WATER QUALITY AND SOIL PROPERTIES OF TWO SELECTED PONDS IN MAVELIKARA BLOCK PANCHAYATH

Project Submitted to the University of Kerala in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science

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CERTIFICATE

This is to certify that this project entitled **“Water Quality and Soil Properties of Two Selected Ponds in Mavelikara Block Panchayath”** is an authentic record of the work carried out by **Anupama R., Reshma Biju, Aishwarya Nair, Archa S., Sani Mathew and Unnimaya**, B.Sc.Zoology (VI semester) student under my supervision and guidance and that no part of thisreport has been submitted earlier for any other degree or diploma.

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Valued by,

1.

2.

DECLARATION

I ……………………………… do hereby declare that this project entitled "Water Quality and Soil Properties of Two Selected Ponds in Mavelikara Block Panchayath" is the bonafide work carried out by me under the supervision and guidance of Ms. Somi Cherian, Assistant Professor, Department of Zoology, Bishop Moore College, Mavelikara for the partial fulfillment of the requirements for the degree of Bachelor of Science and that no part of this project work has been submitted earlier for award by any other degree, diploma or recognition of any university.

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CONTENTS

INTRODUCTION

Water is one of the most important nutritional compounds of the ecosystem. Living things exist on the earth because this is the only planet that has water. It is necessary for the survival of plant, animal and all living things in this ecosystem. It is the most abundant commodity in nature but also the most misused one. India receives about 1400-1800 mm of rainfall annually. It is estimated that 85% of water is used for agriculture, 10% for industry and 5% for domestic use and analysis conducted revealed that about 70% of all the available water in our country is polluted (Andhale, 2008).

In India it has been estimated that current utilized water resources potential of approximately 1122 Km^3 /year (surface water 690 Km3 /year; ground water 432Km^3 /year) is significantly lower than anticipated water requirements, approximately 1450 Km^3 / year for population projection in the year 2050 (Murugesan et al., 2007). Our environment has witnessed a continuous and rapid deterioration which cause pollution in its entire abiotic and biotic components.

Nowadays, water pollution is a burning issue all over the world. Like other developing countries water pollution in India also reaches an alarming situation. Most of the surface and ground water in India faces vast quantity and quality threat. Many ponds have been degraded or lost, mainly due to anthropogenic activities such as change in agricultural activities, expansion of urban areas and pollution. Lakes, rivers, ponds are dead and dying in India with no plan for recovery and revival (Sushma et al., 2011). The natural freshwater of India which is available to man in the form of ponds, tanks, lakes and reservoirs has been polluted. Ponds have become more eutrophic owing to excessive nutrient additions and as a result they have often changed from macrophyte dominated and clear water states to turbid states, dominated by phytoplankton or floating water hyacinth or Salvinia (Gioria et al., 2009). Moreover, the water spread area of 0.72 million hectre has been reduced to about 0.65 million hectre in the country, Ravikumar et al. (2007).

Kerala is one of the smallest states in India covering only 1.3 percent of the total area of the country. The state account for 1.18 percent of Indian land area, but it has about 4.8 percent of the country's water resources. However, the population density of the state, 7472 /Km, is much higher than the national average of 267 2 /Km. It means that the per captia water availability is low (Binu, 2008). Ponds are found distributed all over Kerala. These ponds are either owned by religious institutions or private and panchayat / corporation. Centre of Water Resource Development Management (CWRDM) in 1989 identified 885 large ponds within the state, with minimum summer storage capacity of 1500 MCM. Of these, 287 were public owned, 137 belonged to temples and other are private. It has been cited that number of ponds and tanks have either disappeared or are being hopelessly mismanaged. Large number of ponds and paddy fields distributed all over the state also acts as an excellent water harvesting mechanism (Agarwal and Narain, 1997).

Ponds are the simplest surface water bodies which are closest to the heart of human being and of considerable ecological, social and cultural significance in every locality. Ponds have an overwhelmingly greater significance in human affairs and contribute greatly to the freshwater storage of organic matter (Gioria, Margherita and Feehan, 2009). Ponds are built in the past to hold water for agriculture and domestic uses. These water bodies not only provide drinking water, support livelihoods and biodiversity but also control runoff and act as natural rainwater recharging structures (Khanna, et.al. 2011). Ponds have been used as a traditional source of water supply in India. In addition to these services, ponds are vital for many rare and endangered species, both at regional and national levels. The networks of ponds support meta-populations of many aquatic species, including amphibians, invertebrates and wetland plants. Ponds are particularly important at the landscape scale: they have shown to contribute as much as to regional biodiversity as rivers or lakes, and they provide stepping-stones and increased connectivity between other freshwater habitats (Khanna, et al., 2011).

