PRE-MONSOON AND POST-MONSOON PUZHAL LAKE, NORTH CHENNAI, CHEMICAL PARAMETER COMPARISON

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ABSTRACT

Aim: The objective of this research article is to perform the effects of variation of physical and chemical characteristics of water collected from Puzhal lake compared with drinking water in pre-monsoon and post-monsoon periods. **Materials & Methods:** The samples were collected from Puzhal Lake. The samples have applied physical parameters for analysis of drinking water qualities was sample 8 (Group 1= 4 and Group 2 = 4) and calculation is performed utilizing G-power 0.8 with alpha and beta qualities are 0.05, 0.2 with a confidence interval at 95%. Analyzing the quality of water is performed by the Standard drinking water where as number of samples (N=4) and Puzhal lake water where number of samples (N=4). **Results:** The quality of Puzhal lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 10, 434, 105, 8, 31, 130 and 15 and the standard drinking water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 7, 800, 600, 100, 200, 600 and 5. The study has a significance value of $p<0.05$ i.e. $p=0.021$. **Conclusion:** Standard drinking water provides better outcomes in physical characteristics of water when compared to Puzhal lake water for analyzing the quality of water.

INTRODUCTION

Water is essential for almost all biochemical operations in every way, as it is the most important component of all organisms. Water quality is determined by physical, chemical, and biological factors. The human body can be affected by the values of some physical properties of water that are over the authorised limits(Altin, Filiz, and Iscen 2009; D'Alessandro et al. 2012; Memon et al. 2011). Water quality monitoring is one of the most significant tools for sustainable development, as it offers crucial data for water management. As a result, ensuring the quality of groundwater is critical in order to use it for diverse reasons. The purpose of this study was to evaluate the water quality of Puzhal Lake using physical and chemical criteria(R. P. Kumar and Preethi 2017). In the pre-monsoon and post-monsoon seasons of 2020–2021, the samples were examined for physico–chemical parameters such as pH, Turbidity, Electrical Conductivity, Alkalinity, Total Hardness, Calcium, and Magnesium. Water is a valuable resource with a wide range of applications, including household, recreational, transportation, hydroelectric power, industrial, and commercial applications(Raskin and Kemp-Benedict 2002).

For the past few years, many academics have published their investigations on the features of lake water in the literature(Khan, Jadhav, and Ustad 2012);(Raman and Sathiyanarayanan 2011; Kliot, Shmueli, and Shamir 2001; Manjare, Vhanalakar, and Muley 2010). There are 58 research publications on IEEE Explore, and 95 articles on Google Scholar. Vashi et al.(Shroff and Vashi 2013; Daraigan, Wahdain, and Ba-Mosa

2011; Chaurasia et al. 2015) evaluated the Groundwater Water Quality Index in Tumkur Taluk, Karnataka State, India. Sami G. Daraigan et al.(Shroff and Vashi 2013; Daraigan, Wahdain, and Ba-Mosa 2011; Chaurasia et al. 2015) conducted a linear correlation analysis study of drinking water quality data for Al-Mukalla city, Hadhramout, Yemen, and found that all physicochemical parameters of drinking water in Mukalla city are more or less correlated with each other. Chaurasia et al. (Chaurasia et al. 2015) used a water quality index and an ANN simulation method to examine the water quality features of the River Ganga in Kolkata, India. Dadolahi-Sohrab et al.(Dadolahi-Sohrab, Arjomand, and Fadaei-Nasab 2012) looked at the Water quality index as a basic measure of watershed contamination in the southwestern portion of Iran, and found that quality dropped dramatically during the dry season. Deepa P et al.(Deepa et al. 2016) conducted a study to analyse the physicochemical parameters of Korattur lake in their work Seasonal fluctuations of physicochemical parameters of Korattur lake, Chennai, Tamil Nadu, India.(Parakh et al. 2020; Pham et al. 2021; Perumal, Antony, and Muthuramalingam 2021; Sathiyamoorthi et al. 2021; Devarajan et al. 2021; Dhanraj and Rajeshkumar 2021; Uganya, Radhika, and Vijayaraj 2021; Tesfaye Jule et al. 2021; Nandhini, Ezhilarasan, and Rajeshkumar 2020; Kamath et al. 2020)

The physical and chemical characteristics that impact the quality of lake water in a given area are influenced substantially by geological formations and anthropogenic activity. The main issue with lake water is that it is difficult to recover its quality once it has been contaminated. As a result, there is a need and concern for lake water quality protection and management. As a result, the physical features of water taken from the Puzhal lake during pre-monsoon and post-monsoon periods are examined in this research, and the results are compared to drinking water. The samples were tested and compared to Indian effluent discharge standards. pH, turbidity, electrical conductivity, alkalinity, total hardness, calcium, and magnesium were examined as physical parameters.

