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SEASONAL VARIATIONS IN GROUNDWATER QUALITY: PHYSICO-CHEMICAL ANALYSIS LAKES IN TELANGANA ACROSS DIFFERENT MONTHS

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ABSTRACT

The aim of this study was to determine the water's physicochemical characteristics in the Indian state of Telangana from January 2023 to December 2023. S1, S2, S3, and S4 are the four locations in Medchal Lake that were selected for water sampling. Physicochemical properties were assessed using monthly samples in conformity with the methods specified by APHA (2005). This set of parameters includes things like oxygen saturation, biological oxygen demand, chlorides, phosphate, nitrates, salt, potassium, temperature, turbidity, and total dissolved solids and hydrocarbons [1]. The results showed that the water from the lake is of high quality, as most of the physicochemical parameters were within the acceptable range. A small number of these markers, however, showed substantial heterogeneity. It was determined that the water was safe to consume.

***Keywords**: Groundwater Quality, Physico-Chemical Analysis, Seasonal Variations, Telangana Lakes, Water Sampling, Environmental Impact, Eutrophication, Trophic State, Water Pollution Studies*

1. INTRODUCTION

Lakes, which are an essential part of the natural environment, are the ones who are accountable for defining the topography as well as the biological activities that take place inside it. One of the most important ways in which lakes are responsible for determining the topography is via this action. Lakes have been the primary focus of environmental research in the most recent decades that have been conducted all over the globe. It is because of the great diversity of lakes that exist in terms of their origin, location, hydrology, and the many different types of substrate that they include that this is the case. Whenever the quality of the water is being examined, a broad variety of ecological factors, both living and nonliving, are taken into consideration. These factors have an impact on the water's quality. When it comes to the maintenance of an ecosystem that is in a state of equilibrium, the biological and physicochemical properties of water are two of the most essential aspects that contribute to the preservation of environmental balance (also known as the ecological balance). As Mududhula Thirupathaiah (2012) discovered, the quality of an ecosystem is determined not only by its physicochemical characteristics, but also by its biological characteristics [2]. This is in conformity with the results of the aforementioned researcher. By examining the water quality, which in turn reflects the biotic and abiotic state of the ecosystem, it is able to gain a good sense of the interaction that takes place between all of the hydrobiological components. This is because the water quality is a reflection of environmental conditions. The source is mentioned in Smitha AD (2013) [3], which is a reference to the source.

Physical properties such as temperature, light intensity, transparency, pressure, conductivity, and water current are examples of abiotic factors; chemical properties such as levels of dissolved oxygen, free carbon dioxide, alkalinity, hardness, phosphate, and nitrate in lake water define the trophic status of the body of water, and abiotic factors, such as changes in quantity and biodiversity, are examples of biotic factors. The health of an ecosystem, as well as its distribution and its capacity to function, is impacted by the abiotic factors, which are the driving forces of nature. These variables also have an effect on the ability of an ecosystem to function. Wetzel (1983) [4] has said that the physicochemical and biotic environment has a dynamic influence on the productivity of the freshwater ecosystem, which in turn governs the growth of fish. This notion is supported by the fact that the environment has an effect on the development of fish. This is the circumstance that has come about as a result of the environment being a dynamic system.This investigation is being carried out with the intention of determining the extent to which physicochemical factors are associated with the quality of water.

2. MATERIALS AND METHODS

The Hyderabad Metropolitan Development Authority's (HMDA) Lake Protection Committee has proposed a number of research locations, including the Pedda Cheruvu region near Medchal. A study conducted in 2013 determined that the lake's dimensions are 1,200 meters in bund length, 356 acres at full tank level, and 1.5 acres under water. The exact coordinates of the lake are 17O.251 17.0004" N, 780.331 16.3800" E. Rajiv Gandhi International Airport is 45 kilometers away and Secunderabad Railway Station is 30 kilometers away. People used to be able to get water for agriculture, drinking, and other purposes from this lake. The lake would be a winter haunt for migratory birds. According to the inhabitants, this lake is the largest in the mandal. It covers 18 towns, including Medchal. This is why Pedda Cheruvu is the most prevalent name for it.One might argue that it predates the Nizam's reign.

The water analysis began in January 2023 and continued through December 2023, with surface water samples taken between 8 and 10 a.m. from four different sampling sites (S1, S2, S3, and S4). We used two-liter plastic containers that had been washed and dried to gather water samples. The physicochemical characteristics of the water samples were examined. In the field, a digital thermometer and a pH meter were used to monitor the chemical parameters, including temperature. The APHA approach (APHA 2005)[5] and the standard literature, Trivedi and Goel (1986)[6], were used for further analysis.

3. RESULTS AND DISCUSSION

Tables and figures show the results for different physico-chemical parameters that were measured, including temperature, pH, carbonates, bicarbonates, dissolved oxygen, biological oxygen demand, chemical oxygen demand, organic matter, total hardness, calcium, magnesium, chlorides, phosphates, sulphates, nitrates, nitrites, silicates, and total dissolved solids.

Temperature: One of the most fundamental aspects that affects the organism's metabolic processes is the monitoring of temperature. Table 1 and Figure 1 demonstrate that temperatures varied between 21.7 and 31.14 degrees Celsius from January to December 2023. May had the highest recorded temperature, while December had the lowest. Water temperature was shown to have an effect on blooms of algae and aquatic weeds (Zafer, 1968) [7].

pH: The biochemistry and life cycle of all forms of life are impacted by the water's pH, a crucial environmental component. Its reported values vary from 7.2 in September to 8.5 in May across all stations. A pocket pH meter was used to assess the pH at the lake's surface. According to Chisty (2002), the pH value is crucial for the development of phytoplankton.It was stated in a 2007 study by Umavathi et al. [9]. Plankton thrive in environments with a pH between 5 and 8.5. (Figure-2, Table-1).

Carbonates: Carbonate plays a crucial function in regulating the pH of water bodies and is the primary component responsible for this (Hegde et.al, 2005)[10].May had the greatest concentration of carbonates at 52.94 mg/l, while June had the lowest at 26.64 mg/l. (Table 1 and Figure 3).

Bicarbonates: Bicarbonate is an essential component of aquatic biota.When the bicarbonate value is higher, the pH becomes more alkaline. The highest bicarbonate concentration was found in August at 250.64 mg/l, while the lowest was recorded in October at 140.56 mg/l. (Table 1 and Figure 4)

Dissolved Oxygen: The regulation of several metabolic and physiological processes by dissolved oxygen makes it a crucial metric for water quality evaluation. This shows that bodies of water are polluted. A range of 8.2 to 11.4 mg/l was observed for the DO values. The months of November and March had the highest and lowest levels of DO, respectively. (Figure-5, Table-1). Decreased dissolved oxygen levels in the lake are an indicator of organic contamination, as many kinds of life are threatened when dissolved oxygen levels fall below 5.0 mg/l (Bowman et. al., 2008)[11].

Biological Oxygen Demand: According to Table 1 and Figure 6, the greatest concentration of BOD was 10 mg/L in April, while the lowest was 2.62 mg/L in August. A combination of factors, including an abundance of trash, runoff from nearby areas, and the introduction of organic waste into the lake as a result of certain human activities, may lead to an increase in biological oxygen demand (BOD) (Solanki HA 2007)[12]. The metabolic processes of several bacteria in water were sped up throughout the summer due to the high levels of biological oxygen.

Chemical Oxygen Demand: Table 1 and Figure 7 show that the range of results was from 10.00 mg/L to 31.00 mg/L. The summer saw the highest readings, while the wet season saw the lowest. When combined with BOD, COD measurements provide valuable information on the existence and state of physiologically resistant organic compounds as well as their toxicity. (Queen et al., 2010)[13]. In order to detect harmful conditions and non-biodegradable compounds in water, it is important to estimate COD in addition to BOD (Sawyer, McCarty and Parkin, 2003)[14].The presence of non-biodegradable oxygen demanding contaminants in the water is suggested by the high COD levels. According to Table 1 and Figure 7, the highest COD level was 30 mg/l in April, while the lowest was 11 mg/l in August.

Total hardness: In March, the highest values of 260.00 mg/L were observed (Table-1, Figure-8). August was the month with the lowest reported readings of 120.00 mg/L. A reduction in water volume and an increase in hardness may be caused by high temperatures, detergents, chlorides, and wide-range organic components. During the winter, when calcium and magnesium concentrations are lower, the overall hardness measures the lowest. In 2006, Salve BS published an article [15].

