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Assessment of Seasonal Variations of Physico-chemical parameters of Talikatte lake water of Chitradurga District, Karnataka, India

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Abstract

The present study aimed to analyse the seasonal variations of physicochemical parameters of Talikatte lake and was carried out from June 2019 to May 2021. All season samples were collected from the sampling site. The various physicochemical parameters such as Air and Water Temperature, Turbidity, Electrical conductivity, Total solids, Total dissolved solids, Total suspended solids, Total alkalinity, Total hardness, pH, Free CO2, Dissolved Oxygen (DO), Biological oxygen demand (BOD), Chemical oxygen demand (COD), Calcium, Magnesium, Chloride, Phosphate and Nitrate were analysed. The correspondence matrix of different Physico-chemical parameters is measured and analyzed. There is a relationship between the ecologists and micro planners regarding the importance of the conservation of ponds as a sustainable source of water in rural communities. The water quality is significant for intake, farming, and aquaculture use.

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Introduction

A satisfactory understanding of aquatic sources requires knowledge not only of the organisms inhabiting them but also of those external influences which directly or indirectly affect them. Water supports life on earth and it is one of the abundantly available substances which man has exploited more than any other resource for the sustenance of life. Water resources have reached a point of crisis due to unplanned urbanization and industrialization (Singh *et al*., 2002).

Water has a unique component of nature and has played a vital role in life processes. Our natural resources are limited and hence water has become more precious. The property of water of dissolving and carrying suspension, a variety of chemicals has the undesirable consequence that water can easily become contaminated. Most of the natural water bodies are gradually becoming degraded to a great extent due to the rapid growth of industrialization and population explosion. The increasing demands for fresh water in all sectors like drinking, agriculture and aquaculture. Fresh water is going to be the scarcest resource in future. Unplanned and excessive exploitation and mounting anthropogenic influence in and around aquatic ecosystems have resulted in pollution problems. (Chandrashekar and Kodarkar, 1996).

Water quality studies of any aquatic ecosystem are fundamental to understanding the water resource and one of the important features of the water body is how they interact with the surrounding land, particularly due to the agricultural activities of man, construction of dams, deforestation and domestic as well as the industrial inputs. Since the quality of water affects aquatic life in several ways, water must be of good quality for the health of all organisms. The water resource is being used for various purposes such as domestic use, agriculture and fish culture etc. by the local community. Now wetlands are shrinking rapidly because of urbanization and industrialization. Due to urbanization and anthropogenic pressure, most of the wetlands have succumbed to a greater degree of biologically active nutrient accumulation.

It is an essential element for all living beings which are present on earth and is the primary source of food for root levelled producers in all food webs on earth. Water quality refers to the chemical, physical, biological and radiological characteristics of water (Hussein *et al*., 2019). It is a measure of the condition of water relative to the requirements of one or more biotic species and any human need or purpose (Khan *et al*., 2017) and is determined by various Physico-chemical, biological variables and changes generally due to many factors like a source of water, type of pollution, seasonal fluctuations and adjacent human intervention that directly or indirectly affect its quality and consequently its suitability for the distribution and production of fish and other aquatic animals (Dixit, 2019).

Recent reviews indicate that land degradation, forest loss, biodiversity and habitat degradation, scarcity and pollution of fresh water are increasing hence this limnological study is important. There are many man-made ponds in the village and water from these ponds is used for drinking purposes. The pond is very economical and eco-friendly management for harvesting rainwater to check the groundwater level depletion. Industrial sewage and municipal wastes are being added to water reservoirs affecting the Physico-chemical quality of water and making it unfit for use by livestock and other organisms (Dwivedi and Pandey, 2002).

The purpose of the present study is to observe the water quality of Talikatte lake situated in Holalkere taluk, Chitradurga District, Karnataka by physicochemical procedures and to determine the changes in water quality parameters by seasons and to find the relationship between different physicochemical parameters. It is undertaken to access the effect of seasonal variation on water quality in rainy, winter and summer seasons. The objectives of the study are (1) To assess the physicochemical characteristics of the water of Talikatte lake in three different seasons and (2) To establish the correlation

between the parameters and the season. This study was conducted from June 2019 to May 2021, at the sampling site of Talikatte lake. This work is therefore aimed at studying the water quality as well as its seasonal variation.

Materials and methods

Study area

The lake that was selected for the present investigation, is Talikatte lake near Talikatte Village and it is situated at 13.93185 Latitude and 76.1422 Longitude,.at a distance of about 20 Km, Southwest of Holalkere Taluk in Chitradurga district of Karnataka state (Fig. 1).