MATERIALS AND METHODS

This work was carried out in the Biotechnology Laboratory, Department of Civil Engineering, and Saveetha School of Engineering. Puzhal Lake was used to collect the samples. For the pre-monsoon and post-monsoon seasons, data is collected on a regular basis. Water quality parameters such as pH, turbidity, electrical conductivity, alkalinity, total hardness, fluoride, calcium, and magnesium were estimated in the laboratory using standard methods as prescribed by APHA, AWWA,(Vega et al. 1998), Trivedy and Goel(Trivedy and Goel 1984)1984), and Kodarkar(Kodarkar et al. 1998). It involves two sample groups, each of which requires 10 samples and 20 sample tests for the experiment to be completed. Puzhal lake water was in Group 1 and drinking water was in Group 2. The calculation is done with G-power 0.8, alpha and beta values of 0.05, 0.2, and a 95 percent confidence interval.

Physical and Chemical Characteristics of Lake Water

Turbidity

The average turbidity of Puzhal Lake is 15 NTU. This was well beyond the acceptable

level of 5 NTU and the permissible limit of 10 NTU in the absence of an alternate source. Turbidity is a fluid's optical characteristic that pertains to how much light it scatters or absorbs. Suspended solids and colloidal matter in water generate turbidity. It could be the result of dredging-induced soil erosion or the development of microorganisms.

Electrical Conductivity (EC)

The value of Puzhal Lake was found to be 434mho/L. EC is the numerical representation of an aqueous solution's ability to conduct electric current. This ability is associated with the presence of ions, their overall concentration, mobility, valence, relative concentrations, and measurement temperature. Low EC values could be due to higher temperatures, water stabilisation due to deposition, and high sodium concentrations due to discharged household sewage and organic matter in the lake, whereas high EC values could be due to the entrance of significant amounts of residential sewage.

Hydrogen Ion Concentration (pH)

The most of aquatic species prefer a pH range of 6.5 to 8.0. When pH falls outside of this range due to physiological stress, diversity within the water body may decrease, leading in lower reproduction. Variations in pH can put aquatic organisms in perilous situations. The pH of Puzhal Lake shall not increase the acceptable level of 10 at 25 degrees Celsius.

Alkalinity

The entire amount of carbonates and bicarbonates in the water is referred to as total alkalinity. The amount of a substance that elevates the pH of water determines total alkalinity. High levels of alkalinity indicate the presence of extremely alkaline industrial wastes and sewage. Decomposition of plants, living animals, and organic waste in the water body can produce an increase in carbonate and bicarbonate levels, as well as a rise in alkalinity. The alkalinity of Puzhal Lake was estimated to be 130 mg/l.

Calcium

Calcium levels ranged from 39 to 65 mg/l throughout the post-monsoon and pre-monsoon seasons. Calcium in water has a suggested limit of 75 mg/l and a permissible limit of 200 mg/l if no other source is available (BIS. IS: 10500, Indian Standard for drinking water). Because calcium is a component of cell walls and regulates a range of physiological actions in animals, it is essential for all living things. Puzhal Lake's calcium concentration was determined to be 31 mg/l. The average calcium concentration in Puzhal Lake was discovered to be below the permissible threshold.

Total Hardness

Total hardness refers to the overall amount of divalent cations in water, which is measured in milligrammes per litre of equivalent total calcium and magnesium. In most cases, calcium is discovered in the vicinity of 14 carbonate ions. Magnesium is necessary for chlorophyll-producing algae to thrive. The total hardness of Puzhal Lake was reported to be 105 mg/l. Water should have an overall hardness level of 600 mg/l.

Magnesium

Magnesium levels in the post-monsoon period ranged from 32 mg/L to 57 mg/L in the pre-monsoon period. In Puzhal Lake, the magnesium concentration was 8 mg/l. Magnesium is also required for a number of cellular enzymatic changes in algal, fungal, and bacterial cells, including trans-phosphorylation. Magnesium ions, along

with calcium and other ions, play a role in water hardness.