Calcium: In March, the highest values of 260.00 mg/L were observed (Table-1, Figure-8). August was the month with the lowest reported readings of 120.00 mg/L. A reduction in water volume and an increase in hardness may be caused by high temperatures, detergents, chlorides, and wide-range organic components. During the winter, when calcium and magnesium concentrations are lower, the overall hardness measures the lowest. In 2006, Salve BS published an article [15].

Magnesium: April had the highest value at 40.24 mg /l, while December had the lowest at 24.78 mg /l (Table-1, Figure-10). The phytoplankton population is reduced when the magnesium content is lowered (Govindan, 1991)[18].It is possible that the high levels seen during the summer are caused by evaporation, which increases the magnesium content (Sharma R, 2010)[19].

Total Dissolved Solids (TDS): When water is in its natural state, it contains dissolved substances. Carbonates, bicarbonates, chlorides, sulphates, calcium, phosphate, and iron make up the majority of the dissolved solids (Trivedy, 1986)[20].According to Table 1 and Figure 11, the highest estimated total dissolved solids (TDS) value for Medchal lake occurred in April at 495 mg/l and the lowest in August at 310 mg/l. An increase in total dissolved solids (TDS) might be due, in part, to the pollution of surface water bodies by human and animal waste (Reasoner, 2004)[21].

Chlorides: In water, it exists as an inorganic anion. Table 1 and Figure 12 show that in April the chloride content was 198.96 mg/l, but in July it was 126.25 mg/l. A greater chloride content is thought to be a sign of more pollution caused by more organic waste from animals (.Mishra et al 2007)[22].According to Munnavar (1970), there is a clear correlation between the degree of pollution and the concentration of chloride [23].The chloride level drops to its lowest point during the monsoons because rainwater dilutes lakes (Shastri 1970)[24].

Sulphates: Over the course of the study, the concentrations reached a high of 36 mg/l in February and a low of 24 mg/l in September.A sulfur shortage might indirectly slow the development of algae by preventing the production of chlorophyll (Cole, 1979)[25]. This information is shown in Table 1 and Figure 13.

Phosphates: Sewage from homes and farms, as well as agricultural runoff and the accidental discharge of laundry detergents, contribute to the very low phosphate concentrations seen in Medchal Lake. During the month of April, the concentration of phosphate (phosphorus) was found to be between 0.37 and 0.98 mg/l. According to the data in Table 1 and Figure 14.

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Nitrates: Nitrate levels ranged from 0.64 mg/l in March to an estimated 1.15 mg/l in June. The data is shown in Table 1 and Figure 15.

Nitrogen: In water, nitrogen may be found in dissolved organic molecules, nitrite, ammonia, urea, and nitrate. Blooms could be sustained at the maximum nitrate content. (Audama, U. (2014) at [26]).

Silicates: This parameter controls the number of diatoms in a freshwater habitat, making it crucial. Silicates are play an important role in the production of algal growth is well recognized. April values varied from 1.92 mg/l to June values of 2.99 mg/l, according to the current study. (Table-1, Figure- 16).

Organic matter: Table 1 and Figure 17 show that the concentrations ranged from 0.4 mg/l in August to 2.5 mg/l in September. The introduction of organic substances into the lake by the influx of water from beyond the basin.

Nitrites: The nitrogen-rich floodwater that flows into the lake causes an increase in nitrites.Table 1 and Figure 18 show that the highest reported value was 0.08 mg/l in July, while the lowest was 0.02 mg/l in March. Possibly as a result of eutrophication, the summer and monsoon seasons had the lowest concentrations of nitrite.(Srinivas, M., 2018)[28], As per Abdar (2013)[27].

Table 1. Monthly variation of Physico-chemical parameters

Parameters	JAN 2023	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC 2023	AVG.
Temp(OC)	22.4	27.1	30.1	31.14	31.13	29.2	24.2	23.2	22.9	22.4	21.6	21.7	25.58
pH	7.8	8.0	8.0	8.2	8.5	8.3	8.4	8.1	7.2	7.4	7.4	7.9	7.91
Carbonates (mg/l)	51.62	34.25	46.31	36.28	52.94	26.64	39.34	48.40	42.68	41.56	47.26	27.44	41.22
Bicarbonates(mg/l)	234.24	241.26	229.76	239.56	249.24	248.65	249.79	250.64	232.68	140.56	226.34	248.61	232.58
DO(mg/l)	8.2	6.9	4.3	4.4	4.5	5.2	5.6	5.8	6.4	7.2	8.4	8.3	6.26
BOD	8	6	8	10	8	8	4	4	5	10	8	10	7.41
COD(mg/l)	19	28	24	31	29	27	10	10	12	14	16	16	19.66
TH(mg/l)	222	245	260	188	196	178	182	120	194	180	194	218	198.08
Calcium(mg/l)	35.26	38.28	44.29	46.96	49.92	41.34	44.66	60.49	46.74	42.12	51.39	54.58	46.33
Magnesium(mg/l)	35.79	28.84	34.68	40.24	38.66	28.24	30.66	26.78	34.42	29.94	26.64	24.78	31.63
TDS(mg/l)	320	360	410	495	395	330	340	310	360	340	330	320	359.16
Chlorides(mg/l)	127.26	165.28	122.6	198.96	145.56	126.25	158.56	148.64	140.67	160.54	140.68	190.58	152.13
Sulphates(mg/l)	32	36	30	34	30	34	32	36	24	28	26	36	28.75
Phosphates (mg/l)	0.88	0.66	0.53	0.98	0.44	0.56	0.42	0.77	0.76	0.64	0.89	0.67	0.68
Nitrates(mg/l)	0.87	0.85	0.64	0.66	0.98	1.15	1.08	0.98	0.97	0.67	0.74	0.95	0.87
Silicates(mg/l)	2.24	2.44	2.16	1.92	2.75	2.99	1.93	1.94	2.18	1.96	2.56	1.96	2.25
Organic matter(mg/l)	1.8	0.9	1.4	1.8	1.8	0.6	0.5	0.4	2	1.9	1.6	1.8	1.37
Nitrite(mg/l)	0.04	0.06	0.02	0.06	0.03	0.04	0.08	0.02	0.04	0.04	0.02	0.05	0.04

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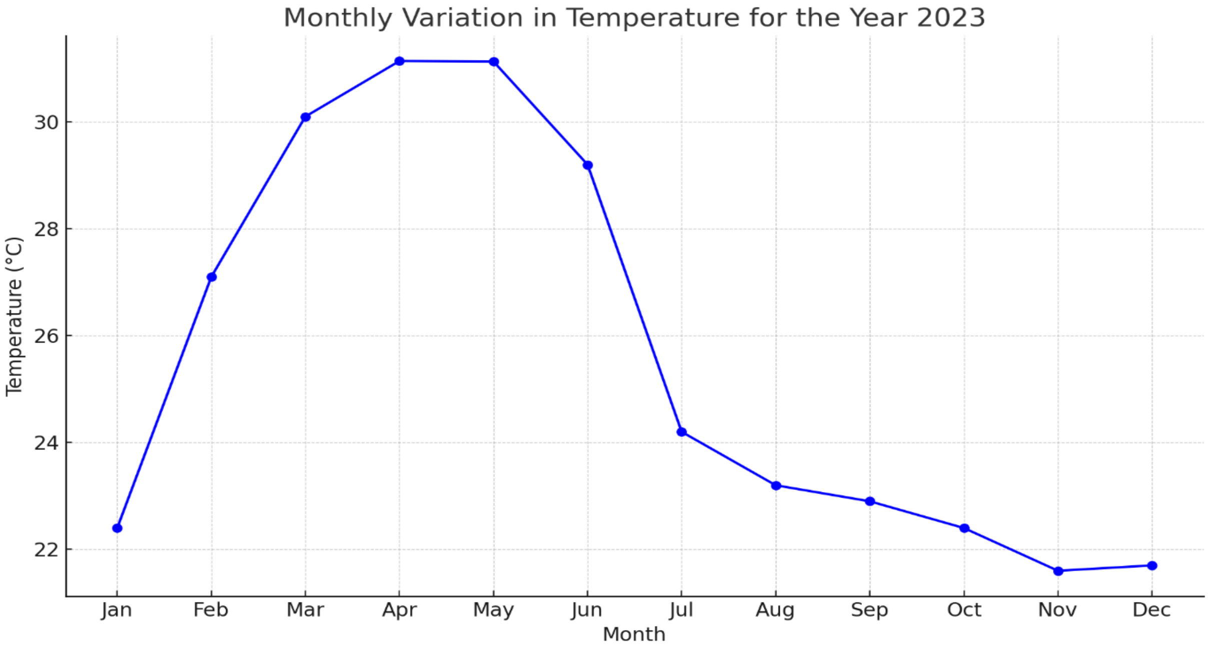

Figure-1:- Showing variation in temperature.

