

## A Study on the Spatio-Temporal Variation of Physico-Chemical Parameters, Water Quality Index, and Pearson Correlation Coefficient in Hub Lake, Mysuru

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**Abstract:** The present study investigates the spatio-temporal variations in the physico-chemical characteristics and overall water quality of Hub Lake, Vajamangala, Mysuru, during the months of April, May, and June 2024. Water samples were collected from four different sites and analysed for eleven key parameters including pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), calcium, chloride, carbon dioxide, alkalinity, biological oxygen demand (BOD), dissolved oxygen (DO) and chemical oxygen demand (COD) using standard analytical procedures. The Water Quality Index (WQI) was computed to assess the suitability of the lake water for domestic purposes, while Pearson correlation analysis and PCA were employed to evaluate interrelationships among the parameters. Results revealed notable seasonal fluctuations, with most parameters showing elevated values during summer (April–May) due to increased evaporation, organic decomposition and reduced water levels. WQI values ranged from poor to very poor, indicating significant deviation from natural water quality and suggesting that the water is unsuitable for drinking without treatment. Correlation analysis demonstrated strong positive associations among parameters such as EC, chloride, calcium, carbon dioxide and BOD, highlighting their combined influence on water quality deterioration. Overall, the study emphasizes the need for continuous monitoring and management interventions to improve and protect the ecological health of Hub Lake.

**Keywords:** water quality index, parameter, drinking water, Hub Lake

### I. INTRODUCTION

Water is one of the most essential resources for life and for sustaining ecosystems on our planet. Earth is the only known planet that contains liquid water, and water occupies nearly 71% of its surface, while also occurring beneath the ground. It exists in all three physical states- solid, liquid, and gas making its study crucial for understanding environmental systems and life processes. Chemically, water is a transparent, colourless substance consisting of two hydrogen atoms covalently bonded to one oxygen atom. Water is a basic necessity required for a wide range of human activities, including drinking, bathing, washing, irrigation, industrial processes, and navigation. Many industries such as power generation, mining, textile manufacturing, pulp and paper production, and food processing rely heavily on water as a key component of their operations. Hydrology, defined as the study of the distribution, availability, consumption, and movement of groundwater, plays a vital role in understanding how water resources are utilized and replenished (Uddin, 2014). Earth's

freshwater availability is limited. Of the approximately 36 million cubic kilometres of freshwater present globally—only about 2.6% of total water, merely 11 million cubic kilometre's (0.77% of total global water and about 30% of freshwater) is actively involved in the water cycle and circulates at a comparatively fast rate (Pereira, 2012). This highlights the importance of monitoring and managing freshwater resources efficiently. Assessing water quality is crucial for ensuring safe and sustainable usage. The Water Quality Index (WQI) is widely used as an integrative tool to describe overall water quality based on physical, chemical, and biological parameters. WQI typically involves four key steps: (1) selection of parameters, (2) transformation of raw data into a common scale, (3) assignment of weights to parameters, and (4) aggregation of sub-index values into a single numerical score ranging from 0 to 100. Brown et al. (1970) developed a widely adopted WQI model using nine variables: dissolved oxygen (DO), pH, temperature, biochemical oxygen demand (BOD), total phosphate, nitrate concentrations, turbidity, and total solids. The index was calculated using arithmetic weighting, where

ratings for each parameter were derived, converted into temporary weights, and then normalized by dividing each temporary weight by the total of all weights (Kachroud et al., 2019; Shah & Joshi, 2017). Later, Brown (1973) suggested that geometric aggregation is more suitable than arithmetic aggregation, as it is more sensitive when any variable exceeds its permissible limits.

## II. MATERIALS AND METHOD

### Water Sample Collection and Experimental Conditions

The experiment was conducted from April to June 2024 at Hub Lake, located in Mysuru, Karnataka, India. Water samples were collected from Hub Lake to assess seasonal variations in water quality. Samples were obtained from four designated sites during the months of April, May, and June. All samples were transported to the laboratory under proper conditions and analyzed to determine the concentrations of various chemical parameters and the influence of physical parameters. Each parameter was examined using standard methods as prescribed by established protocols. Standard analytical procedures followed the guidelines of APHA (2017), Standard Methods for the Examination of Water and Wastewater.

