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A Case Study On: Monthly Wise Water Quality Analysis of Kukkarahalli Lake of Mysore City

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Abstract

Water is one of the most abundant resources of nature and prime necessity for the survival of life. The availability of water both in terms of quality and quantity is essential for the existence of living world. The rapid industrialization, urbanization, modern civilization and increased population have led to the increasing demand for water in domestic, agricultural and industrial sectors. Lakes have always remained the sources of water for agriculture, irrigation, drinking, domestic uses, industries and other related purposes. The aim of this paper is to determine Physical-chemical and biological parameters of water pollution in Kukkarahalli Lake, of Mysore city with a view to reveal information about its water quality, the impact of water pollution on the aquatic ecosystem and public health of the Kukkarahalli Lake of Mysore city.

Keywords: Lakes; Water Pollution; Aquatic Ecosystem; Quality Parameters

Introduction

Water is indispensable and one of the most abundant resources of nature and prime necessity for the survival of life. So, the availability of water both in terms of quality and quantity is essential for the existence of living world. The rapid industrialization, urbanization and modern civilization (increased population) have led to the increasing demand for water in domestic, agricultural and industrial sectors. Surface water comprises of flowing fresh water system (lotic), such as, river, streams, canals etc. and static fresh water system like ponds, lakes, and reservoirs etc. Rivers attracted more attention by providing water for large scale activities and are defined as a relatively large

volume of water moving within a visible channel, including sub surface water moving in the same direction and the associated flood plain and riparian vegetation.

Lakes have always remained the sources of water for agriculture, irrigation, drinking, domestic uses, industries and other related purposes. Lakes were preserved and maintained to help the man kind at the time of water crisis during long dry periods and droughts.

The aim of this paper is to determine Physical-chemical and biological parameters of water pollution in Kukkarahalli Lake, of Mysore city with a view to reveal information about its water quality, the impact of water pollution on the aquatic ecosystem and public health of the

Kukkarahalli Lake of Mysore city. It will also help in conservation, effective utilization, and sustainable exploitation of the vast aquatic resources that abound in the lake along with aquatic life.

History of lakes

One of the most attractive tourist destinations in India is the royal city of Mysore. Mysore is the second largest city in the state of Karnataka in India. It is located at a distance of 130 Km from the state capital Bangalore. It is well known for its world-famous Palace, Art Galleries, Gardens, Temples, Churches, Mosques, Mansions and Museums. It is the headquarters of Mysore District where divisional administration is being carried out. Mysore is also known for its rich Culture and Heritage which are reflected in the artifacts, handicrafts, woodcrafts, silk sarees and sandal wood products and ivory works. Mysore is known for its memorable annual Dasara celebrations which are unforgettable events in the History of Karnataka. This report highlights the lakes of the city of Mysore.

The beautiful and historical city of Mysore apart from its architectural marvels also has some beautiful lakes to spend some time in the city. Well surrounded by the greenery the lakes are good picnic spots and also attracts migratory birds. The serene lakes surrounded by green plants are best space to take some rest after a busy week at work. The city has got 5 major lakes which are Karanji, Kukkarahalli, Lingabudi, Dalavai and Devanoor lakes.

The City of Mysore

Geographically, Mysore is located in a very unique environment. This region is surrounded by Western Ghats in the West, B.R. Hills in the east and Ooty Hills in the South. The popular and perennial river Cauvery and one of its tributaries Kabini are draining through this District. The Krishnaraja Sagar Dam and the Kabini Dam are the large reservoirs existing in this region. These Dams irrigate the fertile agricultural lands out of which a huge population survives. The city of Mysore is known for the Chamundi Hills where the temple of Goddess Chamundeswari is present.

The beauty of the city of Mysore lies in its Colourful gardens, Green Plantations, and the number of lakes located within and outside the city. Mysore lakes are popular picnic spots and tourist destinations in and 8 minutes North. The topography of Mysore is very undulating with an altitudinal variation from 690 m to 1900 m above mean sea level. More than 8 million people live in this city excluding a huge floating population of national and international tourists.

Climate of Mysore

The climate of Mysore will be pleasant all through the year and hence it is called as “Pensioners’ Paradise” in Karnataka.