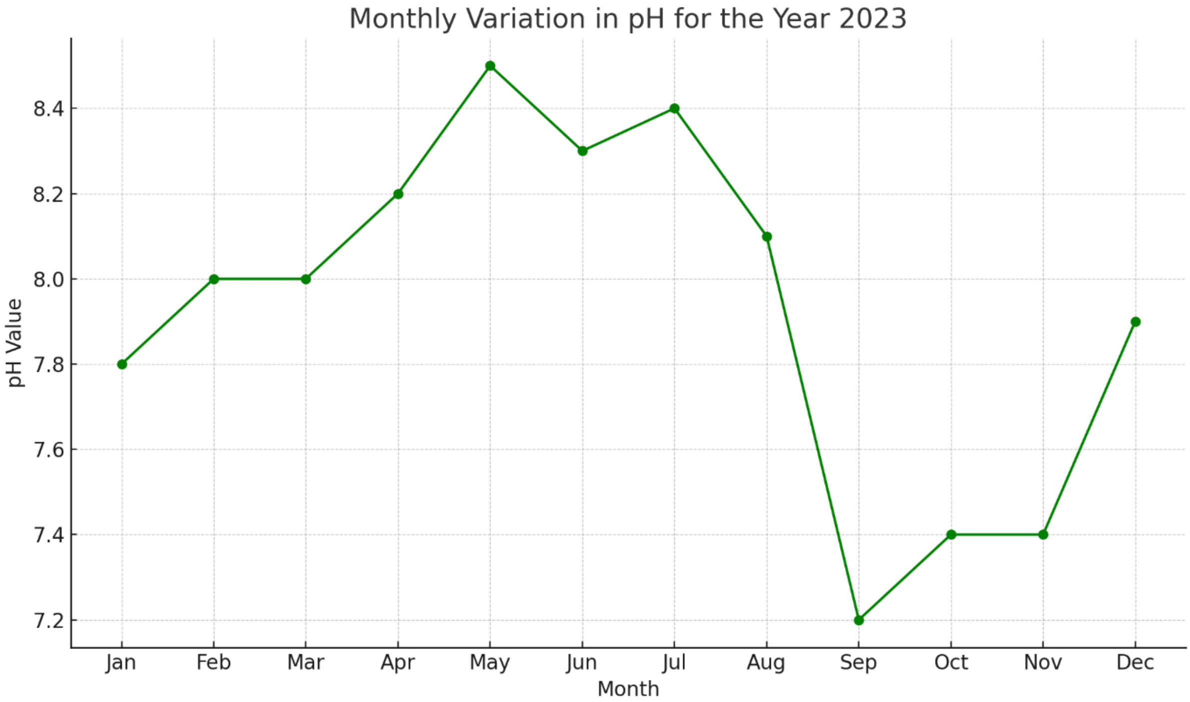

Figure-2:- Showing variation of pH

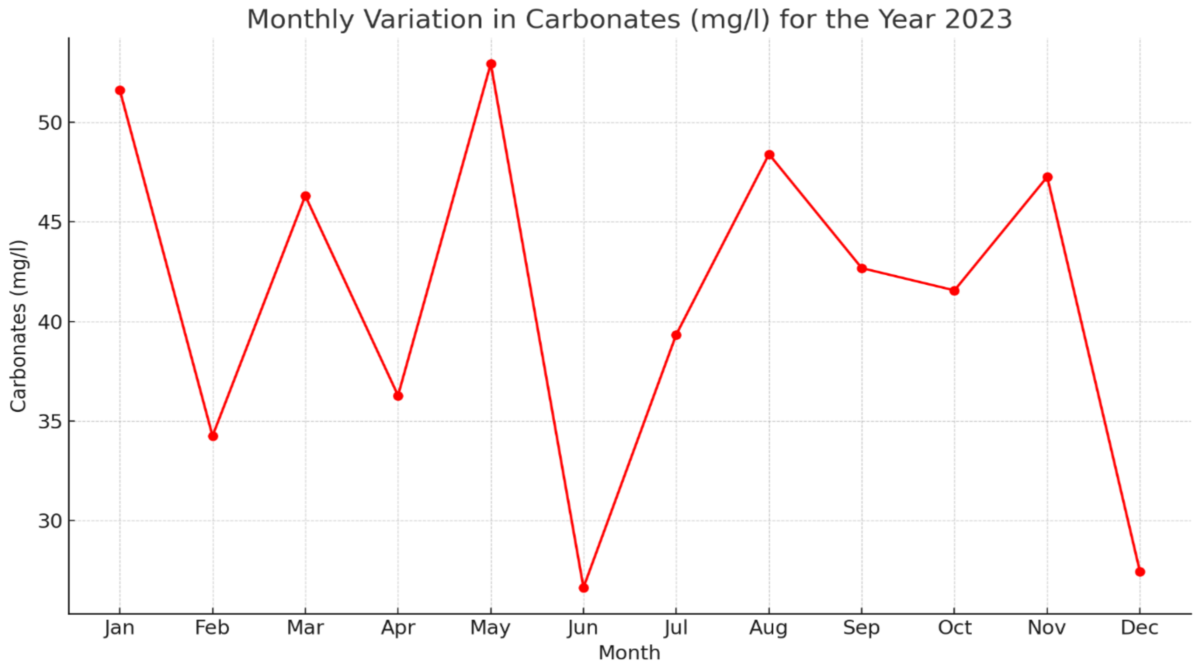

Figure-3:- Showing Amount of Carbonates

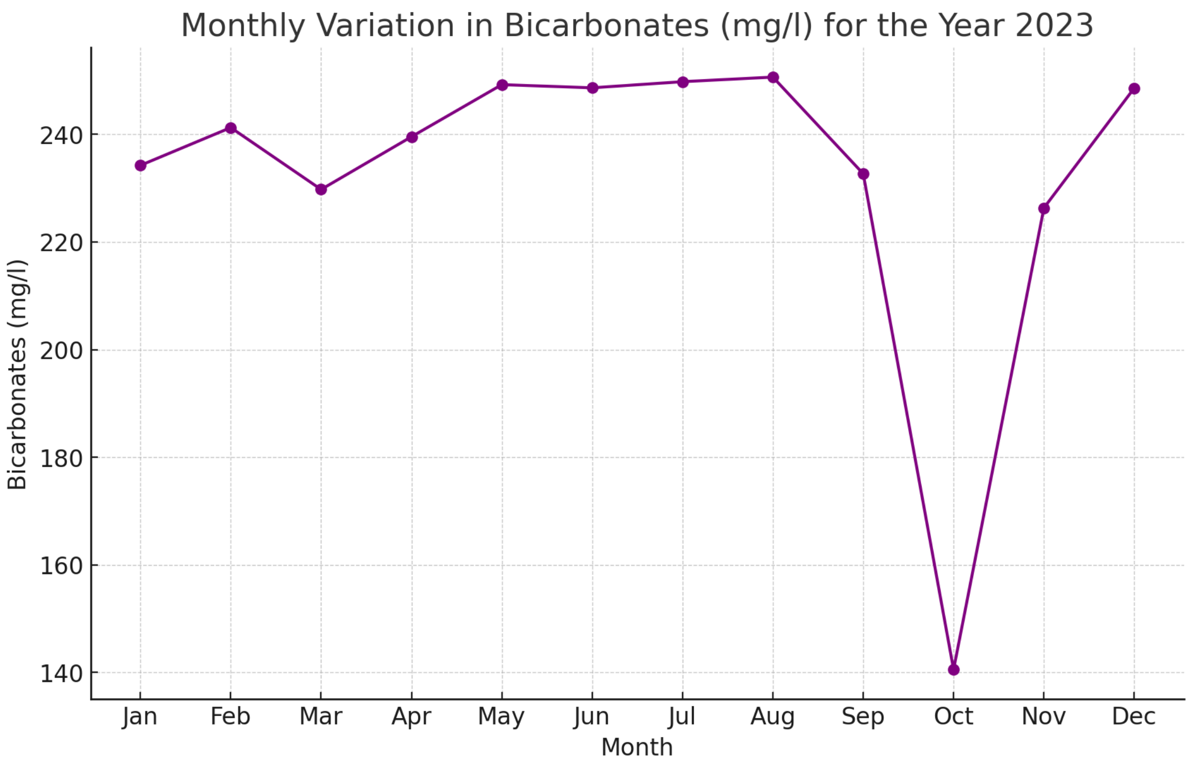

Figure-4:- Showing Amount of Bicarbonates

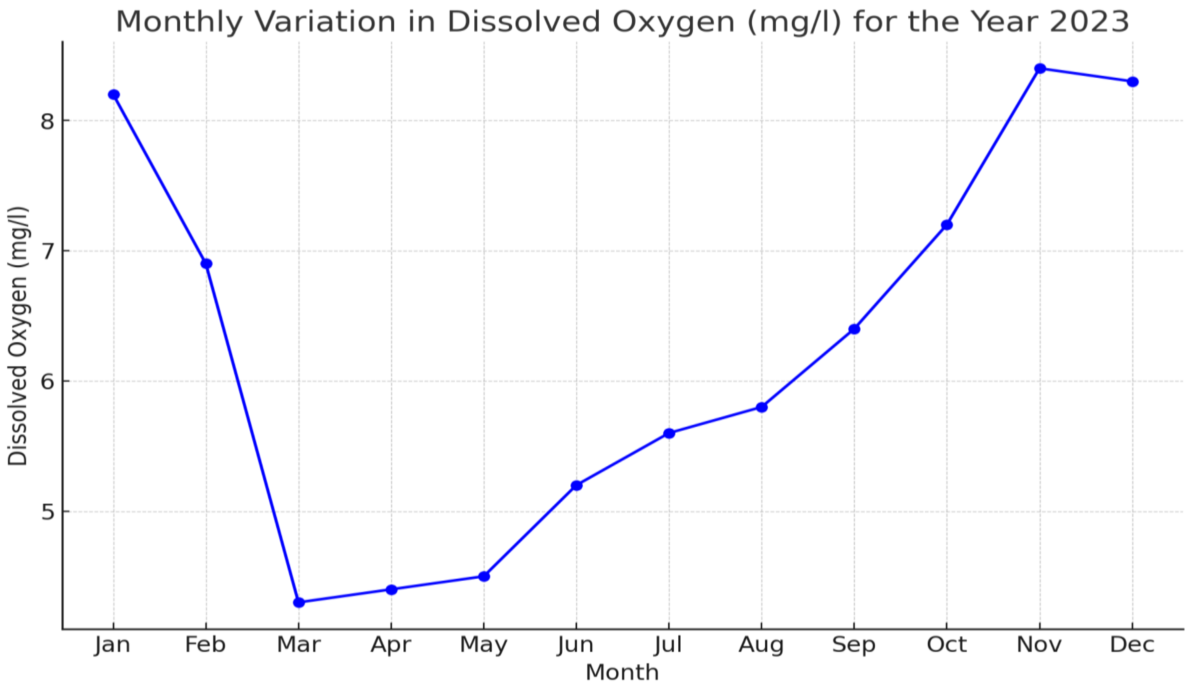

Figure-5:- Showing variations in Dissolved Oxygen

