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Original Research Article

# STUDY OF PHYSICO CHEMICAL PARAMETERS IN SELECTED PONDS OF NEDUMANGAD BLOCK PANCHAYAT, KERALA

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## ABSTRACT

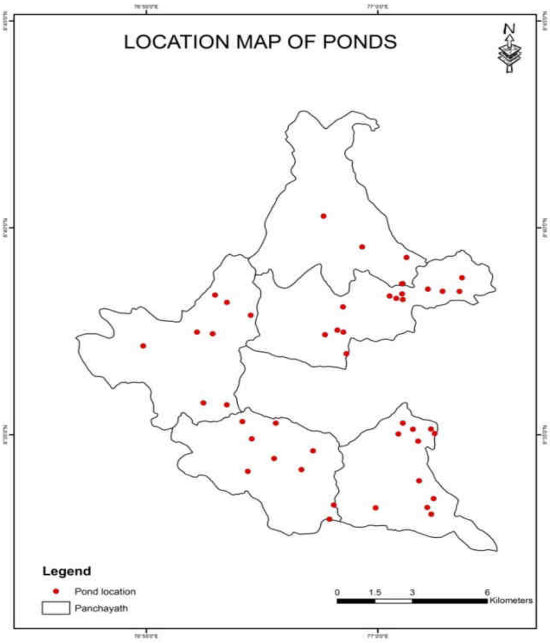
The present study was carried out to analyse the physicochemical parameters of 36 selected ponds in Nedumangad Block Panchayat. Water samples collected for the analysis of water quality parameters showed that the temperature varied between 25.5 and 32.5˚C, 39.51 µS to 250.67µS for EC, 4.67 to 8.58 for pH (The values observed were not within the acceptable range (6.5-8.5) of WHO for natural waters), 121.58mg/L to 2.6mg/L for DO (The lowest DO value of this pond might be due to low solubility of oxygen at high temperature (The lowest DO value of PAN-2 pond might be due to low solubility of oxygen at high temperature.), 20.11 mg/L to 127.26 mg/L for TDS, 17.34 mg/L to 543.26 mg/L for salinity, 0 mg/L - 100 mg/L for hardness, 10 mg/L - 105mg/L for alkalinity and 7.1mg/L and 24.85 mg/L for chloride respectively. All the values of total hardness found in this study were within the permissible limit for drinking standard. In the current study, the value of Na ranges from 7 mg/L to 47 mg/L. The values of potassium varies in the same manner in every ponds studied. Results of physico-chemical parameters of various ponds at Nedumangad as studied in the present investigation clearly shows that the water is not good for human consumption and also struggling for their existence. Therefore, it needs some corrective measures to maintain the water chemistry of the pond.

**KEYWORDS:** Temperature, Hardness, Alkalinity, Electrical conductivity, Dissolved oxygen

## INTRODUCTION

Water being vital in various human life processes, the quality of water is of concern for humans beings. Recent reviews (Dhanalakshmi et al, 2013) indicate that land degradation, forest loss, biodiversity and habitat degradation, scarcity and pollution load of fresh water in addition to population pressure are increasing and is the major cause of the degradation of water quality, leading to many waterborne-diseases. Ponds constitute "hot spots" within a region or a landscape. Owing to their important contribution to aquatic biodiversity, ponds are considered as an important target system in strategic plans that aim at conserving or developing aquatic biodiversity at the landscape scale. Anthropogenic activity on pond like discharged waste water from residential areas, sewage outlets, solid wastes, detergents, automobile oil wastes, fishing facilities and agricultural pesticides ultimately, deteriorate the water quality by accumulation of toxic chemicals and sediment in turn leading to shrinkage of catchment area and thereby its aesthetic value (Chaurasia and Pandey 2007), hence this limnological study is important. The monitoring of physico-chemical characteristics of a water body is vital for both long and short-term analysis because the quality, distribution and productivity level of organisms in a water body are largely governed by its physico-chemical and biological factors (Heimbach et al, 1992). Phytoplankton and zooplankton are good indicators for changes in nutrient pollution over time because they respond quickly to changes in nutrient input to the lagoon. The biological analysis of water bodies, especially the phytoplankton analysis will describe clearly about the pollutant materials impact on the aquatic life and a decrease in biological diversity. Furthermore, the phytoplankton will reflect the condition of the waters, not only at the time of sampling, but also the condition at a previous time point. Moreover, planktons are sensitive to many environmental conditions such as salinity, rainfall, temperature, dissolved oxygen levels, turbidity, and other factors. Phytoplankton has also been reported to cause fish poisoning in so many parts of the world because of the ability of some species to form toxins during blooms (Boyd, 2004). Thus, these reasons make it very essential to estimate the levels of planktons in each pond samples which will in turn indicate its water quality.

