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Temporal Variability of Physicochemical Water Quality Parameters in the Kalpathy River, Palakkad District, Kerala

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***Abstract:** This study investigates the seasonal variations in the water quality of the Kalpathy River from 2022 to 2024, focusing on physical, chemical, and biological parameters across the pre monsoon, monsoon, and post-monsoon seasons. Monthly water samples were collected at a depth of 0.5 meters using sterilized plastic bottles. The key parameters analysed included temperature, dissolved oxygen (DO), electrical conductivity (EC), pH, nitrates, total coliforms (TC), faecal coliforms (FC), faecal streptococci (FSC), phosphates, total dissolved solids (TDS), total suspended solids (TSS), chemical oxygen demand (COD), and biochemical oxygen demand (BOD). Standard laboratory procedures were followed to ensure the accuracy of results and minimize contamination. The results revealed consistent seasonal trends in water quality. Temperature remained stable across seasons, with a slight decrease in the post-monsoon period. DO levels peaked during the monsoon, likely due to increased water turbulence. EC, TDS, and phosphate concentrations were highest during the monsoon, driven by runoff from agricultural and urban areas. Microbiological parameters, including TC, FC, and FSC, showed elevated levels throughout all seasons, with significant spikes during the monsoon, suggesting contamination from untreated sewage and agricultural runoff. COD and BOD values were highest in the pre monsoon period, decreasing in the monsoon and post-monsoon due to dilution from rainfall.*
***Keywords:** Water Quality, DO, COD, BOD.*

I. INTRODUCTION

Kerala, a state located in the southern most part of India, is renowned for its unique geographical features, rich biodiversity, and tropical climate. With its vast network of rivers, lakes, and backwaters, Kerala's water bodies play a pivotal role in the socio-economic and ecological landscape of the region. The state's topography, characterized by mist-covered mountains, lush forests, and expansive coastal plains, is supported by a climate that provides abundant rainfall, which sustains its intricate network of rivers and wetlands. These rivers, often referred to as the "veins of the land," form the lifeblood of Kerala's ecosystem, providing essential freshwater resources for domestic, agricultural, and industrial use. Among the most significant rivers in Kerala is the Kalpathy River, which flows through several urban and rural areas, offering crucial water resources for both human consumption and ecological sustenance. The river's importance extends beyond its role as a water source, as it serves as a habitat for diverse aquatic species, sustains agricultural activities, and facilitates transportation. However, like many rivers in Kerala, the Kalpathy River is increasingly subjected to a combination of natural and anthropogenic pressures that are affecting its water quality, leading to ecological degradation and public health concerns.

The monsoon season, which brings intense rainfall, results in higher runoff, leading to increased nutrient loads and contaminants entering the river system. In contrast, the pre-monsoon and post-monsoon seasons introduce specific challenges such as higher temperatures, reduced water flow, and higher concentrations of pollutants, which further complicate the water quality scenario.

II. MATERIAL AND METHODS

Sampling locations were selected along point of the Kalpathy River. The sampling ponits geographical coordinates are approximately Latitude 10.794477 and Longitude 76.643146. Samples were collected monthly for two years, durin Pre-monsoon, Monsson, and Post monsoon, to account for seasonal variations. Specific seasonal changes in water quality were monitored.

Water samples were collected at a depth of 0.5 meters from the river's surface using clean, sterilized plastic bottles. For chemical and physical analyses, samples were transferred to the laboratory within 24 hours for immediate analysis to avoid any contamination or changes in water quality.

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Key Parameters Analyzed: Physical Parameters: Temperature, Turbidity
Chemical Parameters: pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) ,Biological Parameters: Total Coliforms, E. coli, Fecal Coliforms.

Table.1. Water quality parameters and methods of analysis

1	pH.	pH Meter
2	Electrical Conductivity.	Conductivity Meter
3	Turbidity	Ephelometric Method
4	Dissolved Oxygen.	Winkler Method
5	Total Suspended Solids	(TSS) Gravimetric Method
6	Total Dissolved Solids	(TDS) Gravimetric Method
7	Total Fixed Solids (TFS).	Gravimetric Method
8	Biochemical Oxygen Demand	5-Day BOD Test Method
9	Chemical Oxygen Demand	Dichromate Oxidation Method
10	Sulphate	Molybdate Method
11	Faecal Coliform.(FC	Membrane Filtration Method (MF)
12	Total Coliform.(TC)	Membrane Filtration Method (MF)
13	Faecal Streptococci.	Membrane Filtration Method (MF
14	Temperature.	Thermometer
15	Nitrate	Colorimetric Method
16	Phosphate	Colorimetric Method

Sample Collection: Water samples for BOD were collected in two BOD bottles for testing BOD and chemicals. For chemical fixation, $MnSO_4$ and KI were added to the initial Samples to preserve the water's condition for later analysis. The primary data for the study is obtained from the Pollution Control Board (PCB), which has been monitoring water quality in the selected river basins from 2022 to 2024. The data includes monthly records for key physical, chemical, and biological parameters, and covers all three seasons like Pre-Monsoon(February–May), Monsoon(June–September) and Post-Monsoon(October–January).

