

Seasonal Variations in Physico-Chemical Characteristics, Phytoplanktons and Zooplanktons Diversity of Devarkulam and Vennilingapuram Pond in Tenkasi District (Tamilnadu, India)

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Abstract — The present day problem with regards to environmental quality is targeted on water due to the fact of its significance in preserving the human health and health of the ecosystem. The study was carried on February 2022 to April 2022. Present investigation deals with the analysis of Physico-chemical parameters, Phytoplankton and Zooplankton density in the Vennilingapuram pond and Devarkulam pond at Tenkasi district. Collected plankton sample were evaluated for study of physicochemical parameters was high in month of April and lower in month of February. Registered phytoplankton were belonged to 15 species of 3 genera of different groups like as Chlorophyceae (5 species), Bacillariophyceae (5species), and Cyanophyceae (5 species). In the research duration of Chlorophyceae was dominated over the rest of the phytoplankton population. Registered zooplankton was belonged 10 to 15 species of different groups like as Rotifera (5species). Cladocera (5 species), and copepods (5species). In this study density of plankton was maximum in April, minimum in the month of February. By looking at the end result it can be concluded that the parameters which have been taken for find out about the water quality are below the pollution level for Devarkulam pond which fulfill the requirement for the use of numerous functions like domestic, agricultural, industrial etc.

Keywords—pond water, parameters, summer, winter, plankton diversity, phytoplankton, and zooplanktons.

I. INTRODUCTION

Freshwater is one of the primary needs for survival of all living organism. Most of freshwater system all over the world is getting polluted, as a result reducing the portability of water [1]. Pond is vital role for ecology and lot of importance in environments such as (I) food and nutrition for many organisms, (II) surface ground water, (III) rain water harvesting recharge, (IV) food control, (V) wild existence habit, etc. Water is a essential for the beginning of lifestyles on this earth. Out of the total water present on this earth 96.5 percent is the sea water and is not directly used for any purpose. 1.7 percent is in the form of glacier, and 1.7 percent is ground water only 0.1% of water is available for all of the process of living beings [2].

Unrestrained increase in human population and fast urbanization and industrialization in all over the world is placing stress up on fresh water ecosystem [3]. Village ponds were the only source of perennial water among the villagers, but due to urbanization, these water bodies are being used as a sink for the dumping of domestic wastes, discharge of sewage and being used for washing clothes and animals only. Biota in the ecosystem relies upon on physical and chemical parameters such as water level, nutrient levels, etc. Regular monitoring of physic-chemical parameter and biological parameters would useful resource in assessing the status of the water body. Favorable water quality maintains the essential production with suitable ranges of secondary and tertiary production, which helps in maintaining the balance. Parameters such as temperature, pH, light penetration, and total dissolved solid etc. Affect the water quality and these elements are influenced by using the anthropogenic as well as herbal dynamics such as geological, hydrological and so on [4].

Planktons are the base of the aquatic ecosystem. They are the microscopic organisms which wander at the mercy of winds, currents and tides. Due to brief lifestyles cycle, they respond rapidly to environmental modifications hence, they are used as pollution indicators. Distribution of plankton is indirectly associated to water quality parameters [5]. Planktons are divided into two categories- phytoplankton and zooplankton. Phytoplanktons are the chlorophyll bearing microorganisms consisting of algae with representatives from all major taxonomic phyla. They have the special ability to convert inorganic material to organic as a result all different aquatic organisms are depending for food on phytoplankton. Several phytoplankton species have served as bio-indicators and it is a well-suited device for grasp water pollution studies. Phytoplankton is very sensitive to their environment, and any alternate in their habitat might also lead to the alternate in the planktonic communities in terms of tolerance, abundance, diversity and dominance in the habitat. Therefore, population of plankton statement can be used as a reliable device to examine the pollution stats of water [6].

Move over, the physico chemical properties and nutrient popularity of the water performs a vital role in production of plankton, which is necessary in preserving healthful and productive aquatic organisms [7]. Zooplankton occupies the secondary stage in the food chain and plays an enormous role in the transformation of food power synthesized by means of the phytoplankton to the higher trophic level. The phytoplankton population of the pond noted pond consists of Chlorophyceae, Bacillariophyceae and Cyanophyceae and Euglenophyceae while zooplankton consists of or Rotifers, Cladocerans and, copepods. In the present study an attempt has been made to examine the range of phytoplankton and zooplankton and their distribution in the pond. Zooplanktons are essential aspects of aquatic food and make a contribution considerably to aquatic productivity in freshwater ecosystems; they are having the capability to swim or move freely. The goal of the current find out about was to report and disseminate the records on plankton biodiversity existing within some freshwater Zooplankton (Greek, zoon, animal, planktons, wandering) are myriads of numerous floating and drifting animals with confined strength of locomotion. Majority of them are microscopic, unicellular or multicellular varieties. Zooplanktons constitute essential food for many fishes; the larva of carps feed in the main on zooplankton. In view of above an attempt was made to determine the impact of various kinds of pollution on physico-chemical characteristics and plankton diversity of two ecologically different freshwater ponds.