Figure 1: Location map showing pond sampling sites in Nedumangad Panchayath




## MATERIALS AND METHODS

The samples were labeled and transported to the laboratory, stored at 40C in the refrigerator for analysis of selected parameters. Samples were collected in plastic containers (Can) previously rinsed with distilled water. The present study was carried out in 36 ponds of 4 panchayaths within Nedumangad Block in Thiruvananthapuram dist., Kerala, India. Ex-situ measurements were conducted for each physical parameter.

**Table 1: Standard Procedures for Physico-Chemical Parameters to Determine Pond Water Quality (Apha, 1998)**

| Parameters | Method | Reference |
|---|---|---|
| **Temperature** | Centigrade thermometer | APHA,1980 |
| **pH** | pH meter | Trivedi and Goel,1984 |
| **Electrical Conductivity** | Conductivity meter | Trivedi and Goel,1984 |
| **Total Alkalinity** | Titrimetry | APHA |
| **Total Hardness** | Titrimetry | APHA |
| **Chloride** | Titrimetry | APHA |
| **Dissolved Oxygen** | Winkler's Method | Strickland and Parsons,1972 |
| **TDS** | Evaporation method | APHA,1995 |
| **Na & K** | Flame Photometry | Ramteke and Moghe, 1988 |
| **Salinity** | Salinity meter | Trivedi and Goel,1984 |

## RESULTS AND DISCUSSION

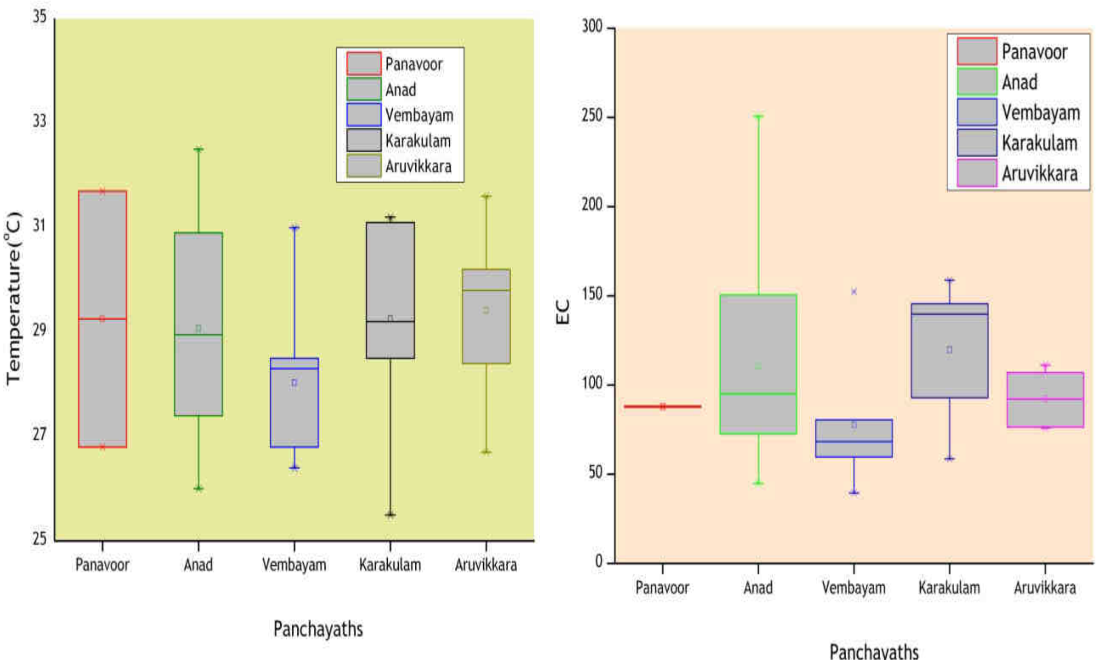
The results obtained in the present study are demonstrated in table 2 and variations in various parameters are depicted through graphs 1-4. On the basis of analysis for 36 ponds in the Nedumangad block, the temperature varied between 25.5 and 32.5˚C (Graph 1). Dhrubajyoti (2013) recorded almost the same range of temperature (21.52˚C- 32.96˚C). Amankwaah et al, 2014 also noted a nearly similar range of temperature in their study (23.9˚C to 31.2˚C). According to them this range can be attributed to high exposure of standing ponds water to the sun. High levels of temperature in ponds could be attributed to sediments loads in ponds (Poole and Berman, 2000). Among the ponds, maximum temperature of 32.5˚C was observed in the pond AND-1 of Anad gramapanchayath. The minimum value of temperature was found in KRKM-5. The average temperature of ponds in Panavoor is 29.25˚C. The average values of temperature for Anad, Vembayam, Karakulam and Aruvikkara are 28.8˚C, 28.03˚C, 29.26˚C and 29.42˚C respectively. The higher values of temperature are associated with decrease in solubility of gases. Increased water temperature results in reduction in dissolved oxygen that eventually affect the life of aquatic organisms (Moriber, 1974).