III. RESULTS AND DISCUSSION

Water quality parameters of samples from Kalpathy river

SI. NO	PARAMETERS	PRE - MONSOON	MONSOON	POST-MONSOON
1	Temperature	29.5 ± 1.5	29 ± 1	28.13 ± 2.2
2	DO	5.5 ± 1.9	6.68 ± 1.03	6.54 ± 0.83
3	Electrical conductivity	345.8 ± 238.22	522.8 ± 198.3	511.13 ± 216.7
4	PH	7.99 ± 0.14	8.02 ± 0.19	7.863 ± 0.48
5	Nitrate	0.338 ± 1.93	0.58 ± 0.25	0.396 ± 0.112
6	TC	471 ± 228	436 ± 226.8	507.5 ± 144.11
7	FC	325 ± 228	270.6 ± 267.67	177.63 ± 117.06
8	FSC	21.4 ± 23.2	190.72 ± 224.71	30.35 ± 24.05
9	Phosphate	0.215 ± 0.0335	4.6 ± 4.28	0.378 ± 0.473
10	TDS	198.16 ± 117.54	315.8 ± 151.42	330.63 ± 128.08
11	TFS	261 ± 307	169.75 ± 72.71	151.88 ± 140.2
12	TSS	10 ± 0	10 ± 0	10 ± 0
13	Sulphate	0.215 ± 0.34	4.6 ± 4.28	0.38 ± 0.47
14	COD	9.818 ± 6.58	7.025 ± 2.11	7.28 ± 2.96
15	BOD	3.38 ± 1.93	2.06 ± 0.69	1.94 ± 0.99
16	Turbidity	1.96 ± 4.18	1 ± 0	0.35 ± 0.4183

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The river's water temperature remained relatively consistent throughout the year, with values of 29.5 ± 1.5°C during the pre-monsoon, 29 ± 1°C in the monsoon, and 28.13 ± 2.2°C in the post-monsoon period. Although there was a slight decrease in temperature during the post-monsoon season, this fluctuation can be attributed to the cooling effect of rainfall and reduced solar radiation. Such temperature patterns are typical for tropical rivers, as noted by Atel Vaishali et al. (2012), who found that temperature changes in tropical river systems are often minimal.

The highest DO concentration was observed during the monsoon season, which can be attributed to the increased water turbulence from rainfall, leading to enhanced oxygenation. These levels are well above the critical threshold of 5 mg/L required to support aquatic life, indicating that the river remains well-oxygenated. Similar findings were reported by Venkatesharaju et al. (2010), who observed that DO levels in rivers are typically higher during the monsoon due to increased aeration. Atel Vaishali et al. (2012) also highlighted that high DO concentrations are crucial for maintaining a healthy aquatic ecosystem, and the river in this study appears to support such conditions, ensuring the survival of aquatic organisms.

The EC values remained within acceptable ranges for freshwater systems, indicating that the river's water quality was not adversely affected by the variation in EC levels. Similar observations were made by Rajagopal et al. (2010. The pH values in this study fall within the optimal range for most aquatic organisms, as most species thrive in waters with pH levels between 6.5 and 8.5 (OECD, 2013).

The increase in nitrate levels during the monsoon can be attributed to the leaching of fertilizers and nutrients from agricultural lands. The study found relatively high levels of total coliforms across all seasons, with values of 471 ± 228 CFU/100 mL in the pre-monsoon, 436 ± 226.8 CFU/100 mL during the monsoon, and 507.5 ± 144.11 CFU/100 mL in the post-monsoon. These high levels indicate ongoing contamination, possibly from untreated sewage or runoff from urban areas. Venkatesharaju et al. (2010) also noted that high coliform levels are commonly found in tropical river systems, often linked to poor wastewater management and urbanization. This reinforces the importance of implementing better waste treatment solutions and improving hygiene practices to mitigate the risk of contamination.

