

## SEASONAL STUDY OF WATER QUALITY OF YEROOR POND IN ANCHAL, KOLLAM

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### Abstract

Water is our lifeline that bathes us and feeds us. In ancient cultures water represented the very essence of life. This study is very relevant now as humanity is more dependent on limited resources like the surface water and underground water these days than any time in the past. The knowledge of dissolved salts in water is a pre-requisite for making any decision on the proposed or potential use of water for any specific industrial, irrigational or domestic purposes. The study of the chemistry of the dissolved constituents of water is very relevant now as humanity is more dependent on such limited resources like the surface water and underground water these days than any time in the past. The knowledge of dissolved salts in water is a pre-requisite for making any decision on the proposed or potential use of water for any specific industrial, irrigational or domestic purposes. The pond ecosystem is a fresh-water environment that can reveal the health of a local area. Fresh water ecosystems such as pond have specific life form that shows its overall health. Yeroor Panchayat pond is a typical village pond in Kollam. In the case of water systems, hydrological parameters help in identifying the status of water. This study was conducted with a clear objective of seasonal study of hydrological parameters and to assess the productivity of Yeroor Panchayat pond. The premonsoon, monsoon and postmonsoon season show different seasonal fluctuation in various hydrobiological parameters. The water present in the said pond is useful for irrigation as well as fish culture.

**Key words:** Hydrological Parameters, Seasonal Study, Yeroor Panchayat Pond, Productivity

### Introduction

Water is our lifeline that bathes us and feeds us. In ancient cultures water represented the very essence of life. The Romans were the first to pipe water into their growing cities, especially with their aqueducts. They also realised that sewage water could cause damage to their people, and needed to be removed from large areas of people. Water is the most abundant compound on Earth's surface, covering 70 percent of the planet. In nature, water exists in liquid, solid, and gaseous states. It is in dynamic equilibrium between the liquid and gas states at standard temperature and pressure. At room temperature, it is a tasteless and odourless liquid, nearly colourless with a hint of blue. Many substances dissolve in water and it is commonly referred to as the universal solvent. Because of this, water in nature and in use is rarely pure and some prop-

erties may vary from those of the pure substance. However, there are also many compounds that are essentially, if not completely, insoluble in water. Water is the only common substance found naturally in all three common states of matter and it is essential for all life on Earth. Water makes up 55% to 78% of the human body.

Water covers, 71% of the Earth's surface. It is vital for all known forms of life. On Earth, 96.5% of the planet's water is found in seas and oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapour, clouds (formed of solid and liquid water particles suspended in air), and precipitation. Only 2.5% of the Earth's water is fresh water, and 98.8% of that water is in ice and groundwater. Less than 0.3% of all

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freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount of the Earth's freshwater (0.003%) is contained within biological bodies and manufactured products. Water is typically referred to as polluted when it is impaired by: anthropogenic contaminants and either does not support a human use, such as drinking water, or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish. Natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water.

Water quality is the measure of suitability of water for a particular use based on its selected physical, chemical and biological characteristics. Various parameters of the water are measured which later compared with the standard guidelines and then decided on the suitability of the water for particular use. The most common physical assessment of water quality is the measurement of temperature, pH, dissolved oxygen, carbon dioxide, transparency and productivity.

### Study Area

Kerala is a state located on the south western tip of India. It is a water privileged state having boundaries such as the Arabian Sea in west and Western Ghats in the east. The study area is pond in Yeroor Grama Panchayat of Anchal block in Kollam district. The study site is located between latitude 8.5543°N and longitude 76.5505°E, is well enriched with many streams and ponds. The panchayath has been divided into 19 wards and total geographic area is 4479 hectares of land. Average annual rainfall is 2753 mm. The temperature in summer goes up to 37.1 °C and winter came down to 19.6° C. This pond is mainly used for agricultural purpose and fish rearing.