Nowadays, the water in the ponds is polluted mainly due to discharged wastewater from residential areas, detergents and agricultural pesticides from farmlands. The productivity of a pond or lake depends upon the quality of water and soil. The principal physical conditions such as depth, shore conditions, pressure and movement of water, temperature, turbidity and light are important for aquaculture. Similarly, the chemical conditions such as oxygen, carbon dioxide, and pH, total hardness of water, nitrates, phosphates, conductivity, chlorides and heavy metals are important (Boyd, 1989; Ademoroti, 1996; Biggs et al., 2005).

Eutrophication is a major threat for the natural water bodies. It is characterized by excessive plant and algal growth due to the increased availability of one or more limiting growth factors needed for photosynthesis (Schindler 2006), such as sunlight, carbon dioxide, and nutrient fertilizers. Eutrophication occurs naturally over centuries as lakes age and are filled in with sediments (Carpenter 1981). However, human activities have accelerated the rate and extent of eutrophication through both point-source discharges and non-point loadings of limiting nutrients, such as nitrogen and phosphorus, into aquatic ecosystems with dramatic consequences for drinking water sources, fisheries, and recreational water bodies (Carpenter et al., 1998).

After the time of industrialization and the green revolution, the discharge of untreated effluents from industries and agricultural wastes which enters in the environment, disturbs the biological balance with the growth of technology. These two groups of substances in particular have lasting effect on the natural balance in aquatic systems; "Nutrient" which promote unrestricted biological growth and in turn oxygen depletion and sparingly degradable synthetic chemicals and other waste substances which often constitute an adverse effect on aquatic ecosystems. It was estimated that industrial and domestic wastewater adds up to a million different pollutants into natural water. Substances such as polycyclic aromatics, pesticides, radioactive substances and trace metals directly endanger human life (Kodarkar, 1995).

The composition of solids present in a natural body of water mainly depends upon the nature of the bedrocks and the soil developed from it. The physico-chemical factors, which govern the chemistry of salts in water, may also influence the composition. Assessment of water quality can be defined as the analysis of physical, chemical and biological characteristics of the water. Water quality indices used for assessing surface water quality (Bharti and Katyal, 2011). Water quality assessment is essential for proposing conservation strategies for the freshwater ecosystems.

Soil is another most important part and ecological factor in an aquatic ecosystem. The Productivity of water body related with soil conditions. Soil serves as a more reliable index for productivity than water qualities. The productivity of any pond depends largely on the quality of bottom soil that is “store house of nutrients.” The chemical and biological changes continuously take place resulting in releases of different nutrients in to the over lying water and their absorption by the soil mass and microbial population. The growth and abundance of different aquatic flora and fauna are greatly dependent upon the presence of essential nutrients in water body in adequate and balanced quantities. Therefore, bottom soil described as the “chemical laboratory of pond.” The capacity of soil to retain water for aquatic flora and fauna. The ability of soil to provide various nutrients for biological production are assessed through the analysis of important soil constituents such as pH, specific conductivity, total alkalinity, calcium, magnesium, chloride, nitrate-nitrogen, phosphate-phosphorus, sulphate, sodium and potassium. Most of the dying out component of our environment are being contaminated by human activities like rapidly urbanization, industrialization population explosion, agricultural waste and anthropogenic activity in and around pond (Coskun et al., 2006).

Ponds require special attention on recent of its uncontrolled pollution from various sources. Aquatic ecosystem conservation and management requires collaborated research involving natural, social, and interdisciplinary study aimed at understanding various components, such as monitoring of water quality, soil properties, biodiversity and other activities, as an indispensable tool for formulating long term conservation strategies (Reshma, 2008).