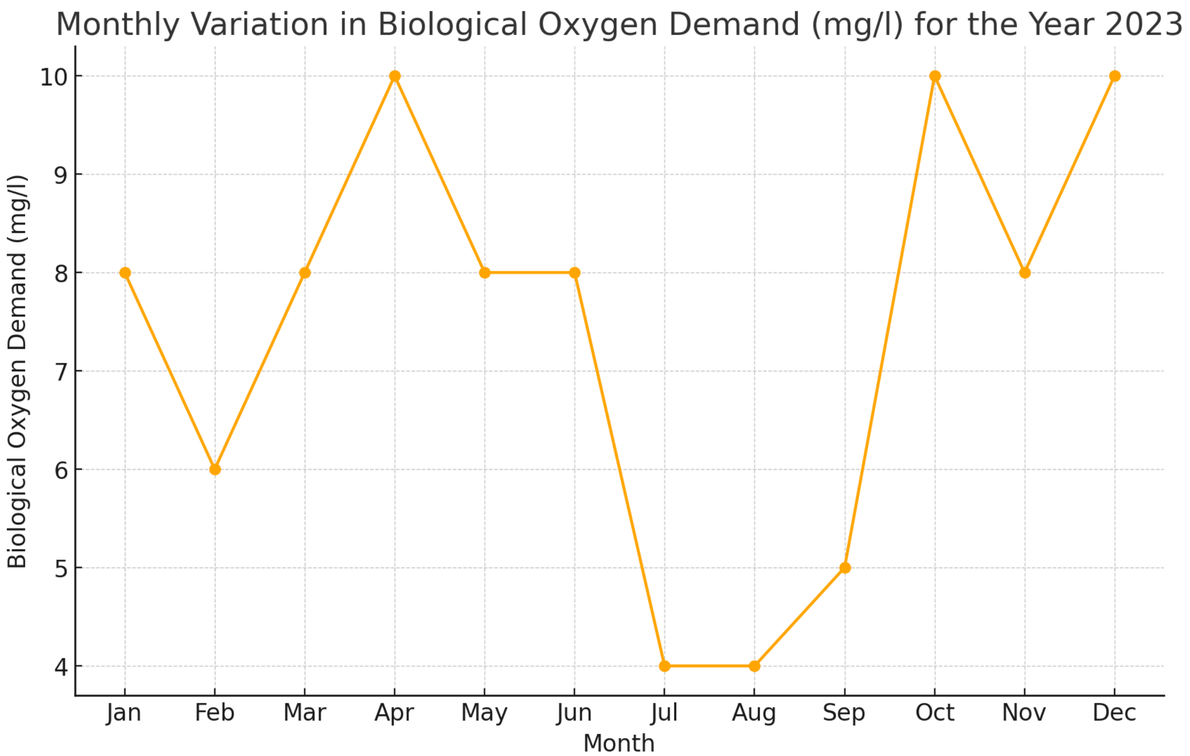

Figure-6:- Showing variation of Biological Oxygen Demand

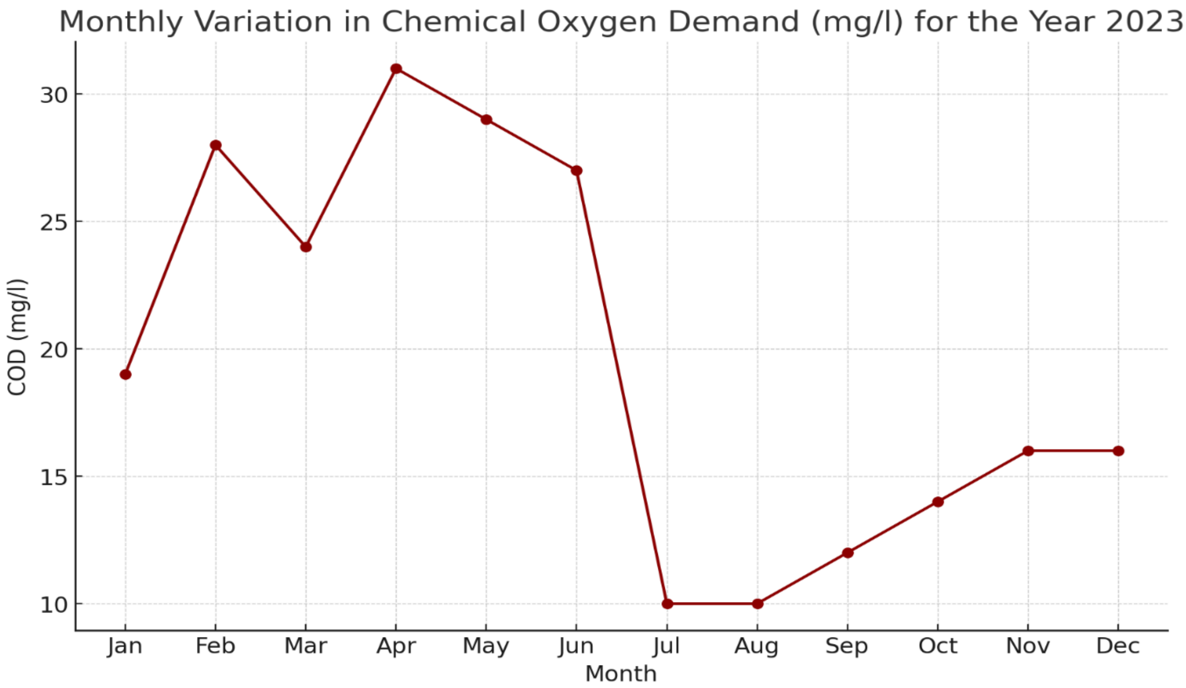

Figure-7:- Showing variation of Chemical Oxygen Demand

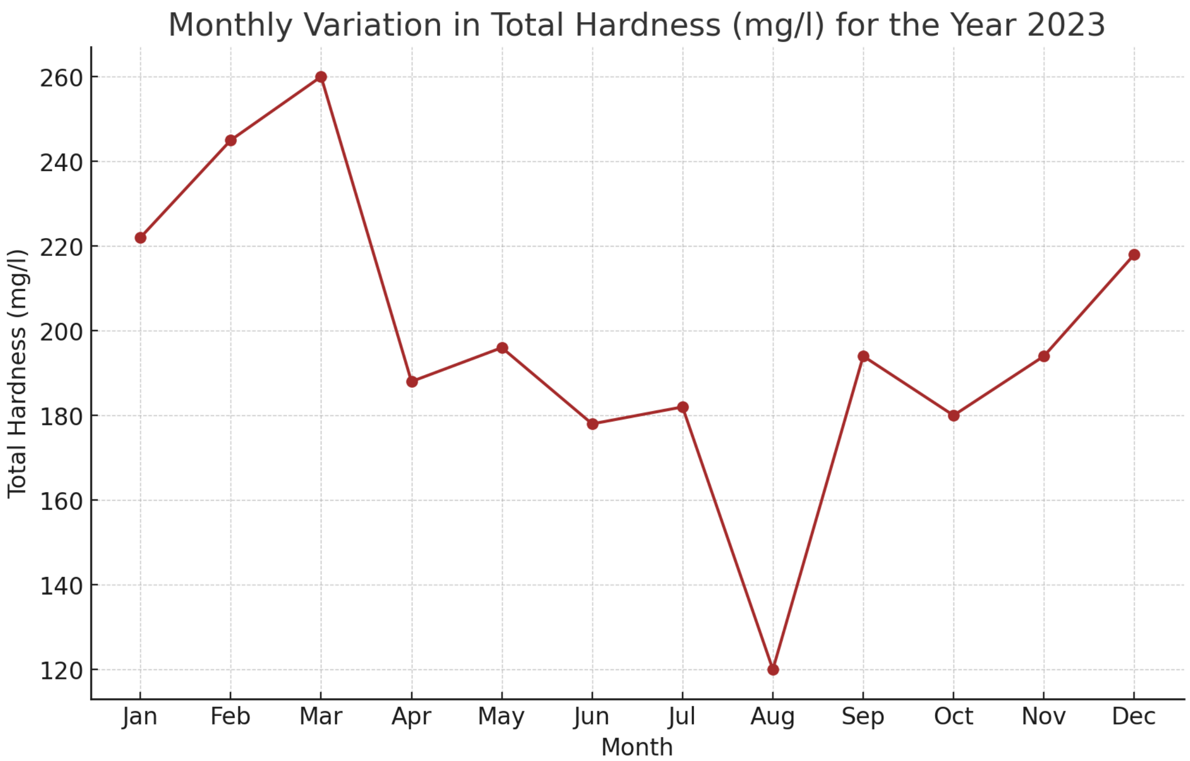

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Figure-8:- Showing variation in Total Hardness