TABLE: 1 Physico chemical parameters

Parameters	Methods / Instruments	References
pH	pH meter	Uddin et al, (2014)
Temperature	Thermometer	Gorde, & Jadhav, (2013).
Electrical conductivity	pH Meter	Trivedi, & Goel, (1984).
T D S	Digital meter method	Trivedi, & Goel, (1984).
Calcium	Titration Method	Trivedi, & Goel, (1984).
Chloride	Argentometric method	Trivedi, & Goel, (1984).
Carbon dioxide	Titration Method	Trivedi, & Goel, (1984).
Alkalinity	Titration method	Trivedi, & Goel, (1984).
Biological oxygen demand	5-day BOD method	Uddin et al., (2014)
Dissolved oxygen	Winkler's iodometric Method	Uddin et al., (2014)
Chemical oxygen demand	Winkler's iodometric Method)	Uddin et al., (2014)

**pH and Temperature:** pH, defined as the negative logarithm of hydrogen ion concentration ( $-\log [H^+]$ ), is a key parameter

that indicates the acidity or alkalinity of water. The pH scale spans from 0 to 14, with values below 7 considered acidic, 7 neutrals, and above 7 alkaline. The drinking-water pH typically falls within the range of 4.4 to 8.5. Measurement was performed with a pH meter by immersing the electrode in the sample until a stable reading was achieved. Temperature, a critical factor influencing biogeochemical processes in aquatic systems, was measured with a standard laboratory thermometer. Seasonal fluctuations, especially in winter, result in lower water temperatures due to cooler ambient conditions and reduced photoperiods.

**Electrical Conductivity (EC) and Total Dissolved Solids (TDS):** Electrical Conductivity (EC) indicates the water's ability to conduct electric current and is influenced by the concentration and mobility of dissolved ions. Distilled water exhibits very low conductivity ( $<1 \mu\text{S/cm}$ ), whereas natural waters show higher values due to dissolved salts and inorganic constituents. EC measurements were taken with a conductivity meter until a stable value was achieved. Total Dissolved Solids (TDS) denote the total concentration of dissolved substances in water. TDS was determined by filtering the sample and evaporating the filtrate in an oven at  $100^\circ\text{C}$  for 24 hours, with the increase in weight calculated as:  $\text{TDS} = W_2 - W_1$ .

**Calcium and Chloride:** Calcium, a vital nutrient for aquatic organisms, fulfils structural and regulatory functions within biological systems. It was quantified by titrating a 25 mL sample with 0.01 M EDTA, using Murexide as the indicator after the addition of NaOH, with the endpoint indicated by a colour transition from pink to purple. Chloride, ordinarily present as NaCl, CaCl<sub>2</sub>, and MgCl<sub>2</sub>, enters aquatic environments from natural and human-caused sources such as soil leaching, sewage, and industrial effluent. Concentrations exceeding 250 mg/L may signify pollution. Chloride was measured by titration with 0.02 N silver nitrate using potassium chromate as the indicator until a brick-red endpoint was observed.

**Free Carbon Dioxide and Total Alkalinity:** Free carbon dioxide (CO<sub>2</sub>), produced by the decomposition of organic matter, reflects metabolic activity within aquatic ecosystems. It was estimated by adding phenolphthalein indicator to the sample; if the solution remained colourless, it was titrated with 0.1 N NaOH until a persistent pink colour appeared. Total alkalinity, expressed as mg/L CaCO<sub>3</sub>, denotes the buffering capacity of the water. A 25 mL sample was initially tested with phenolphthalein indicator. If a pink color developed, it was titrated with 0.1 N HCl to determine phenolphthalein alkalinity; otherwise, it was recorded as zero. Subsequently, methyl orange indicator was added, and titration continued until a pink endpoint to determine total alkalinity.

**Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen demand:** Dissolved Oxygen (DO), vital for aquatic organisms, was measured via the Winkler method. Water samples were carefully collected in BOD bottles to prevent air entrapment, fixed with manganese sulphate, alkaline potassium iodide,

and sulfuric acid, and titrated with sodium thiosulfate using starch as an indicator until the solution turned colourless. Biochemical Oxygen Demand (BOD) quantifies the oxygen required by microorganisms to decompose organic matter. Two BOD bottles were prepared: one assessed the initial DO, and the other was incubated at 20°C for five days to determine the final DO. The difference between the initial and final DO values served to calculate the BOD. Chemical Oxygen Demand (COD) assesses the oxygen required for chemical oxidation of organic matter. The sample underwent reflux with potassium dichromate and sulfuric acid for two hours. The remaining dichromate was titrated with ferrous ammonium sulphate using ferroin as the indicator, with the endpoint indicated by a transition in colour from blue-green to reddish-brown.

