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COMPARATIVE ASSESSMENT ON THE ECOLOGICAL HEALTH OF FOUR DIFFERENT PONDS IN MANATHANA REGION OF KANNUR DISTRICT, INDIA

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AUTHORS' CONTRIBUTIONS

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ABSTRACT

Freshwater is one of the basic needs of mankind and is essential for the existence of all forms of life. Ponds are an integral component of the hydrological system and perform diverse role in biosphere. Ponds are of immense significance to human civilization as they are sources of water for domestic, agriculture and industrial purposes etc. Now a days we can see that the world's pond ecosystem is in danger. It is threatened by many factors .These include a variety of anthropogenic activities, which entail urgent need for research and education programs to create awareness in the society for their protection and conservation. In the present study physico-chemical parameters of four different ponds in Manathana region of Peravoor panchayat, Kannur district in Kerala, India was determined. Manathana is located in Thalassery tehsil of Kannur district in Kerala, India. It is situated 50km away from sub-district headquarter Kannur and situated in Peravoor grama panchayat. More than six ponds are situated in Manathana village. The present study was conducted over the selected four ponds in Manathana village namely, Manathana pond, Karimbanackal pond, Kunden Temple pond and Madappurachal pond. The objectives of the study were to investigate the seasonal variations of physico-chemical parameters such as temperature, pH, transparency, salinity, ammonia, carbon dioxide, dissolved oxygen, Chemical Oxygen Demand. Water samples were collected during the year 2020-2021 from the study area and the physico-chemical parameters were analysed with respect to the seasons following standard methods. The major objective of this study was to collect information about pond water quality and importance for their conservation against anthropogenic activities. Because of their small size, ponds are much more vulnerable to degradation. Ecological assessment and monitoring of ponds are a major topic in their conservation and management. The improper management of water system causes serious problems in availability and quality of water, since water quality and human health are closely related, water analysis before usage is of prime importance. The study highlights the point that anthropogenic pressure makes responsible for causing destructive nature of pond ecosystems.

Keywords: Dissolved oxygen; chemical oxygen demand; management; anthropogenic; physico-chemical.

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1. INTRODUCTION

Water is one of the most abundant compounds of the ecosystem. It is an inorganic, transparent, tasteless, odourless, and nearly colourless chemical substance, which is the main constituent of Earth's hydrosphere and the fluids of all known living organisms. Water plays an important role in the world economy. Water is the basic essential entity for all living beings. Freshwater ecosystem is a subset of Earth's aquatic ecosystems. It can be divided into lentic and lotic ecosystem. They include lakes, ponds, rivers, streams, springs, bogs, and wetlands [1]. All lentic habitats, such as ponds, lakes are extremely important as they are enriched with other natural resources too. These water bodies were used by mankind for domestic, agricultural and industrial purposes. Due to industrialization, increase in population, use of fertilizers in the agricultural fields and other anthropogenic activities make water highly polluted with harmful contaminants. Among other freshwater resources ponds are useful in many ways and it is one of the methods of artificial infiltration of underground water.

Ponds are small bodies of freshwater with shallow and still water, marsh and aquatic plants. They can be further divided in to four zones: vegetation zone, open water, bottom mud and surface film [2]. Ponds may either natural or artificial. Ponds are frequently man-made or expanded beyond their original depths and bounds by anthropogenic causes. Among their many uses ,ponds provide water for agriculture, livestock and communities, aid in habitat restoration , serve as breeding grounds for local and migrating species, and are components of landscape architecture, flood control, general urbanization, mitigate particular pollutions and greenhouse gasses, and support wide varieties of organismal ecosystems. Ponds are important hotspots of biodiversity. Collectively they support more species, and more scare specie, than any other freshwater habitat [3]. They often contribute more to regional biodiversity than the rivers or another habitat. Ponds are easily disrupted by human activity. The pond water is polluted mainly due to the discharge of wastes from residential area, sewage outlets, solid wastes, detergents and automobile oil waste [4] Physico-chemical parameter analysis of any aquatic ecosystem is necessary because their hydrochemistry affects its biota to a great extent. Water quality influences the existences of aquatic organisms [5]. The physico-chemical characteristics of pond water have a direct impact on prevailing organisms as well as human being using such water. The study of different water quality parameters helps in understanding the metabolic events of the aquatic system. Certain parameters such as temperature, pH, transparency, salinity, ammonia, carbon dioxide, dissolved oxygen, and chemical oxygen demand are necessary for the proper understanding of flora and fauna and their abundance and distribution with time. The changes in these parameters provide valuable information on the quality of water, the sources of the variations and their impacts on the functions and biodiversity of the pond.