In the history of India and civilizations, cities are located near rivers and natural lakes. Sometimes to control the climate and provide water supplies man-made lakes were also created surrounding human settlements by Kings and Lords. A city encompassing a good number of lakes is considered to be a venue of joy for all life.

Objectives

- To list out the main reasons and causes for the Kukkaralli lake water pollution.
- To study the impact of human activities on Kukkaralli lake water quality.

Methodology

The present study reveals Kukkarahalli lake Mysore city and its impact on health. For this we have collected both primary and secondary data. Secondary data collected from of Karnataka state pollution control board regarding to the lake details from Mysore City Corporation. Goggle earth software used to create the map of Kukkrhali Lake, and some graph prepared by using software excel.

Study Area

Mysore city is geographically located between 12° 18’ 26” North Latitude and 76° 38’ 59” East Longitude. It is located at an altitude of 2,427 feet. It encompasses an area of 6,268 sq. km., the temperature varying between 14oC and 35oC. The weather of Mysuru is pleasant throughout the year. Mysore city is located in the southern part of the Deccan Plateau. Location map of Mysuru city is as shown in Figure 1. It is a beautiful land, bordered by luxuriant forests. Mysuru is located 140 km from the city of gardens, Bengaluru Mysuru has several large and small water bodies. Some of the major lakes are Kukkarahalli Lake and Though Mysuru, a heritage city, has developed into a modern city, is still moving at a gentle, unhurried and leisurely pace. The city has a good green cover and has a few lakes that add to the beauty and calmness of the city. These lakes are popular picnic spots and are frequented by nature lovers as they attract a number of migratory birds

Lakes were preserved and maintained to help the man kind at the time of water crisis during long dry periods and draughts Lakes have always remained the sources of water for agriculture, irrigation, drinking, domestic uses, industries and other related purposes. Lakes were preserved and maintained to help the man kind at the time of water crisis during long dry periods and draughts. Lakes have always remained the sources of water for agriculture, irrigation, drinking, domestic uses, industries and other related purposes. Lakes were preserved and maintained to help the man kind at the time of water crisis during long

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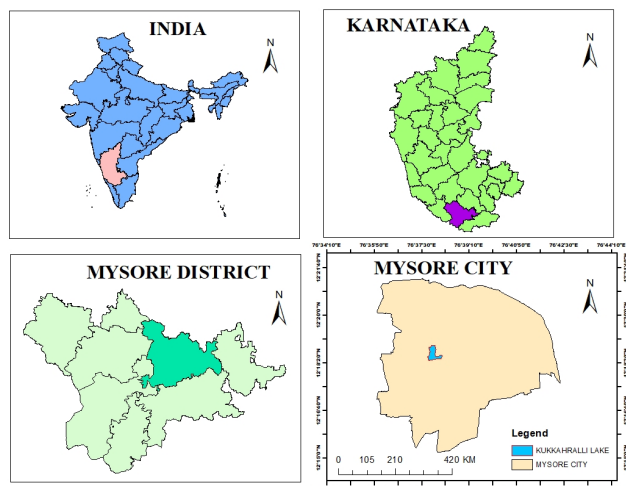


Fig. 1. Study Area

Introduction of lake

Lakes in Mysore encompass the diverse natural lakes that attract the itinerant birds. For this the tourists from all parts of the world come and visit the place. Mysore has developed into a modern city, the city still moves at a gentle, unhurried and leisurely pace. Mysore has a good green cover and has a few lakes that add to the attractiveness and tranquillity of the metropolis. These natural lakes are accepted picnic spots and are frequented by nature lovers as they attract a number of migratory birds.