The present study is an attempt to assess the water quality and soil properties of well-maintained temple pond and inaccessible eutrophic pond. Temples are centers of worship for Hindus and Sikhs. Hindu temples in Kerala and other states of India have in their vicinity certain ponds which are holy and called temple ponds. Ponds are found inside the temples or outside the temples. Temple management imposes restrictions over misuse of these holy ponds; therefore, they remain comparatively clean. Eutrophic ponds are the ponds affected by extreme levels of eutrophication. The water surface of such ponds is covered by bog vegetation. Eutrophic ponds are inaccessible for the society. Detailed study of water and soil properties help us to develop appropriate conservation strategies for the freshwater ecosystem.

OBJECTIVES

Water and soil quality monitoring is an important exercise, which helps in evaluating the nature and extent of pollution control required, and effectiveness of pollution control measures already in existence.

1. To document the water quality of selected ponds.
2. To document the soil properties of selected ponds.
3. To compare the water and soil properties of temple pond and eutrophic pond.

REVIEW OF LITERATURE

The health of any water body depends on the quality of its water, which is influenced by the presence of pollutants. The quality of water is generally assessed by a range of parameters, which express physical, chemical and biological composition of water and soil (Meybeck and Helmer, 1992). Much work has been carried out by many workers on physico-chemical properties of freshwater bodies.

International Research Efforts

Bubb and Lester (1991) studied the impact of heavy metals on lowland rivers and the implications for man and the environment. Ronald and Perkins (1991) had done routine monitoring of the public water supply in Aberystwyth and revealed high levels of Al with variable Zn content in a field study of 43 finish landfills. Assmuth and Strandberg (1993) characterized the toxic substances in groundwater especially Zn in groundwater.

Ali (2000) had studied the effect of seasonal variation of physical and chemical characteristics of mixed water from rivers Ravi and Chenab at union site in Pakistan. Lawson (2001) conducted a study on physico-chemical parameters and heavy metal contents of water from the mangrove swamps of Lagos lagoon, Nigeria.

Momot and Synzynys (2005) studied toxic Al and heavy metals in groundwater of middle Russia egarding health risk assessment. Boaventura and Freitas (2006) studied the adequacy of traditional ground water investigating parameter pH, EC, TDS. Na, K, Ca, Mg, Fe, Al, Cu, Cd, Cr, Mn, Zn were determined by ICP – AES. Batarseh (2006) analyzed various physio-chemical parameters and trace metals content of various rivers in four provinces in Jordan.

Boyacioglu (2007) studied the environmetric method which deals with the interpretation of river water monitoring data from the basin of the Buyuk Menderes river and its tributaries in Turkey. Kamau et al. (2007) studied the seasonal and spatial variation of labile Cu, Fe, Mn, Pb and Zn sediment fractions in lake Naivasha, Kenya. Diaz and Lopez (2007) assessed the spatial and temporal variations in water quality over the last 25 years with two approaches: the use of a water quality index multiplicative and a Principal Component Analysis (PCA).

Yakubo et al., (2009) analysed the groundwater quality using water quality index and conventional graphical methods in the Volta region. Yidana andYidana (2009) studied the factors viz. Conventional graphical and multivariate statistical methods, playing significant roles in the hydrochemistry of groundwater from the Southern Voltaian formation and WQI, which were in turn used to classify groundwater from the study area.

Sekabira et al., (2010) investigated the heavy metal contaminants in the Nakivubo stream water in Kampala, Uganda. Peiyu et al., (2011) studied the chemical characteristics of drinking groundwater and its distribution patterns in Pengyang County, Ningxia, and Northwest China. Juahir et al., (2011) assessed the spatial water quality of Langat river Basin (Malaysia) using environmetric techniques.

Indian Research Efforts

Wahid et al., (1990) studied the water quality and pollution by heavy metal like Fe, Cu, Zn, Ni, Co, Pb and Cd in western Uttar Pradesh. Appa et al., (1991) studied the groundwater pollution due to industrial effluents in certain areas of Dindigul town of Tamilnadu. Ghandrashekar et al., (1991) made statistical studies on the correlation of dissolved oxygen levels with environmental factors in Amaravathi river (South India).

Patel (1991) studied the groundwater pollution in and around Ujjain city with reference to degradation in groundwater quality mainly due to disposal of industrial and municipal sewage waste. Malik et al., (1991) studied the water quality and water toxicology of river Ganga at Fatehgarh and Kannauj Uttar Pradesh, India.