The main objectives of the study were to analyze the hydrographical features such as temperature, pH, transparency, salinity, ammonia, carbon dioxide, Dissolved oxygen and Chemical Oxygen Demand of four different ponds in Manathana region. The study deals with the assessment of fluctuations in the physico-chemical characteristics of four ponds in Manathana region that would form a reminder to conserve these precious ecosystems. It is possible that in future decades anthropogenic activities on water resources will further endanger aquatic biodiversity present in these systems. The lack of information on the natural values of these ponds and the inappropriate management measures results in their deterioration or even disappearance. The study highlights the need for revitalization of natural fresh water ecosystems. The present study deals with the analysis of the physio-chemical parameters of four ponds in Manathana region. These ponds were facing threat due to anthropogenic activities. The ponds selected for study are:

1. Manathana pond
2. Kunden Temple pond
3. Karimbanackal pond
4. Madappurachal pond

2. MATERIALS AND METHODS

Water samples were collected during the year 2020-2021 from the study area and the water samples were collected in clean plastic containers of 2-litre capacity and transported to the laboratory for doing physico-chemical analysis and they were analysed following [6].

2.1 Study Area

Manathana is located in Thalassery tehsil of Kannur district in Kerala, India. It is situated 50 km away from sub-district headquarter Thalassery and 55km away from district headquarter Kannur. Peravoor is the grama panchayt of Manathana village. The total geographical area of village is 1802 hectares. This small village has seven temples and remnants of some other temples or such structures. The history of Pazhassi Raja, the Lion of Kerala, has been related to

this small village. The Aralam Wild Life Sanctuary is located nearby.

2.1.1 Site 1). Manathana pond

Manathana is a place in between Ayothumchal and kottamchuram villages. The total geographical area of village is 1802 hectares.More than 6 ponds were situated in Manathana village. Manathana pond is situated at the centre of Manathana village town. The pond is situated nearby Sree Kulangareth Sree Paliyara Bhagavathi Temple. People uses this pond for swimming training and bathing purposes. Water lettuce were seen in pond abundantly.

2.1.2 Site 2). Karimbanackal pond

Karimbanackal pond is located 400 meters away from Manathana pond. It is associated with Karimbanackal (Chathoth) Bhagavathi Temple. It is a small pond and it is filled up with a small type of water lettuce. Water is not clear and transparent. Sugar cane cultivation is situated near to this pond.

2.1.3 Site 3). Kunden Temple pond

Kunden Temple pond is located in Odomthode - Madappurachal road. It is situated 1km away from Manathana pond.This pond is associated with Sree Kunden Mahavishnu Temple. It is a small pond, several underwater plants and some water hyacinth plants found in this pond. People uses this pond for bathing purposes.

2.1.4 Site 4). Madapurachal pond

Madappurachal pond is located near a nursery school in Madappurachal road. It is a small pond with clear and transparent water. several underwater plants found in this pond. People uses this pond for washing, bathing and agricultural purposes.

Image 1. Pond at Manathana village

Image 2. Karimbanackal pond

Image 3. Kunden temple pond

Image 4. Madapurachal pond

3. RESULTS AND DISCUSSION

The study of physico-chemical parameters of selected four ponds in Manathana region of Peravoor panchayat, site 1(Manathana pond), site 2 (Karimbanackal pond), site 3(Kunden temple pond), site 4 (Madappurachal pond) of two different month collection of water samples were analysed and compared.

3.1 Temperature

The temperature showed minimum range of 24ºC and exhibited maximum range of 30ºC. In post monsoon period, the temperature ranges from 27ºC to 30ºC. A higher range of temperature was observed in site 1 (30ºC) and a lowest temperature was observed in two sites, site 2 & site 4 (27ºC). The temperature of water sample in the pre monsoon period ranged from 24ºC to 28ºC. A high temperature was noticed in the site 1 (28ºC) and lower range was noticed in the site 4 (24ºC) (Table 1 and Fig. 1). The mean ±standard deviation ranges from 28 ±1.22 to 26 ±1.41.