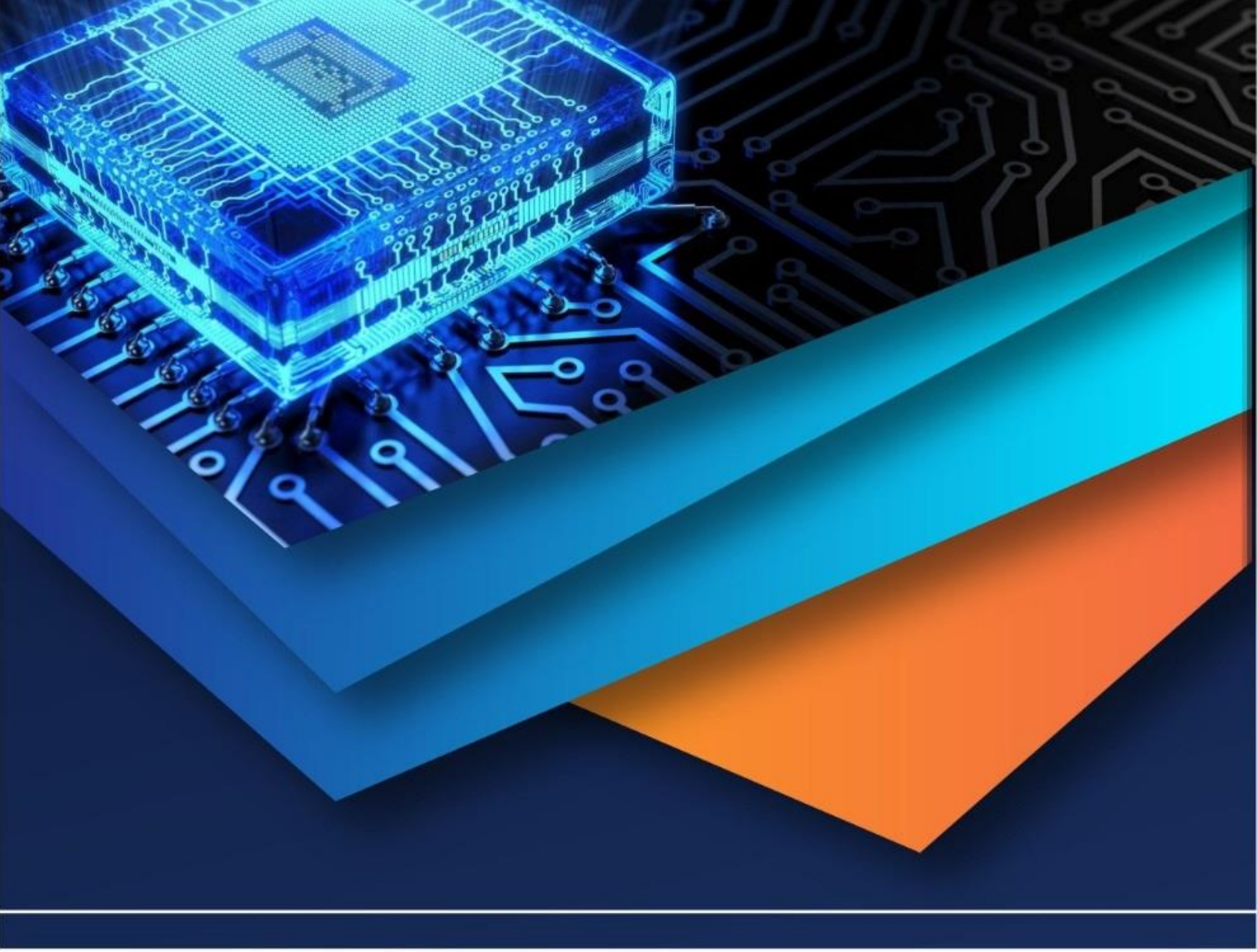
Fecal coliforms (FC) are a more specific indicator of fecal contamination and pose significant health risks, as they are closely linked to the presence of pathogenic microorganisms. The increase in fecal streptococci emphasizes the need to address contamination from animal waste and improve runoff management practices, particularly during the rainy season.Phosphate concentrations in the river varied significantly between seasons. The pre-monsoon levels were relatively low at 0.215 ± 0.0335 mg/L, but a sharp increase was observed during the monsoon, reaching 4.6 ± 4.28 mg/L, before decreasing to 0.378 ± 0.473 mg/L in the post- monsoon. TDS levels were recorded at 198.16 ± 117.54 mg/L in the pre-monsoon, 315.8 ±151.42 mg/L during the monsoon, and 330.63 ± 128.08 mg/L in the post-monsoon. Such seasonal variation in TDS levels has been reported in several studies, including those by Singh et al. (2017)COD values remained within acceptable limits for freshwater ecosystems, as discussed by Sharma et al. (2017), who noted that COD is an essential water quality indicator in monitoring organic pollution.

The relatively low BOD levels across all seasons indicate that the river's water quality is not heavily impacted by organic pollution and remains suitable for aquatic life. These findings are consistent with those of Venkatesharaju et al. (2010), who found that BOD is a significant indicator of organic pollution in rivers. TFS concentrations fluctuated across seasons, they remained within acceptable limits, suggesting that the river's water quality was not severely impacted by excess inorganic pollutants. Similar findings were noted by Sharma et al. (2019), who observed that fixed dissolved solids in rivers typically remain stable unless significantly impacted by anthropogenic activities such as mining, agriculture, or industrial discharges. Sulphate concentrations in the river were found to be within an acceptable range, with an average level of 0.215 ± 0.0335 mg/L in the pre-monsoon, which sharply increased to 4.6 ±4.28 mg/L during the monsoon, and then returned to 0.378 ± 0.473 mg/L in the post-monsoon season. Turbidity increased slightly during the monsoon, it remained within acceptable limits.

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