Physical Characteristics

Kukkarahalli Lake located in the heart of the Mysore city, adjoins the Manasagangotri (University of Mysore). It provides lung-space to the city. Mummadi Krishnaraja Wodeyar, (1794–1868) of the Mysore Dynasty (Kingdom of Mysore) was responsible for getting the lake created, in the year 1864, to provide water for irrigation to about 4000 ha (10,000 acres) of land outside the city. The Lake also used to be a source of water supply to the city of Mysore but over the years, sewage and excessive land encroachments (mostly illegal) and blockage of water flow sources almost led to the eutrophication of the lake. The University of Mysore and the citizen forums of Mysore continue to make efforts to preserve the lake by implementing several remedial measures. The Lake drains a catchment area of more than 414 square kms (160 sq. mi) and the water body spreads over 62 hectares

(150 acres). Dewan Poornaiah feeder canal, 27 km (17 mi) long, which passes through Hinkal, Bogadi, Kudremala and Manasagangotri outfalls into the Lake. The Lake is 'J' shaped. The maximum depth of lake is reported to be 5 m (16 ft.). The east-west bund holds water on one side. Sandy loams to clay loam form the dominant ecological condition of the Lake. On the northern side another temporary bund hold back the direct flow of waste water into the lake. The highest flood level in the lake is 755.73 m.



Fig. 2. Source: Compiled by Authors

Demography of Mysore City

Mysore is a city in southern India in the state of Karnataka, India. It is also known as the cultural capital of Karnataka & lies in the foothills of the Chamundi Hills about 145.2 km towards the southwest of Bangalore. It served as the capital city of the Kingdom of Mysore for nearly six centuries from 1399 until 1956. It is the third most populated city in Karnataka after Mysore & Hubli-Dharwad.

As per provisional reports of Census India, the population of Mysore City in 2011 is 8,93,062 (8.93 Lakhs) and the estimated population of Mysore in 2023 is 12 lakhs.

Mysore District Population

Mysuru District is a district in the state of Karnataka, India. It is one of the oldest & prominent districts of Karnataka. As per census 2011, Mysore district population is 30,01,127 (30 Lakhs) of which 15,11,600 are males and 14,89,527 are females. The literacy rate is 72.79% & Male-Female Sex ratio is 985. The child sex ratio is 961.

- **Objective 1: To study the find out list the reasons cause for the Kukkarahalli Lake Water Pollution**

Water pollution can be defined as the contamination of water bodies. Water pollution is caused when water bodies such as rivers, lakes, oceans, groundwater and aquifers get contaminated with industrial and agricultural effluents. Water is one of the most vital natural resources on earth and has

been around for a long time. In fact the same water which we drink has been around in one form or the other since the time of the dinosaurs. As commercialization and industrialization have progressed, that number continues to dwindle down. Furthermore, inefficient and outdated practices, lack of awareness and a plethora of other circumstances have led to water pollution. One of the primary causes of water pollution is the contamination of water bodies by toxic chemicals. These result in water pollution, which harms not just humans, but the whole ecosystem. Toxins drained from these pollutants, travel up to the food chain and eventually affect humans. In most cases, the outcome is destructive to only the local population and species, but it can have an impact on a global scale too. The main water pollutants include bacteria, viruses, parasites, fertilisers, pesticides, pharmaceutical products, nitrates, phosphates, plastics, faecal waste and even radioactive substances. These substances do not always change the colour of the water, meaning that they are often invisible pollutants. That's why small amounts of water and aquatic organisms are tested to determine water quality. It is sometimes caused by nature, such as when mercury filters from the Earth's crust, polluting oceans, rivers, lakes, canals and reservoirs. However, the most common cause of poor quality water is human activity and its consequences. Water is one of the most important elements on Earth when it comes to sustaining life. Unfortunately, it is also extremely susceptible to pollution. This is largely because water is a universal solvent that can dissolve many substances. While this is a wonderful quality that we take advantage of for everyday tasks such as cooking, cleaning and taking medication, it is also the exact quality that causes water to become polluted so easily.

1. The discharging of garbage, sewage, and liquid wastes of agricultural lands, households, and factories into the rivers and lakes.
2. The dumping of litter like plastic and glass, and other solid wastes into water bodies
3. The pollutants like lead, asbestos, petrochemicals, etc. coming from the industrial wastes are discharged into the water bodies.
4. The water in the oceans is getting polluted because of oil spillage from tankers and ships.
5. Acid rain is also a pollution of water resulting from air pollution
6. Reduction of catchment area
7. Indiscriminate dumping of solid wastes
8. Chocking of storm water drains
9. Non-optimal utilization of lake resources for medicinal plants, aquaculture etc
10. Non utilization of lake as a source of human and livestock biomass requirements