Sample collection

For physicochemical analysis, water samples were collected from Talikatte lake in the Chitradurga district. Water was collected in a collection bottle during three successive seasons (winter, summer and Rainy) for Two successive years from June 2019 to May -2021. Physicochemical parameters such as Water Temperature, Air Temperature, Turbidity, Conductivity, pH, TDS, Calcium, Total hardness, Phosphate, Chloride, Potassium, Sodium, Magnesium, Nitrate, Sulphate, Suspended solids, Total alkalinity, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD) and Dissolved Oxygen (DO) were analysed in the laboratory. For dissolved oxygen measurement a 500ml capacity BOD bottle was used for the collection of water samples and the oxygen was fixed by adding $MnSO_4$ and alkaline potassium iodide at the sampling site before being carried to the laboratory (Gahlawat *et al.*, 2020). For analysing the various parameters, methods given in APHA, (2012) were followed.

Fig. 1. Satellite image of Talikatte lake.

Results and discussion

The physicochemical characteristic provides a fair idea of the water quality in any water body. The results of the seasonal variation in the physicochemical parameters of Talikatte lake are summarized in Tables 1 and 2.

Air Temperature and Water Temperature

The air temperature was recorded as high at 31.5°C in the summer season and low at 27.5 °C in the Rainy season and the maximum temperature of lake water was recorded as 29.6°C in the summer season and minimum of 27.0 °C rainy season (Fig.2 and 3).

Temperature plays an important role, which governing the seasonal succession of the biota. The temperature was high in May and June which is associated with decreased solubility of gases in the lake. This investigation is also in close conformity with the findings of (Kumar *et al.*, 2011) and (Elaya Raj *et al.*, 2016).

Total Dissolved Solids (TDS)

Dissolved solids denote the various types of minerals present in the water in dissolved forms, this may also include organic substances in the dissolved forms as in the case of polluted water. The maximum value of TDS of 445 mg/L was recorded at Talikatte lake during summer, whereas a minimum of 291 mg/L was recorded during the rainy season showing low TDS.

pH

pH – the potential of Hydrogen, is the measure of the concentration of hydrogen ions. It provides the measure of the acidity or alkalinity of a solution and is measured on a scale of 0- 14.

The pH of water determines the solubility and biological availability of certain chemical nutrients such as phosphorus, nitrogen and carbon. The pH measured in the lake throughout the year ranges from 7.32 to 9.10. The lowest value was recorded in July. And the highest value was recorded in April.

Table 1. Seasonal variations in Physicochemical parameters of Talikatte lake (2019-2020).

Sl no.	Parameters	June 2019 to May 2020		
		Rainy	Winter	Summer
1	Air Temperature	27.5	28.5	31
2	Water Temperature	26.3	27.2	29.6
3	TDS	291	376	445
4	pH	7.32	8.10	9.11
5	Turbidity	3	5	11
6	Conductivity	290	345	642
7	Calcium	37	39	61
8	Chloride	61	67	93
9	Potassium	7.5	8.17	9.5
10	Magnesium	7.0	9.5	17.5
11	Free Ammonia	0.017	0.021	0.17
12	Sulphate	49	68	97
13	Total Alkalinity	192	148	131
14	Total Hardness	121	132	172
15	COD	58	63	93
16	BOD	5.7	6.1	8.7
17	Free Carbon Dioxide	11.0	16.5	20.6
18	Suspended Solids	3	5	16
19	Sodium	31	94	46
20	Phosphate	0.021	0.043	0.10
21	Nitrite	4.15	3.13	2.26
22	Dissolved Oxygen	18.5	14.5	9.0

Turbidity

The suspension of particles in water interfering with the passage of light is called turbidity. The turbidity of water is responsible for the light being scattered. Turbidity in natural water restricts light penetration thus limiting photosynthesis, which consequently leads to depletion of oxygen content. Turbidity in Talikatte Lake throughout the year ranges from 3 to 11 NTU. The highest value was recorded during June and February and the lowest value was recorded in August.

Conductivity

Electrical conductivity in the water is due to the salt

present in water and the current produced by them. Conductivity is thus a measurement of total dissolved solids in water. The EC value recorded throughout the year ranges from 290 to 642. the highest value was recorded in July and the lowest value was recorded in December.

Table 2. Seasonal variations in Physicochemical parameters of Talikatte lake (2020-2021).