**Table 2: Results of Pond Water Quality Analysis Based On Standard Procedures**

| Sl No | Pond Code | Latitude | Longitude | Temp | p H | EC | TDS | DO | Salinity | TH | TA | Na | K | Chloride |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PAN - 1 | 8°40'17.1" | 76°58'49.8" | 31.7 | 6.33 | 87.6 | 47.75 | 7.35 | 46.73 | 40 | 25 | 13 | 3 | 10.65 |
| 2 | PAN - 2 | 8°39'17.2" | 77°0'37.3" | 26.8 | 6.25 | 88.2 | 45.01 | 2.61 | 42.36 | 45 | 25 | 17 | 2 | 14.2 |
| 3 | AND - 1 | 8°37'51.4" | 77°1'6.3" | 32.5 | 6.13 | 112.5 | 57.4 | 7.37 | 56.93 | 70 | 65 | 47 | 4 | 35.5 |
| 4 | AND - 2 | 8°37'46.3" | 77°0'59.5" | 29.2 | 7.91 | 159.7 | 81.76 | 7.25 | 79.3 | 0 | 40 | 22 | 3 | 24 |
| 5 | AND - 3 | 8°37'40.3" | 77°1'5.1" | 31.9 | 7.42 | 151 | 76.5 | 11.96 | 75.5 | 20 | 25 | 25 | 2 | 17.75 |
| 6 | AND - 4 | 8°39'32.4" | 76°59'39" | 26.7 | 6.7 | 78.41 | 40.1 | 4.72 | 38.26 | 45 | 40 | 18 | 3 | 21.3 |
| 7 | AND - 5 | 8°39'21.1" | 77°0'15.44" | 27.1 | 5.76 | 90.5 | 46.03 | 5.73 | 45.15 | 35 | 25 | 7 | 1 | 10.65 |
| 8 | AND - 6 | 8°38'17.8" | 77°0'24" | 30.1 | 5.87 | 150.54 | 76.6 | 7.21 | 72.11 | 30 | 35 | 13 | 2 | 7.1 |
| 9 | AND - 7 | 8°38'24.3" | 77°0'31.5" | 26 | 4.67 | 72.53 | 36.06 | 2.97 | 34.2 | 45 | 40 | 24 | 3 | 21.3 |
| 10 | AND - 8 | 8°38'16.1" | 77°0'32.5" | 31.3 | 6.72 | 250.67 | 127.26 | 6.25 | 124.31 | 20 | 30 | 11 | 2 | 10.65 |
| 11 | AND - 9 | 8°37'39.95" | 77°1'19.26" | 29.5 | 5.81 | 69.73 | 35.36 | 8.56 | 31.59 | 40 | 35 | 15 | 2 | 10.65 |
| 12 | AND - 10 | 8°38'39.1" | 77°0'32.3" | 27.4 | 6.63 | 89.57 | 45.56 | 6.4 | 43.68 | 45 | 55 | 19 | 5 | 14.2 |
| 13 | AND - 11 | 8°38'38.9" | 77°0'31.3" | 28.1 | 5.77 | 58.44 | 29.67 | 7.58 | 27.01 | 25 | 30 | 17 | 2 | 14.2 |
| 14 | AND - 12 | 8°37'25" | 76°58'51" | 28.7 | 5.55 | 120.6 | 61.78 | 7.57 | 58.71 | 25 | 35 | 20 | 4 | 14.2 |
| 15 | AND - 13 | 8°38'5.4" | 76°59'14.9" | 27.6 | 5.33 | 99.78 | 50.61 | 7.75 | 49.01 | 35 | 25 | 11 | 2 | 10.65 |
| 16 | AND - 14 | 8°37'31.7" | 76°59'7.61" | 30.9 | 5.31 | 44.81 | 23.56 | 8.06 | 21.68 | 25 | 30 | 9 | 2 | 14.2 |
| 17 | VEM - 1 | 8°37'53.3" | 76°57'15.4" | 26.9 | 6.56 | 152.3 | 78.11 | 5.58 | 76.59 | 35 | 60 | 23 | 4 | 7.1 |
