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Research Article

# Study of Physicochemical Parameters in Selected Ponds of Athiyannoor Block Panchayat, Kerala

**Aswathy Ashok J.A, Reshma John, Anu Mathew, Rajesh Raghunath, Asha M.S. Nair**

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## Abstract

The present study was carried out in 37 ponds of 5 panchayaths within Athiyannoor Block in Thiruvananthapuram dist., Kerala, India. Water samples were collected from the ponds for the analysis of physico-chemical parameters. The physico-chemical factors have great importance in defining the trophic status of aquatic habitats. The gathering of different types of pollutants and nutrients through the municipal effluents, and agricultural activities in to the ponds makes alterations in the physico-chemical features of fresh water. Present work was conducted to examine water quality of Athiyannoor pond due of its prominence in ground water recharging, irrigation and drinking purposes. The temperature varied between 26.5 and 29.6˚C, EC between 49.19 and 517.70µS, 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 10.96mg/L and 0.62mg/L. Outcomes of physico-chemical factors of numerous ponds studied in the present investigation clearly showed that the water is not good for human consumption. So there is an immediate need of restoration, improvement and proper management of these underground water bodies for the human and environment.

**Keywords** alkalinity, dissolved oxygen, electrical conductivity, hardness, temperature

## Introduction

Due to urbanization and population burden water resources are rapidly decreasing every day. Decline in the water quality is now a global difficulty (Mahananda *et al*, 2010). Recent reviews (Dhanalakshmi *et al*, 2013) show that forest loss, biodiversity, land degradation and increasing population is the main reason for the degradation of water quality and it is also responsible for many waterborne diseases.

Presently, the biodiversity of pond and lake ecosystems is endangered by human activities, among which the most imperative comprise of threat of eutrophication, acidification and pollution by poisonous substances. Implementation of new environmental strategies and administrations, and international agreements, are positive signs of changes that should improve the ability to manage old as well as new, yet undiscovered, threats. Lakes and ponds are important freshwater habitats throughout many regions of the world, although the amount of water in them constitutes only a minute fraction of the total freshwater resource on earth. Since ancient times, ponds have been used as a customary resource of water supply in India. They establish “hot spots” within a region or a landscape, defying conventional applications of species-area models (‘big is best’) in applied nature conservation (Tiwari and Mishra 2006). The superiority of water largely depends on its source of origin and varies with it accordingly. The class of water is evaluated on the basis of laboratory analysis of several factors. Thus, the terms “source” and “laboratory analysis” are reliant. In the regional context, ponds are considered as focal points for groundwater recharge, both abiotic factors and biotic processes control the dynamics of lakes and ponds as natural systems. Important abiotic dimensions of the abiotic frame in ponds include lake morphology, sediment characteristics, nutrient concentrations, light availability, oxygen concentration, pH and temperature.

A.J.A Aswathy, J.K. Reshma, A. Mathew ✉, R. Raghunath, A.M.S. Nair

Post Graduate Department of Environmental Sciences, All Saints’ College, Thiruvananthapuram- 695007, Kerala