**Water Quality Index (WQI):** Water Quality Index (WQI) was calculated following the standardized methodology described by Jena et al. (2013). After calculating the WQI, the measurement scale classifies the water quality from “unsuitable water” to “excellent water quality” as given in the following table.

Table: 2 Categorization of Water Quality Using Water Quality Index Levels

Water quality index level	Water quality status
0-25	Excellent water quality
25-50	Good water quality
51-75	Poor water quality
76-100	Very poor water quality
>100	Unsuitable for drinking

Table: 3 Water Quality Index (WQI) Classification Scale

WQI Range	Water Quality Status	Description
0 – 25	Excellent Water Quality	Water is clean and suitable for drinking without significant treatment.
26 – 50	Good Water Quality	Water requires minimal treatment and is generally safe.
51 – 75	Poor Water Quality	Water is moderately polluted and requires treatment before use.
76 – 100	Very Poor Water Quality	Water is heavily polluted and unsuitable without significant treatment.
> 100	Unsuitable for Drinking	Water is severely polluted; not fit for human consumption.

### Principle Component Analysis (PCA)

Principle Component Analysis (PCA) was performed to identify patterns, correlations, and underlying relationships among the physicochemical parameters of the water samples. The Pearson correlation matrix was first generated to assess the strength and direction of linear relationships between variables, with coefficients ranging from -1 to +1, where values beyond ±0.5 indicate strong correlation, between ±0.3 to ±0.5 indicate moderate correlation, and values near zero represent weak relationships. The correlation matrix served as the input for PCA. PCA was conducted using **PAST software, version 4.06**, which extracted principal components, eigenvalues, and loading plots to visualize grouping patterns and parameter contributions to overall variance.

## III. RESULTS AND DISCUSSION

### Results

The month of April water quality assessment of Hub Lake reveals that, although pH remains within the acceptable range and exhibits slight alkalinity, the overall condition of the lake is not healthy. The elevated temperatures during this period can diminish the water’s capacity to retain dissolved oxygen and increasing microbial activity, thus elevating the oxygen demand. Despite low electrical conductivity (EC) and total dissolved solids (TDS)—which may result from dilution or measurement issues—other parameters indicate pollution. The markedly high alkalinity, particularly at Site 1, implies substantial bicarbonate content, which enhances buffering capacity but can disrupt aquatic life. Furthermore, elevated Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) across all sites signify a large influx of organic waste, likely originating from domestic sewage or agricultural runoff. Although dissolved oxygen (DO) levels remain above the minimum threshold, the pronounced oxygen demand demonstrates that the lake is under stress and may experience hypoxia in the future. In summary, the findings indicate moderate to severe pollution, highlighting the necessity for ongoing monitoring and effective management to prevent further deterioration of the lake ecosystem.

The month of May water quality of Hub Lake shows clear seasonal and site-specific variations. The pH remained within the BIS permissible range, indicating slightly alkaline water, while temperatures exceeded the recommended 25°C due to summer conditions, which can reduce oxygen solubility and increase microbial activity. Electrical conductivity (EC) and total dissolved solids (TDS) were unusually low across all sites, possibly due to dilution or measurement inconsistencies. Calcium levels were highly elevated at Site 1, suggesting localized mineral inputs, whereas chloride remained within limits but varied slightly between sites. Carbon dioxide levels increased compared to April, especially at Site 1, reflecting higher biological activity and organic matter decomposition. Total alkalinity decreased sharply from April, likely due to dilution or lower bicarbonate content. Biochemical Oxygen Demand (BOD) remained above permissible limits at all sites, indicating ongoing organic pollution, while dissolved oxygen

(DO) was high, probably due to enhanced photosynthesis. Chemical Oxygen Demand (COD) showed extreme variability, with very high values at Sites 3 and 4, suggesting the presence of chemically oxidizable, non-biodegradable pollutants. Overall, the May results indicate that Hub Lake continues to experience moderate to severe pollution, with strong site-specific influences, highlighting the need for regular monitoring and effective management to prevent further water quality deterioration.