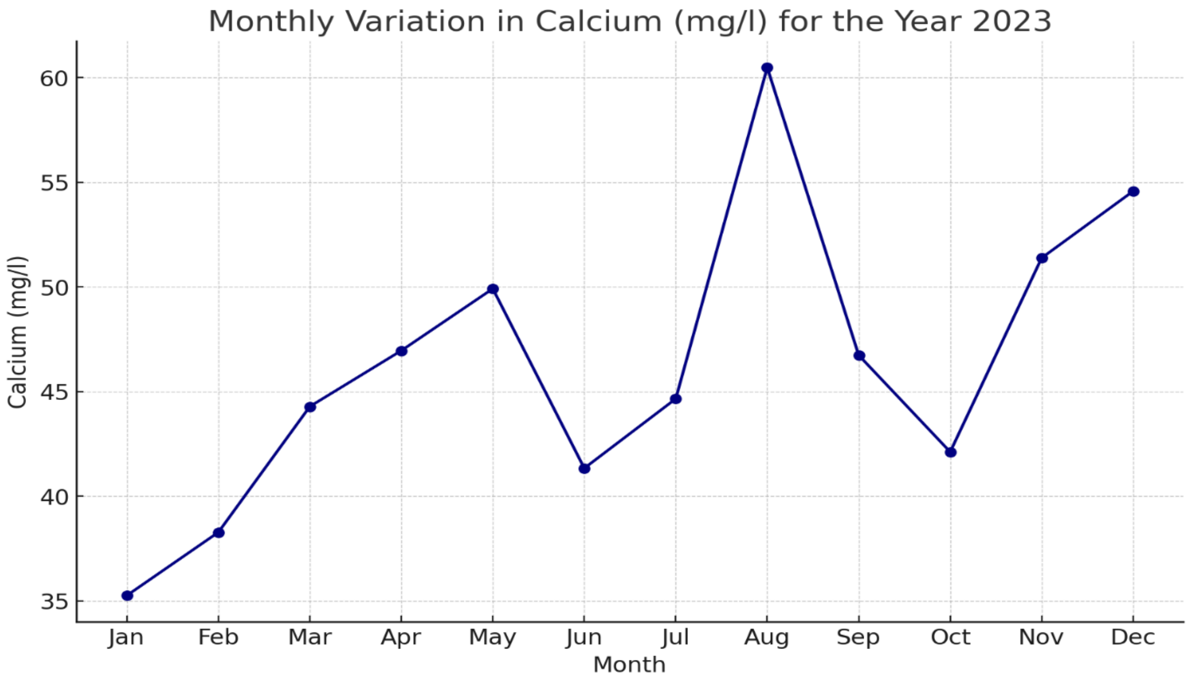

Figure-9:- Showing Amount of Calcium

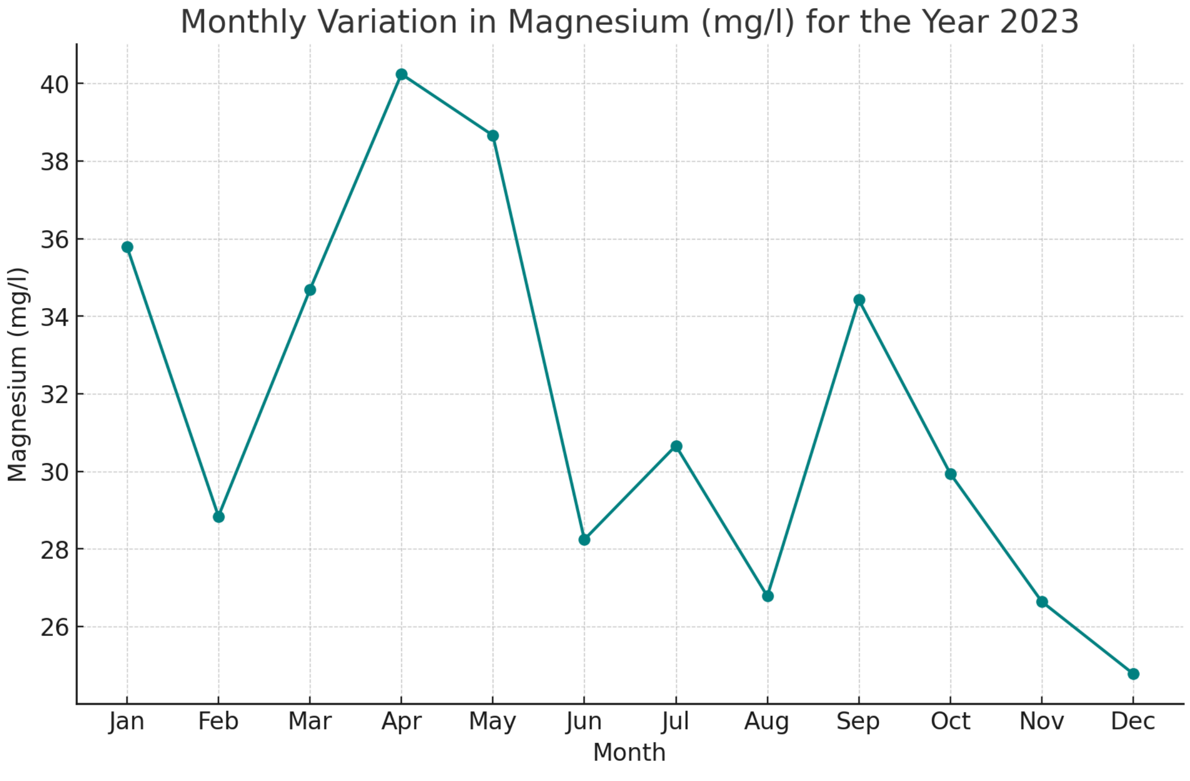

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Figure-10:- Showing Amount of Magnesium