II. MATERIALS AND METHODS

The Water sampling was done swelling months from February, March and April 2022. The water sample collected from two sample station in and around Tenkasi district.

1. STUDY AREA

- i. DEVARKULAM POND
- ii. VENNILINGAPURAM POND

2. PHYSICO-CHEMICAL PARAMETERS ANALYSIS

Observation and evaluation had been carried out each and every month however; the outcomes are expressed on seasonal basis as variant used to be of much less magnitude. Since the climate of the location is tropical monsoon, two surely described seasons had been recognized viz, winter and summer. The sampling used to be carried out during morning hour (6 to 7 am) and the water samples have been collected the usage of modified Hal's sampler.

Physico-chemical parameters like temperature, pH, electrical conductivity, dissolved oxygen, total dissolved solids, nitrate nitrogen, phosphate have been analyzed with the assist of thermometers and Elico Water Quality Analyser PE 138. Transparency was measured through Secchi disc. For evaluation of different chemical parameters, the samples had been collected in glass bottles and transported to laboratory and had been analyzed as per technique given through [8, 9].

3. PLANKTONS WATER SAMPLE COLLECTION AND ISOLATION

Water samples had been collected from the surface column with the depth ranging from 70 cm to 100 cm and had been transferred in separate plastic containers (1.50 liter capacities). During the time of sampling and collection. Water samples had been collected separately from above mentioned sample station at random the usage of plankton net of nylon blot mesh. The collected sample filtered one by one using filtering stand with unique mesh size of 30µ, 50µ, 100µ, 160µ for separating the planktons.

4. DIVERSITY INDICES

For determined numerical data of plankton different population indices like Shannon's diversity index, Margalef's richness index [10] Pielou's evenness index and had been used to calculate and quantify the plankton of selected water bodies.

Shannon's diversity index = P_i in P_i

P_i = The relative abundance of each group of organisms

Margalef's richness index = $(s-1)/1 n N$

N = The number of individuals

H'

Pielou's evenness index = $J = \frac{H'}{H'_{max}}$

H'_{max}

H' = The Shannon weaver diversity index

H'_{max} = The maximum value of H' .

5. IDENTIFICATION

Water sample for plankton study were preserved for 24 hrs and identified under a Compound microscope. Phytoplankton was identified on the generic level using published literatures [11]. Photomicrographs were taken for proper identification of each phytoplankton.

TABLE 1. PHYSICAL PARAMETER ANALYSIS IN DEVARKULAM POND

Physical parameters	February	March	April
Appearance	Colourless & Clear	Colourless & Clear	Colourless & Clear
Odour	None	None	None
Turbidity NTU	12	12	15
Total dissolved solids mg/L	157	169	218
Electrical conductivity (mico mho/cm)	317	354	416

TABLE 2. CHEMICAL PARAMETER ANALYSIS IN DEVARKULAM POND

Chemical parameters	February	March	April
PH	6.53	6.59	6.89
Alkalinity ph (as CaCo3)mg/L	0	0	0
Alkalinity Total (as CaCo3)mg/L	122	121	108
Total Hardness (as Ca) mg/L	118	119	129
Calcium(as Ca) mg/L	11	13	17
Magnesium (as Mg) mg/L	19	19	23
Sodium (as Na) mg/L	34	37	37
Potassium (as K) mg/L	42	46	49
Iron (as Fe) mg/L	0.12	0.43	0.85
Manganese (as Mn) mg/L	-	-	-

Free Ammonia (as NH3) mg/L	1.59	1.85	2.17
Nitrite (as NO3) mg/L	0.09	0.10	0.13
Nitrate (as NO3) mg/L	4	5	7
Chloride (as Cl) mg/L	110	116	124
Fluoride(as F) mg/L	0.4	0.4	0.5
Sulphate (as SO4) mg/L	31	37	37
Phosphate (as PO4) mg/L	0.29	0.26	0.21

TABLE 3. PHYSICOCHEMICAL PARAMETER ANALYSIS IN VENNILINGAPURAM POND

Physical parameters	February	March	April
Appearance	Greenish	Greenish	Greenish
Odour	-	Rotten egg smell	Rotten egg smell
Turbidity NTU	22	24	25
Total dissolved solids mg/L	429	502	529
Electrical conductivity (mico mho/cm)	615	734	778