The month of June observations indicate a gradual stabilization of several physicochemical parameters in Hub Lake compared to April and May, while still revealing clear spatial variations among the sampling sites. The pH remained within the acceptable BIS range (6.5–8.5), confirming consistently alkaline conditions across all locations, with values overall fluctuating between 7.47 and 8.25 during the study period. Water temperature, however, continued to exceed recommended limits, remaining between 28°C and 31°C due to persistent summer heat, which likely influenced biological and

chemical processes in the lake. Electrical Conductivity (EC) and Total Dissolved Solids (TDS) showed very low and relatively stable values in June (0.1–1.0 mhos/cm and 1–14 mg/L, respectively), although such unusually low readings may require re-verification to rule out analytical or sampling inconsistencies. Calcium concentrations displayed moderate levels across sites, ranging from 30 to 152 mg/L, with Site 2 showing comparatively higher values, possibly due to localized geological or anthropogenic inputs. Chloride concentrations (35–170.16 mg/L) remained well within permissible limits, with noticeable spatial variation and the lowest levels observed at Site 2. Carbon dioxide concentrations, ranging from 1.76 to 13.6 µmol/mol, showed a slight decline in June compared to May, suggesting reduced respiration or enhanced aeration and photosynthetic uptake. Total alkalinity values (220–1080 mg/L) remained moderately high, though lower than April levels, indicating gradual stabilization of carbonate and bicarbonate buffering systems within the lake.

Table: 4. Analysis of water quality parameters for the month of April

APRIL											
Parameters	pH	Temperature	EC	TDS	Calcium	Chloride	Carbon dioxide	Alkalinity	BOD	DO	COD
BIS Standards	6.5-8.5	25	300	500	100	250	99.7	200	10	4	30
SITE 1	8.06	29	1	9	104	170.16	3.52	1080	17.6	8.8	74.6
SITE 2	8.23	31	1	2	68	161.6	1.76	480	19.2	7.2	90.6
SITE 3	8.25	30	0.9	14	48	130.45	1.76	560	12.8	6.4	128
SITE 4	8.17	29	0.8	8	36	102.09	1.78	540	13.6	9.8	122

Table: 5 Analysis of water quality parameters for the month of May

MAY											
Parameters	pH	Temperature	EC	TDS	Calcium	Chloride	Carbon dioxide	Alkalinity	BOD	DO	COD
BIS Standards	6.5-8.5	25	300	500	100	250	99.7	200	10	4	30
SITE 1	8.11	30	0.2	1	152	76.5	12.3	340	20	14.4	10.6
SITE 2	7.63	28	0.1	3	88	116.2	7.04	400	21.6	9.6	32.6
SITE 3	7.59	29	0.2	1	32	68.06	3.53	220	13.6	15.2	133
SITE 4	7.47	31	0.1	1	32	107.7	5.28	380	14.4	11.2	117

Table: 6 Analysis of water quality parameters for the month of April

JUNE											
Parameters	pH	Temperature	EC	TDS	Calcium	Chloride	Carbon dioxide	Alkalinity	BOD	DO	COD
BIS Standards	6.5-8.5	25	300	500	100	250	99.7	200	10	4	30
SITE 1	7.89	30	0.2	2	30	110.2	5.28	370	14.9	10.2	14.9
SITE 2	8.01	29	0.1	3	103.8	35	5.22	359	15.2	8.2	34.7
SITE 3	8.23	28	0.3	1	32	99.3	4.86	326	14.9	7.9	124
SITE 4	8.2	30	0.2	2	38	99.4	4.98	315	15.2	7.2	109.9

Despite some improvements, organic pollution indicators remained a concern. Biochemical Oxygen Demand (BOD), ranging from 12.8 to 21.6 mg/L, remained above BIS standards

at all sites, although a slight decrease from May values suggests a modest reduction in organic load and microbial activity. Dissolved Oxygen (DO) levels (6.4–15.2 mg/L) were generally

above the minimum requirement, indicating the lake still supports aerobic conditions; however, the decline compared to May may be attributed to reduced photosynthetic activity and continued organic decomposition. Chemical Oxygen Demand (COD) showed significant variation (0.32–133 mg/L) and remained particularly high at Sites 3 and 4, highlighting the presence of persistent chemically oxidizable pollutants and ongoing contamination sources in these areas. Overall, the results demonstrate partial recovery in certain water quality parameters during June, but continued organic and chemical pollution—especially at Sites 3 and 4—indicates that the lake ecosystem is still under stress. These findings emphasize the need for continuous monitoring and implementation of targeted management strategies to control pollutant inputs and improve the overall ecological health of Hub Lake.