11. Shrinking of feeder canal (Poornaiah canal) from 25 km to 5 km due to urbanization

Present Status

- Depending on the type of natural habitat, bird density and diversity differs. More birds frequent water-bodies, woodland, and grasslands. The Kukkarahalli Lake surrounded by CFTRI, RIE, AIISH, Chandravana, and Mysore University is a vast expanse of green patch supporting varied life forms. Mysore University campus and the Lake supports 432 species of plants spread over 85 families.
- Within Kukkarahalli many habitat types occur, birds may utilize a few of these. The majority of birds strictly restrict to particular habitat where ample natural food and suitable micro habitat exist. For example, family Ardeidae (Egrets, Heron & Bittern) mostly found in shallow waters, followed by Reed beds, floating vegetation and drying water hole. The variation in the habitat usage pattern infers availability of preferred food in turn quality of water body. In case habitat is poor in resource, resident and migratory birds will find another.
- Birds' diet depends on the species and changes with the seasons depending on the availability of natural food. By ensuring a diversity of native plants that support insect life, fruits at different time of the year offering berries, seeds retain the bird's density and diversity throughout the year. Smaller herbs & grass undergrowth to shrubs to trees -offering different strata of vegetation, provides supportive summer and winter cover as well supports suffice food for sustenance.



Fig. 3. Kukkarahalli Lake

- **Objective 2: Impact of human activities on lake water quality of Kukkarahalli Lake**
- Waste water from surrounding area: The major objective of the study was to evaluate the uptake rate of different heavy metals by water hyacinth under varied environmental conditions. This included the concentration

and contact time of the heavy metal uptake, characterization of wastewater and heavy metal uptake by various parts of the plant. It also evaluated the influence of water hyacinth on the removal of other wastewater quality parameters.

- The Lake also used to be a source of water supply to the city of Mysore but over the years, sewage and excessive land encroachments (mostly illegal) and blockage of water flow sources almost led to the eutrophication of the lake.
- Domestic wastewater enters from the northern side of the lake. Hence a temporary bund is built over it to avoid the direct flow of the wastewater into the lake. The lake seems to be accumulating nutrients coming through the wastewater, mainly phosphorus and nitrogen, which promote the growth of algae and other aquatic plants. This is accelerating eutrophication and as a result the lake is dying day by day. Apart from this, the lake is gradually losing its storage capacity, mainly on account of siltation, which is accelerated with profuse growth of water hyacinth and other weeds. This has been adversely affecting the fish production, recreational activities and hence the aesthetic value of the lake.

Tourist place

Kukkaharali Lake is one of the tourist spot in Mysore where it's famous for lake and immigration birds. For local people of Mysore the lake is so much beneficial daily morning so many people go for walking and jogging where the place is helpful for the people health. And the surrounding place are also giving benefit to people where local people are putting food stalls and earning there where it's beneficial in financial state for people.

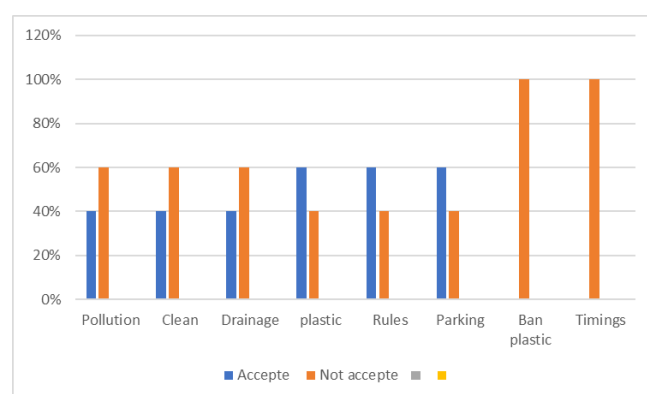


Fig. 4. Physico-chemical and biological parameters of the lake water

Chemical runoff

The sewage water is flowing as the pipe near the magic box is broken. “We have already alerted the Mysore City Corporation to repair the pipe to prevent further inflow of water into the Lake.

