

**EVALUATION OF SEASONAL VARIATIONS IN THE PHYSICO-CHEMICAL
PARAMETERS OF LAKE WATER-THE STUDY OF A PERRINIAL FRESHWATER
LAKE****P. Gowri***

Department of Zoology, Kakatiya Govt. College (Autonomous), Hanamkonda-506001, Warangal (TG).

***Corresponding Author: Dr. P. Gowri**

Department of Zoology, Kakatiya Govt. College (Autonomous), Hanamkonda-506001, Warangal (TG).

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ABSTRACT

This study investigates the physico-chemical characteristics of Hasanparthy Lake water, it is located in the Hasanparthy village of Warangal district in Telangana State. The study was conducted over a period from February 2021 to January 2022. Water samples were systematically collected from four collection sites and the mixed composite water samples of the lake water was analyzed using standardized laboratory methods. The findings revealed the variations in several parameters across different seasons within the lake. The parameters examined included Water Temperature, pH, Turbidity, Electrical Conductivity, Total Alkalinity, Total Hardness, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Chlorides, Sulphates, and Phosphates. Water Temperature exhibited seasonal variability, peaking at $29.5 \pm 2.05^\circ\text{C}$ during summer and dipping to $24.8 \pm 6.37^\circ\text{C}$ in winter. The pH levels reached a maximum of 8.07 ± 0.19 in summer and a minimum of 7.12 ± 1.66 in winter. Turbidity was highest in winter at 59.27 ± 36.51 NTU, while the lowest was observed during the rainy season at 17.95 ± 0.22 NTU. Total Dissolved Solids (TDS) were most elevated in winter (85.6 ± 0.30 mg/L) and lowest in summer (13.43 ± 28.37 mg/L). Electrical Conductivity (EC) recorded values of 487.5 ± 63.5 $\mu\text{mhos/cm}$ during summer and 411 ± 99.13 $\mu\text{mhos/cm}$ in winter. Total Alkalinity reached its peak in summer at 139.2 ± 12.8 mg/L and fell to 90.4 ± 23.00 mg/L during the winter season. Total Hardness was highest in summer (106.2 ± 20.4 mg/L) and lowest during the rainy season (83.5 ± 5.40 mg/L). Dissolved Oxygen levels were recorded at 8.27 ± 0.72 mg/L in summer, while the lowest value was noted during the rainy season at 5.2 ± 0.78 mg/L. Biological Oxygen Demand (BOD) was measured at 3.42 ± 0.25 mg/L in summer, compared to 2.87 ± 0.81 mg/L in winter. Chemical Oxygen Demand (COD) values were highest during the rainy season at 8.97 ± 0.14 mg/L and recorded at 7.17 ± 0.85 mg/L in summer. Chloride concentrations were 77.35 ± 4.38 mg/L in summer, with a minimum of 72.80 ± 1.94 mg/L in winter. Sulphate levels were recorded as 5.82 ± 0.43 mg/L during rainy season and 4.77 ± 0.68 mg/L in summer. Phosphate concentrations peaked in the rainy season at 3.6 ± 0.30 mg/L and were at their lowest in summer at 2.27 ± 0.33 mg/L. The seasonal variations of these water quality parameters, along with the potential factors contributing to their fluctuations, are discussed in light of contemporary literature on aquatic biology.

KEYWORD:- Physico-chemical parameters, Seasonal variation, Freshwater Lake.**INTRODUCTION**

Water is known as the universal solvent and is paramount to life on Earth. Often referred to as the "liquid of life," water is the essence of all living processes. The health of aquatic environments is largely determined by their physico-chemical characteristics and stability. Biological productivity in any aquatic ecosystem is directly linked to its physico-chemical status (Sharma et al., 2013). Freshwater bodies are vital components of the world's biological diversity and provide significant socio-economic benefits through tourism and recreation. However, the growing global population has led to increased consumption of water resources, placing pressure on these essential reserves