### **Pearson Correlation Coefficient**

The Pearson coefficient is used to analyse the linear relationship between pairs of water quality parameters, such as pH, dissolved oxygen (DO), and total dissolved solids (TDS). A correlation coefficient of  $+1$  indicates a perfect positive linear relationship,  $-1$  indicates a perfect negative linear relationship, and  $0$  indicates no linear relationship.

### **Pearson Correlation Analysis for the month of April**

The Pearson correlation matrix for April indicates (Table 7) several strong linear relationships ( $|r| > 0.5$ ) among water quality parameters. pH shows strong negative correlations with CO<sub>2</sub>, alkalinity, calcium, and DO, while exhibiting a positive relationship with COD, indicating the influence of carbonate chemistry and organic pollution on pH. Temperature is positively correlated with pH and BOD and negatively correlated with DO, reflecting enhanced biological activity and reduced oxygen solubility during warmer conditions. Electrical conductivity (EC) exhibits strong positive correlations with calcium, chloride, and BOD, indicating increased ionic concentration and organic load. CO<sub>2</sub> and alkalinity are highly correlated, confirming their close association in buffering processes. BOD shows strong positive relationships with EC and chloride, while COD displays strong negative correlations with EC, calcium, chloride, and BOD, suggesting differences in the nature and sources of organic matter. Overall, the results indicate that temperature, EC, chloride, CO<sub>2</sub>, alkalinity, and BOD play a major role in controlling water quality during April.

### **Pearson Correlation Analysis for the month of May**

The Pearson correlation analysis for May reveals several strong linear relationships ( $|r| > 0.5$ ) among the water quality parameters. pH shows strong positive correlations with calcium and CO<sub>2</sub>, indicating the influence of carbonate chemistry on pH regulation. Electrical conductivity (EC) exhibits strong negative correlations with chloride and alkalinity, while showing a strong positive association with dissolved oxygen (DO), reflecting variations in ionic composition (Table.8). Total dissolved solids (TDS) display strong negative correlations with temperature and DO, and a strong positive correlation with chloride and BOD, suggesting increased organic and dissolved

matter during warmer conditions. Calcium shows strong positive correlations with pH, CO<sub>2</sub>, and BOD, indicating its role in buffering and biological activity. BOD is strongly and positively correlated with TDS, calcium, CO<sub>2</sub>, and alkalinity, while COD exhibits strong negative correlations with calcium, CO<sub>2</sub>, alkalinity, and BOD, highlighting differences in the nature of organic pollution. Overall, the results indicate that chloride, CO<sub>2</sub>, BOD, calcium, and TDS are the dominant parameters influencing water quality during May.

### **Pearson Correlation Analysis for the month of June**

The Pearson correlation analysis for June shows several strong linear relationships ( $|r| > 0.5$ ) among the water quality parameters. pH exhibits strong negative correlations with CO<sub>2</sub>, alkalinity, and DO, while showing a strong positive correlation with COD, indicating the influence the organic load on pH. EC and TDS show a perfect inverse relationship and are strongly associated with calcium and chloride, reflecting variations in dissolved ionic content. CO<sub>2</sub> is strongly and positively correlated with alkalinity and DO, while BOD shows strong positive correlation with TDS and calcium and a strong negative correlation with EC and chloride, indicating increased biodegradable organic matter during this month. COD exhibits strong negative correlations with CO<sub>2</sub>, alkalinity, and DO, highlighting the presence of chemically oxidizable pollutants. Overall, the results indicate that chloride, CO<sub>2</sub>, BOD, calcium, and TDS are the key parameters governing water quality during June (Table.9).