There is a two-foot-wide drinking water pipeline at the Valmiki Junction and when the gate valve is locked after water supply, over 8 to 9 thousand liters of fresh water is wasted in the reverse gravitational force. This water then reaches the magic box to mix with the sewage that flows into the Lake. “If a pipe is laid from the waterline to Kukkarahalli Lake, the wasted drinking water can directly flow into the Lake and this will infuse life into the Lake, as a 700-metre pipeline has to be laid to carry fresh water into the Lake, he added.

Effect

Depending on the type of natural habitat, bird density and diversity differs. More birds frequent water-bodies, woodland, and grasslands. Within Kukkarahalli many habitat types occur, birds may utilize a few of these. The majority of birds strictly restrict to particular habitat where ample natural food and suitable micro habitat exist. For example, family Ardeidae (Egrets, Heron & Bittern) mostly found in shallow waters, followed by Reed beds, floating vegetation and drying water hole. The variation in the habitat usage pattern infers availability of preferred food in turn quality of water body. In case habitat is poor in resource, resident and migratory birds will find another.

Micro habitats mentioned below are most essential for birds' presence and survival. Nests: floating - half submerged, reed beds, walking about on the grass-covered edges of Lakes

Results and Discussion

Sampling and Analyses

The sampling sites were selected by keeping in the mind to locations of inflow and outflow. The location map of Kukkarahalli Lakes as shown in Figures 2 and 3 respectively. Water samples were collected from the surface and few meters below water level to find out the varying characteristics, if any, of surface and bottom waters, by using specially designed airtight sampler, using clean and sterile polythene bottles.

Experimental Finding and discussion

The results of the physico-chemical and biological parameters of the lake water are tabulated in Table 1. The trends of some of the main parameters like pH, DO, BOD, COD, Faecal and total coliforms in different months is also represented in Figures 5, ?? and ?? respectively. The physical condition of water strongly influences the chemical and biological process that take place in the water body. The depth of the sampling

Table 1. Physico-chemical and biological parameters of the lake water

	Causses				Solution			
	Pollution	Clean	Drainage	plastic	Rules	Parking	Ban plastic	Timings
Accepted	40%	40%	40%	60%	60%	60%		
Not Accepted	60%	60%	60%	40%	40%	40%	100%	100%

stations can Influence the other parameters of the water. The mean depth of Kukkarahalli Lake was recorded as 5mm respectively during the analyses. The temperature, also have effect on hydrochemistry and biological reactions in the organisms in both surface and ground waters. Temperature of the water body varied from 22°C to 32°C during the study period.

The pH of the surface waters mainly contributes the atmospheric precipitation and the presence of several compounds. pH is considered as an ecological factor and is the result of interaction of various substances in solution, in water and also influences numerous biological phenomenon. The pH values were found to be 8.7 Kukkarahalli lake.

The electrical conductivity (E:C) is an index to represent total concentration of salts. High level of electrical conductivity indicates the pollution status as well as tropic level of aquatic body. The E:C values varied from 663 to 589 μ S in kukkarahalli lake. The value of conductivity is directly related to total solids. Greater will be the amount of ions in water. The turbidity of the kukkarahalli lake ranges from 10.80 ntu to 4.8.

The oxygen dissolved in water can influence the biological process of the aquatic ecosystem. The major sources of oxygen in water include diffusion from the air and photosynthetic activity within water. The dissolved oxygen level varies 6.6 to 6.3 mg/l in kukkarahalli lake was found which is due to the increase in temperature or adding of some organic matter in sediments and dissolved ammonia can contribute oxygen depletion due to nitrification.

In the present study, the calcium, magnesium and total hardness values showed an increasing tendency, the concentration of total hardness, calcium and magnesium varied between 124 to 88 mg/l as CaCO₃ 92 to 80 mg/l. respectively, the lake water gets evaporated rapidly devoid of the dissolved cations and anions in the water, and contributes to hardness. The nitrate concentration varied from 2.20 to 1.8 mg/l in kukkarahalli lake respectively. The nitrites and nitrates are the oxidized form of nitrogen and in water. It's most important source is biological oxidation of nitrogenous organic matter, fertilizers, animal waste, municipal sewage decaying plant debris. Water naturally contains less than 1 mg/L, higher levels indicate that the water has been contaminated.