Sahu and Pande (1991) investigated the Water quality index of the river Brahmani at Rourkela industrial complex of Orissa. Bhatt and Pathak (1992) studied the assessment of water quality and aspects of pollution in a stretch of river Gomti (Kumaun: Lesser Himalaya) which reveals a high pollution load in the form of 4 SO^{-}, Cl^{-}, TDS, organic matter, BOD and COD.

Mittal et al., (1994) assessed the surface and underground water quality of some areas in Patiala city. Krishnamurthy and Bharati (1994) showed the distribution of iron, manganese, Zinc in the surface waters and investigated the toxic metal (Pb, Ni, Cd, Co, Ch, Cu) of the polluted river Kali, around Dandeii, (North Kanara District), Karnataka, India.

Venkateswarlu et al., (1994) investigated the heavy metal pollution in the rivers of Andra Pradesh, India. Srivastava and Singh (1995) studied the physicochemical characteristics of Ami river water. Singanan and Rao (1995) analysed ground water of Rameswaram Island. Sridhar (1995) investigated the chemical characteristics of the groundwater in parts of Dharsiwa block, Raipur district, Chhattisgarh.

Kataria (1996) investigated the physico-chemical parameters like turbidity, sulphate, BOD and COD contents in bore-wells water of Bhopal (MP). Bhargava and Sewani (1996) monitored the periodic variation in the physico-chemical characteristics of river Chambal at Kota. Sawant et al., (1996) studied the heavy metals in well water samples collected from tribal area of Satpura valley by Inductively coupled plasma atomic emission spectroscopy (ICP-AES) and flamephotometry.

Jain (1999) assessed the water quality of Khnop reservoir in Chatarpur, Madhya Pradesh India. Pillai et al., (1999) monitored the physico-chemical characteristics of drinking water of Durg municipality. Sharma and Agarwal (1999) studied the physico-chemical characteristics of Yamuna water at Agra in order to ascertain the viability of the water for domestic use.

Mohanta and Patra (2000) studied the water quality index of river Sanamachhakandana at Keonjhar Garh, Orissa, India. Aggarwal et al., (2001) studied the acidification of surface water in central India. Most of the rain and fog water samples collected from Bikunthpur and Korba sites were found to be acidic in nature.

Krishnamurthy (2003) studied the physico-chemical characters of water of Bilaspur city. Sahu (2003) investigated the toxic elements in coal, coal ash, soil, water and plants of Dipika coal area, Korba. Sharma (2003) studied the toxic elements due to industrialisation in soil, water, plants and fish. Chatterjee et al., (2003) analysed the physico-chemical parameters of Loco tank, a reservoir in Asansol town, West Bengal.

Sinha (2005) analyzed the chemicals present in soil, water, plant and aquatic animals with special reference to industrial effluents and pollution effects in Bilaspur District (Chhattisgarh). Patel et al., (2005) investigated the heavy metal, arsenic in contaminated water. Kumar et al., (2005) studied the physico-chemical characteristics of Amanishah Nallah and neighbouring groundwater sources in Sanganer, Jaipur. Hydrochemical study had been carried out by Mondal et al., (2008) on the groundwater resources of Potharlanka Island, Krishna delta, India. Groundwater samples were collected and analyzed at 42 sites in December 2001 and October 2006.

Shankar et al., (2008) identified the groundwater contamination problems in Bangalore city (Karnataka) in India. Groundwater samples from 30 different locations of the industrial area were collected. Their investigations revealed that most of the study area is highly contaminated due to the excessive concentrations of one or more water quality parameters such as nitrates, total hardness, calcium, magnesium, total dissolved solids, sulphates and fluorides, which have rendered nearly 77% of the water samples tested, non- potable. Discussions held by the authors with the local public as well as the primary health centre authorities of the area revealed that a lot of people in the area are suffering from severe health problems on using this water. The findings showed that there is a clear correlation between the ill health faced by the public and contamination of the said groundwater.