3.2 pH

From the study, in post monsoon season the pH ranged from 7 to 6. A higher level of pH was observed in site 1 & site 4 (7). And lower pH was observed in site 2 & site 3 (6). The pH of water

sample in pre monsoon season ranges from 8 to 6. A higher level of pH was observed in site 3 (8), and lower level of pH was observed in site 2 & site 4 (6). Site 1 and site 2 shows same range of pH in both seasons (Table 1 and Fig. 2). The mean deviation ranges from 6.5 ±0.5 to 6.75±.82.

3.3 Transparency

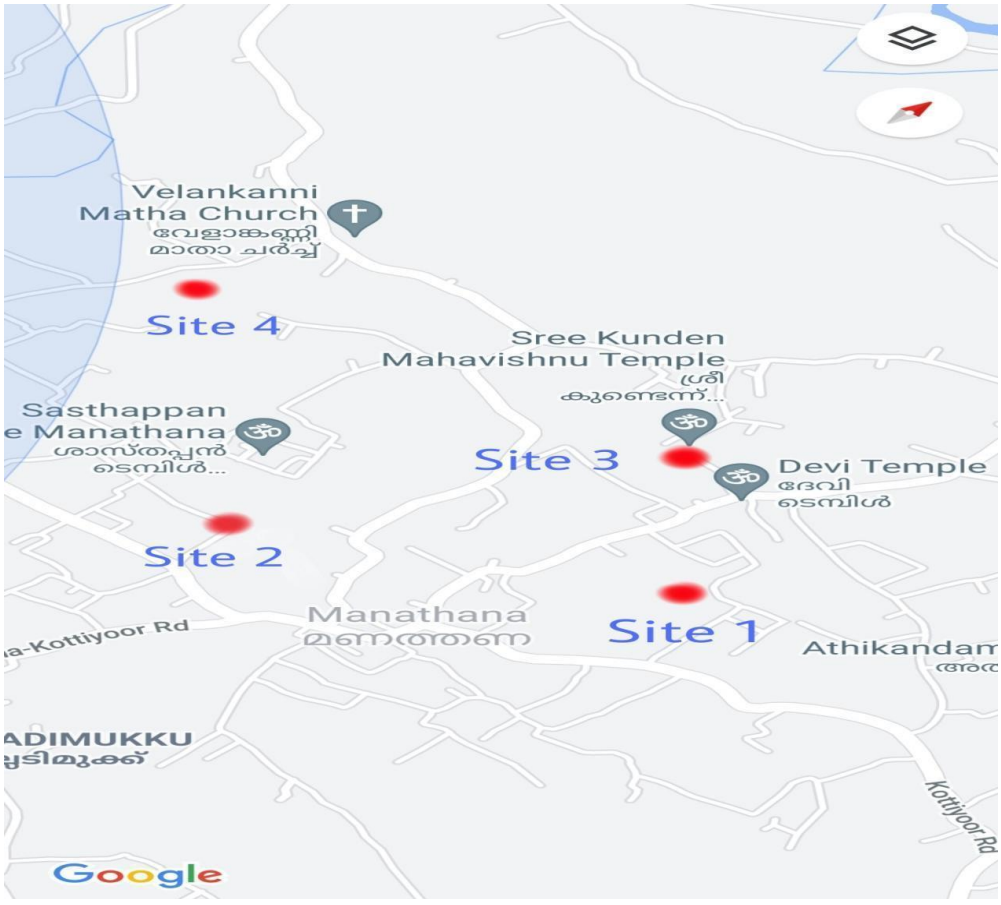
Transparency range showed slight variations in these two seasons. A higher transparency value was noticed about 93 c.m in site 1 of post monsoon season. The lower range was 38 c.m in site 3 of pre monsoon season. In post monsoon season the transparency of water ranges from 42 to 93 c.m. Transparency of water in pre monsoon ranges from 38 to 88 c.m. A high range of transparency observed in site 1 in both seasons and lower range was observed in site 3 in both seasons (Table 1 and Fig. 3). The mean±0.5 standard deviation ranges from 61.75 ± 18.93 to 58.25 ±0.5.47.

