



Studies on Variations of Physico Chemical Parameters of Pond Water Samples Collected from Different Ponds at Tirunelveli Corporation, Tamil Nadu, India

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ARTICLE INFO

Article history:

Received: 12 May 2020;

Received in revised form:
30 May 2020;

Accepted: 8 June 2020;

Keywords

Tirunelveli,
Pond water,
Physico Chemical Characters.

ABSTRACT

The aim of the current study was to determine the common physico-chemical parameters (pH, Electrical Conductivity, Dissolved Oxygen content, Biological Oxygen Demand, Total dissolved solids, Hardness, Alkalinity, Acidity) of two different pond water systems-Nainaarkulam and Udaayarpatti kulam at Tirunelveli corporation were analyzed fortnightly from April to June 2019 and found that the water body that receives vegetable garbage, scrap, refuge and organic wastes from the main market of the town was more polluted than the other sites. Both water bodies varied according to the surrounding environments during the period of study. These results were used to inform the common people and decision-makers of the state environmental agencies.

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Introduction

Water is the universal solvent required for all the living beings. Without the knowledge of water quality, it is difficult of understand the biological phenomenon fully, because the chemistry of water reveals much about the metabolism of the ecosystem and explains the general hydro biological inter – relationship. The physico-chemical parameters of water and the dependence of all life process of these factors make it desirable to take water as an environment (Gowinda, et.al.2009.). Most human activities and needs are closely related to water. Very existence of the society will be endangered if the gravity of the burning problem of water pollution is not realized. Water bodies are fed up by sewage because of rapid population growth and increasing industrialization. Polluted and un-potable water due to poor environmental sanitation has been the major cause of several diseases. The environment is degraded every day and the chemistry of it changes accordingly (Hema and Muthalagi 2009). This present work reports the physico chemical characters of the water bodies of two pond water systems Nainaarkulam and Udaayarpatti kulam at Tirunelveli Corporation, Tamil Nadu.

Materials and Methods

The two ponds Nainaarkulam and Udaayarpatti kulam were selected for the study area at Tirunelveli corporation limit. The major pond in the city is Nainaarkulam pond and Udaayarpatti pond. The area around the Tamirabarani River and the Chittar has five streams: Kodagan, Palayan, Tirunelveli, Marudur East and Marudur West, and the Chittar feed fifteen other channels. The soil is friable, red and sandy. The arid, desert-like regional pattern is seen only in Tirunelveli District, and is known as *Palai* in Tamil literature. The climate of Tirunelveli is generally hot and humid.

The average temperature during summer (March to June) ranges from 25 °C (77 °F) to 41 °C (106 °F), and 18 °C (64 °F) to 29 °C (84 °F) during the rest of the year. The average annual rainfall is 680 millimeters.

Nainaarkulam – The water of Thamiraparani is diverted into a canal near the village Suthamalli. The water that flows through the canal are collected at Nainaarkulam. The area of Nainaarkulam is about 122 acre. It can hold water that can be used for 30 days for irrigation. Udaayarpatti kulam - The area of the pond is 84 acres. It can hold water that can be used for 20 days for irrigation the water from the fourth reservoir of Thamiraparani River is diverted into Kodakan canal. It flows towards Nainaarkulam canal and finally gets collected in the Udaayarpatti kulam Two sites were selected in each pond. The period of study was from April to June 2019. Six fortnightly variations were analyzed and totally twenty four samples were collected.

The physico chemical characters analyzed fortnightly in this study are temperature, pH, electrical conductivity, dissolved oxygen content (DO), biological oxygen demand (BOD), permanent hardness, temporary hardness, total hardness, total dissolved solids (TDS), suspended solids, total solids, alkalinity and acidity (APHA; Murugesan et al. 1994, 2010,2011) The temperatures were measured by mercury thermometer and pH of the water samples was determined with digital pH meter. Electrical conductances of the water samples were measured using a digital conductivity meter (Systronics type-304) with a conductivity cell of cell constant 1.0. Winkler method is the chemical technique involved in the measurement of dissolved oxygen content. The determination of BOD is based on the measurement of dissolved oxygen content before and after oxidation of organic matter of the sample by micro organisms in

incubation period of 5 days at 20°C. The hardness of the water samples were determined by titration with EDTA using Eriochrome black -T indicator. The sample was evaporated in a previously dried weighed evaporating dish. The dish residue was dried in the 100°C oven for 1 hour, cooled in the desiccator and weighed. This gives the value of total solids. The same procedure was followed after proper filtration to determine TDS. The alkalinity and acidity of the samples were determined by titration against 0.02 N sulphuric acid and 0.02 N Sodium hydroxide using suitable indicators, respectively.