(Agarwal, and Saxena, 2011; Alam, 2013). The physical and chemical characteristics of the freshwater ecosystems are influenced by various factors, including climate, geochemistry, geomorphology, and pollution. Therefore the study of the physico-chemical factors of the waterbody may very commonly influences the biological productivity of these water bodies which is crucial to assess the quality of the waterbody (Sahni and Yadav, 2012). The quality of aquatic life in a given pond is entirely dependent on the water quality within it. In recent years, numerous studies have addressed this issue (Yadav et al., 2013), highlighting how water quality affects species composition, abundance, productivity, and the physiological conditions of indigenous aquatic

organisms (Wetzel, 2001). Altering physico-chemical parameters can lead to eutrophication, which has emerged as a significant problem contributing to the deterioration of water quality. Factors such as rising human populations, increased food demands, and land degradation have further exacerbated this issue in many freshwater resources (Ray et al., 2000; Carpenter, 2005). Eutrophication is a global phenomenon characterized by nutrient enrichment in aquatic ecosystems, and numerous studies have been conducted 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).

MATERIAL AND METHODS

Water samples for physico-chemical analysis were collected from Hasanparthy Lake in Warangal. 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).

Study area

Most of the fresh water bodies in Warangal district have become polluted for the past several years. Warangal district lies between 17° 19' & 18° 36' N latitude and 78° 49' & 80° 43' East longitude. Rainfall in the Warangal district receives maximum rainfall through the South – West monsoon, during the months of July, August and September. Normal annual rainfall is 994 mm and many areas in the district have been commonly facing drought related problems. To evaluate the water quality of a larger freshwater body in the vicinity of Warangal an effort was made to investigate the Hasanparthy Lake water body in the district. It is located 79° 37' 13" longitude and 17° 49' 18" latitude. The Submergence area is 36 Acres; Length of Bund is 1400 Million Cubic Feet. Weir and Sluice are present in this lake. This lake shows good diversity of Ichthyofauna along with other fauna.

Sampling programme

To assess the water quality parameters and the suitability of water for fish culture, the water samples were

collected at four identified sampling stations and a composite sample was prepared in order to minimize the error. The water samples have been analysed for a period of one year from February, 2021 to January, 2022. The water samples were collected during early hours of the day and usually in the first week of every month. Prior to sample collection, all the sampling bottles were thoroughly washed, sun-dried and rinsed with the same water to be collected in the pond. The sampling bottles were labeled with dates and collection sites and they were kept in a cool container maintaining temperature below 25°C till the analysis collected.

Sampling procedure

Water samples for physico-chemical analysis were collected from four stations. The parameters like Temperature, PH, and Conductivity were analysed with the help of Thermometer and Water analysis kit developed by EI-PRODUCTS, (MODEL – 161- E), Measurement of transparency was done by Sacchidisc. Sample for dissolved Oxygen determination was collected in 250ml capacity BOD bottle from just below the surface slowly to avoid air bubble entering into the bottle and fixed by Winkler's A and Winkler's B solutions at the collection site itself. For the analysis of chemical parameters the water samples were collected in plastic cans and brought to the laboratory, physico-chemical parameters were analysed as the procedure given in APHA(2000), Kodarkar (1992), Bhalarao (1998) and Khana (2004).

Statistical analysis

The data obtained were subjected to Analysis of Variance using the Statistical Analysis System User's Guide (SAS, 1999). Duncan's Multiple Range Test (Duncan, 1955) was performed to compare the means of the stations at $P = \leq 0.05$ level of significance.

RESULTS AND DISCUSSION

The present investigation analyzes the physico-chemical parameters of Hasanparthy Lake over a period from February 2021 to January 2022, with the results summarized in Tables-1. Water temperature varied between 25.0°C and 32.0°C, peaking in May and reaching its lowest in December, which aligns with the findings of Jayabhai (2013).



Fig. 1: Shows the satellite image of hasanparthy freshwater lake.



Fig. 2: Shows the over view of hasanparthy freshwater lake.