TABLE 4. CHEMICAL PARAMETER ANALYSIS IN VENNILINGAPURAM POND

Chemical parameters	February	March	April
PH	6.84	6.89	7.04
Alkalinity ph (as CaCo3)mg/L	0	0	0
Alkalinity Total (as CaCo3)mg/L	124	114	114
Total Hardness (as Ca) mg/L	167	179	200
Calcium(as Ca) mg/L	28	32	32
Magnesium (as Mg) mg/L	23	26	29
Sodium (as Na) mg/L	43	45	50
Potassium (as K) mg/L	51	52	60
Iron (as Fe) mg/L	0.87	1.12	1.18
Manganese (as Mn) mg/L	-	-	-
Free Ammonia (as NH3) mg/L	3.72	4.11	4.32
Nitrite (as NO3) mg/L	0.14	0.19	0.19
Nitrate (as NO3) mg/L	3	6	9
Chloride (as Cl) mg/L	123	136	148
Fluoride(as F) mg/L	0.6	0.8	0.9
Sulphate (as SO4) mg/L	35	39	42
Phosphate (as PO4) mg/L	0.48	0.43	0.29

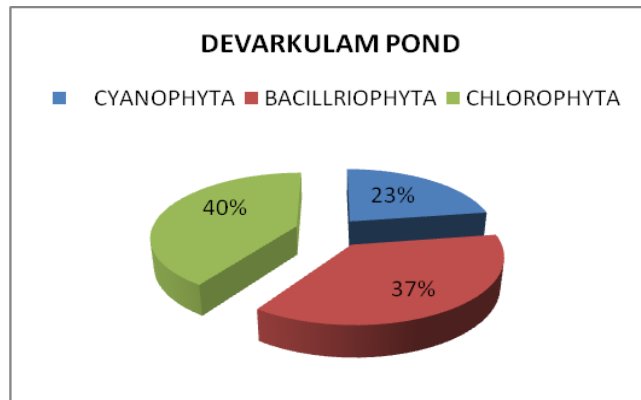


FIGURE 1. RECORD OF PHYTOPLANKTONS DENSITY COLLECTED FROM DEVARKULAM POND

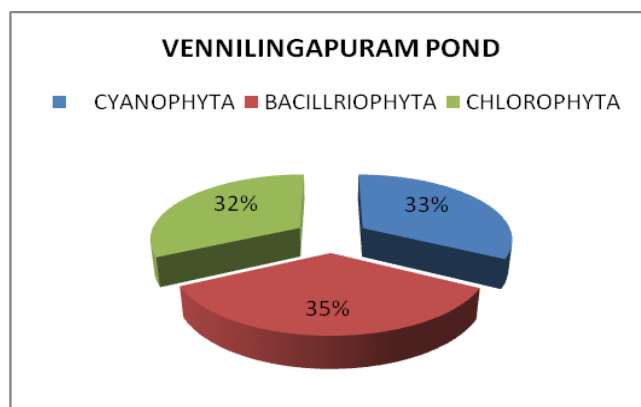


FIGURE 2. RECORD OF PHYTOPLANKTONS DENSITY COLLECTED FROM VENNILINGAPURAM POND

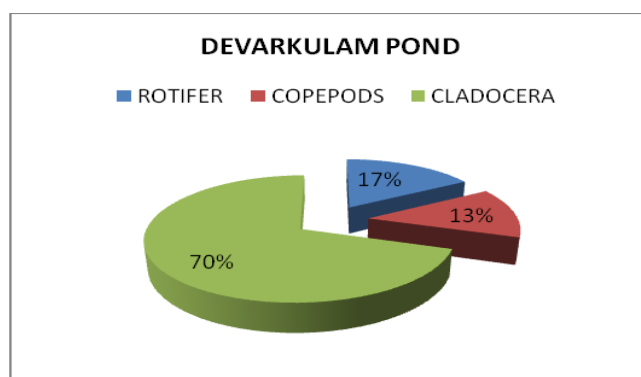


FIGURE 3. RECORD OF ZOOPLANKTONS DENSITY COLLECTED FROM DEVARKULAM POND

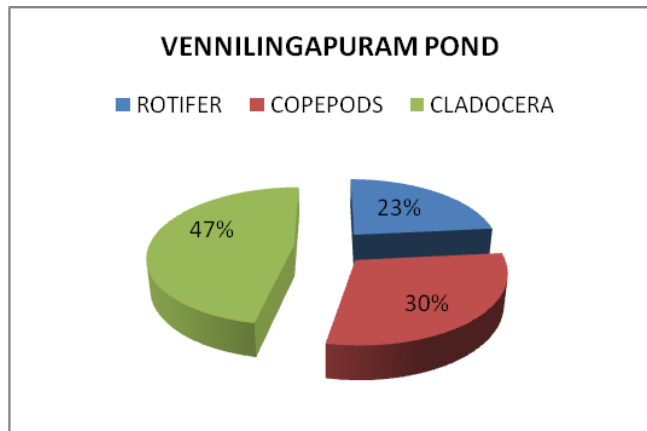


FIGURE 4. RECORD OF ZOOPLANKTONS DENSITY COLLECTED FROM VENNILINGAPURAM POND

TABLE 5. PHYTOPLANKTONS DIVERSITY SHANNON INDEX

Pond /month	Vennilingapuram	Deverkulam
FEBRUARY	2.9792	2.80262
MARCH	2.9521	2.9820
APRIL	2.9953	2.8872