The coliform bacteria are discharged from the human intestine and their presence indicates the possibility of the presence of pathogenic organisms. The coliform bacteria include the genera *Escherichia*, *Citrobacter*, *Enterobacter* and *Klebsilla* etc. This result reveals that the lake water is

bacteriologically contaminated and is not suitable for bathing and other recreational activities.

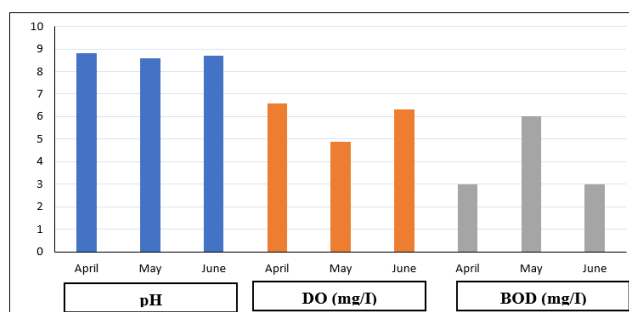
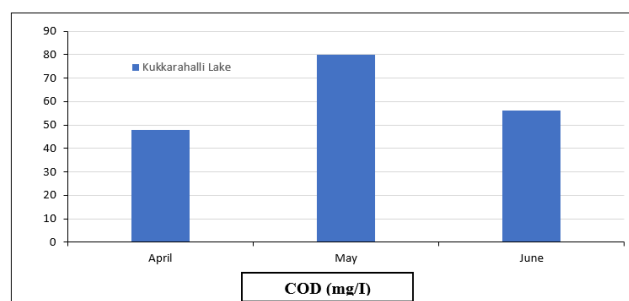
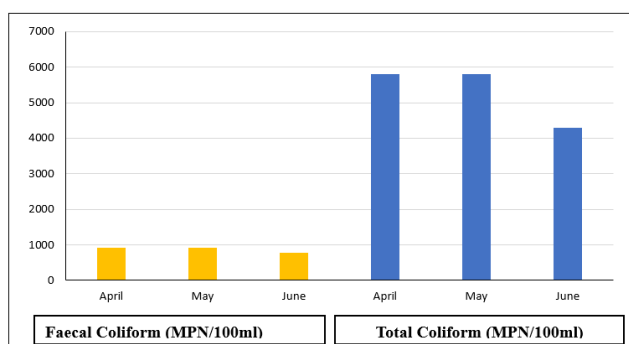
**Fig. 5.** Monthly biological observation**Fig. 6.** COD**Fig. 7.** Microbial parameter

Table 2. Monthly biological observation

Name of the water body		Kukkarahalli lake		
PARTICULARS	Units	APRIL 2023	MAY 2023	JUNE 2023
Ph	–	8.80	8.6	8.7
Dissolved Oxygen	mg/l	6.6	4.9	6.3
Bod	mg/l	3.0	6.0	3.0
Cod	mg/l	48	80	56
Conductivity	us/cm	663	609	589
Turbidity	NTU	10.80	6.2	4.8
Magnesium as CaCO ₃	Mg/l	124	100	88
Calcium as CaCO ₃	Mg/l	92	88	80
Nitrate As N	Mg/l	2.20	2.3	1.8
Feacal Coliform	MPN/100 ml	910	910	780
Total Coliform	MPN/100 ml	5800	5800	4300

Solution

- Construction of Treatment plant near Kukkahrali lake, so that Sewage release from nearby areas can be treated and disposed.
- Establishment of plastic free environment in Kukkahrali lake.
- Regulating strict rules against plastic free environment, and regulating visitors' activities on usage of plastic inside Kukkahali lake.
- Regular cleaning of lake should be done.
- Regular Checking of Physical, chemical, biological properties of Lake waterr
- The foul smell is once again emanating from the north bund of Kukkarahalli Lake on Hunsur Road creating problems for walkers.
- As the summer season is here, the growth of blue green algae increases and once it grows it will not have sufficient food. Thus it starts emanating foul smell.

Conclusion

The water quality parameters like pH, COD and BOD are in the range which supports the aquatic growth in the lake the DO level at lakes is found to be minimum it can be concluded that the lake are not fit for aquaculture The fencing

surrounding the lake should be maintained properly to retain its green flora and fauna from the surrounding and rapidly growing urban habitat.

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