Jipsa et al., (2013) studied the limnological features of two temple ponds, the Ramott pond and Guruswamiyar pond. All values are found to be within or less than the permissible limit. Both ponds showed an oligotrophic nature with the presence of poor nutrients and low vegetation. Both ponds are unpolluted freshwater bodies which have no chemical or sewage pollution. Saroj and Billore (2014) Studied the physico-chemical characteristics of the Soil of Nagchoon Pond Khandwa, MP, India.

Different hydrobiological parameters such as temperature, transparency, pH, BOD and DO of Balapur pond located in UP was analysed by Varma (2019). Systematically analyzed season wise samples indicated that the water quality of the pond studied is although having some pollutants but is more or less suitable for aqua culture and agricultural purposes.

Research Efforts in Kerala

Harikrishnan and Aziz (1989) prepared a preliminary investigative report on the ecological characteristics of Neyyar reservoir in Kerala, Western Ghats and recorded highest phosphate in the system at the end of monsoon. Water quality of forty-two randomly selected open wells along Malappuram Coast (Kozhikode, India) reveal that portability of the majority of the wells (90.6%) is below permissible levels as per the ICMR and WHO standards (Abbasi and Nipaney, 1995).

Prakasam and Joseph (2000) studied the water characteristics of Sasthamcotta lake, Kerala on the basis of primary productivity. The lake water was clear, soft and acidic. All the physico-chemical characteristics were stable throughout the period of study. The effects of soap-detergent-fertilizer discharges, as revealed by indicator parameters, were not at dangerous levels. Microbial analysis of faecal coliforms indicated that the water was contaminated with human excreta.

Vijith and Satheesh (2007) investigated the hydrogeochemistry of groundwater in upland sub-watersheds of Meenachil river, parts of Western Ghats, Kottayam, Kerala, India was used to assess the quality of groundwater for determining its suitability for drinking and agricultural purposes. The spatial analysis of groundwater quality patterns of the study area shows seasonal fluctuations and these spatial patterns of physical and chemical constituents are useful in deciding water use strategies for various purposes. Shaji et al. (2009) studied the hydrogeochemical characteristics of groundwater in coastal phreatic aquifers of Alleppey district. Melenti et al. (2009) studied the hydrogeochemical characteristics of groundwater in aquifers of Alleppey district.

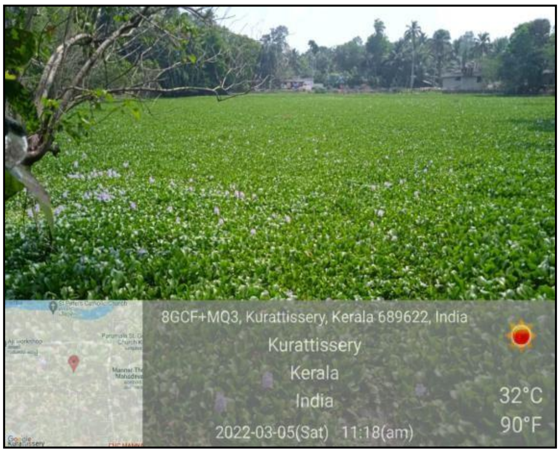
Aswathy et al., (2015) investigated 37 ponds of 5 panchayaths within Athiyannoor block in Thiruvananthapuram district, Kerala. Water samples were collected from the ponds for the analysis of physico-chemical parameters. The temperature varied between 26.5 and 29.6˚C, EC between 49.19 and 517.70 µS/m, the value of pH ranges between 4.51 and 7.7. The values observed were not within the acceptable range (6.5-8.5) of WHO for natural waters, DO was found to be between 10.96 mg/L and 0.62 mg/L. Outcomes of physico-chemical factors of numerous ponds studied in the present investigation clearly showed that the water was not good for human consumption.

Smitha et al., (2015) investigated the water quality of Athiyannoor block Panchayath by using GIS techniques and water quality index method. A total of thirteen parameters were analyzed of which nine were considered for calculating the WQI. GIS was employed for obtaining the geospatial data of the study area with respect to the themes, drainage, digital elevation model (DEM), triangulated irregular network (TIN) and Relative Relief which in turn have significant implications on the water quality of the ponds. Sreeja and Pooja (2017) analysed Water Quality of Two Temple Ponds in the Industrial Area, Kollam District, Kerala. Ray et al., (2021) studied the physicochemical water quality parameters eutrophic freshwater bodies in Kerala.