Statistical analysis

The software package utilised here for statistical implementation is IBM SPSS V26.0(Hilbe 2004). The independent sample t test was used to determine the mean, standard deviation, and standard error mean statistical significance between the groups, and then the two groups were compared with SPSS software to obtain accurate values for the two different parameters, which were then used with the graph to calculate the significant value with maximum accuracy value (7%), mean value (7%), and standard deviation value (0.76893). Accuracy is a dependent variable, while Ph, EC, TH, Mg, Ca, Alkalinity, and Turbidity are independent variables.

Study area

Puzhal lake also known as Red Hills lake is located in Red Hills, Thiruvallur district, Tamil Nadu State. It's one of the two reservoirs from where the drinking water is drawn for chennai city.The full capacity of the lake is 3300 million cubic feet. Chennai is one of the largest metropolitan cities in India. It is divided into major parts like central,south,west and north chennai. The latitude of Puzhal lake is 13.13 ” N and longitude 80.1629” E .Chennai city corporation covers an area of 172 km2. Adyar river originates from this lake through this lake chennai city gets its water supply for drinking and other usages. It is built by Rajandra chola-1 the son of Rajandra chola and he is the prince of kodumbalur and it is the first artificial lake ever built. Its surface area is about 3800 acres . The full tank level is 85.45 ft and full capacity of 3645 million ft3. The pipelines of lake water treatment are located near the bypass of poonamallee.This lake is dependent on northeast monsoon during the month of October, november and december rainfall. The rainfall occurs through cyclones in the Bay of Bengal. The water quality and quantity changes in the pre-monsoon and post-monsoon period.

RESULTS

Figure 1 shows the Simple Bar graph for Puzhal lake water quality of water is compared with Standard drinking water in pre monsoon and post monsoon season. The standard drinking water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 7, 800, 600, 100, 200, 600 and 5. The pre-monsoon quality of Puzhal Lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 10, 434, 105, 8, 31, 130 and 15 and post-monsoon quality of Puzhal Lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 12, 375, 170, 9.5, 33, 110, and 10. There is a significant difference between pre-monsoon Lake water and post-monsoon lake water ($p<0.05$ Independent sample test). X-axis: pre-monsoon Lake water quality vs post-monsoon Lake water quality Y-axis: Median of quality of water, for identification of keywords ± 1 SD with 95 % CI.

Table.1 shows the evaluation metrics of comparison of pre-monsoon lake water and post-monsoon lake water for analyzing the quality of water. The pre-monsoon Lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 10, 434, 105, 8, 31, 130 and 15 and post-monsoon lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 12, 375, 170, 9.5, 33, 110 and 10.

Table.2 shows the statistical calculation such as Median, standard deviation and standard error Median for pre-monsoon lake water and post-monsoon lake water. The quality of water parameter used in the t-test. The pre-monsoon quality of lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 10, 434, 105, 8, 31, 130 and 15 and post-monsoon water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 12, 375, 170, 9.5, 33, 110 and 10. The standard deviation of pre-monsoon water is 1.50923 and post-monsoon water is 0.76893. The Standard Error Median of pre-monsoon water is 2.09319 and post-monsoon water is 1.38127.083.

Table.3 displays the statistical calculations for independent sample tests between pre-monsoon lake water and post-monsoon lake water. The significance value for the quality of water is 0.021. Independent samples T-test is applied for comparison of pre-monsoon lake water and post-monsoon lake water with the confidence interval as 95% and level of significance as 0.12323. This independent sample test consists of significance as 0.001, significance (2-tailed), Median difference, standard error difference, and lower and upper interval difference.

DISCUSSION

The physical parameters derived from pre-monsoon and post-monsoon analyses of puzhal lake water samples were showed in Table 1. Ph, colour, turbidity, TDS, and TSS are all essential indicators of water quality. Water temperature affects a number of water quality measures and is one of the most important physical properties of aquatic ecosystems. The pH values in regular drinking water range from 6.5 to 8.5 on a pH metre scale; if the pH value is higher or lower than this, it has an effect on the mucous membrane, causing improved taste and corrosion in aquatic life. According to our findings, the pre-monsoon quality of Puzhal Lake water in terms of Ph, EC, TH, Mg, Ca, Alkalinity, and Turbidity is 10, 434, 105, 8, 31, 130, and 15, whereas the post-monsoon quality is 12, 375, 170, 9.5, 33, 110, and 10. The discharge of domestic wastewater, sewage, and industrial effluent, among other things, resulted in high PH values during the wet season. Reduced light penetration, plant development, and oxygen production in the water are all affected by increased turbidity. As a result, fish and other aquatic animals' reproduction and survival rates have decreased. These properties are monitored to see if the water complies with government standards and is safe for human consumption and the environment.