| 18 | VEM - 2 | 8°38'11.9" | 76°56'44.5" | 31 | 5.47 | 59.67 | 30.18 | 7.4 | 29.12 | 25 | 50 | 21 | 3 | 21.3 |
| 19 | VEM - 3 | 8°38'22.5" | 76°56'29.1" | 28.3 | 6.32 | 80.5 | 41.46 | 7.66 | 40.03 | 15 | 25 | 16 | 3 | 14.2 |
| 20 | VEM - 4 | 8°37'8.8" | 76°54'56" | 28.5 | 6.2 | 78.36 | 40.4 | 7.7 | 39.1 | 100 | 105 | 21 | 6 | 10.65 |
| 21 | VEM - 5 | 8°37'26.4" | 76°56'26" | 28.3 | 6.37 | 68.23 | 35.87 | 7.77 | 33.63 | 15 | 20 | 14 | 1 | 24.85 |
| 22 | VEM - 6 | 8°35'46.2" | 76°56'14" | 26.4 | 5.59 | 65.86 | 37.79 | 5.31 | 35.21 | 50 | 60 | 24 | 7 | 21.3 |
| 23 | VEM - 7 | 8°35'43.4" | 76°56'44.3" | 26.8 | 6.04 | 39.51 | 20.11 | 6.79 | 17.34 | 35 | 55 | 29 | 3 | 24.85 |
| 24 | KRKM - 1 | 8°34'54.1" | 76°57'16.7" | 31.1 | 8.58 | 139.8 | 70.98 | 121.58 | 65.25 | 75 | 65 | 11 | 3 | 10.65 |
| 25 | KRKM - 2 | 8°34'25.5" | 76°57'45.6" | 28.5 | 7.24 | 145.4 | 73.44 | 7.69 | 70.61 | 30 | 20 | 13 | 3 | 10.65 |
| 26 | KRKM - 3 | 8°34'9.5" | 76°5'21" | 29 | 7.04 | 97.41 | 50.2 | 6.69 | 49.81 | 30 | 70 | 18 | 3 | 14.2 |
| 27 | KRKM - 4 | 8°34'6.9" | 76°57'11.5" | 31.2 | 6.23 | 145.5 | 75.32 | 10.7 | 72.01 | 40 | 35 | 18 | 3 | 21.3 |
| 28 | KRKM - 5 | 8°34'54.3" | 76°59'11.5" | 25.5 | 6.55 | 58.59 | 30.94 | 5.5 | 29.01 | 25 | 15 | 10 | 3 | 7.1 |
| 29 | KRKM - 6 | 8°35'39.5" | 76°57'45.4" | 29.2 | 7.16 | 158.8 | 79.28 | 10.93 | 75.42 | 30 | 10 | 9 | 1 | 10.65 |
| 30 | KRKM - 7 | 8°35'16.8" | 76°57'47.9" | 30.3 | 7.28 | 92.88 | 47.28 | 7.87 | 44.47 | 25 | 10 | 19 | 2 | 10.65 |
| 31 | AVKA - 1 | 8°33'14.5" | 77°1'4.1" | 28.4 | 6.33 | 107 | 54.57 | 7.47 | 25.01 | 30 | 20 | 16 | 3 | 14.2 |
| 32 | AVKA - 2 | 8°33'4.94" | 77°1'9.29" | 29.5 | 6.55 | 76.41 | 39.51 | 7.58 | 34.3 | 30 | 20 | 14 | 2 | 14.2 |
| 33 | AVKA - 3 | 8°33'27.4" | 77°1'12.3" | 30.2 | 5.59 | 79.25 | 40.45 | 7.7 | 37.18 | 35 | 20 | 19 | 3 | 14.2 |
| 34 | AVKA - 4 | 8°35'31.8" | 77°1'18.7" | 30.1 | 6.63 | 75.94 | 38.27 | 8.67 | 35.29 | 35 | 20 | 25 | 2 | 17.75 |
| 35 | AVKA - 5 | 8°35'25.6" | 77°1'24.9" | 31.6 | 5.65 | 104.9 | 53.38 | 7.45 | 50.61 | 50 | 25 | 17 | 2 | 10.65 |
| 36 | AVKA - 6 | 8°35'26.4" | 77°1'27.6" | 26.7 | 5.89 | 111.2 | 56.11 | 6.6 | 543.26 | 35 | 15 | 9 | 2 | 10.65 |