Results and Discussion

The fortnightly variations of the physico chemical characters of the water samples taken at 4 different sites at Nainaarkulam and Udaayarpatti kulam are given in Table 1 and Fig. 1&2. It shows the variation of DO and BOD in site 4. The water temperature fell to low value after rains as expected for air temperature because of the cool breeze around the site during the time of collection.

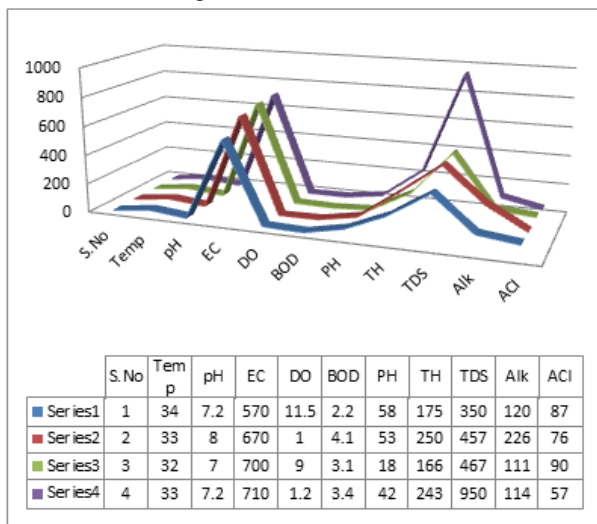


Figure 1. Fortnight variations of Physico chemical parameters of sites 1 to 4 on 1st April 2019.

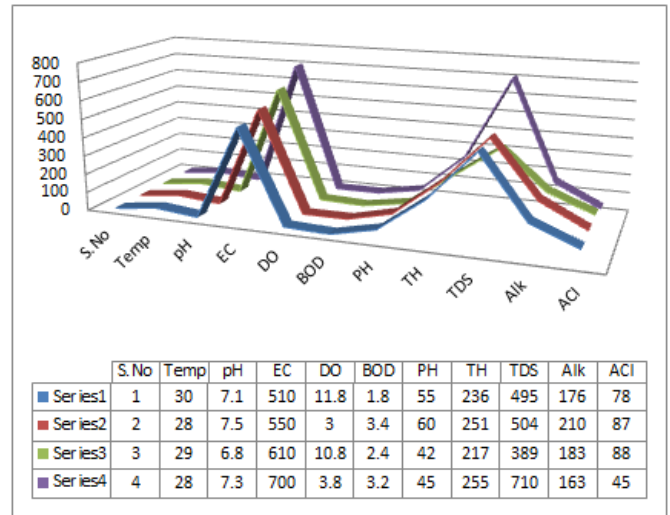


Figure 2. Fortnight variations of Physico chemical parameters of sites 1 to 4 on 15th June 2019

The observed pH in site 1 at Nainaarkulam varied between 6.6 and 7.2. The decrease in pH was due to inflow of rain water after rains. The increase in pH was due to increased rate of photosynthesis during hot summer (APHA 2009, Palaniappan et al 2010). The pH observed in site 2 at Nainaarkulam varied between 6.9 and 8.0. The higher pH value observed at this site was 8.0. This was due to human activities like bathing, washing of cattle, clothes etc; The pH observed in site 3 at Udaayarpatti kulam varied between 7.0 and 6.5 and the decrease in pH was due to inflow of rain water after rains. The increase in pH was due to increased rate of photosynthesis during hot summer (APHA 2009 and Murugesan et al 2011). The pH values observed are within permissible values.