✉anumathew85@yahoo.co.in

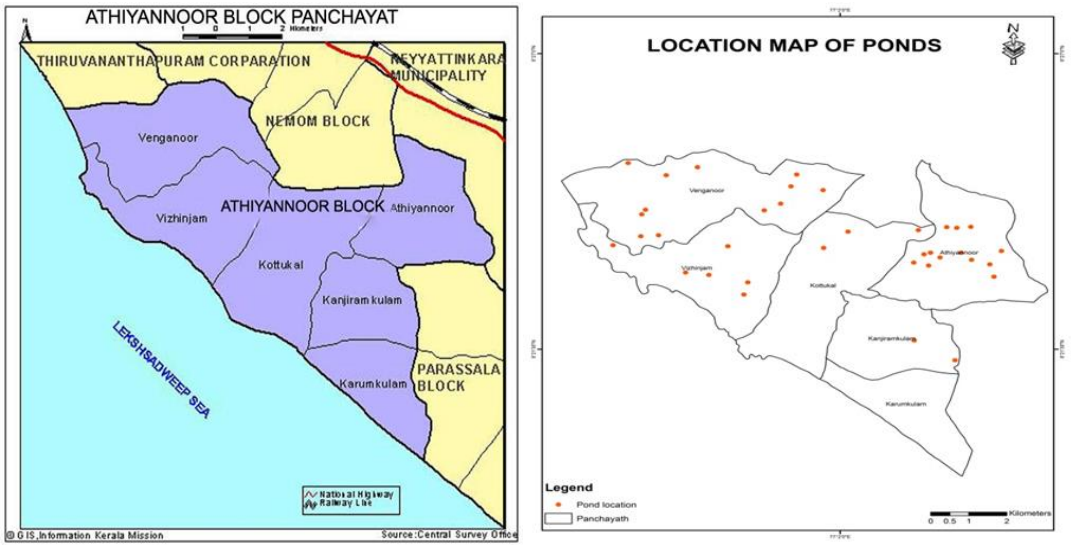


**Figure 1 Location map showing pond sampling sites**

In the present study 37 ponds of 5 panchayats (Vizhinjam,Venganoor, Athiyannoor Kanjiramkulam, Kadinamkulam) in the Athiyannoor block panchayath were analyzed in terms of their water quality. It is felt that the rejuvenation of the ponds will lead to the rejuvenation of the surface and subsurface water environment of the state and this attains importance in the background of the declining and diminishing groundwater potential of the state.

## Material and Methods

The present study was carried out in 37 ponds of 5 panchayaths within Athiyannoor Block in Thiruvananthapuram district, Kerala, India. During sampling, water samples were collected from the pond from a depth of 30 centimeters. The samples were labeled and transported to the laboratory, stored at 40C in the refrigerator for analysis of selected parameters. The standard methods of APHA (1995) were followed for the analysis of physico-chemical parameters and is shown in table 1.

## Results and Discussion

The pH of a pond is the extent of the acidity of water. Among the 37 ponds analyzed, the higher pH value showed in KTL-2(7.7) and the lower pH value showed in VZM-1(4.51) (Table 2). Ponds with a pH less than 6.0 may result in stunted or reduced zooplankton populations. Ponds with a pH less than 5.5 or above 8.5 should not be used for dairy cows. In mining areas, very low pH may be found in ponds that are influenced by acid mine drainage. Acidic nature of the pond samples (Vizhinjam) might be due to the presence of many quarries in that area and alkaline nature of pond may be due to the persisting geographical conditions of that area.

**Table 1: Standard procedures for physico-chemical parameters to determine pond water quality, APHA (1995)**

| 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 |

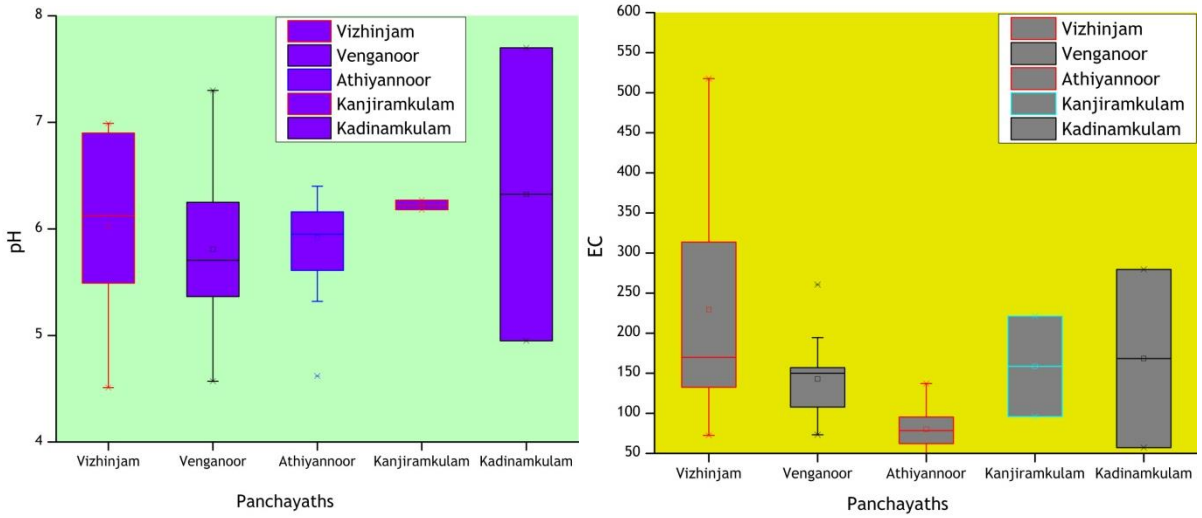


**Figure 2: Variations in pH and EC of Athiyannoor panchayath**

pH of the sample was either found to be highly acidic in nature as in VZM-1 (Vizhinjam gramapanchayath) or alkaline (7.70; KTL-2 Kottukal gramapapanchayath)as illustrated in Fig 2. In both cases it cannot be said to be suitable for the life.