Sl no.	Parameters	June 2020 to May 2021		
		Rainy	Winter	Summer
1	Air Temperature	28	28.5	31.5
2	Water Temperature	26.5	27	29
3	TDS	310	376	443
4	pH	7.38	8.14	9.10
5	Turbidity	4	6	11
6	Conductivity	295	351	638
7	Calcium	35	39	62
8	Chloride	59	69	94
9	Potassium	7.3	8.2	9.6
10	Magnesium	7.1	9.8	17.3
11	Free Ammonia	0.015	0.022	0.18
12	Sulphate	51	67	96
13	Total Alkalinity	194	152	134
14	Total Hardness	122	137	178
15	COD	53	64	95
16	BOD	5.1	6.2	8.8
17	Free Carbon Dioxide	11.5	17.5	21.0
18	Suspended Solids	3	5	15
19	Sodium	33	92	43
20	Phosphate	0.023	0.041	0.12
21	Nitrite	4.57	3.23	2.21
22	Dissolved Oxygen	19.5	14.0	9.5

Calcium

Calcium is commonly present in all water bodies where it usually has a quantity varying from traces to 100 mg/L. The calcium value recorded throughout the year ranges from 35 to 62 mg/l. the highest value was recorded in July and the lowest was recorded in October.

Chloride

The greater source of chlorides in pond water is the disposal of sewage and industrial waste. The human body releases a very high quantity of chlorides through urine and fasces.

The chloride concentration is used was used as an important parameter for the detection of contamination by sewage. The chloride value recorded throughout the year ranges from 59 to 94 mg/l. The lowest value recorded was found in August and the highest value was recorded in May, during the summer season.

Potassium

The concentration of potassium in most drinking waters is trivial. It has similar chemistry to sodium and remains mostly in solution without undergoing any precipitation. It is not very much significant from the health point of view, but in excessive amounts, it acts as cathartic.

It is reported that foaming may be caused by more than 50 mg/l of potassium and sodium in water. The concentration of potassium is determined by flame photometric methods (Ma *et al.*, 2020).

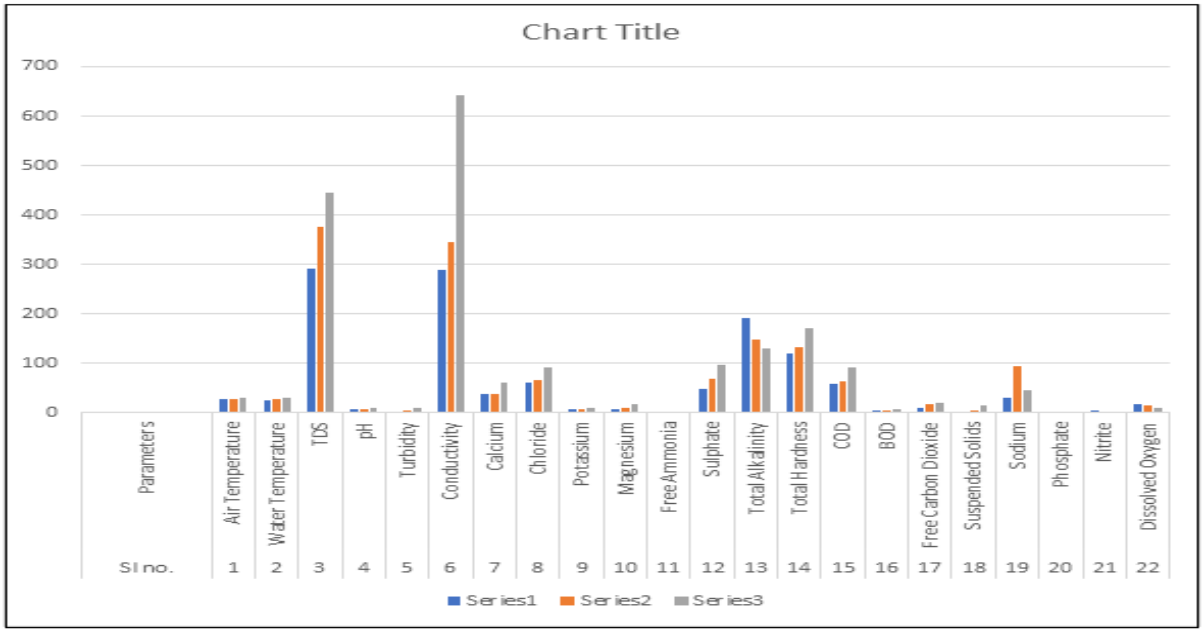

Fig. 2. Seasonal variations in Physicochemical parameters of Talikatte lake (2019-2020).

