Journal of Advanced Zoology

ISSN: 0253-7214
Volume 44 Issue 04 Year 2023 Page 23:27

Research of Physical-Chemical and Ecological Characteristics of Ukkadam Lake Water Coimbatore District, Tamil Nadu, India

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Article History

Received: 06 June 2023
Revised: 15 Sept 2023
Accepted: 30 Oct 2023

Abstract

Degradation of lake water quality has been seen for many years, particularly in lakes close to urban areas with human activity. The goal of the current inquiry was to identify the various physical, chemical, and biological aspects of the surface water quality of several lakes in Coimbatore, India. The significance of the sampling points was considered when choosing them. Water samples were mostly taken from open wells in and around the Coimbatore district from the following sampling locations: Ukkadam Lake. The physical-chemical characteristics, such as total dissolved solids, pH, electrical conductivity, biochemical oxygen requirement, faeces coliforms, dissolved oxygen, and turbidity, Alkalinity, Sulphate, Nitrate, Phosphate, Chlorides. The findings indicated that lake water samples taken at several locations in and around Coimbatore city were above WHO criteria.

Keywords: *Chemical, Ecological, Water-quality*

1. Introduction

The elixir of life, water, is a priceless gift from nature to us and the billions of other creatures who inhabit the planet. In the vast majority of the world, it is quickly turning into a rare commodity. Nearly 13% of the world's population does not have access to safe drinking water because of urbanisation and growing economic activity 1. By the year 2030, roughly half of the world's population might experience severe water scarcity due to the present trajectory in water consumption. An important aspect of the natural environment, surface water quality is currently a cause for severe worry. In essence, manmade and natural factors combine to cause differences in water quality. Anthropogenic inputs from a number of sources are frequently the main variables impacting the water quality of most rivers, lakes, estuaries, and oceans, especially those that are adjacent to heavily urbanised areas. This is due to the extensive human activities. Numerous studies on anthropogenic pollutants in ecosystems have been done (4-6). In terms of its physical, chemical, and biological properties, water quality is determined. An ecosystem that is balanced cannot exist in polluted surface waters. A balanced ecosystem is one in which interactions between the environment and living things are positive. Water quality is obviously important in this relationship7 since it is essential to maintaining a healthy ecosystem. Important multi-use components exist in lakes, rivers, and tanks, including supplies of drinking water, irrigation, fisheries, and energy generation. These heavily rely on the water's quality; thus, it should be maintained at a specified level. The main sources of the addition of chemicals and nutrients to aquatic ecosystems are thought to be agricultural, industrial, and urban activities8.Due to the occurrence of direct contact between surface and ground water, the quality of surface water in an inland water body has a significant impact on the ground water table and ground water quality of the neighbouring aquifers9. Large-scale reclamation for other uses, garbage dumping, and other city development-related problems all contribute to the fast deterioration of lakes in Coimbatore. There are around 28 lakes inside and beyond the city borders, and the river Noyyal, which flows next to the city, supplies the majority of their water. These wetlands act as percolation and storage tanks and are important groundwater recharge areas. Despite the biological functions that these lakes provide, infilling and encroachment threaten to destroy many of them. The goal of the current study is to evaluate the level of lake pollution in and around Coimbatore as well as the changes in water quality that have occurred over the past ten years.

Study Area

The second biggest city in the Indian state of Tamil Nadu is Coimbatore, sometimes known as the Manchester of South India. It may be found at 11° 1′ 6″ N and 76° 58′ 21″ E. In the Tamil Nadu region of India's Coimbatore district, industrialization and urbanisation have a significant influence on the surface water environment. Both surface and underground water sources are being contaminated by development activities. Coimbatore is home to several small-scale and automotive, home appliance, and textile businesses. The quality of surface water is significantly harmed by the effluents from these companies. As a result, the Coimbatore district was chosen for this study's research of the physicochemical and biological characteristics of various lake waters.

FIG.1-Ukkadam Lake

Between Trichy Road and Sungam Bypass Road is where the Ukkadam-Valankulam Lake is located. Ukkadam Lake, often referred to as Ukkadam Periyakulam, has an area of 1.295 square kilometres and a depth of 19 feet on average. Additionally, Selvachinthamani Lake, which is upstream and to the north, supplies water to the lake and drains it. UKkadam Lake, also known as Ukkadam Periyakulam, covers 1.295 square kilometres and has an average depth of 19 feet. Canals that come from the Noyyal river feed the lake. The lake drains water and also gets water from the Selvachinthamani lake upstream in the north. The lake and Valankulam lake are connected via an outflow. Four sluice gates on the south side of the lake allow the water to be discharged. The lake is crossed by a railway track that runs between Podanur and Coimbatore Junction.