The higher EC showed in VZM-3(517.70) and the lower EC showed in ATH-12(49.19) (Table 2). Conductivity of water is influenced by the existence of inorganic dissolved solids such as chloride, nitrate, sulphate, and phosphate anions or sodium, magnesium, calcium, iron, and aluminum cations (Sachin *et al* , 2014). Electrical conductivity of water is a direct function of its total dissolved salts Purandara *et al*, 2003 . Therefore, it is a criteria to signify the whole concentration of solvable salts in water. The electrical conductivity of the pond water samples varied between 130-3000 µS/cm during pre-monsoon (Purandara *et al*, 2003).

Some dissolved organic chemicals may deplete the dissolved oxygen in the receiving waters and some may be inert to biological oxidation (Mehta, 2013). The maximum TDS showed in VZM-3 (486.80) and the minimum TDS showed in ATH-12 (25.44) (Table 2). The permissible total dissolved salts for drinking water is 500 mg/L.Water containing high solids may cause laxative or constipation effects.

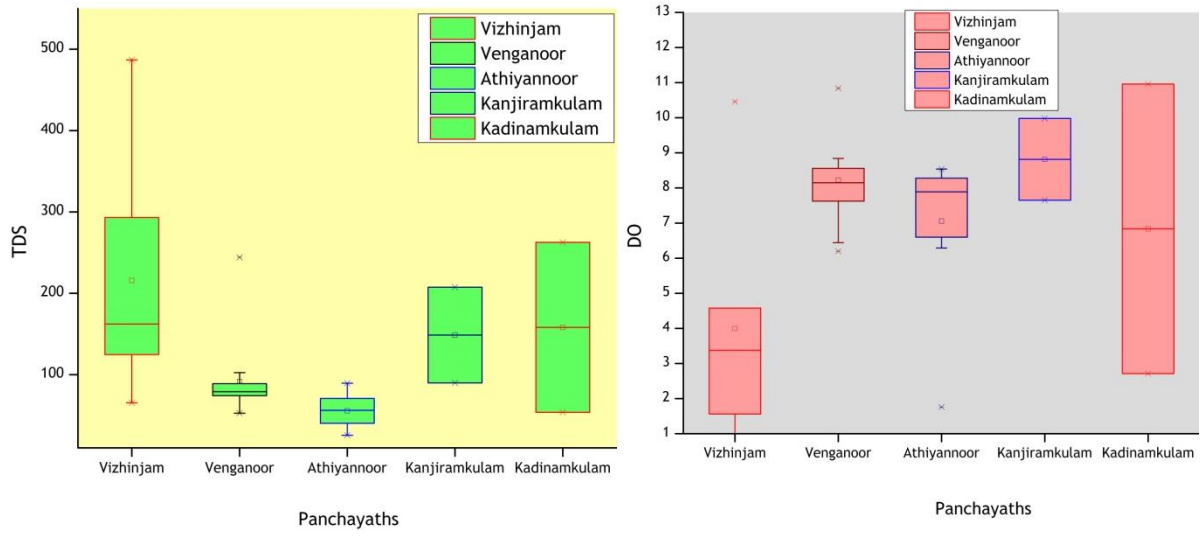


**Figure 3: Variations in TDS and DO of Athiyannoor panchayath**

**Table 2 : Results of pond water quality analysis based on standard procedures**

| SN | Pond Numbers | Latitude | Longitude | PH | EC | DO | Salinity | TEM | Na | K | Cl | TH | Alkalinity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | VZM-1 | 77.007 | 8.390 | 4.5 | 132.5 | 2.4 | 68.8 | 29.0 | 25 | 1 | 14.9 | 20 | 10 |
| **2** | VZM-2 | 77.012 | 8.379 | 5.5 | 72.5 | 1.6 | 40.4 | 28.0 | 8 | 0 | 7.1 | 20 | 20 |
| **3** | VZM-3 | 76.997 | 8.382 | 6.1 | 517.7 | 0.6 | 260.5 | 27.6 | 44 | 2 | 35.5 | 105 | 100 |
| **4** | VZM-4 | 77.011 | 8.375 | 6.2 | 158.4 | 4.6 | 81.5 | 28.4 | 25 | 2 | 14.2 | 55 | 30 |
| **5** | VZM-5 | 77.002 | 8.381 | 6.9 | 181.5 | 10.5 | 95.7 | 28.7 | 67 | 4 | 24.9 | 35 | 50 |
| **6** | VZM-6 | 76.980 | 8.391 | 7.0 | 313.6 | 4.4 | 156.5 | 28.0 | 43 | 2 | 42.6 | 100 | 80 |
| **7** | VGR-1 | 77.023 | 8.413 | 4.6 | 111.2 | 8.2 | 58.7 | 28.2 | 15 | 2 | 12.2 | 15 | 20 |
| **8** | VGR-2 | 76.986 | 8.400 | 5.2 | 150.8 | 10.4 | 76.6 | 28.4 | 15 | 1 | 21.3 | 45 | 25 |
| **9** | VGR-3 | 76.987 | 8.402 | 5.3 | 110.5 | 6.4 | 58.1 | 27.5 | 21 | 0 | 14.2 | 30 | 35 |
| **10** | VGR-4 | 77.019 | 8.404 | 5.4 | 149.3 | 7.3 | 76.8 | 27.7 | 13 | 5 | 14.2 | 45 | 50 |
| **11** | VGR-5 | 77.000 | 8.415 | 5.5 | 105.1 | 8.1 | 55.3 | 27.4 | 12 | 2 | 21.3 | 20 | 35 |