### Materials and Methods

Water samples were collected monthly from the pond in all the three seasons viz. monsoon (June

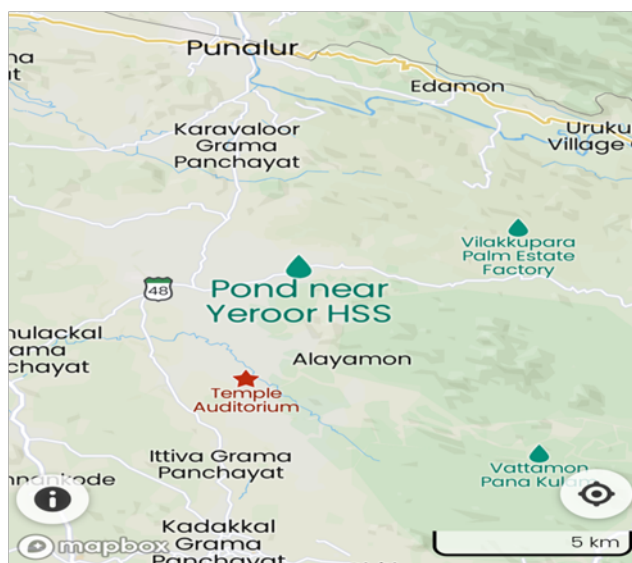


Figure 1. Study area

to September), postmonsoon (October to January) and premonsoon ( February to April ) during June 2021 to May 2022. The collection time was in late morning 8.00Am to 9.00am. .

The pond water was collected in a flask and brought to laboratory for further examination. Hydrobiological parameters were carried out in accordance with Standard Methods for Examination of Water and Waste Water described by American Public Health Association (APHA, 2005). The water quality of Yeroor pond was analyzed in two phases;

#### A. Field study

#### B. Laboratory experiment

**A. Field study** The temperature, pH, odour, colour, transparency etc. were noted at the site itself. Temperature was measured by using a thermometer; pH paper was used for finding the pH of pond water and transparency of water was measured by using a secchi disc. Water samples were collected and taken to laboratory for further analysis. Water sample for estimation of DO was fixed at the site itself before taking to laboratory.

#### B. Laboratory Experiments

Dissolved oxygen, Dissolved carbon dioxide, Hardness, primary productivity estimated through titration procedures ( Trivedi and Goel, 1974) and salinity by Portable salinity meter. The value of pH was confirmed by using pH meter. The colour of the water was determined by the general visual method. For the determination of colour samples were collected in clean glass bottles and the analysis was done soon after collection of the samples otherwise the colour may get changed biologically or physically during storage. The odour of the water was determined by direct smelling method. Samples for odour determination were collected in a clean glass test tube and the test was completed soon after the collection of sample. The temperature was recorded by using a sensitive mercuric thermometer at the time of sample collection. Transparency of water was identified by using a secchi disc.

### Statistical Analysis

Monthly data was pooled into seasonal data and mean and standard deviation were calculated.

### Observations and Results

Yeroor Panchayat pond in Yeroor Grama Panchayath was selected for this work. The data obtained from this work are presented in this section. The results are compared and analysed by the help of pictorial and tabular forms of data presentation . Statistical methods are adopted for the correct presentation of the data. The physicochemical parameters of the pond during the study were analysed. The physicochemical characters changes with time and depth. These variations in study help to understand the status of water quality. In the present study temperature, pH, dissolved oxygen, dissolved carbon dioxide, salinity ,hardness transparency, NPP and GPP were analysed.

Colour in water may due to the presence of fine particles in suspension or due to certain mineral matter in solution. The true colour of the water sample is due to the substances present as fine colloids. In the study area the colour of water was pale, or yellowish green. Disagreeable

odour in water is due to the presence of microscopic organisms or decaying vegetation including algae, fungi, bacteria and weeds. Sewage and industrial effluences causes offensive odours to receiving waters. In the study area the water is not purely disagreeable but slightly turned to undesirable. Water temperature in streams and rivers is an important attribute of water quality and controls the health of freshwater ecosystems. Water temperature is an important parameter because it not only influences the physical and chemical characteristics of water but also the biota in a water body by affecting activities such as behavior, respiration and metabolism. The maximum temperature was recorded during pre monsoon and minimum value was recorded during monsoon. In the present investigation, lower temperature recorded in monsoon season may be due to high water level, less solar radiation, low atmospheric temperature and the higher temperature in premonsoon because of low water level, high solar radiation and clear atmosphere. (Table 1). The variation in pH is due to the presence or absence of free carbon dioxide, carbonate and planktonic density. The water was slightly alkaline in the pond and was above 7 in all seasons high alkalinity recorded during post monsoon season(8.3) while minimum in monsoon season(7.9) (Table 1)The water transparency is measured with a Secchi disk. The transparency of water body is affected by several factors like planktonic growth, rainfall, cloudiness and turbidity due to suspended inert particulate matter. In the present investigation, the maximum value was recorded in pre monsoon( 42.7) and minimum value was recorded in monsoon(23.3). Low value of transparency in monsoon may be due to entry of rain water from catchments area and high turbidity due to suspended inert particulates matter. However, high value of transparency in pre monsoon may be due to clear atmosphere and high light penetration. (Table 1)

