar District, Telangana State, India. *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, 15(6, Ser. II): 12–20.
25. Rajani, V. (2024). Analysis of physico-chemical water quality parameters of freshwater lake of Warangal District, Telangana State, India. *International Journal of Multidisciplinary Research and Development (IJMRD)*, 11(10): 3–9.
26. Raut, N.S. (2006). Ph.D. Thesis, University of Mumbai.
27. Ray, D., Rao, R.R., Bhoi, A.V., Biswar, A.K., Ganguly, A.K., & Sanyal, P.B. (2000). Physico-chemical quality of drinking water in Rohtas District of Bihar. *Environmental Monitoring and Assessment*, 61: 387–398.
28. Sahni, K., & Yadav, S. (2012). Seasonal variations in physico-chemical parameters of Bharawas pond, Rewari, Haryana. *Asian Journal of Experimental Sciences*, 26(1): 61–64.
29. Sarang, S., & Somani, V. (2015). Water quality and phytoplankton diversity from temple pond, Titwala, Maharashtra. In: *UGC Sponsored National Seminar on Wetlands: Present Water Status, Ecology and Conservation*, pp. 227–231.
30. Sharma, R., Sharma, V., Sharma, S., Verma, B., & Sharma, V. (2011). Biodiversity of planktonic and littoral Cladocerans in water bodies of South Rajasthan. Ph.D. Thesis, M.L. Sukhadia University, Udaipur.
31. Sharma, S., Solanki, C.M., Sharma, D., & Pir, Z. (2013). Distribution and diversity of zooplanktons in Madhya Pradesh, India. *International Journal of Advanced Research*, 1(1): 16–21.
32. Srikanth, K. (2009). *Ecological Significance of Freshwater Fishes*. Ph.D. Thesis, Kakatiya University, Warangal.
33. Telkhade, P.M., Zade, S.B., & Dahegaonkar, N.R. (2012). Water quality status of Tadoba Lake, Chandrapur, Maharashtra, India. *Eco Revolution*, 2012.
34. Thorat, S.R., & Masrat, S. (2000). Pollution status of Salim Ali Lake, Aurangabad (M.S). *Pollution Research*, 19(2): 307–309.
35. Trivedy, R.K., & Goel, P.K. (1984). *Chemical and Biological Methods for Water Pollution Studies*. Enviro-media Publishers, Karad, India, pp. 1–215.
36. Vijaykumar, N., Saktivel, D., & Anandam, V. (2009). Studies on physico-chemical parameters in Thingathittu Estuary, Puducherry, South India. *Journal of Aquatic Biology*, 24(1): 104–106.
37. Wetzel, R.G. (1983). *Limnology*, 2nd Ed. Saunders College Publishing, New York, pp. 1–767.
38. Wetzel, R.G. (2001). *Limnology of Lake and River Ecosystems*. Academic Press, New York, USA, pp. 1006.
39. Zutshi, D.P., Subla, B.A., Khan, M.A., & Wanganeo, A. (1980). Comparative limnology of nine lakes of Jammu and Kashmir Himalayas. *Hydrobiologia*, 72: 101–112.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details