Magnesium

Magnesium is found in various salt and minerals, frequently associated with iron compounds. Magnesium is a vital micronutrient for both plants and animals. Magnesium is often associated with calcium in all kinds of water, but its concentration remains generally lower than calcium (Sudhakar, 2021). The maximum (15.8 mg/l) amount of magnesium in the water was recorded during the summer season and the minimum (9.48 mg/l) amount was recorded during the monsoon season.

A decrease in the level of magnesium reduces the phytoplankton population [(Srinivas and Shailaja, 2021). suggested that a considerable amount of magnesium influences water quality. Various subprocesses like bating, pickling, tanning, dyeing and fatliquoring cause water pollution (McCalley *et al.*, 1981).

Free Ammonia

In the ammonium, the test takes 5 ml of water in the test tube and added 5 drops of ammonium reagent to the sample and shakes it well. If the colour produced in the solution is changed to yellow or brown, we can conclude the presence of ammonium in the water sample. Measured the obtained colour with the reference chart and identify the ammonium value.

Sulphate

Sulphate is a major anion present in all kinds of natural waters. In arid and semi-arid zones, it is found in particularly higher concentrations due to the accumulation of soluble salts in soils and shallow aquifers. The biological oxidation of reduced sulphur species to sulphate also increases its concentration. Most of the salts of sulphate are soluble in water and as such, it is not precipitated. However, it may transform sulphur and hydrogen sulphide depending upon the redox potential of water.

The observed levels of sulphate during work were 49 mg/l, in the rainy season and a high value observes at 97 mg/l, in summer.

Alkalinity

The alkalinity of water is its capacity to neutralize a strong acid and is characterized by the presence of all hydroxyl ions capable of combining with the hydrogen ion. Alkalinity in natural water is due to free hydroxyl ions and hydrolysis of salts formed by weak acids and strong bases. Most of the alkalinity in lake water is formed due to the dissolution of carbon dioxide in water. The highest value of Alkalinity was recorded in July and the lowest value was noted in February. The Alkalinity throughout the year ranges from 131 to 194 mg/l.

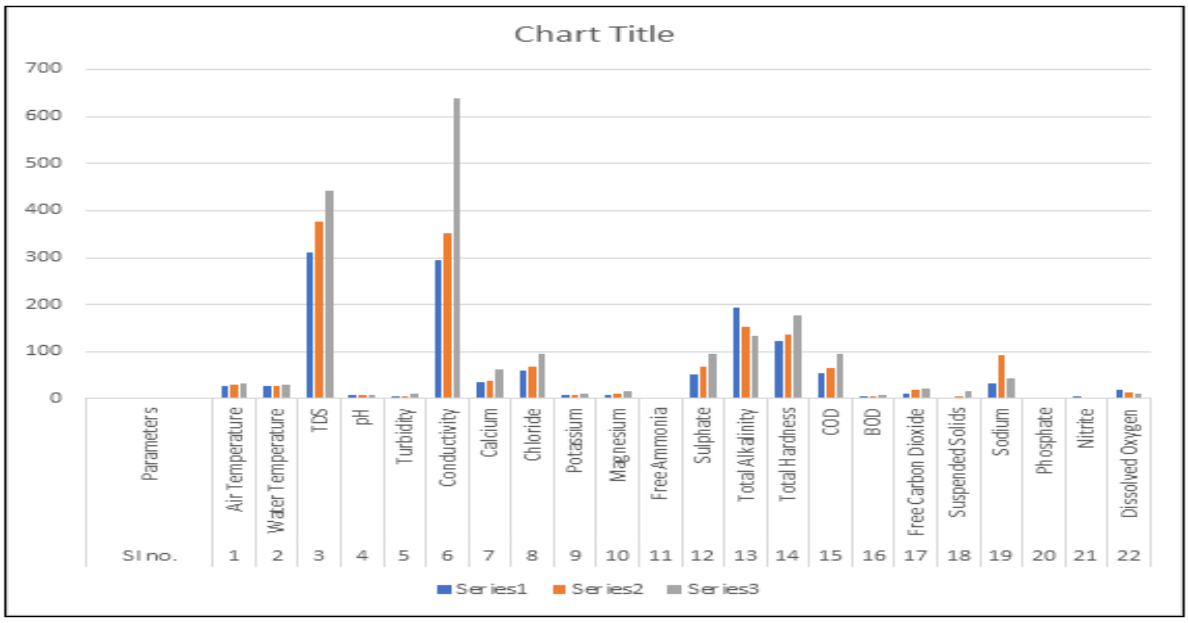

Fig. 3. Seasonal variations in Physicochemical parameters of Talikatte lake (2020-2021).