Table 1: Shows the Seasonal variation in the Physico-Chemical Parameters of the Lake Water during 2021-2022.

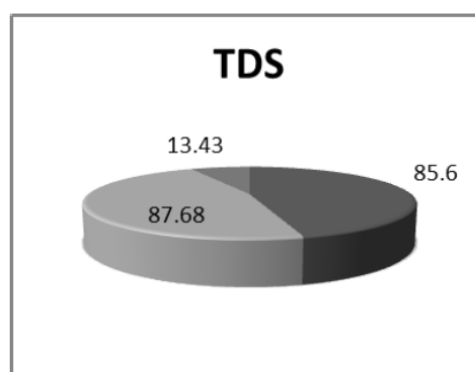
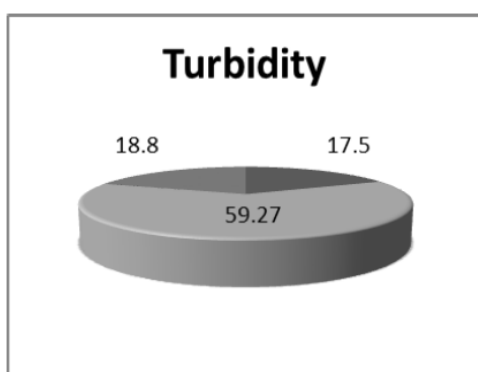
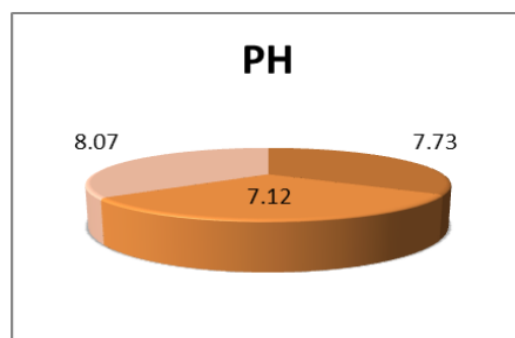
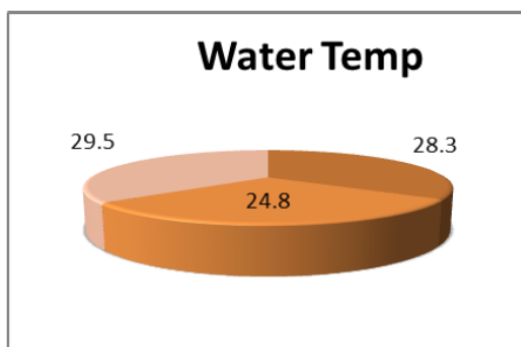
S. No	Parameters	Monsoon	Winter	Summer
		Mean \pm S.D.	Mean \pm S.D.	Mean \pm S.D.
1	Water Tem °C	28.3 \pm 0.83	24.8 \pm 6.37	29.5 \pm 2.05
2	PH	7.73 \pm 0.51	7.12 \pm 1.66	8.07 \pm 0.19
3	Turbidity(mg/lit)	17.5 \pm 0.227	59.27 \pm 36.51	18.8 \pm 1.23
4	TDS (mg/lit)	85.6 \pm 0.305	87.68 \pm 20.62	13.43 \pm 28.37
5	EC	430 \pm 77.2	411 \pm 99.13	487.5 \pm 63.5
6	Total Alkalinity(mg/lit)	94.7 \pm 5.21	90.4 \pm 23.00	139.2 \pm 12.8
7	Total Hardness(mg/lit)	83.5 \pm 5.40	85.20 \pm 25.95	106.2 \pm 20.4
8	DO(mg/lit)	5.2 \pm 0.78	5.22 \pm 1.48	8.27 \pm 0.72
9	BOD(mg/lit)	3.25 \pm 0.73	2.87 \pm 0.810	3.42 \pm 0.25
10	COD(mg/lit)	8.97 \pm 0.14	7.88 \pm 2.07	7.17 \pm 0.85
11	Cl ⁻ (mg/lit)	75.35 \pm 3.91	72.80 \pm 1.94	77.35 \pm 4.38
12	SO ⁴⁺ (mg/lit)	5.82 \pm 0.43	5.41 \pm 1.40	4.77 \pm 0.68
13	PO ⁴⁺ (mg/lit)	3.6 \pm 0.30	3.00 \pm 1.01	2.27 \pm 0.33