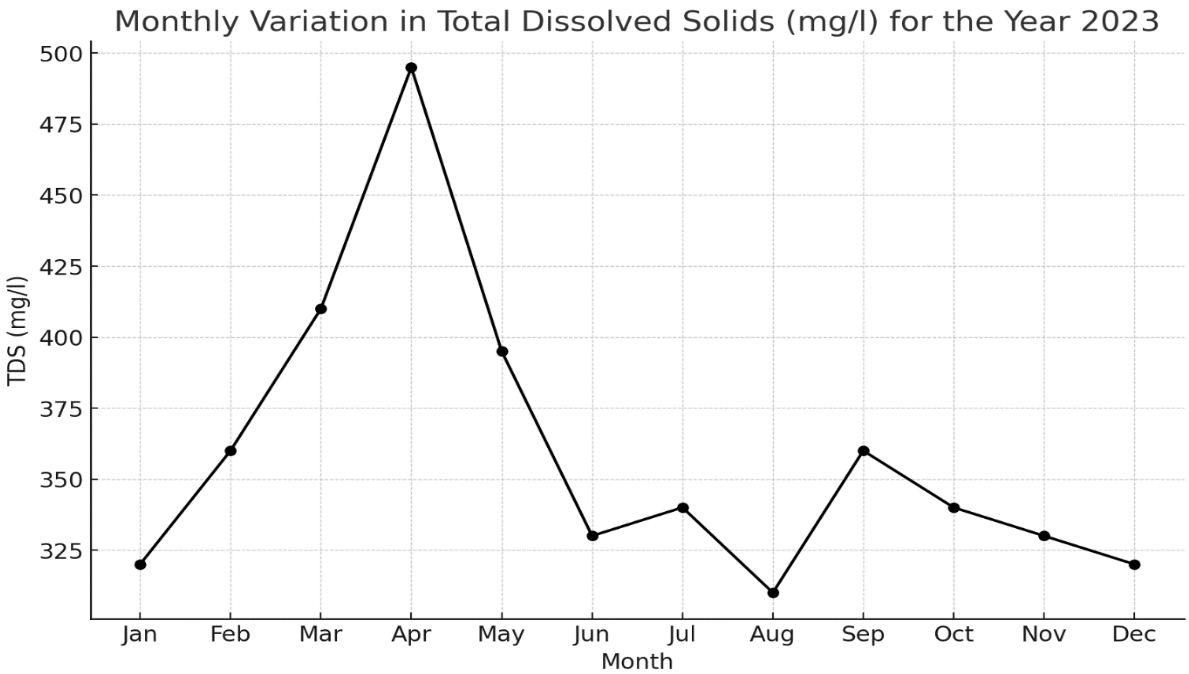

Figure-11:- Showing variation of Total Dissolved Solids

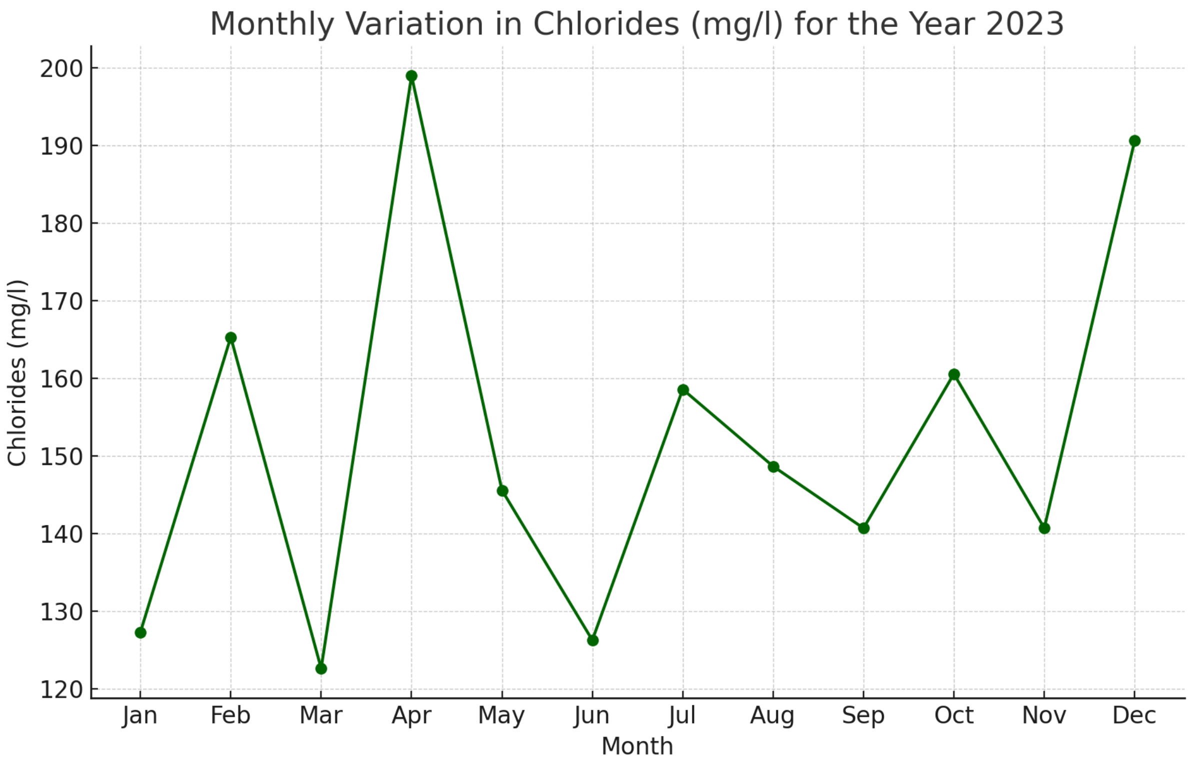

Figure-12:- Showing Amount of Chlorides

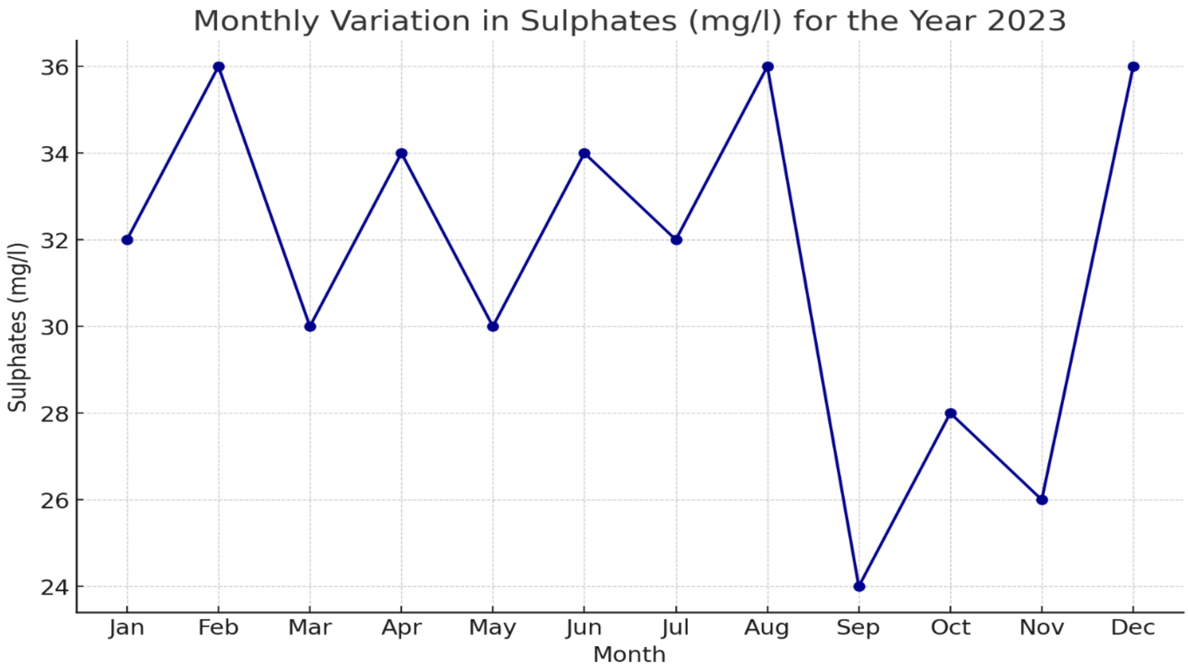

Figure-13:- Showing Amount of Sulphates

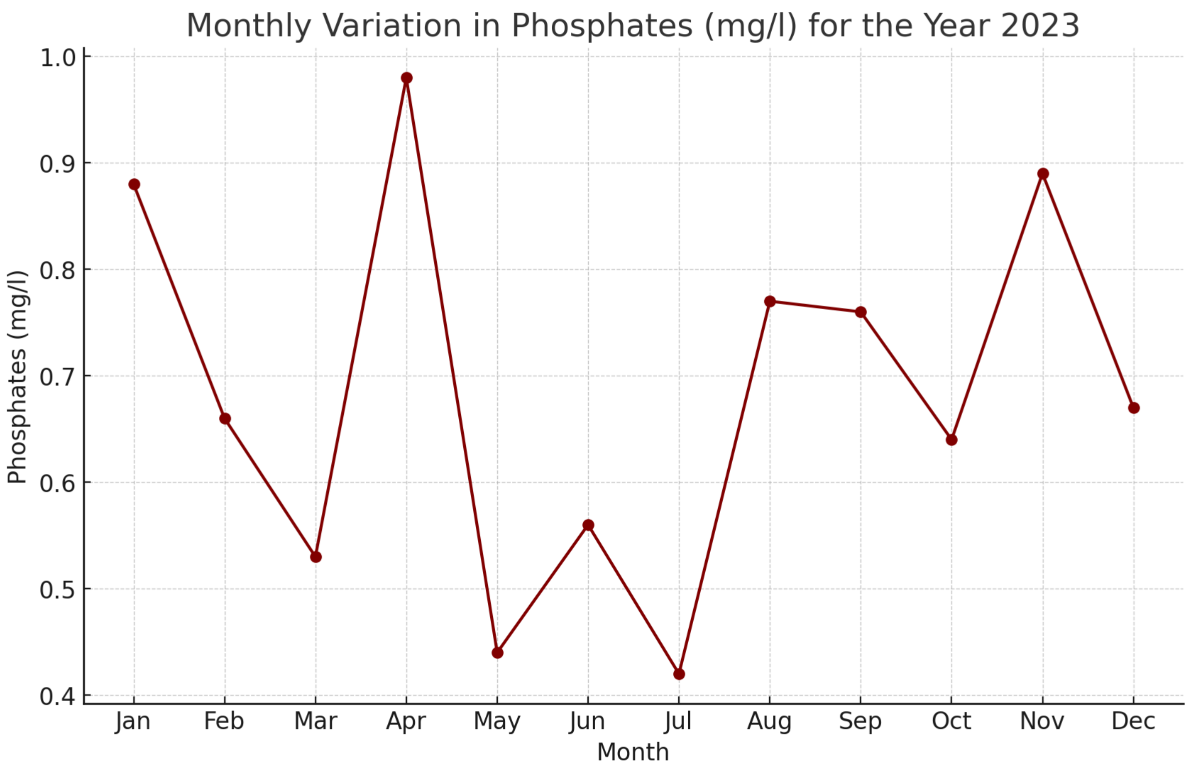

Figure-14:- Showing Amount of Phosphates.