3.4 Salinity

Salinity of water sample in post monsoon season ranges from 6.428 to 12.82 mg / l. A highest range was obtained in site 4 (12.82 mg / l) and lowest range was observed from site 1 & site 2 (6.428 mg / l). In pre monsoon season salinity ranges from 6.42 to 16.026 mg / l. Maximum range was observed in site 4 (16.026 mg / l) and minimum range was observed in site 2 (6.42 mg / l) . The site 2 shows comparatively minimum range of salinity in all seasons. And site 4 shows maximum range of salinity in all seasons (Table 1and Fig. 4). The mean standard deviation ranges from 8.82 ± 2.65 to 11.22 ± 3.57.

3.5 Ammonia

Ammonia of water sample in the post monsoon season ranges from 8.5 to 25.5 mg / l. Maximum range was observed in site 4 (25.5 mg / l) and minimum range was observed in site 3 (8.5 mg / l). In pre monsoon season ammonia of water sample ranges from 17 to 34 mg / l. A highest range was observed in site 4 (34 mg / l) and other three sites showed same range of 17 mg / l (site 1, site 2, site 3). The site 4 shows comparatively highest range of ammonia in both seasons (Table 1 and Fig. 5). The mean ± standard deviation ranges from17 ± 6.01 to 21.25 ± .36.



Map 1. Map showing the study sites in Manathana region

3.6 Carbondioxide

Carbon dioxide in water sample in post monsoon season ranges from 5.28 to 10.56 mg / l. The maximum range was observed in site site 3 (10.56 mg / l) and minimum range was observed in site 2 (5.28 mg / l). In pre monsoon season carbon dioxide of water sample ranges from 7.04 to 12.32 mg / l. The maximum range was observed in site 3 (12.32 mg / l) and minimum range was observed in site 2 (7.04 mg / l) (Table 1 and Fig. 6). The mean ±standard deviation ranges from 8.14 ±1.9 to 9.9 ±1.9.

3.7 Dissolved Oxygen

Dissolved oxygen of water sample in post monsoon season ranges from 3.2 to 5.28 mg / l. The maximum range was obtained in site 2 (5.28 mg / l) and minimum range was observed in site 3 (3.2mg / l). Dissolved oxygen was maximum in during the post monsoon period (site2). And minimum in pre monsoon period (site 3).

3.8 Chemical Oxygen Demand

Chemical Oxygen Demand of water sample in post monsoon ranges from 3.2 to 9.6 mg / l. Maximum range was observed in site 4 (9.6 mg / l) and minimum range was observed in site 1 & site 2 (3.2 mg /l) . In pre monsoon season Chemical Oxygen Demand ranges from 6.4 to 12. 8 mg / l. The maximum range was observed in site 1 (12.8 mg / l) and minimum range was observed in site 2 (6.4 mg / l) (Table 1 and Fig. 9). The mean ± standard deviation ranges from5.2 ± 2.62 to 9.6 ±2.52.

Figs. (1-7) Graphs showing the variations of certain physico chemical factors.

Table 1. Seasonal variations of physico-chemical parameters

Parameter	Seasons	SITE 1	SITE 2	SITE 3	SITE 4	MEAN ± SD
Temperature (ºC)	Post monsoon	30	27	28	27	28 ±1.22
	Pre monsoon	28	26	26	24	26 ±1.41
pH	Post monsoon	7	6	6	7	6.5 ±0.5
	Pre monsoon	7	6	8	6	6.75 ± 0.82
Transparency (cm)	Post monsoon	93	57	42	55	61.75 ± 18.93
	Pre monsoon	88	57	38	50	58.25 ± 18.47
Salinity (mg /l)	Post monsoon	6.428	6.428	9.628	12.82	8.82 ±2.65
	Pre monsoon	9.62	6.42	12.82	16.026	11.22 ± 3.57
Ammonia (mg /l)	Post monsoon	17	17	8.5	25.5	17 ± 6.01
	Pre monsoon	17	17	17	34	21.25 ± 7.36
Carbon dioxide (mg/ l)	Post monsoon	8.8	5.28	10.56	7.92	8.14 ± 1.9
	Pre monsoon	9.68	7.04	12.32	10.56	9.9 ± 1.9
Dissolved oxygen (mg / l)	Post monsoon	4.48	5.28	3.2	4	4.24 ± 0.75
	Pre-monsoon	2.52	3.68	1.8	2.4	2.6± 0.78
COD (mg / l)	Post monsoon	3.2	3.2	4.8	9.6	5.2 ± 2.62
	Pre monsoon	12.8	6.4	8	11.2	9.6 ± 2.52