MATERIALS AND METHODS

STUDY AREA

A well-maintained temple pond and an inaccessible eutrophic pond were selected for the present study. The temple pond is located near the Kottarkkavu Devi Temple in Mannar Grama Panchayath. It lies in 9.305772 latitude and 76.535267 longitude. The total surface area of the pond is 1123.79 sqm. The selected eutrophic pond is located in Chennithala Thriperunthura Grama Panchayath. It lies in 9.302542 latitude and 76.498318 longitude. The total surface area of the pond is 353636 sqm.



Site 1. Temple pond Site 2. Eutrophic pond

SAMPLE COLLECTION AND ANALYSIS

In order to assess the water quality of the study areas, water and soil samples were collected during February - April, 2022. Physicochemical parameters like Temperature, pH, Dissolved Oxygen and Carbon dioxide were analyzed in chemical laboratory within 6 hours of their collection. Water samples were collected in 500 ml wide mouthed polypropylene bottle for analyzing water quality. Analyses of physical parameters like Temperature and pH were done in the field using thermometer and pH indicator papers. Dissolved Oxygen and Carbondioxide were estimated by following the standard methods of APHA (2005). Soil Analysis was carried out for various parameters such as pH, Organic carbon, phosphorus and nitrogen using Soil Testing Kit. Then descriptive statistics were conducted using modified SPSS version.

Dissolved oxygen in water

The Winkler Method is used to determine the concentration of dissolved oxygen in water samples. The dissolved oxygen in the sample is then "fixed" by adding a series of reagents (KI and $MnSO_4$) that form an acid compound that is then titrated with a neutralizing compound ($Na_2S_2O_3$) that results in a colour change. The point of colour change is called the "endpoint," which coincides with the dissolved oxygen concentration in the sample.

Carbon dioxide in water

The 40ml sample water is pipetted out in a conical flask. A few drops of phenolphthalein were added to it. Then titrated the sample against .01 N NaOH solution taken in the burette. The end point was marked by the appearance of pink colour.

Organic carbon in soil

A full spoon of soil was taken in a mixing bottle and added 5 ml of organic carbon reagent - 1 and mixed well. 5 ml of organic carbon reagent - 2 was added very slowly and mixed well and allowed to stand for 10 minutes to complete the reaction. Transfer the supernatant liquid into a test tube and compared with the organic carbon colour chart.

pH of soil

Transferred 10 c.c of soil into the soil mixing tube and 25 ml of pH reagent – 1 was added, then shaked well for 5 minutes. A pinch of decolourizer was added into it and shaked well. Filter the soil mixture into the colour developing bottle using funnel and filter paper. To the clear filtrate 4-5 drops of pH reagent -2 was added.

Wait for another 2-3 minutes, then compared the colour developed with the pH colour chart.

Nitrogen in soil

Transferred 5 c.c of the soil in the soil mixing tube and 25 ml of nitrogen reagent -1 was added and shaked well. Add a pinch of decolouriser was added into it and mixed again. Filter the soil mixture into the colour developing bottle using funnel and filter paper. To the clear filtrate, 2 drops of nitrogen reagent -2 was added for developing colour. Then the colour was compared to the nitrogen colour chart.

Phosphorous in soil

Transferred 5 c.c of the soil into the soil mixing tube and 25 ml of phosphorous reagent-1 was added. Then mixed well and wait for 15 minutes. A pinch of decolouriser was added into it and mixed. Filter the soil mixture into the colour developing bottle using funnel and filter paper. To the filtrate, add 2 ml of phosphorous reagent-2 and mixed well. Wait for 1-2 minutes for colour developing. Then the colour was compared to the phosphorous colour chart.

RESULT AND DISCUSSION

Ponds are vital habitats and provide essential resources for a wide range of species, including humans. Water and soil are the important factors which determine the productivity of the ponds. The present study is an attempt to assess and compare water and soil properties of a well-maintained temple pond and an inaccessible eutrophic pond.

Water Quality

The quality of water is determined by its constituents, which is the totality of the substances dissolved or suspended in water. Physico-chemical characteristics of water such as temperature, pH, dissolved oxygen (DO), and Carbon dioxide (CO_2) were analysed to compare the water quality of temple pond and eutrophic pond.