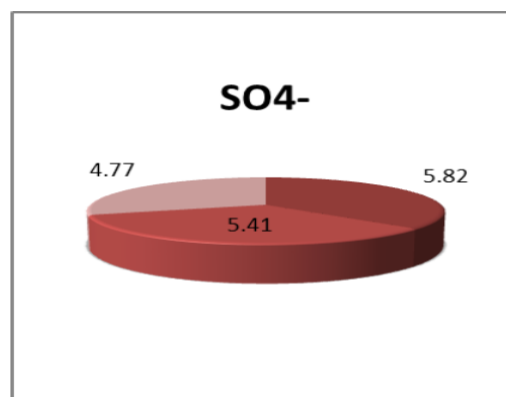
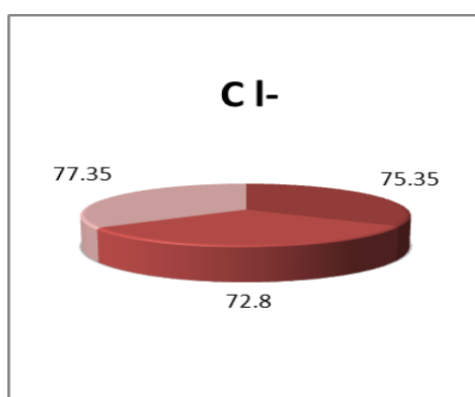
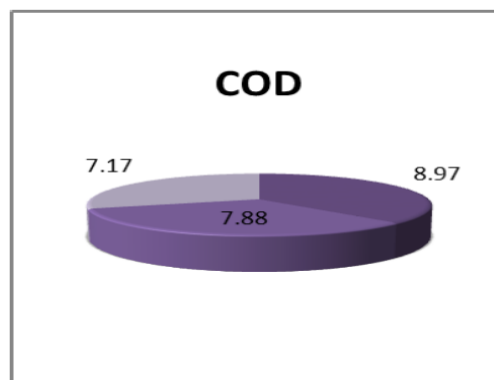
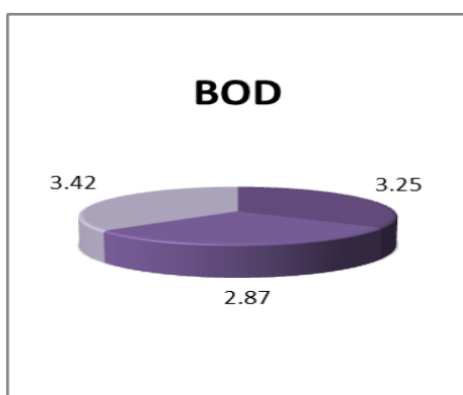
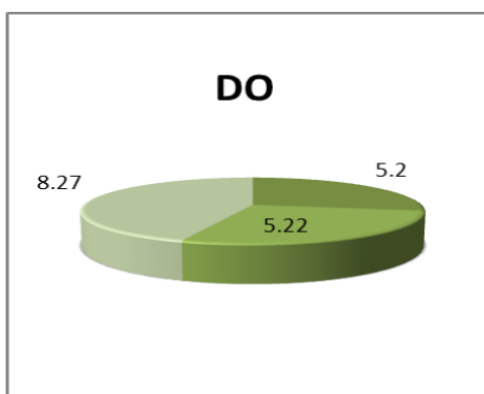
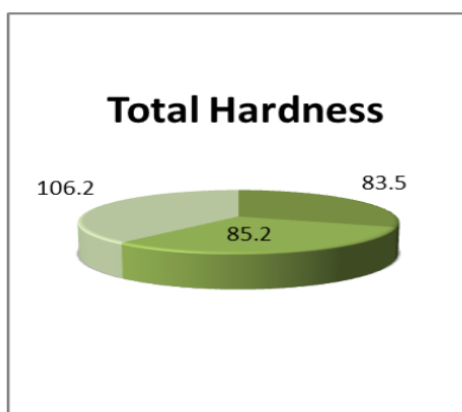
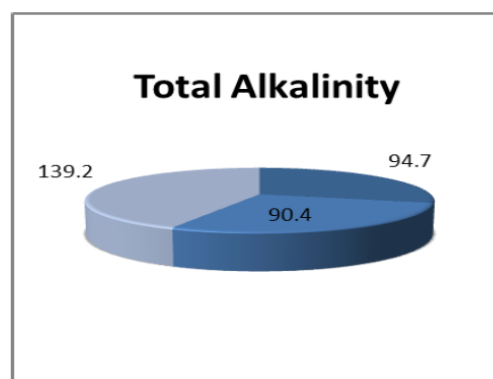
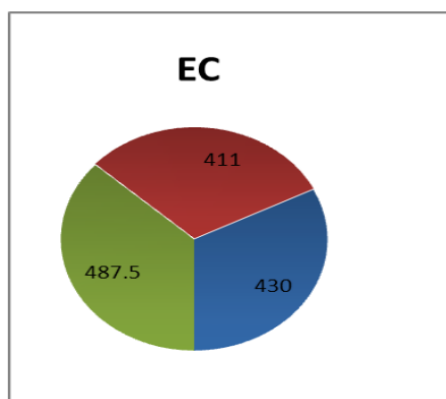
The pH levels, indicative of water acidity or alkalinity were ranged from 7.03 to 8.4, with the highest value observed in June and the lowest in August. Turbidity values, which can indicate sediment and anthropogenic influences, ranged from 12.2 to 19.3, with peak turbidity noted in August and the lowest occurring in December, Similar result has been reported by Alam (2013). Total Dissolved Solids elevates the density of water; influence Osmoregulation of fresh water organisms. The Total Dissolved Solids (TDS), which affect the osmotic regulation of freshwater organisms, ranged from 80.5 to 99.4. The highest TDS value was recorded in March, while June showed the lowest, as reported by Rao et al. (2010). Electrical Conductivity (EC) ranged from 403 to 595, with the highest recorded in May and the lowest in September, corroborating findings by Kumar et al. (2011). Total Alkalinity (TA) values, reflecting the presence of carbonates and bicarbonates, spanned from 87 to 157, reaches peak in May and dropping in June as it was reported earlier (Ray, 2000). The Total Hardness (TH) exhibited values ranging from 76 to 138, with maximum hardness observed in February and minimum levels in August. Dissolved Oxygen (DO), crucial for