Total Hardness

Hardness is commonly expressed as Mg and Ca carbonate equivalent per litre. Although hardness is caused by cations it may also be discussed in terms of carbonate (Temporary) and non-carbonate (Permanent) hardness. The principal hardness-causing ions are calcium and magnesium. The hardness value recorded was found between 121 to 178 mg/l. the highest value was recorded in May and the lowest was recorded in November.

Chemical Oxygen Demand (COD)

COD is another measure of organic material contamination in water specified in ppm. COD is the amount of dissolved oxygen required to cause chemical oxidation of the organic material in water. Both BOD and COD are key indicators of the environmental health of a surface water supply. They are commonly used in wastewater treatment but rarely in general water treatment. The COD is another parameter used to characterize the organic strength of wastewater (Patil, 2012), (Virendra *et al.*, 2013). COD higher value observes in summer 95 and a lower value of 58 mg/l. observe in the rainy season.

Biological Oxygen Demand (BOD)

Biological Oxygen Demand depends on aquatic life; variation in BOD indicates dynamism in aquatic life present in the pond. BOD refers to the oxygen used by the microorganism in the aerobic oxidation of organic matter. Therefore, with the increase in the amount of organic matter in the water the BOD increases. The B.O.D. value recorded throughout the year ranges from 5.1 to 8.8 mg/l. The highest value was recorded in April and the lowest value was recorded in November.

Free carbon- dioxide

Carbon dioxide (CO_2) was in the range of 11.0 to 21.0 mg/l of observations with an average of 16.5 mg/l.

The fluctuation in free carbon dioxide level was marginal during the entire period of study. Maximum carbon dioxide concentrations were recorded in May Relatively lower concentrations of free carbon dioxide were recorded during most of the months.

Total suspended solids

The maximum TSS was recorded as 16 mg/l in the summer season and a minimum of 3 mg/l in the rainy season. Solids refer to a suspended and dissolved matter in water, they are very useful parameters in describing the chemical constituents of the water and can be considered as a general of edaphic relations that contribute to productivity within the water body.

Sodium: During the period of study, it was observed

the value of sodium was higher in winter, medium in summer and lower in rainy. The value of sodium was 46 mg/l during summer, 31 mg/l during rainy and 94 mg/l during the winter season.

Phosphate

The maximum phosphate content was recorded at 0.12 mg/l during the summer season and a minimum of 0.021 mg/l during the rainy season. Phosphate has a few sources in nature and also acts as a regulating factor for the productivity of the water body. Phosphate may occur in the lake as a result of domestic waste, detergent and agricultural run-off containing fertilizer (Gopalkrushna, 2011). A higher concentration of phosphate is an indicator of pollution, which induce the possibility of eutrophication (Singare *et al.*, 2011).

Nitrite

Though nitrogen is a major constituent of the atmosphere, it is found in small amounts in aquatic ecosystems due to low solubility but it is also found in small amounts in the form of ammonia, nitrates, nitrites, organic nitrogen and so on. In the present study, only nitrates were quantitatively estimated from the ecosystem under study. The maximum value of 4.57 mg/L of nitrate was recorded during the rainy season whereas the minimum value was 2.21 mg/L of nitrate during summer.

Dissolved Oxygen

The oxygen in water can be dissolved from the air or is produced from photosynthetic organisms like algae and aquatic plants, oxygen is a poorly soluble gas in water and its solubility depends on the temperature of the water and its partial pressure. The solubility of oxygen also decreases with the increasing salinity of the water. (Mukhopadhyay *et al.*, 2011) has established a direct relationship between photosynthesis and dissolved oxygen. The measurement of dissolved oxygen is a primary parameter in all pollution studies. In the present studies, the DO recorded throughout the year ranges from 9.0 to 19.5 mg/l. The highest value was recorded in September and the lowest value was recorded in May.

Conclusion

The fact revealed that wide variation in different physicochemical parameters was observed throughout the year. Here all the parameters were within the permissible limit, but many of the parameters were above the desirable limit. This indicates that water shows some level of pollution. The water quality of Talikatte lake is slightly polluted as many parameters were above prescribed limits.

The surface runoff, sewage discharge, dumping of waste material, religious activities and the main sources of organic pollution are non-point sources like agricultural run-off, cattle dropping etc, which may be the causative factor for deteriorating the water status. All these discussions indicate that limnological characters or parameters fluctuate or change monthly or seasonally. These variations are due to ecological factors. These influence the life of aquatic animals and the ecosystem at that particular time.

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