Temperature

Temperature is one of the most important factors in the aquatic environment (Dwivedi and Pandey, 2002). The temperature plays a crucial role in physicochemical and biological behaviour of aquatic systems. The water temperature of the temple pond is greater than the inaccessible pond. The mean temperature of the temple pond water is 29^0C and the temperature of the eutrophic pond is 25^0C. The temperature rise may be due to the shallowness of water and also because of the sunny day. The bog vegetation may lead to the lower water temperature of eutrophic ponds. The high temperature may facilitate the DO production (Nair et al., 1984). The water temperature dramatically changes the rate of chemical and biological reaction within the water and influences the inhabitants.

pH

The pH of a pond is a measure of the acidity of the water. pH is considered as an important ecological factor and is the result of the interaction of various substances in solutions in the water. It is the scale of intensity of acidity and alkalinity of water and measures the concentration of H+ ions. The pH of pond water is important for a number of pond uses. In the present study, both the temple and eutrophic pond water are very strongly acidic in nature (Table 1). Temple pond water records 4.5 and eutrophic pond water records 5. Welch (1952) states that the limnological value of pH is a limiting factor and works as an index of general environmental condition.

Dissolved oxygen

Dissolved oxygen levels are considered as the most important and commonly employed measurement of water quality and indicator of a water body's ability to support desirable aquatic life. Dissolved oxygen level of temple pond is 4.8 mg/L and that of eutrophic pond is 1.2 mg/L. The high temperature and addition of sewage and other waste might be responsible for low value of DO in eutrophic pond (Mathuthu et al., 1993). Depletion of dissolved oxygen in water is due to high temperature and increased microbial activity (Kataria et al., 2011). Vijayan (1991) reported that the measurement of dissolved oxygen is a primary parameter in all pollution studies. The amount of dissolved oxygen is higher in those places where there is a good aquatic life. Moreover, levels of DO act as an indicator of status of the waterbody.

Carbon dioxide

Carbon dioxide is an odorless, colorless gas produced during the respiration cycle of animals, plants and bacteria. Free carbon dioxide in a water body may be derived from the atmospheric sources, biotic respiration, inflowing groundwater which seep into the pond, decomposition of organic matter due to bacteria and may also from within the water body itself in combination of other substances mainly calcium, magnesium etc. Carbon dioxide liberated during respiration and decay of organic matter is highly soluble in natural waters. In the present study the eutrophic pond shows high CO_2 level (Table 1). The CO_2 level in temple pond water is 4.4 mg/L and that of eutrophic pond is 13.2 mg/L. The carbon dioxide content of water depends upon the water temperature, depth, rate of respiration, decomposition of organic matter, chemical nature of the bottom and geographical features of the terrain surrounding the water body (Sakhare and Joshi, 2002).

Soil Properties

The soil characteristic of an aquatic ecosystem largely depends upon their geography, particular location, siltation rate, concentration of total suspended solids and the suspended load inflow, outflow ratio etc. In India however, very little work has been carried out to explore the soil characteristics of aquatic bodies. Physicochemical characteristics of soil such as P^H, organic carbon, nitrogen and phosphorus were analysed to compare the soil properties of temple pond and eutrophic pond.

pH

Soil is characterized into acidic, neutral and alkaline, according to its reaction or the concentration of H ions. The soil pH is influenced by transformation of soluble phosphate, response of different nitrogenous fertilizer absorption and releases of nutrients at the soil water interface including bacterial activity in soil and maximum at neutral pH (7.0). While, wide variations in soil pH of lake and pond have been encountered under different agro climatic conditions. The selected ponds show pH in acidic range (Table 2). Soil pH of the temple pond is 4.5 and that of the eutrophic pond is 5. Soil pH in the range of 6.5to 7.5 is considered ideal for any lake or pond reservoir (Saroj Mahajan and Dilip Billore, 2014).

Organic Carbon

The organic matter and organic carbon are the most important components of soil. Humus or organic matter present in the soil is more varied and complex in nature compared to mineral-to mineral constituents of the soil. In ponds, the process of sedimentation and decomposition of organic matter takes place and as a result various nutrients are released from complex organic forms to simple inorganic compounds. Temple pond soil contains a low amount of organic carbon (<0.5%) whereas the eutrophic pond soil contains medium amount of organic carbon (0.5-0.75%). The higher amount of organic carbon content in the inaccessible pond may be due to the excess decomposition (Saroj Mahajan and Dilip Billore, 2014).