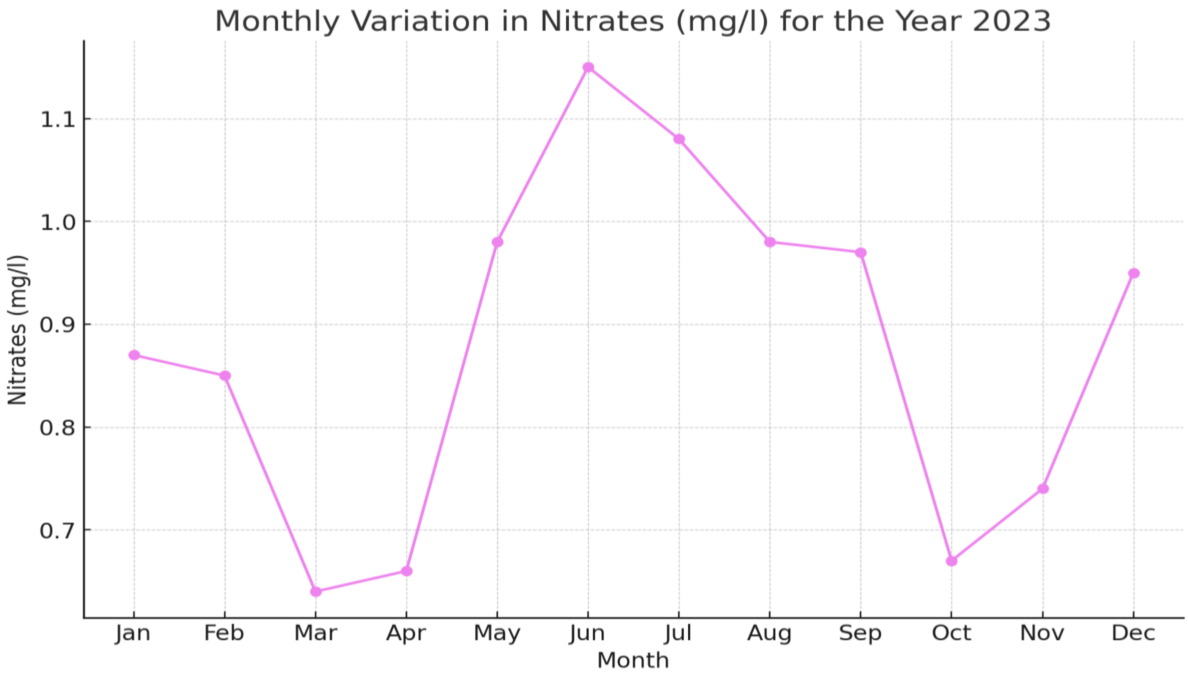

Figure-15:- Showing Amount of Nitrates

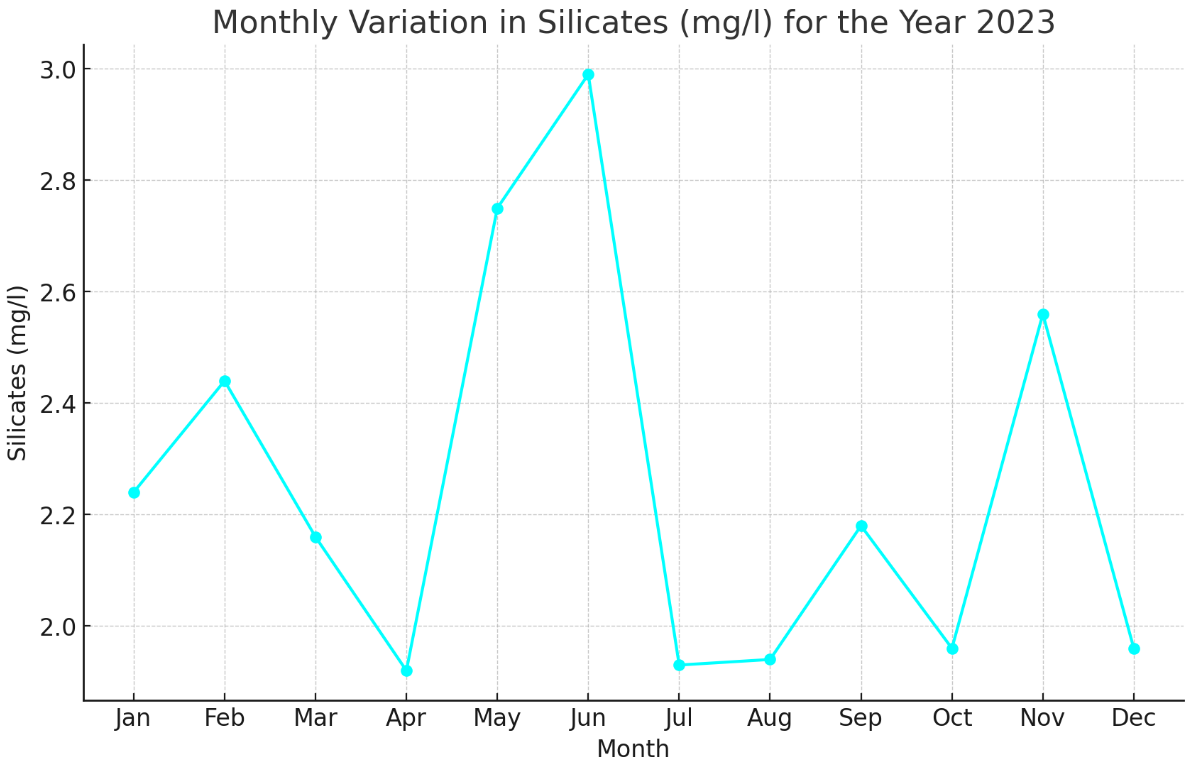

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Figure-16:- Showing variation of Silicates

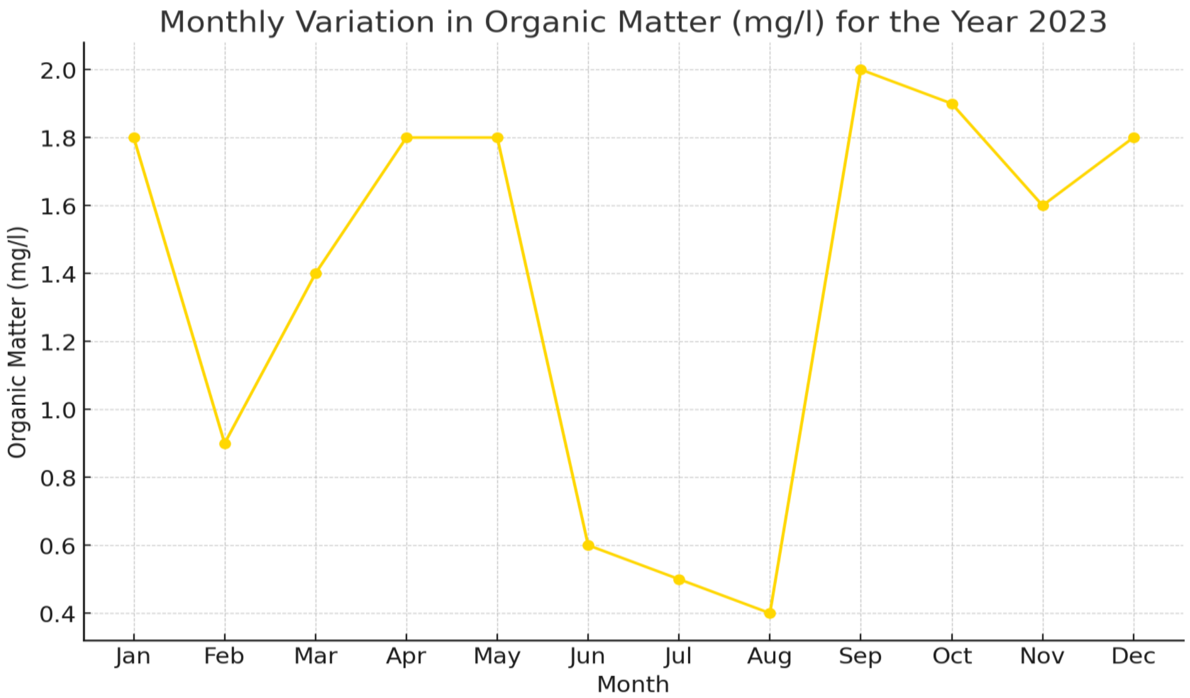

Figure-17:- Showing Content of Organic Matter

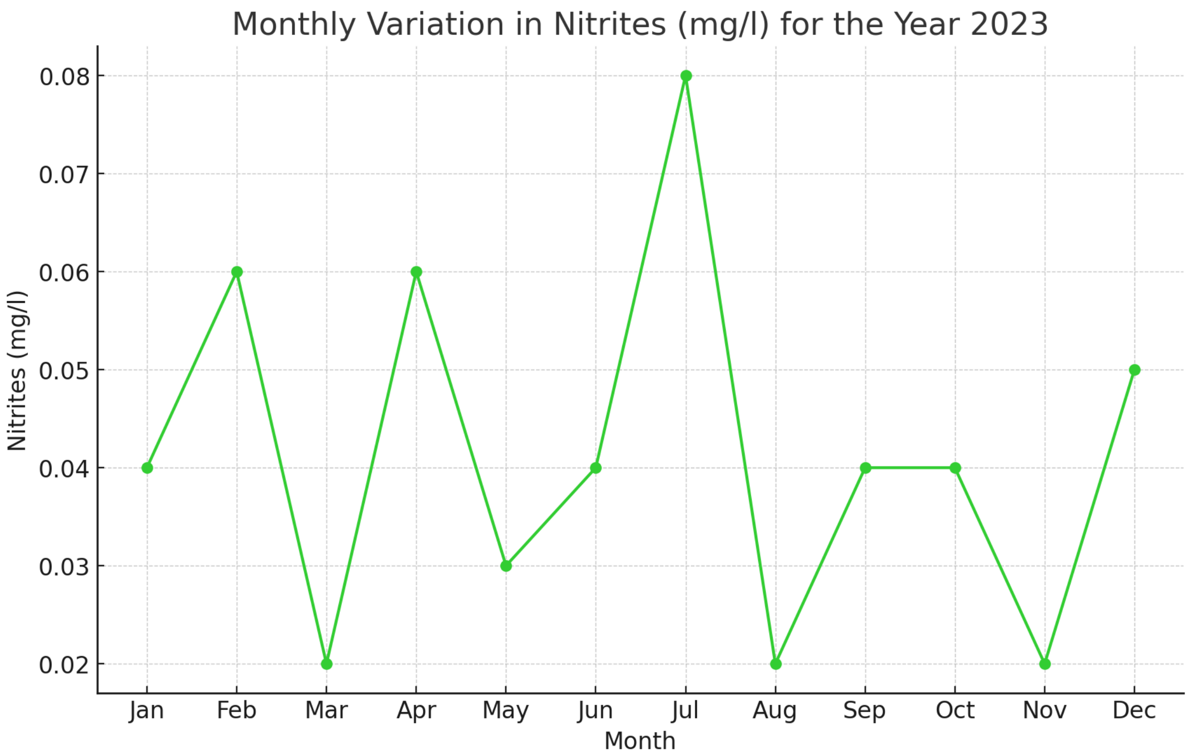

Figure-18:- Showing Amount of Nitrites

CONCLUSION

The results of the present investigation, which included an analysis of physicochemical properties, revealed that eutrophication was caused by human activity and the entrance of rubbish from domestic sources into the lake. This was the conclusion reached by the investigation. The findings of the examination of the physicochemical properties were found to be within or slightly over the permissible range that was stated by the World Health Organization (WHO). This indicated that the characteristics were within the acceptable range. The physicochemical analysis of the water in the lake has shown that there is a continuous shift in the trophic state of the lake, which correlates temporally with an increase in the activities that are induced by people. This is something that has been demonstrated.

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