| **12** | VGR-6 | 77.029 | 8.408 | 5.6 | 155.3 | 8.8 | 79.8 | 28.7 | 23 | 2 | 24.9 | 55 | 35 |
| **13** | VGR-7 | 76.983 | 8.416 | 5.8 | 194.5 | 8.2 | 97.1 | 28.3 | 21 | 3 | 24.9 | 50 | 10 |
| **14** | VGR-8 | 76.990 | 8.394 | 6.0 | 158.5 | 8.3 | 80.9 | 27.2 | 16 | 2 | 24.9 | 35 | 75 |
| **15** | VGR-9 | 76.992 | 8.412 | 6.1 | 153.6 | 8.0 | 78.5 | 27.3 | 12 | 3 | 21.3 | 50 | 40 |
| **16** | VGR-10 | 77.022 | 8.409 | 6.4 | 73.3 | 8.0 | 73.3 | 29.4 | 19 | 2 | 17.8 | 30 | 40 |
| **17** | VGR-11 | 77.015 | 8.401 | 6.6 | 91.2 | 6.2 | 50.4 | 28.9 | 11 | 3 | 10.7 | 25 | 30 |
| **18** | VGR-12 | 76.986 | 8.393 | 7.3 | 260.6 | 10.8 | 132.1 | 28.0 | 14 | 3 | 17.8 | 60 | 25 |
| **19** | KTL-1 | 77.035 | 8.395 | 5.0 | 57.3 | 2.7 | 34.5 | 27.6 | 9 | 0 | 6.8 | 15 | 15 |
| **20** | KTL-2 | 77.052 | 8.395 | 7.7 | 279.5 | 11.0 | 139.8 | 28.2 | 45 | 2 | 28.2 | 50 | 55 |
| **21** | KJM-1 | 77.061 | 8.355 | 6.2 | 95.8 | 10.0 | 52.0 | 27.6 | 2 | 0 | 10.7 | 55 | 50 |
| **22** | KJM-2 | 77.051 | 8.361 | 6.3 | 221.4 | 7.7 | 110.8 | 26.5 | 13 | 10 | 7.1 | 80 | 85 |
| **23** | ATH-1 | 77.051 | 8.385 | 4.6 | 62.1 | 1.8 | 32.6 | 27.6 | 10 | 1 | 7.5 | 15 | 20 |
| **24** | ATH-2 | 77.072 | 8.389 | 5.3 | 95.6 | 8.1 | 56.3 | 28.5 | 10 | 2 | 24.9 | 30 | 30 |
| **25** | ATH-3 | 77.053 | 8.388 | 5.5 | 63.4 | 7.8 | 36.8 | 27.1 | 12 | 1 | 14.2 | 50 | 45 |
| **26** | ATH-4 | 77.061 | 8.396 | 5.6 | 110.2 | 7.9 | 58.8 | 29.6 | 19 | 1 | 7.1 | 25 | 10 |
| **27** | ATH-5 | 77.062 | 8.388 | 5.7 | 75.4 | 6.7 | 42.6 | 27.6 | 13 | 2 | 10.7 | 35 | 20 |
| **28** | ATH-6 | 77.057 | 8.387 | 5.9 | 42.9 | 6.6 | 28.0 | 27.3 | 3 | 1 | 10.7 | 15 | 20 |
| **29** | ATH-7 | 77.002 | 8.381 | 5.9 | 57.1 | 7.6 | 34.2 | 27.8 | 11 | 1 | 28.2 | 15 | 35 |
| **30** | ATH-8 | 77.064 | 8.396 | 6.0 | 68.1 | 8.4 | 38.9 | 26.8 | 5 | 1 | 14.2 | 20 | 35 |
| **31** | ATH-9 | 77.059 | 8.396 | 6.0 | 89.1 | 8.3 | 48.6 | 28.1 | 16 | 1 | 7.1 | 25 | 35 |
| **32** | ATH-10 | 77.054 | 8.384 | 6.1 | 86.5 | 3.3 | 46.9 | 27.0 | 11 | 3 | 7.1 | 30 | 25 |
| **33** | ATH-11 | 77.055 | 8.388 | 6.1 | 91.5 | 8.2 | 49.8 | 27.8 | 14 | 3 | 10.7 | 25 | 25 |
| **34** | ATH-12 | 77.055 | 8.388 | 6.2 | 49.2 | 8.5 | 31.3 | 26.8 | 10 | 0 | 10.7 | 25 | 25 |
| **35** | ATH-13 | 77.065 | 8.386 | 6.4 | 95.4 | 6.3 | 51.2 | 28.1 | 7 | 3 | 7.1 | 40 | 35 |
| **36** | ATH-14 | 77.069 | 8.385 | 6.4 | 137.1 | 8.4 | 71.0 | 28.1 | 13 | 4 | 17.8 | 35 | 60 |
| **37** | ATH-15 | 77.070 | 8.381 | 7.2 | 78.3 | 8.0 | 44.1 | 28.5 | 7 | 2 | 7.1 | 30 | 30 |