The dissolved oxygen (DO) is one of the most important and limiting parameter of water quality assessment, which maintains aquatic life. It regulates the metabolic process of aquatic

organisms. The maximum dissolved oxygen was recorded in post monsoon (10.4mg/l) and minimum dissolved oxygen was recorded in the pre monsoon season (7.4mg/l). The highest dissolved oxygen in post monsoon may be due to low temperature and minimum dissolved oxygen in pre monsoon may be due to high metabolic rate of organisms. (Table 1)

Carbon dioxide is readily soluble in water. Over the ordinary temperature range (0-30° C) the solubility is about 200 times that of oxygen. Calcium and magnesium combines with carbon dioxide to form carbonates and bicarbonates. The value varied from 3.89ppm to 4.32ppm (Table 1). Total hardness of water is the parameters used to describe the effect of dissolved minerals (mainly Ca and Mg), determining suitability for domestic and industrial purposes which is attributed to the presence of bicarbonates, sulfates, chlorides and nitrates. Total hardness of water was maximum during premonsoon (103.75±2.986) and minimum in monsoon season (88.25±1.70).

Salinity plays an important role in the growth of culture organisms through osmoregulations of body minerals from that of the surrounding water. It is a major driving factor that affects the density and growth of aquatic organisms population. It acts as a major ecological factor controlling the phytoplankton population of freshwater. Salinity was maximum during premonsoon (16±1.414) and minimum in monsoon season (12±1.414). In the present study the net primary productivity (225±0.031) and gross primary productivity (0.66± 0.93) were high during post-monsoon and low in pre monsoon season.

## Discussion

The present study was aimed to assess the deterioration of water quality due to pollution. The role of water in nature is unique not only from the point of human consideration; even the numerous organisms make aquatic medium their abode. Understanding such aquatic life requires a sound knowledge not just for organisms themselves but also of those of external influences of

the medium that affect them. The physical and chemical properties of fresh water bodies are characterized by the climatic, geochemical, geomorphological and pollution conditions. The quality of aquatic life depends on the water quality. In order to utilize fresh water bodies successfully for fish production, it is very important to study the physico-chemical factors which influence the biological productivity of the water body.

Colour is an important parameter for any aquatic water body and indicates the purity of the water. National Agricultural Extension and Research states pale color, light greenish or greenish waters suitable for fish culture. Delince (1992) stated that the abundance of phytoplankton and zooplankton is responsible for the determination of the color of an aquatic body and Green, bluish green/ brown greenish color of water indicates good plankton population hence, well for fish. In the present study, the pond water color is light green so the pond water is good for fish productivity.

The results obtained from this work showed temperature values ranging from 23.87°C to 28.6°C. The temperature was recorded maximum during summer (28.60±1.02) and minimum during monsoon season (23.87±0.56). According to (Desai 1995), water temperature may depend on the seasons, geographic location and sampling time. The results were also within the standards (WHO and ICMR). The temperature range showed that the pond water studies were good for fish productions.