### **Discussion**

The physicochemical analysis of Hub Lake revealed clear seasonal and spatial variations influenced by climatic conditions, hydrological processes, and biological activity. The lake water remained slightly alkaline throughout the study period, indicating good buffering capacity. Higher pH values observed during April may be associated with increased photosynthetic activity, whereas the slight decline during May could be due to enhanced respiration and decomposition of organic matter. Seasonal temperature variations significantly affected dissolved oxygen (DO), biological oxygen demand (BOD), and carbon dioxide (CO<sub>2</sub>). Elevated summer temperatures during April and May reduced oxygen solubility and accelerated microbial decomposition processes. The elevated BOD and COD values observed during April–May may be attributed to multiple environmental factors. Reduced water levels during the pre-monsoon period likely concentrated organic pollutants and nutrients within the lake. In addition, higher temperatures enhanced microbial metabolism and decomposition of accumulated organic matter, thus increasing oxygen demand. Agricultural runoff, domestic sewage inputs, and decaying aquatic vegetation may also have contributed to the higher organic load. Particularly high COD values at Sites 3 and 4 suggest the presence of chemically oxidizable non-biodegradable pollutants, possibly originating from anthropogenic activities around the lake.

Table: 7 Pearson Correlation Matrix of Physicochemical Parameters for the Month of April

	pH	Temperature	EC	TDS	Calcium	Chloride	CO <sub>2</sub>	Alkalinity	BOD	DO	COD
Ph	1										
Temperature	0.724 *	1									
EC	-0.234 *	0.455 *	1*								
TDS	0.002 *	-0.477 *	-0.371 *	1							
Calcium	-0.714*	-0.094 *	0.842 *	-0.182	1						
Chloride	-0.354 *	0.341 *	0.992	-0.344 *	0.903	1					
CO <sub>2</sub>	-0.921 *	-0.530 *	0.514 *	0.102*	0.892 *	0.616	1				
Alkalinity	-0.912 *	-0.593 *	0.443 *	0.217 *	0.846 *	0.549 *	0.993	1			
BOD	-0.296*	0.428 *	0.834 *	-0.802 *	0.708 *	0.832 *	0.384*	0.274*	1		
DO	-0.675 *	-0.760 *	-0.420*	-0.179 *	0.029 *	-0.324 *	0.336 *	0.330 *	-0.031 *	1	
COD	0.668 *	-0.030 *	-0.829 *	0.519*	-0.932 *	-0.879 *	-0.762 *	-0.681 *	-0.890 *	-0.160*	1

The above table depicts the Pearson correlation coefficient of April month. At significance the value  $< -0.5 / > 0.5$  exhibit a strong relationship (the parameters like Temperature, EC, Chloride, Carbon dioxide, BOD, Alkalinity) are having a strong linear relationship.

Table: 8 Pearson Correlation Matrix of Physicochemical Parameters for the Month of May

	pH	Temperature	EC	TDS	Calcium	Chloride	CO <sub>2</sub>	Alkalinity	BOD	DO	COD
Ph	1										
Temperature	0.018 *	1									
EC	0.615 *	0.000 *	1								
TDS	-0.166*	-0.775 *	-0.577	1							
Calcium	0.938 *	-0.108 *	0.323	0.14	1						
Chloride	-0.456 *	-0.094 *	-0.978	0.686 *	-0.131	1					
CO <sub>2</sub>	0.920 *	0.119 *	0.267 *	0	0.972	-0.094	1				
Alkalinity	-0.003 *	0.096 *	-0.788 *	0.537*	0.307 *	0.875*	0.383	1			
BOD	0.557 *	-0.491 *	-0.173 *	0.701 *	0.799*	0.375 *	0.711	0.609 *	1		
DO							*				
COD	0.441 *	0.195 *	0.961	-0.757 *	0.106 *	-0.995	0.093	-0.857 *	-0.429*	1	

The above table depicts the Pearson correlation coefficient of April month. At significance the value  $< -0.5 / > 0.5$  exhibit a strong relationship (the parameters like, Chloride, Carbon dioxide, BOD, Calcium, TDS) are having a strong linear relationship.

Table: 9 Pearson Correlation Matrix of Physicochemical Parameters for the Month of June

	pH	Temperature	EC	TDS	Calcium	Chloride	CO <sub>2</sub>	Alkalinity	BOD	DO	COD
Ph	1										
Temperature	-0.481 *	1									
EC	0.557 *	-0.426 *	1								
TDS	-0.557 *	0.426 *	-1.000	1							
Calcium	-0.241 *	-0.147 *	-0.828 *	0.828 *	1						
Chloride	0.155 *	0.246 *	0.764 *	-0.764 *	-0.994	1					
CO <sub>2</sub>	-0.969	0.553 *	-0.741 *	0.741 *	0.412 *	-0.321	1				
Alkalinity	-0.960	0.219 *	-0.515 *	0.515 *	0.347 *	-0.283 *	0.911	1			
BOD	0.161 *	0.302 *	-0.707*	0.707 *	0.651 *	-0.631 *	0.087*	-0.243 *	1		
DO	-0.879 *	0.304 *	-0.095 *	0.095 *	-0.170 *	0.234*	0.735 *	0.865 *	-0.606 *	1	
COD	0.987	-0.451 *	0.674 *	74 *	-0.392 *	0.3068 *	-0.990	-0.961	0.030 *	-0.799 *	1