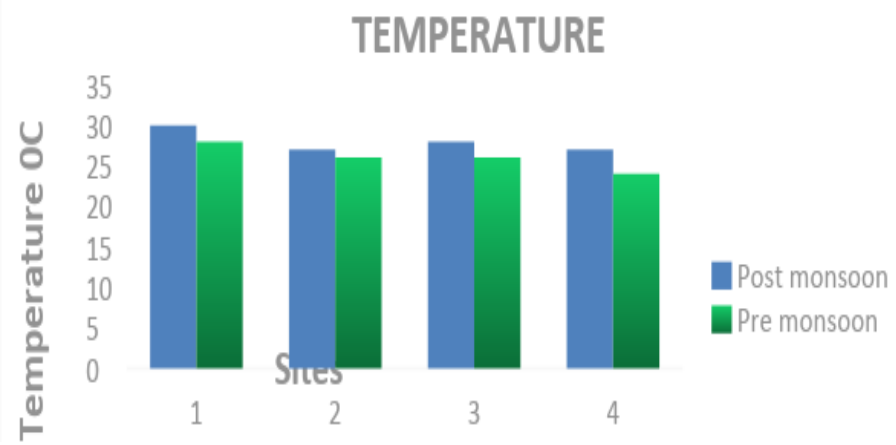


Fig. 1. Graph indicating temperature variations

Fig. 2. Graph indicating pH variations

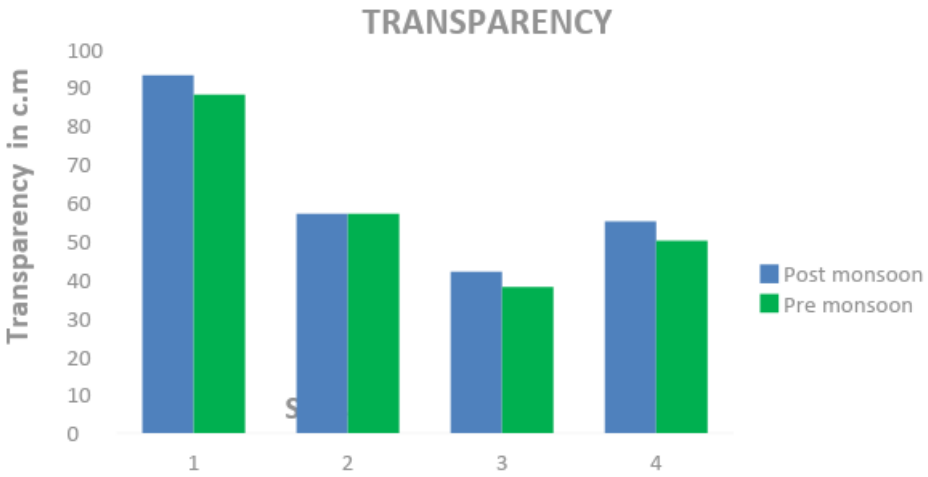


Fig. 3. Graph indicating transparency variations

Fig. 4. Graph indicating salinity variations

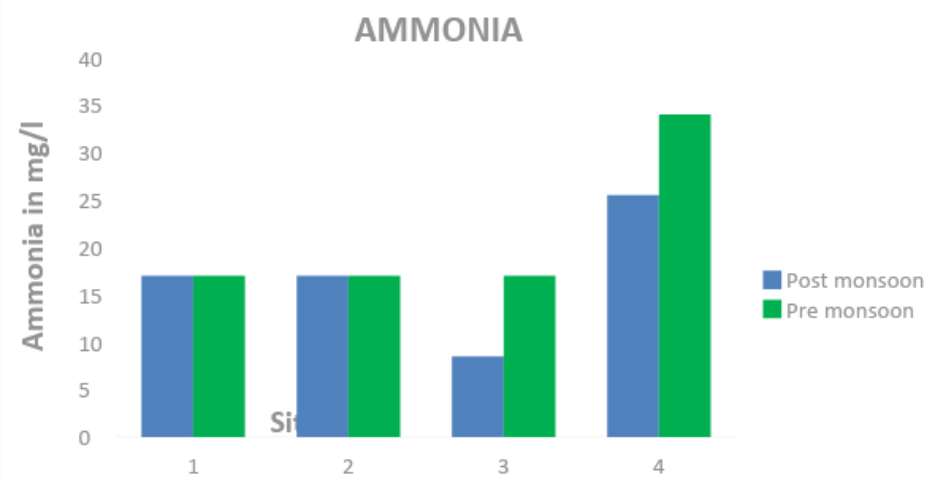


Fig. 5. Graph indicating ammonia variations

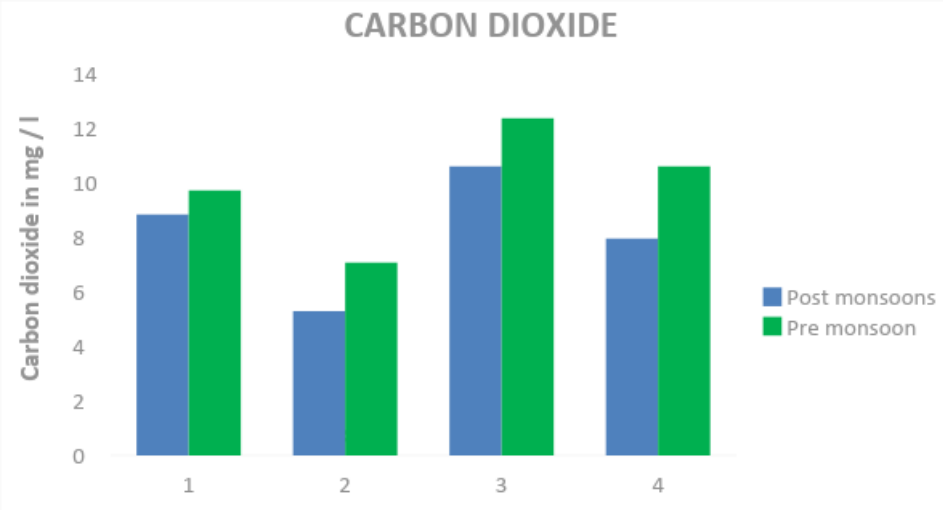


Fig. 6. Graph indicating carbon dioxide variations

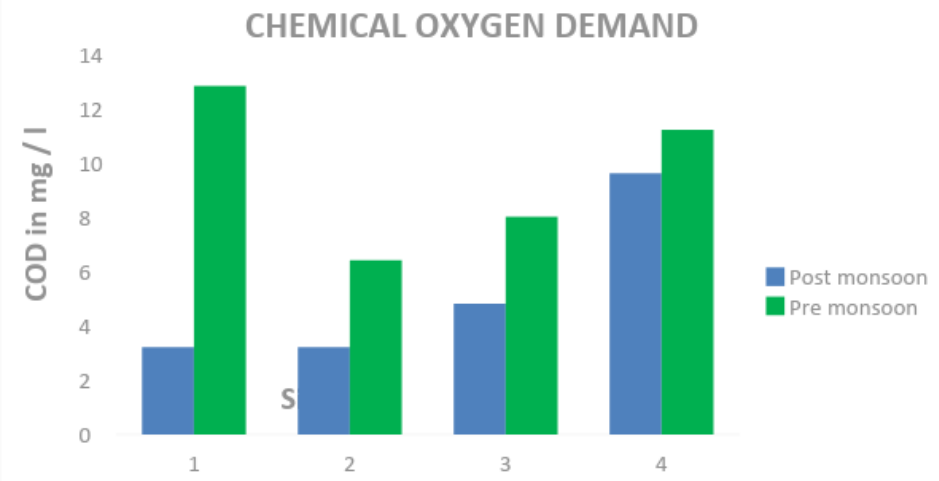


Fig. 7. Graph indicating COD variations

4. DISCUSSION

Physico-chemical characteristics of water are highly influenced by the richness of biota, its exploitation and distribution [7]. Ponds are important hotspots for biodiversity. They support more species than any other fresh water habitat. They are more abundant than any other fresh water habitats and are found in virtually all environments.

The pond water temperature is highly influenced by local climatic conditions. Temperature has an important role in physical, chemical and biological properties of water. Water temperature values ranged from 24^0C to 30^0C. The minimum value was recorded in pre monsoon period and maximum in post monsoon period. The temperature difference might be either due to the geographical differences in the location or due to difference between the collection times [8]. Considering the four sites, high temperature was recorded in site 1 (30^0C) during the post monsoon period. According to Desai [9] water temperature varies depending on the season. This is reflected by lower water temperature at site 4 in pre monsoon due to cloudy weather.