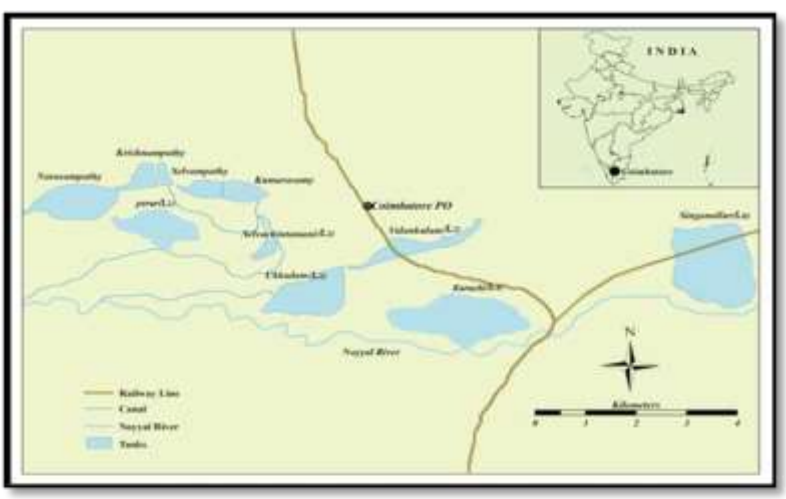

FIG.2-Study Area of Ukkadam Lake.

2. Materials And Methods

Collection of Samples

Both rural and urban areas were included in the sample sites. Samples of surface water were taken from Ukkadam Lakes in the Coimbatore district. To prevent unforeseen changes in the features, samples were collected in sterilised glass bottles for bacteriological quality and plastic bottles for physicochemical purposes. Important physicochemical and biological parameters including dissolved oxygen, faecal coliforms, pH, electrical conductivity, biochemical oxygen demand, chemical oxygen demand, phosphorus, nitrate, sulphate, chloride, alkalinity, turbidity, and total dissolved solids were examined in the collected samples. The instruments were handled with accuracy and precision. Chemicals of the AR grade was also utilised.

Methods of analysis

Using digital pH metres and digital conductivity metres fitted with the appropriate electrodes, pH and electrical conductivity were measured. The presence of bacteria was detected using the multiple-tube fermentation technique. The samples were subjected to a verified and thorough test utilising the nutrient froth. The dissolved oxygen concentration was calculated using the Winkler's titrimetric technique. The samples were incubated for five days at 20^{oC} in order to detect BOD[5]. By oxidising the sample's organic material by potassium dichromate digestion in the presence of strong acid, COD was calculated. Using ferroin as an indicator, titrating with ferrous sulphate solution was used to quantify the amount of unreduced potassium dichromate. The turbidimetric approach was used to measure the content of sulphate, which was then spectrophotometrically detected at wavelength 420. Following the Argentometric titration procedure, chloride was found. By titrating the sample with a standard solution of mineral acid and using the pH indicators phenolphthalein and methyl orange, alkalinity was calculated. The digital turbidity metre, model 863D 'Bio-Chem, was used to measure the turbidity. Standard processes are employed to calculate the total solids using the evaporation method, and the brucine method was used to calculate the nitrate ion. Following the standard process, the stannous chloride method is performed to estimate the total phosphorus.12.

3. Results and Discussion

pH, Dissolved oxygen and Faecal Coliform

Drinking water's pH level is a crucial indicator of its acidity or alkalinity. The sample's final pH value is the consequence of interactions between various minerals and organic materials. The increase in pH shows that the lakes are becoming more polluted. The pH of the water samples used in the current investigation ranged from 7.60 to 8.72. The highest pH measured at Ukkadam Lake was 8.72, which is higher above the acceptable range (6.5-8.5). Most of the time, the pH values in the water at Ukkadam Lake were higher than those in the earlier reports13.The amount of dissolved oxygen in lakes varies depending on their trophic levels, and a decrease in DO in water is perhaps the most typical effect of water pollution14. The DO of the water samples used in the current investigation ranged from 4.10 mg/l to 6.0 mg/l. Due to the lake's proximity to several home sewage pumps, the low DO was detected in Kurichi Lake. Low DO concentration would have resulted from local sewage flow downhill.The presence of faecal coliform bacteria in drinking water is a sign that pathogens that spread water-borne illnesses are present17–18. In the current investigation, the faecal coliform levels in the water samples ranged from 80 MPN/100 ml to 155 MPN/100 ml, with the water from Valankulam Lake having the highest levels. The high faecal coliform score (over 10 MPN/100 ml) indicates poor water quality. A freer discharge of sewage into the lake is indicated by higher FC levels.