The above table depict Pearson correlation coefficient of April month. At significance the value  $< -0.5 / > 0.5$  exhibit strong relationship (the parameters like, Chloride, Carbon dioxide, BOD, Calcium, TDS) are having strong linear relationship.

Electrical conductivity (EC), total dissolved solids (TDS), calcium, and chloride showed noticeable seasonal fluctuations. Higher concentrations during April indicate evaporation-driven concentration of dissolved ions under dry climatic conditions, while their reduction during May and June may be related to dilution effects caused by early rainfall and increased water inflow. Variations in CO<sub>2</sub> and alkalinity further reflect changes in biological productivity, respiration, and carbonate buffering

processes. The Pearson correlation analysis confirmed strong relationships among EC, chloride, calcium, alkalinity, CO<sub>2</sub>, and BOD, indicating their combined role in regulating water quality. Overall, the results demonstrate that Hub Lake experiences considerable seasonal stress during the summer months, emphasizing the importance of continuous monitoring and effective management strategies to control pollution and protect the ecological health of the lake.

Higher concentrations of electrical conductivity (EC), total dissolved solids (TDS), calcium, and chloride in April indicate the combined effects of evaporation and mineral dissolution under warm and dry conditions. The reduction of these parameters during May and June suggests dilution due to rainfall and decreased evaporative concentration. Seasonal fluctuations in CO<sub>2</sub> and alkalinity further reflect changes in biological processes such as photosynthesis, respiration, and carbonate buffering. Increased CO<sub>2</sub> levels in May correspond to intensified decomposition and respiratory activity, whereas higher alkalinity in April indicates bicarbonate concentration during dry conditions. Elevated BOD and COD values in May signify increased organic load and possible pollutant inputs, while comparatively lower values in April reflect reduced organic decomposition. DO showed an inverse relationship with temperature and organic load, with lower values during warmer periods and higher values during cooler or biologically productive conditions.

The Pearson correlation analysis (April–June) highlights strong seasonal interactions among physicochemical and biological parameters. Consistent correlations among CO<sub>2</sub>, alkalinity, calcium, and pH underscore the dominant role of carbonate buffering in regulating water chemistry. Temperature exhibited strong influence on DO and BOD, with higher temperatures leading to oxygen depletion and increased biological activity during the pre-monsoon period. Strong interrelationships among EC, TDS, calcium, and chloride reflect variations in ionic concentration driven by evaporation, runoff, and dilution processes. The contrasting behaviour of BOD and COD suggests variability in the nature and sources of organic pollution. Overall, the results indicate that April was characterized by concentrated ionic and organic constituents due to evaporation, while May and June reflected dilution effects, enhanced biological activity, and variable pollutant inputs. These findings emphasize the importance of regular seasonal monitoring to ensure the long-term ecological health and sustainable management of Hub Lake.

#### IV. CONCLUSION

Water quality is strongly influenced by the nature of pollutants entering the system as well as the inherent mineral composition of groundwater in different bore well zones. In the present study, groundwater samples collected from various locations in Hub Lake during the summer and rainy seasons revealed noticeable seasonal variations in physicochemical characteristics, reflecting the combined effects of natural geochemical processes and anthropogenic activities. The application of water quality indices (WQIs) proved to be an effective approach for simplifying complex datasets into a single, interpretable value, facilitating a comprehensive assessment of overall groundwater quality. The evaluation and comparison of different indices demonstrated their reliability in identifying areas of water quality vulnerability and seasonal deterioration. By integrating key physicochemical and biological parameters, these indices provide a holistic understanding of groundwater status. Overall, the study emphasizes the importance of regular monitoring and the use of

standardized water quality indices for effective groundwater management. Such approaches are essential for ensuring safe drinking water, guiding mitigation strategies, and supporting sustainable water resource planning in rapidly urbanizing regions like Mysuru City.

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