The ability of a solution to conduct electricity is governed by the migration of solutions and is dependent on the nature and number of ionic species in the solution. Conductivity measurements serve as a useful indicator of the degree of mineralization in a sample (Quargraineet al 2010). Conductivity values of pond waters are of definite

Table 1. Fortnightly variations of the physico chemical characters of pond water samples taken in Nainaarkulam and Udaayarpatti kulam sampling Sites .

Site No.	Name of the Pond	Period	Temperature (°C)	pH	Electrical conductivity (µmhos)	Dissolved Oxygen (DO mg/l)	Biological Oxygen Demand (BOD mg/l)	Permanent Hardness (ppm)	Total Hardness (ppm)	Total dissolved solids (ppm)	Alkalinity (ppm)	Acidity (ppm)
1	Nainaarkulam	1st April 2019	34	7.2	570	11.5	2.2	58	175	350	120	87
2	Nainaarkulam		33	8.0	670	1.0	4.1	53	250	457	226	76
3	Udaayarpatti kulam		32	7.0	700	9.0	3.1	18	166	467	111	90
4	Udaayarpatti kulam		33	7.2	710	1.2	3.4	42	243	950	114	57
1	Nainaarkulam	15th April 2019	32	6.9	520	11.6	1.9	38	163	569	114	98
2	Nainaarkulam		32	7.2	570	2.5	3.5	49	247	416	155	77
3	Udaayarpatti kulam		31	6.8	600	10.4	2.8	30	198	488	114	99
4	Udaayarpatti kulam		31	7.1	600	3.0	3.5	22	245	670	144	59
1	Nainaarkulam	1st May 2019	29	6.6	400	12.2	1.1	52	214	580	145	98
2	Nainaarkulam		28	6.9	550	4.0	3.3	50	265	444	214	89
3	Udaayarpatti kulam		27	6.5	560	11.2	2.2	29	199	589	100	89
4	Udaayarpatti kulam		27	6.8	580	4.5	3.4	23	184	732	119	90
1	Nainaarkulam	15th May 2019	30	6.9	520	11.8	1.8	60	143	523	129	90
2	Nainaarkulam		29	7.3	530	3.0	3.3	53	242	398	198	97
3	Udaayarpatti kulam		28	6.6	570	11.0	2.5	31	189	4516	134	98
4	Udaayarpatti kulam		29	7.1	630	3.2	3.7	22	232	679	146	69
1	Nainaarkulam	1st June 2019	29	6.8	490	12.0	1.6	58	120	499	176	88
2	Nainaarkulam		28	7.2	570	3.2	2.0	49	214	504	153	78
3	Udaayarpatti kulam		25	6.5	580	11.2	2.5	37	196	498	165	99
4	Udaayarpatti kulam		27	6.9	630	4.0	3.3	30	217	726	198	83
1	Nainaarkulam	15th June 2019	30	7.1	510	11.8	1.8	55	236	495	176	78
2	Nainaarkulam		28	7.5	550	3.0	3.4	60	251	504	210	87
3	Udaayarpatti kulam		29	6.8	610	10.8	2.4	42	217	389	183	88
4	Udaayarpatti kulam		28	7.3	700	3.8	3.2	45	255	710	163	45

geochemical interest and depend more upon the geological character of the rocks and subsoil in the catchment area and lake basin rather than upon the uppermost soil layer. In this study the electrical conductivity measurements and their fortnightly variations ran more or less to pH measurements and their fortnight variation. In site 1 the conductance values were between 400 and 570 μmhos . In site 2 the conductance varied between 510 and 670 μmhos . In sites 3 and 4 conductance variations were between 550 - 700 μmhos and 580 - 710 μmhos respectively. The higher conductivity was attributed to inorganic substances dissolved in the ionized form. The higher electrical conductivity found in sites 2 and 4 was due to organic nature from soaps, detergents and organic wastes. The total dissolved solids are also high at these sites.