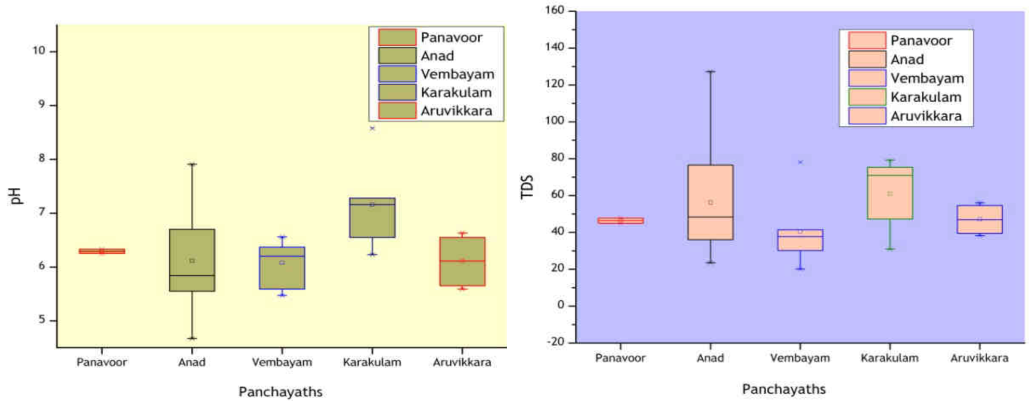
*(PAN-Panavoor; AND-Anad; VEM-Vembayam; KRKM-Karakulam; AVKA-Aruvikkara.EC-Electrical Conductivity; TA-Total Alkalinity; TH-Total Hardness.)

Graph 1: Variations of Temperature And EC




Among the ponds studied the values of electrical conductivity ranges between 39.51 and 250.67µS. Almost similar range of EC was obtained in the study of Shashi et al, 2008 (67.49-201.94 µmhos/cm). EC is found to be good indicators of the overall water quality (Abbasi et al., 1999). The highest value of EC was shown by the pond AND-8. The TDS value was also very high in this pond. This indicates EC is directly proportional to TDS. Thus, the high values of EC in water are due to high concentration of ionic constituent present and this indicates the pollution by domestic wastes as supported by Remia, 2013. The lowest value was obtained for VEM-7. The TDS value of this pond was also low compared to other ponds and shows less pollution due to domestic waste. The Conductivity of water is also affected by the presence of sodium, magnesium and calcium cations (Sachin et al, 2014). Among the 36 ponds studied, 14 ponds have EC values above 100µS (Graph 1) and this shows higher degree of domestic pollution. Anthropogenically, TDS is increased mostly by sewage waste, soap and detergent. It represents all the charged ions, cat ions and anions, as well as the uncharged and molecular species. High values of TDS are caused by the addition of huge quantities of sewage. The 2 ponds in Panavoor showed lower TDS values indicating lesser pollution.