aquatic life, ranged from 4.2 to 9.2, peaking in April and falling to its lowest in August. Biological Oxygen Demand (BOD), which reflects the oxygen demand by microbes for organic matter decomposition, showed values between 2.0 and 3.9, with the highest in July and lowest in September. Chemical Oxygen Demand (COD), an important indicator of water pollution, ranged from 6.0 to 9.2, with peak levels also occurring in July and the lowest in February. Chloride concentrations ranged from 70.1 to 86.5, with maximum levels in January and minimum levels in June. Sulfate values varied from 4.0 to 6.8, with the highest recorded in October and the lowest in March. Lastly, phosphate levels, which can indicate pollution from agricultural runoff, ranged from 1.6 to 4.0, with peak values in July and the lowest in November. Overall, the study highlights significant temporal variations in the physico-chemical parameters of Hasanparthy Lake, reflecting the influences of both natural and anthropogenic factors. The TDS value ranges from 80.5-99.4. The highest TDS value were recorded in the month of March while, the lowest value were recorded in the month of June. Similar result has been reported by Rao et al., (2010). Electrical Conductivity

value ranges from 403-595. The highest EC value were recorded in the month of May while, the lowest value were recorded in the month of September. Similar result has been reported by Kumar et al., (2011). Alkalinity of lake water depend on many factors among them the availability of carbonate and bicarbonate is one of the main factor alkalinity provides idea of natural salts present in water Gawas et.al (2006). Total Alkalinity value ranges from 87-157. The highest TA value were recorded in the month of May while, the lowest TA value were recorded in the month of June. Similar result has been reported by (Vasumathi Reddy et al., 2009). Total Hardness value ranges from 76-138. The highest TH value were recorded in the month of February while, the lowest value TH were recorded in the month of August. Oxygen content is important for direct needs of many organisms and affects the solubility of many nutrients and therefore the periodicity of aquatic ecosystem (Wetzel, 1983). Total DO value ranges from 4.2-9.2. The highest DO value were recorded in the month of April while, the lowest DO value were recorded in the month of August. Biological Oxygen Demand is the amount of oxygen required by microbes to decompose the degradable organic matter under aerobic condition.

Biological Oxygen Demand value ranges from 2.0-3.9. The highest BOD value were recorded in the month of July while, the lowest BOD value were recorded in the month of September. Chemical Oxygen Demand is a liable parameter for judging the extent of pollution in water. COD is a rapid test which measure the oxygen required for the oxidation of all the substances present in water, include those are not biologically decomposable. Chemical Oxygen Demand value ranges from 6.0-9.2. The highest COD value were recorded in the month of July while, the lowest the lowest COD value were recorded in the month of February. Chlorides value ranges from 70.1-86.5. The highest Cl^- value were recorded in the month of January while, the lowest Cl^- value were recorded in the month of June. Sulphates value ranges from 4.0-6.8. The highest SO_4^{4-} value were recorded in the month of October while, the lowest SO_4^{4-} value were recorded in the month of March. Irregular increase of phosphates in water indicates pollution by sewage and agriculture run-off specially phosphate fertilizers. Phosphates value ranges from 1.6-4.0. The highest PO_4^{4-} value were recorded in the month of July while, the lowest PO_4^{4-} value were recorded in the month of November.





Figures: Showing the seasonal mean variations in water quality parameters of the Freshwater Lake at Hasanparthy.

CONCLUSION

In conclusion, the physico-chemical analysis of Hasanparthy Lake water samples collected from June 2021 to May 2022 reveals a fluctuation in various parameters throughout the year. The highest temperature, electrical conductivity, and total alkalinity were recorded in May, while the lowest values were recorded in December, August, and June respectively. Similarly, the highest turbidity, total dissolved solids, and biological oxygen demand were observed in August, March, and July respectively. These variations may be attributed to various factors such as climate, human activities, and geological factors. The results suggest that the lake water quality is influenced by natural and anthropogenic factors, and further studies are required to understand the impact of these factors on the lake's ecosystem. As water quality deteriorates, the biodiversity within the water body is increasingly at risk. Many aquatic species, particularly sensitive organisms such as certain fish and invertebrates, cannot survive in polluted waters. The loss of biodiversity can lead to a collapse of local ecosystems, reducing resilience against environmental changes and impairing the lake's ability to function as a natural resource for the community. From the present, it can be concluded that all the physico-chemical parameters are at nearly permissible limits of the lake at all four stations. The lake has a rich range of flora and fauna. The lake is a treasure for all aquatic life. It is therefore suggested that the lake water needs to be analyzed at regular intervals. Farmers should be educated on better management practices. It is therefore concluded that this baseline data generated would be helpful for further planning and future management to develop fresh water ponds for better water quality and production of fish. To sustain the ecology and aquatic life in the lake, certain measures must be taken by the civic bodies to combat the pollution rate in the lake. At present the lake water is appropriate to use for fish culturing and irrigation purposes, it is concluded.

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