Statistical analyses of water's physicochemical properties have been published from all around the world, including India(Vaishnav and Dewangan 2012; Joshi et al. 2009; N. Kumar and Sinha 2010). The city of Chennai was assessed using water quality; groundwater samples included sodium, chloride, calcium, and magnesium levels that were above the allowed limit(Jagadeeswari and Ramesh 2012; Logeshkumaran et al. 2015). TDS was found to be high in the Tiruvallur district, with sodium and chloride dominating the groundwater(Senthilkumar et al. 2014). Elangovan and Dharmendirakumar(Elangovan and Dharmendirakumar 2013) discovered that water quality indices such as pH, E.C., TDS, BOD, COD, and Sodium were higher in 90% of water samples from the Cooum basin within the Chennai and

Tiruvallur district. Ramakrishna et al.(Ramakrishnaiah, Sadashivaiah, and Ranganna 2009) undertook another study to analyse the Limnology of the lake in three different segments, including an inlet, mid-lake, and outlet, on a seasonal basis. Pollution of pond water is mostly caused by trash discharged from residential areas, sewage outlets, detergents, automotive oil waste, and industrial wastewater(Mol and Shaji 2016).

The fundamental limitation is that the water samples were only evaluated for the seven basic physical and chemical water features; nevertheless, many additional criteria, such as nitrates, copper, lead, fluoride, phosphates, arsenic, and others, affect the survival and health of living creatures. As a result, more research is needed on these other parameters that were not covered in the current study.

CONCLUSION

It is concluded that Puzhal lake water and Standard drinking water, in pre-monsoon and post-monsoon periods in which the pre-monsoon lake water quality has the highest physical and chemical characteristics in water. The pre-monsoon quality of Puzhal Lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 10, 434, 105, 8, 31, 130 and 15 and post-monsoon quality of Puzhal Lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 12, 375, 170, 9.5, 33, 110 and 10. From this research study, it can be concluded that the lake water of the study area is not suitable for drinking purpose and must do the recycling procedure before using irrigation also.

DECLARATION

Conflict of interest

No conflict of interests in this manuscripts

AUTHOR CONTRIBUTION

Author GM was involved in data collection,data analysis , and manuscript writing. Author SLV was involved in conceptualization ,data validation ,and critical review of manuscript.

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TABLES AND FIGURES

Table 1. The evaluation metrics of comparison of pre-monsoon lake water and post-monsoon lake water for analyzing the quality of water. The pre-monsoon Lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 10, 434, 105, 8, 31, 130 and 15 and post-monsoon lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 12, 375, 170, 9.5, 33, 110 and 10.

Test Cases	**WATER QUALITY**													
	Pre-monsoon							**Post-monsoon**						
	pH	EC	TH	Mg	Ca	Ak	Tur	pH	EC	TH	Mg	Ca	Alk	Tur
Sample1	10	434	105	8	31	130	15	12	375	170	9.5	33	110	10
Sample2	10.2	432	107	7	30	128	14	12	372	171	9.3	33.2	111	10.2
Sample3	10.5	435	106	8.5	31	131	14	11	374	172	9.6	33.4	109	10.4
Sample4	10.4	430	105.5	9	32	134	16	12	375.5	170.5	9.2	33.8	108	10.7
Test Results	10	434	105	8	31	130	15	12	375	170	9.5	33	110	10

Table. 2. The statistical calculation such as Median, standard deviation and standard error Median for pre-monsoon lake water and post-monsoon lake water. The quality of water parameter used in the t-test. The pre-monsoon quality of lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 10, 434, 105, 8, 31, 130 and 15 and post-monsoon water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 12, 375, 170, 9.5, 33, 110 and 10. The Standard Deviation of pre-monsoon water is 1.50923 and post-monsoon water is 0.76893. The Standard Error Median of pre-monsoon water is 2.09319 and post-monsoon water is 1.38127.083.