Changes in the pH value of water are important to many organisms. Most organisms have adapted to life in water of a specific pH and may die if it changes even slightly. This is especially true of aquatic macro invertebrates. The pH is a critical factor determining the health of a waterway. It has been reported that the pH between 6 and 9 was appropriate for increased fish production (Boyd, 1979). In the present study pH value recorded ranged from 7.1 to 8.0. This value is

tending towards neutrally which is also within the values for optimum fish survival. The highest value of pH was recorded during postmonsoon season ( $8.3 \pm 0.34$ ) and the lowest was recorded during monsoon season ( $7.9 \pm 0.52$ ). The low value during monsoon season may be due to the dilution of rain water. These values compared very well with results of other workers (Bhatnagar A and Devi P, 2013). They are also within the international standards; ICMR and WHO. For the survival of aquatic organisms a normal pH is required. Almost all aquatic organisms prefer slightly alkaline water because the life activities are normal in such an environment.

The DO level is also very important for the normal life of aquatic organisms. An increased amount of oxygen determines high quality of water and increased fish fauna. The DO obtained from this study had ranged between 7.4 to 10.4 mg/L. The DO was recorded maximum during postmonsoon ( $10.4 \pm 0.54$ ) and minimum during pre monsoon season ( $7.4 \pm 1.06$ ). Results of the present study are similar to those reported by other (Thirupathiah 2012), (Ramulu 2013) and (Priyanka Yadav 2013). These values are within the WHO limit, so the water would be regarded as safe for fish production. Adequate dissolved oxygen is necessary for good water quality. Oxygen is a necessary element to all forms of life. Natural stream purification processes require adequate oxygen levels in order to provide for aerobic life forms. As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress. The lower the concentration of dissolved oxygen, the greater is the stress. Oxygen levels that remain below 1-2 mg/l for at few hours can result in large fish kills

Carbon dioxide in a water body may be derived from the atmospheric sources, biotic respiration, inflowing ground water which seep into the pond, decomposition of organic matter due to bacteria and may also from within the water body itself in a combination of other substances mainly calcium, magnesium etc. (Swann 1997) suggested that fish can tolerate concentrations of

10 ppm provided DO concentrations are high and water supporting good fish populations normally contain less than 5 ppm of free  $\text{CO}_2$ . Bhatnagar 2004 suggested, 5-8 ppm is essential for photosynthetic activity; 12-15 ppm is sub-lethal to fishes and 50-60 ppm is lethal to fishes. In the present investigation the maximum value for  $\text{CO}_2$  was recorded in pre monsoon season ( $4.32 \pm 0.89$ ) and minimum in postmonsoon period ( $3.89 \pm 0.50$ ).

Calcium and Magnesium are essential for bone and scale formation. In the present study, total hardness of water ranged from 88 to 107 mg/l. The calcium was recorded maximum during premonsoon and minimum during monsoon season. Wurts (1992) reported hardness ranged between 25-100 mg/l for good fish culture. Bhatnagar in 2004, opined that the total hardness value of less 20 mg/L would cause stress, an optimum value of 75- 150 mg/L with a lethal value of >300 mg/L. Higher values of hardness during summer (April, May and June) can be attributed to low water level and high rate of evaporation of water and addition of calcium and magnesium salts (figure 2).