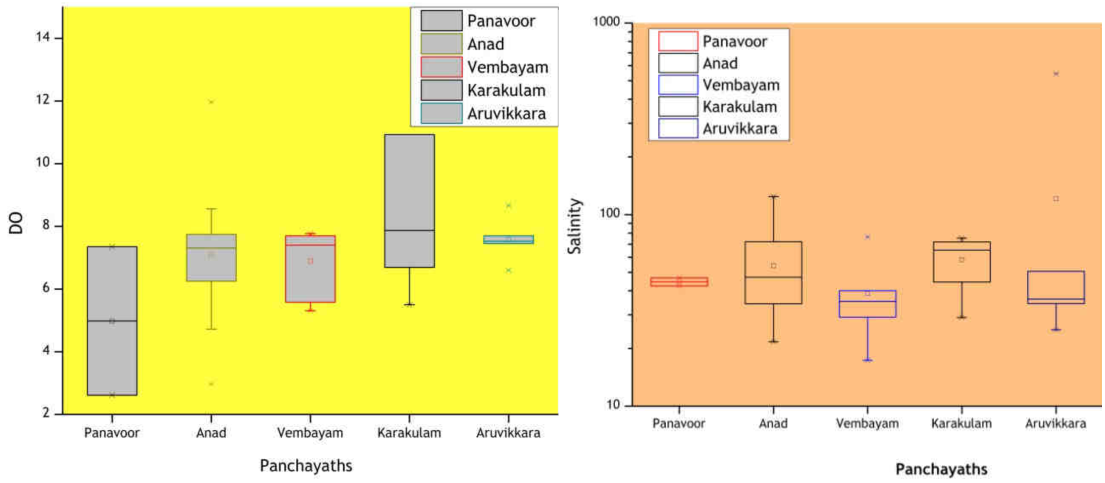
Graph 2: Variations in pH and TDS




In the present study, the value of pH ranges between 4.67 and 8.58 shown in Graph 2 and Table 2. The values observed were not within the acceptable range (6.5-8.5) of WHO (1995) for natural waters. In ponds like in that of Anad panchayath acidic nature of water was observed whereas in most of the other ponds water quality was either restricted to nearly neutral condition or alkaline nature. Here, ponds which showed to have a pH range 7.0 to 7.9 indicate minimal productivity of water in the receiving ponds hence ponds effluent effect is minimal. Maximum value for pH was observed at the pond KRKM-1, and minimum value was found at AND-7. 7 ponds in the Anad grama panchayath and 3 ponds in Aruvikkara showed acidic pH. Similar values are also revealed in the study of Evi, 2014. High pH levels can be attributed to over feeding, photosynthesis and respiration of algae as it can affect the natural acid-base balance of aquatic systems (WQA, 1996). Only one pond in the present study area showed pH 8.58, higher than the maximum permissible limit (KRKM-1). A similar result was obtained in the study of Devi et al (2010) and that was attributed to greater abundance of phytoplankton, accompanied by greater water depth and presence of macrophytes which remove free CO2 by photosynthesis through bicarbonate degradation. The pH affects most of the biological processes and biochemical reactions in water body (Arya et al, 2011, Sachin *et al*, 2014).

In the present study, the highest value for DO found was 121.58mg/L in the pond KRKM-1 (Graph 3). The pH, EC, TDS, temperature and alkalinity of this pond was also very high. The higher value of DO in this pond may be due to the increase values of phytoplankton or decrease of photosynthetic activity, as supported by the study of Remia, 2013. The lowest value of DO found was 2.61mg/L in the pond PAN-2 (Table 2).