DO is a pertinent parameter for assigning the pollution of water resources. An adequate supply of dissolved oxygen is essential for survival of aquatic organisms. There is variety of factors affecting the dissolved oxygen in the surface waters of which atmosphere plays an important role. The low content of dissolved oxygen was due to the entry of surface water, enhanced microbial activity and low volume. The high content of dissolved oxygen was due to the high rainfall, low temperature and photosynthetic activity. The decomposition of organic matter and microbial activity was high in warm weather (APHA 2009) and hence depletion of oxygen during that period in all the four sites and the high DO content was found after rainfall in all four sites. In site 1, the dissolved oxygen content was found to be high and found varied fortnightly between 11.5 and 12.2 mg/l. The high DO content was due to enhanced photosynthetic activity of the water plants especially water hyacinth. It was away from anthropogenic activities and hence microbial activity was less. In site 2, the DO content varied between 1 and 4 mg/l. The lower DO content was due to higher microbial activity. There was excessive use of the water of this site by the people for washing of cattle, clothes, bathing etc. There were no aquatic plants seen at this site. Therefore, enhanced microbial activity and reduced photosynthetic activity attributed for lower DO content. In site 3, DO content varied between 9.0 and 11.2 mg/l. The high DO content was due to the same reasons as established for site 1. In site 4, the DO content fortnight variation oscillated between 1.2 and 4.5 mg/l. This site was opposite to the central market of Tirunelveli Town. The decayed vegetables and other garbage were thrown into the pond water of this site. The decomposition of this garbage led to vigorous depletion of dissolved oxygen in spite of the photosynthetic activity at this site (Lawrence B, (2010).

Biochemical oxygen demand represents the quantity of oxygen required by bacteria and other micro organisms during biochemical degradation of organic matter present in waste water under aerobic conditions. Among the four sites, sites 1 and 3 had the lowest BOD values attributed by the similar reasons quoted for lower DO content. The BOD values of site 2 and 4 are comparatively high due to enhanced microbial activity and higher decomposition of organic matter which needs oxygen supply. In warm weather, BOD values are high due to increase in microbial activity in this period at high temperature, whereas the lowest BOD in cold weather indicating lower biological activity at lower temperatures (Rout 2016).

The hardness of the water sample taken from site 2 was high as that was the place used for domestic purposes comparatively more than that in other sites. Total hardness values (175 to 280 ppm) of pond water are less than the

highest desirable limit (300 ppm) . The site that had next high hardness was site 4. The high value of hardness among the six fortnight periods may be attributed to evaporation of the surface water due to high temperature in all the four sites. The value decreased after heavy rains due to excessive dilution (Onozeyi 2013, Murugesan 2011).

High solid content of water was observed in the water samples collected in site 4. The fortnight variations of the solid content of the water samples show that the high value was observed after heavy rains because of the flush outs of the garbage, refuse, organic matter etc., from land into water bodies.

The total dissolved solids in water are due to the presence of sodium, potassium, calcium, magnesium, manganese, carbonates, bicarbonates, chlorides, phosphate, organic matter, and other particles. The values of the total dissolved solids for all the pond water samples vary between 350 and 950 mg/l. The maximum allowable limit of total dissolved solids in pond water sample for domestic purpose is 1500 mg/l (WHO 2006). WHO classified the drinking water on the basis of TDS values is one of the important parameter. In this study, the TDS value for all the pond water samples are well within the permissible limit of 1500 mg/l

The alkalinity and acidity values of the pond water samples in all the sites are in correlation with the pH values. The alkalinity is seemed to decrease after entry of rain water into the pond and the acidity is seemed to increase. The high alkalinity values were observed in site 2. Degree of pollution in the pond waters varies according to the climatic conditions. Total alkalinity values are found to be in the range 100-226 ppm, which indicates only few sampling sites are above the permissible limit (200 ppm) prescribed by WHO and BIS. The higher alkalinity of pond water is owing to the presence of bicarbonates and trace amount of carbonates and hydroxide salts (Hema 2009).

It has been found that the water after rains can be used only after proper treatment because of the pollutants that enter the pond waters from the land. The pond waters of Nainarkulam and Udaayarpatti kulam must be preserved from pollutants like garbage and sewage. It should be devoid of disease causing organisms which may produce infectious diseases. The water should be disinfected properly before the utility of the water by public.

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