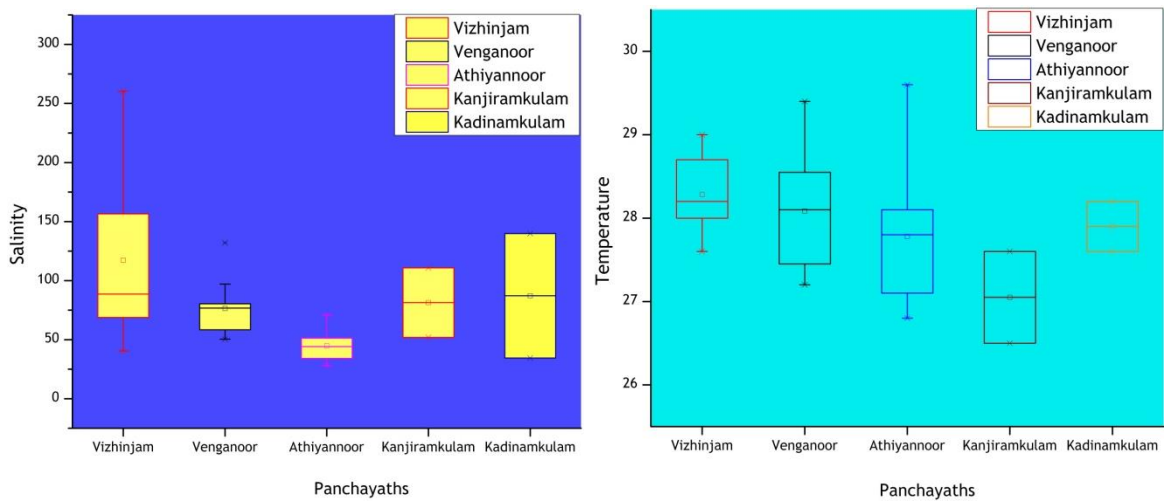


**Figure 4: Variations in Salinity and temperature of Athiyannoor panchayath**

Survey report of Vizhinjam (2010) shows TDS in the ground water ranging from 36mg/l to 238 mg/l. The sample collected from Vizhinjam recorded high TDS values of 238 mg/l. So, the TDS are within the limits prescribed for the drinking water standards. The higher DO showed in KTL-2(10.96) and the lower DO showed in VZM-3(0.62) as depicted in Fig 3.The higher value of DO in this pond may be due to the increase in number of phytoplankton or decrease of photosynthetic activity. The highest oxygen levels are observed in the ponds during late afternoon due to the buildup of oxygen during the day due to photosynthesis (the natural production of oxygen by green plants).