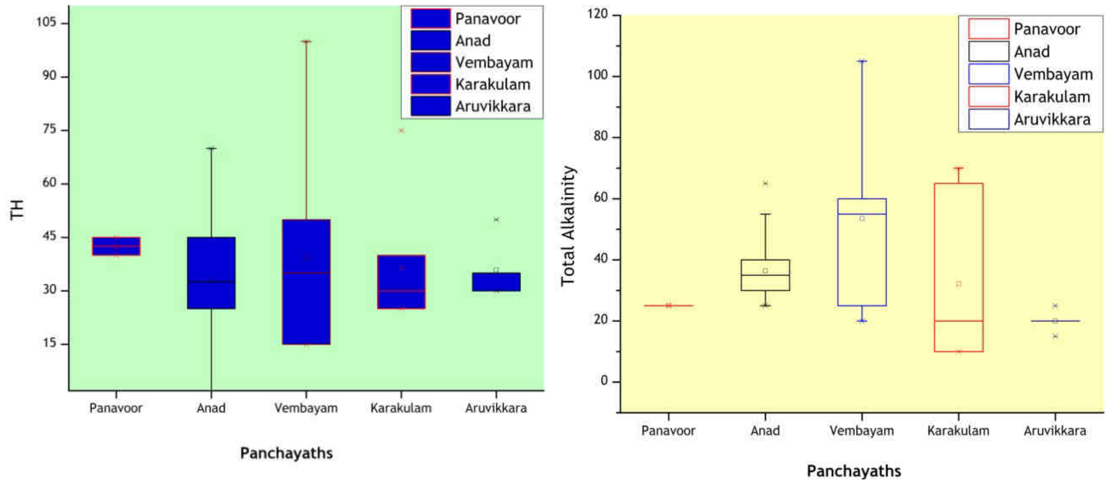
Graph 3 : Variations In DO And Salinity




The lowest DO value of this pond might be due to low solubility of oxygen at high temperature as supported by Rajagopal et al (2010) and due to the high rate of oxygen consumption by several microbes present in the water bodies accelerated their metabolic activities with concentrated amount of organic matter in the form of municipal and domestic wastes discharge into water bodies and hence required more amount of oxygen and so the demand of oxygen increased (Anita et al, 2005). Salinity influences the kinds of plants that will grow in a water body. In the present study, the salinity ranges in between 17.34 mg/L and 543.26 mg/L. Highest value of salinity was shown by the pond AVKA-6 and lowest value was found at VEM-7 (Graph 3).

Here, the value of chloride ranges from 7.1mg/L and 35.5 mg/L. Highest value were found in the pond AND-1 and lowest value was found in AND-6, VEM-1 and KRKM-5 (Table 2). Hardness plays an important role in the distribution of the aquatic biota and many species are identified as indicators for hard and soft waters. 3 ponds are medium (60-120mg/L) and all the remaining ponds have soft water (0-60mg/L). All the values of total hardness found in this study within the permissible limit for drinking standard (600 mg/L; BIS: 10500-1991) as reported in the study of Sachin, 2014. The higher alkalinity values may be due to the discharge of municipal sewage, domestic sewage and urban wash off into the fresh water bodies. The present study of ponds shows that the value of alkalinity ranges between 10 mg/L and 105mg/L (Graph 4). The maximum value was found in the pond VEM-4 and lowest value was found in the ponds KRKM-6 and KRKM-7.

Graph 4: Variations in TH and TA




In the current study, the value of Na ranges from 7 mg/L to 47 mg/L (Table2). The highest value of sodium was obtained in the pond AND-1 and lowest value was obtained for the pond AND-5. Sachin et al (2014) obtained higher value of sodium in Laxmikund (93.5 mg/L) and they concluded that it may be due to high rate of mineralization in the sediments. In the case of K, the highest value obtained was 7 mg/L (VEM-6). The values of potassium varies in the same manner in every ponds studied. The values of sodium were higher than that of potassium.

## CONCLUSION

Results of physico-chemical parameters of various ponds at Nedumangad as studied in the present investigation clearly shows that the water is not good for human consumption and also struggling for their existence. So there is an immediate need of restoration, improvement and proper management of these secret water bodies for the human and environment. Basic pond management principles are designed to maintain good water quality and reduce incidence of disease. It is important to develop a plan of action to be taken when a water quality measurement approaches being outside the desirable range and stressful concentrations. This is why monitoring regularly and recording data is important—it will aid in anticipation of needed action.

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