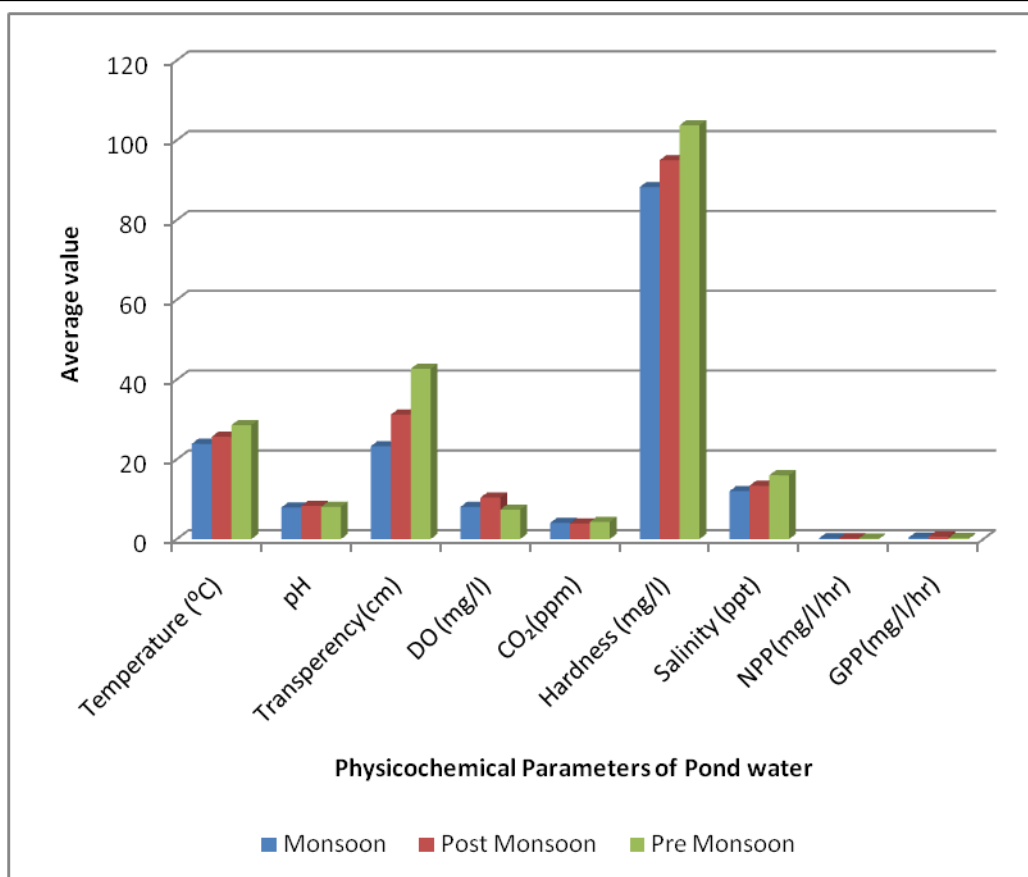
According to (Meck, 1996) fresh and saltwater fish species generally show poor tolerance to large changes in water salinity. Often salinity limits vary species to species level. During the present study the salinity ranged between 11 to 18 ppt. The maximum value for salinity was recorded in pre monsoon season and minimum in monsoon period. High salinity concentration was associated with fungi and bacterial density of phytoplankton population as observed by (Shrivastava, 2013)

Human activities are primary causes of water pollution. These pollutants are then washed down to lakes, rivers and other streams along with runoff or other agents and damage water quality. Carelessness, lack of knowledge and awareness are major cause of water pollution. Houses, Farms, factories, automobiles are potential sources of pollutants. The wastes from the household drainage pollute water. Though

fertilizer and pesticides are useful for the plants, its excessive use causes the nutrition to wash down the water bodies. Excessive nutrition produces more algae which make water green and nuisance and may also kill the fishes and aquatic lives due to lack of oxygen. Similarly the toxic pesticides if swept to water bodies make them toxic for aquatic organisms.

**Table 1.** Water parameters of Yeroor pond in different seasons( Mean ± SD)

Seasons	Temperature (°C)	pH	Transparency (cm)	DO (mg/l)	CO <sub>2</sub> (ppm)	Hardness (mg/l)	Salinity (ppt)	NPP mg/l/hr	GPP mg/l/hr
Monsoon	23.87±0.594	7.9±0.52	23.3±1.337	8.1±1.43	4.05±0.34	88.25±1.70	12±1.414	0.19±0.02	0.39±0.035 ±0.78
Post Monsoon	25.64±0.580	8.3±0.34	31.2±0.485	10.4±0.54	3.89±0.50	95±0.816	13.25±2.21	.225±0.031	0.66±0.93
Pre Monsoon	28.60±1.02	8.1±0.81	42.7±1.489	7.4±1.06	4.32±0.89	103.75±2.986	16±1.414	0.152±0.035	0.28±0.67



**Figure 2** Graph showing water parameters of Yeroor pond in different seasons

## Conclusion

The present study shows water parameters in different months of a year. The pre monsoon, monsoon and post monsoon season show different seasonal fluctuation in various physico-chemical parameters. The water present in the said pond is useful for irrigation as well as fish culture. Seasonally analyzed samples indicated that the water quality of the said pond is although having some pollution but is suitable for agricultural purposes and fish rearing, as it is rich in organic humus, planktons and nutrients. The pond water is not fit for human consumption. The water quality standard for drinking water is different than that for the safety of aquatic life, irrigation etc.

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