Salinity is an ecological factor of considerable importance, influencing the types of organisms that live in a water body. The maximum salinity showed in VZM-3(260.50) and the minimum salinity showed in ATH-6(27.99) (Fig 4). Primary salinity is produced by natural processes such as weathering of rocks and wind and rain depositing salt over thousands of years and Secondary salinity has occurred with widespread land clearing and altered land use. Salts also help fine materials (such as suspended clay particles) to flocculate, allowing more sunlight to penetrate ponds. This may lead to more harmful algal blooms if there are suitable environmental conditions. Out of 37 ponds analyzed, the temperature was observed as almost the same. The higher temperature was showed in pond ATH-4 ($29.6^0$C).The lower temperature was showed in pond KJM-2($26.5^0$C). Water temperatures above 32° for prolonged periods can stress aquatic biota and reduce growth. Inverse relationship with DO saturation was observed.

Sodium content is high in VZM-5(67) and low in KJM-1(2). So, the range of sodium in the present study is between 12-67, which is above the permissible limits. This might be due to discharge of domestic sewage, or leaching of fertilizers used in nearby agricultural field. In the 5 ponds analyzed potassium was found to be absent. Thus, the potassium levels in this study lies in the range of 0-10. On Comparison the values of sodium and potassium, levels of sodium was higher than potassium in the pond samples. The sodium content of water is extremely imperative to choose its superiority for irrigation as salts finally influence the soil quality and plant growth.

Total hardness is maximum in VZM-3(105 mg/L ) and minimum in VGR-1, KTL-1, ATH-1, ATH-6, and ATH-7(15 mg/L) as shown in figure 5. Total hardness value is same in these ponds. TH values are found to be with the accepted irrigation and drinking standards. Alkalinity is high in VZM-3(100) and low in VZM-1, VGR-7, and ATH-4(10). In Vizhinjam gramapanchayath alkalinity is maximum in VZM-3(100 mg/L) and minimum in VZM-1(10 mg/L). The entire ponds sample showed lower alkalinity values than the permissible limit (140 mg/L) of irrigation standard, FAO and lower values than the permissible limit (600 mg/L) of drinking standard, BIS which implies water samples collected can be utilized both for irrigation purposes. Alkalinity is significant in many uses and treatments of natural waters and wastewaters. Because the alkalinity of many surface waters is

primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents.

## Conclusion

Outcomes of physico-chemical factors of numerous ponds at Nedumangad as studied in the present study clearly indicate that the water is not good for human consumption. 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.

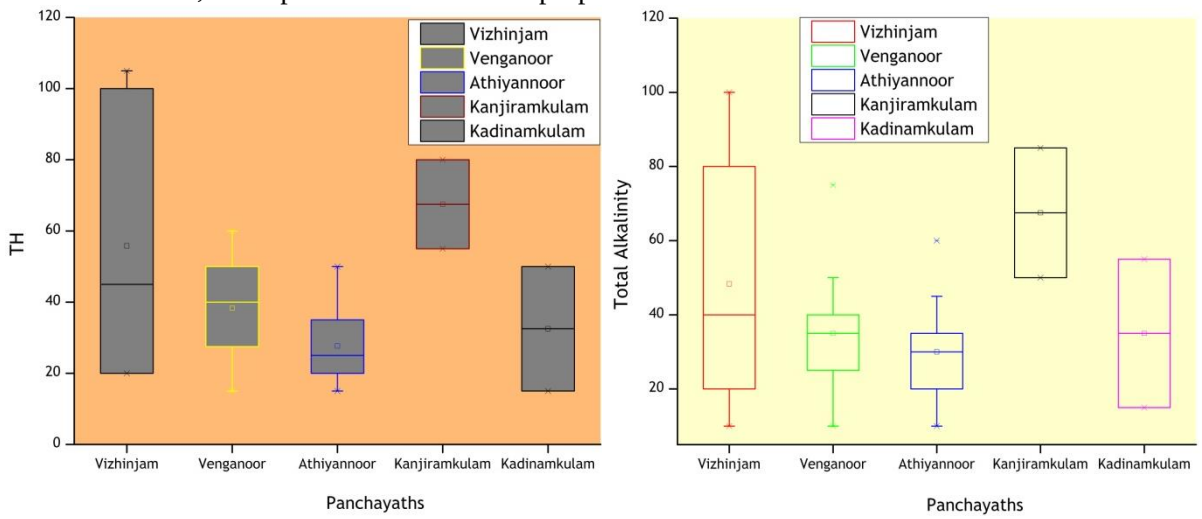


**Figure 5: Variations in TH and Total alkalinity of Athiyannoor panchayath**

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