Nitrogen

Nitrogen occurs in various dissolved forms as dissolved molecular nitrogen, inorganic nitrogen as ammonia nitrite, nitrate and organic nitrogen as amino acid proteins etc. The major source of nitrogen in soil includes fixing of atmospheric nitrogen by bacteria and cyanobacteria, precipitation, surface and ground water drainage. Temple pond soil contains low levels of nitrogen (< 50 Kg/Acre) whereas the eutrophic pond soil contains medium level of nitrogen (50-99 Kg/Acre).

Phosphorus

Both organic and inorganic phosphorus occurs in soil, inorganic form considered important for production. Temple pond soil contains low levels of Phosphorus (<1Kg/Acre) and eutrophic pond contain high levels of Phosphorus (>15 Kg/Acre). The phosphate and nitrate are the chief nutrients for the growth of aquatic flora and phosphorus is often suspected to be the limiting nutrient in primary production in freshwater, so called as 'sub optimum' element.

Parameter	**Temple Pond**	**Eutrophic Pond**
Temperature	29^0C	25^0C
pH	4.5	5
Dissolved Oxygen	4.8 mg/L	1.2 mg/L
Carbon dioxide	4.4 mg/L	13.2 mg/L

Table 1. Water quality of selected ponds

Parameter	Temple Pond	Eutrophic Pond
pH	4.5	5
Organic Carbon	<0.5 % (Low amount)	0.5-0.75 % (Medium amount)
Nitrogen	<50 Kg/Acre (L1 level)	50-99 Kg/Acre (L2 level)
Phosphorus	<1 Kg/Acre (L1 level)	>15 Kg/Acre (H2 level)

Table 2. Soil properties of selected ponds

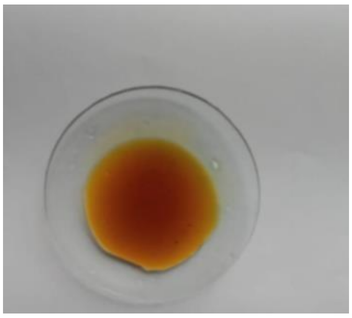
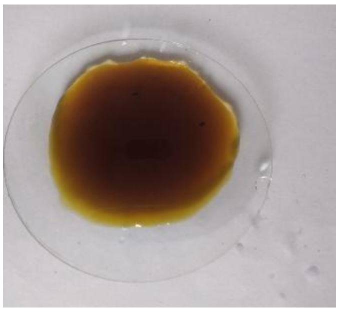
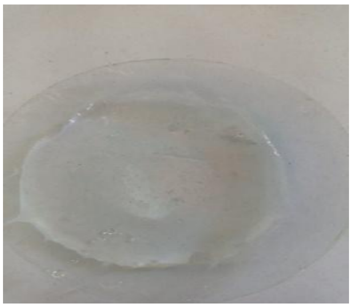
Parameter	Temple Pond	Eutrophic pond
Soil pH		
Soil organic carbon		
Nitrogen		

Fig 1. Test result of soil properties

CONCLUSION

The physico-chemical parameters of water and soil collected from a well-maintained temple pond and an inaccessible eutrophic pond were compared. The water and soil samples collected from the selected ponds were acidic in nature. As a result of eutrophication, the eutrophic pond water shows low level of dissolved oxygen and high level of carbon dioxide. Temple pond soil contains low amount of organic carbon whereas the eutrophic pond soil contains medium amount of organic carbon. Phosphate and nitrate are the chief nutrients for the growth of aquatic flora, the eutrophic pond soil shows high nitrogen and phosphorus content when compared with the temple pond soil. Temple ponds are considered as holy place and it is well maintained. Temple management imposes restrictions over misuse of these holy ponds; therefore, they remain comparatively clean. The eutrophic pond is polluted and it is inaccessible due to the accumulation of excess nutrients and bog vegetation. Aquatic ecosystem conservation and management requires collaborated research involving natural, social, and interdisciplinary study aimed at understanding various components, such as monitoring of water quality, biodiversity and other activities, as an indispensable tool for formulating long term conservation strategies.

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