Group		**N**	**Median**	**Standard Deviation**	**Standard Error Median**
pH	Pre-monsoon	4	10	0.76893	1.38127
	Post-monsoon	4	12	1.50923	2.09319

EC	Pre-monsoon	4	434	0.60122	0.99727
	Post-monsoon	4	375	1.69712	0.80212
TH	Pre-monsoon	4	105	0.73002	0.50987
	Post-monsoon	4	170	1.70132	1.98278
Mg	Pre-monsoon	4	8	0.69811	1.43432
	Post-monsoon	4	9.5	1.60832	1.90047
Ca	Pre-monsoon	4	31	0.30813	1.70413
	Post-monsoon	4	33	1.71732	1.99654
Alkalinity	Pre-monsoon	4	130	2.45713	2.90918
	Post-monsoon	4	110	1.08742	1.19847
Turbidity	Pre-monsoon	4	15	2.89741	2.50131
	Post-monsoon	4	10	1.18471	1.74723

Table 3: The statistical calculations for independent samples test between pre-monsoon lake water and post-monsoon lake water. The significance value for quality of water is 0.021. Independent samples T-test is applied for comparison of pre-monsoon lake water and post-monsoon lake water with the confidence interval as 95% and level of significance as 3.97305. This independent sample test consists of significance as 0.001, significance (2-tailed), Median difference, standard error difference, and lower and upper interval difference.

Group		Levene's Test for Equality of Variances		t-test for Equality of Medians						
		F	Sig.	t	df	Sig. (2-tailed)	Median Difference	Std. Error Difference	95% Confidence Interval (Lower)	95% Confidence Interval (Upper)
	Equal variances	0.412	0.021	16.427	16	.001	12.2314	0.79943	3.97305	12.63218

Pre-monsoon	assumed									
	Equal variances not assumed			15.175	13.8613	.001	12.1223	0.27149	3.08383	11.02463
Post-monsoon	Equal variances assumed	0.673	0.034	17.827	18	.001	11.78274	0.82943	11.67283	13.63748
	Equal variances not assumed			17.123	12.8273	.001	11.01823	0.20129	10.21839	12.02393

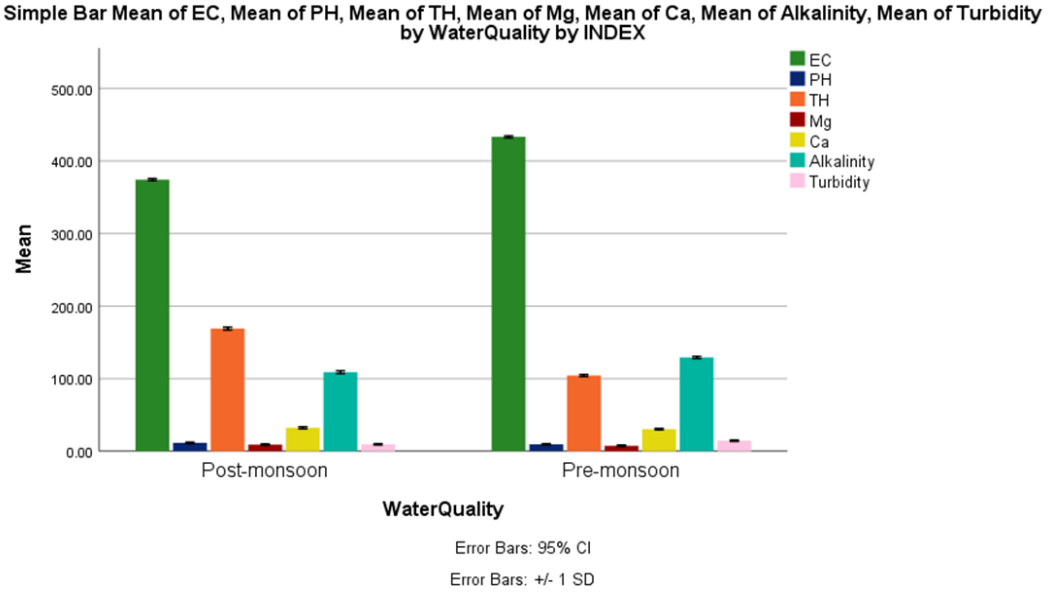

Fig. 1. The Simple Bar graph for Puzhal lake water quality of water is compared with Standard drinking water in pre monsoon and post monsoon season. The standard drinking water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 7, 800, 600, 100, 200, 600 and 5. The pre-monsoon quality of Puzhal Lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 10, 434, 105, 8, 31, 130 and 15 and post-monsoon quality of Puzhal Lake water of Ph, EC, TH, Mg, Ca, Alkalinity and Turbidity is 12, 375, 170, 9.5, 33, 110 and 10. There

is a significant difference between pre-monsoon Lake water and post-monsoon lake water ($p<0.05$ Independent sample test). X-axis: pre-monsoon Lake water quality vs post-monsoon Lake water quality Y-axis: Median of quality of water, for identification of keywords ± 1 SD with 95 % CI.