The pH of pond water is considered as an index of environmental conditions. It affects the biochemical reactions and controls the activities and distribution of aquatic fauna and flora. A slight variation in the pH can change the acidity or alkalinity of water. In the present study, the pH value was maximum in pre monsoon period (6.75 ± 0.82) and minimum in post monsoon period (6.5 ± 0.5). The high value of pH 8 observed in site 3 during pre-monsoon period. The amount of calcium increases during pre-monsoon period due to rapid oxidation or decomposition of organic matter and pH become alkaline state (Billore, 1981). Slight deviation towards acidity maybe due to the anthropogenic activities like improper irrigation and weathering process [10].

Transparency is the measurement of light penetration in the water body. The secchi disc transparency correlates closely with the percentage of transmission of light. The average range of transparency was 58.25 c.m to 61.75 c.m. High transparency of 93 c.m was observed in site 1 during post monsoon season. Transparency of water is generally influenced by factors like wind action, suspended silt particles, plankton concentration and decomposition of organic matter at the bottom (Gorde *et al*., 2013).

Salinity is the saltiness or dissolved salt content of a body of water. In the present study it has been observed that salinity ranged from 6.42 to 16.026 mg/l. Maximum salinity is recorded in site 4(16.026 mg/l) during the pre-monsoon period and minimum is recorded in two sites (6.428 mg/l) during the post monsoon period (site 1& 2). Increased salt content water will not be used for the drinking or irrigation purpose (WHO, 1997).

Ammonia is lethal to aquatic life even if present in small concentration. In the present study, the amount of ammonia ranged from 17 to 34 mg/l. The maximum range of ammonia was observed in site 4 (34 mg/l) during pre monsoon period. Same values of ammonia were observed in sites 1 and site 2 during both seasons. When algae and other suspended microorganisms die and settle down to the bottom and release their nitrogen content during decomposition. Ammonia in natural waters can be traced to percolating nitrates from sources such as decaying plant and animal material, agricultural fertilizers and domestic sewage [11]. Drinking water contains more than 500 mg/l ammonia can cause methamoglobinemia in infants [12]. High amount of ammonia in water bodies cause over growth of algae and other organisms and produce foul smell.

Carbon dioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net ecosystem metabolism [13]. In the present study the maximum carbon dioxide range was recorded in site 3 (12.32 mg/l) during the pre monsoon period and minimum range was recorded in site 2 (5.28 mg/l) during the post monsoon period. According to Joshi et al., [14], the increase in carbon dioxide may be due to decay and decomposition of organic matter.

5. CONCLUSION

The present study indicates the seasonal variations of physico- chemical parameters of four different ponds in Manathana region of Peravoor panchayat namely Manathana pond (site 1), Karimbanackal pond (site 2), Kunden Temple pond (site 3) and Madappurachal pond (site 4). The temperature range was maximum in post monsoon period and minimum value was recorded in pre monsoon period. pH value was observed highest in pre monsoon period. Site 3 exhibited alkaline pH in pre monsoon season and site 2 shows the acidic pH in two seasons.The site 1 shows 7 pH in both seasons. Moderately high levels of transparency were observed in post monsoon period. Salinity is maximum in the pre-monsoon period. Ammonia is maximum in the pre monsoon period. Higher values of ammonia were observed in site 4 during the pre monsoon season. Carbon dioxide is maximum in the pre monsoon period. Increased carbon dioxide affects the pH which affects the biota of that region. Highest range of COD is observed in

pre monsoon season. High rate of ammonia, carbon dioxide and other parameters were noticed in the study area that would affect the aquatic life.Uncontrolled algal growth can produce green water low oxygen levels , and unpleasant odours.So the proper management of all these hydrographic features are necessary for conserving the pond ecosystem.The quality of an aquatic ecosystem depends on its physicochemical qualities as well as biological diversity. Different studies on ponds in India have been taken with the underlying concept that the physicochemical qualities of pond water directly impact pond aquatic ecosystem as a whole. The study indicates that the factors investigated exhibited some marked variations with distinct minima and maxima.The investigation reveals the necessity for rejuvenation of these ponds for preventing the dark future of these ponds if no effective measures are undertaken.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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