Table l Physico-Chemical and biological characteristics of water samples collected from various Lakes in and around Coimbatore District

S.No	Parameters	Units	L_1
1	DO	mg/l	5.4
2	FC	MPN/100ml	110
3	pH	pH units	8.2
4	EC	µS/cm	320
5	BOD	mg/l	4.30
6	COD	mg/l	255
7	PO_4	mg/l	2.10
8	NO_3	mg/l	5.20
9	SO_4	mg/l	21.10

10	Cl^-	mg/l	185
11	Alkalinity	mg/l	140
12	TDS	mg/l	218
13	Turbidity	NTU	9.20

4. Results and Discussion

Electrical Conductivity, BOD and COD

Water's electrical conductivity, which is used as an indicator to measure the total concentration of soluble salts in water20–21, is directly related to its total dissolved salts19. Electrical conductivity that is too high can cause corrosion, boiler scaling, and product quality degradation. The electrical conductivity of water samples used in this investigation ranged from 280 to 1456 s/cm. Water has the highest conductivity in Ukkadam Lake Aquatic life determines the biochemical oxygen demand, and variations in BOD signify the presence of dynamic aquatic life in the lake. The oxygen consumed by the microorganisms during the aerobic oxidation of organic materials is referred to as BOD. As a result, the BOD rises as the amount of organic matter in the water grows.

TDS, Chloride and Total Alkalinity

Total dissolved solids can be either organic or inorganic, but specifically, the dissolved solids are mostly made up of carbonates, bicarbonates, chloride, sulphate, calcium, magnesium, phosphate, nitrate, sodium, potassium, and iron25–26. The water's TDS levels varied from 198 mg/l to 952 mg/l. The highest TDS reading in the Ukkadam Lake was 952 mg/l, whereas the lowest reading in the Perur Lake was 198 mg/l. The effluents from nearby industrial facilities, such as dyeing enterprises, may be to blame for the high TDS in Ukkadam Lake.One of the most crucial factors in determining the water quality is chloride.The COD increases when the amount of chlorides in lake water from various sources, such as the dumping of sewage and industrial waste, grows.

Turbidity

Turbidity of drinking water is frequently utilised as a stand-in for the likelihood of microbiological contamination and the efficacy of the treatment of public drinking water40. It can obstruct the disinfection process, offers a perfect environment for microbial development, and has been linked to a few reported cases of waterborne illness outbreaks41. The maximum turbidity allowed by the WHO is 5 NTU42. The water samples' turbidity levels ranged from 7.2 NTU to 12.5 NTU. In comparison to other lakes, the Ukkadam Lake has the greatest turbidity readings.

4. Conclusion

The water quality from the aforementioned lakes needs considerable attention because it is dangerous for human consumption or usage. According to practically all of the water quality measures examined, the study's findings showed that the lakes under investigation have filthy water. Ukkadam lakes' water continues to be of an alkaline character and total TDS concentrations that were higher than allowed. Lake water samples, have chloride ion concentrations that are significantly higher than allowed. The high concentrations of electrical conductivity, COD, alkalinity, and turbidity that have been reported in lakes, notably Ukkadam, are likely the result of domestic and industrial wastes into those bodies of water. According to the assessments, the degradation of the lakes in our research region was mostly brought on by industrial effluents from dyeing, jewellery manufacturing, foundries, urban sewage, and municipal solid waste disposal. Domestic trash is frequently dumped around the lakes' edges. As a result, according to drinking water regulations and WHO recommendations, surface water from lakes in our research area in the Coimbatore region is unfit for residential use. The pollution level in Coimbatore city may worsen in the future due to the city's rapid industry and urbanisation. Coimbatore city does not, however, have an underground drainage system. Therefore, it is strongly advised that automated measuring and monitoring equipment be provided in addition to continuous effluent collection for monitoring purposes to assess discharge parameters against set standards for drinking water, aquatic life, and other objectives. This approach could offer practical planning for reducing pollution and averting the future deterioration of lake water quality.

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