TABLE 6. PIOLOU INDEX

Pond/ month	Vennilingapuram,	Deverkulam
FEBRUARY	2.7118	2.5510
MARCH	2.6871	2.7143
APRIL	2.7264	2.6281

TABLE 7. MARGALEF INDEX

Pond/month	Vennilingapuram	Deverkulam
FEBRUARY	0.4865	0.4192
MARCH	0.4381	0.3863
APRIL	0.3565	0.3482

TABLE 8. ZOOPLANKTONS DIVERSITY SHANNON INDEX

Pond/month	Vennilingapuram	Deverkulam
FEBRUARY	2.8890	2.8139
MARCH	2.9252	2.1373
APRIL	2.7266	2.1961

TABLE 9. PIOLOU INDEX

Pond/month	Vennilingapuram	Deverkulam
FEBRUARY	2.6297	2.5613
MARCH	2.6626	1.9454
APRIL	2.4818	1.9990

TABLE 10. MARGALEF INDEX

Pond/month	Vennilingapuram	Deverkulam
FEBRUARY	0.7578	0.7578
MARCH	0.7059	0.5719
APRIL	0.5719	0.4632

III. RESULT AND DISCUSSION

In the present study an affiant has been made on physic-chemical characteristics and plankton diversity of two irrigation water bodies, located nearby Tenkasi district. The physic-chemical parameters appearance and odour of Devarkulam pond water is colourless and no specific odour, and Vennilingapuram pond water was greenish and rotten egg smell was found in both water samples. In the present investigation the values of turbidity noticed is showing seasonal variation, being maximum during summer and minimum during winter season. Increased Turbidity of Vennilingapuram pond may be due to presence of increased total dissolved solids. Total solids of water are due to disposal of domestic and industrial effluent. Turbidities in natural waters seldom exceed 20,000mg/l [12]. Excessive organic maturing and feed wastage have been reported to increase TDS [13] and often lead to poor water quality [14].

The range of electrical conductivity in the present study was between 317 mico mho/cm and 778 mico mho/cm. The values of electrical conductivity showed marked seasonal variation being maximum during summer and minimum during winter season. Similar results were observed by various workers [15-17]. The water during the summer decreases as a result of death and decay of plants and animals. Water is a universal solvent and have a large number of salts dissolved in it which largely govern the physico-chemical properties. The maximum value of total dissolved solids was recorded in summer season (529mg/l) at Vennilingapuram pond and minimum were recorded in winter season (317mg/l) at Devarkulam pond (Table 1&3). Seasonal variations showed maximum values in summer and minimum during the winter season. Increased high concentration of TDS increases the nutrient status of water body which was resulted into eutrophication of aquatic bodies [18, 19].

The total alkalinity ranged between 108 mg/l to 124 mg/l. It is gradually decreased from April and then increased in the month of February. Seasonally highest value was recorded during winter season and lowest during the summer season. Increases in total alkalinity during rainy season were due to input of water and dissolution of calcium carbonate ion in the water column [20]. Hardness of water is principally due to salts of Ca^{++} and Mg^{++} mainly the carbonates and [21]. In the present study the total hardness of water ranged from 118 mg/l to 200 mg/l. seasonally, highest value was recorded during summer and lowest during the rainy season. Similar observations were found by various workers [22-26]. found that higher value in summer and lower in winter season.

In this study calcium content of two pond waters ranged from 11 mg/l to 32 mg/l. It used to be found that the value of calcium increases from February to April and barely reduced from February. Seasonal value point out the greater during the summer at Vennilingapuram pond and decrease during the winter at Devarkulam pond (Table 2&4). [27]. Observed that the calcium content was greater in summer and decrease in monsoon season. Chloride content ranged between 110mg/l to 148 mg/l. The chloride content showed marked seasonal variant being most during April and minimum during February, which is the agreement with the observation made by [28, 29]. However, higher concentration of chloride during the summer and decrease for the duration of the winter was also stated [30-32].

Nitrates are contributed to fresh water through discharge of sewage, industrial wastes and runoff from agricultural fields. Results of the current study envisaged that the value of $\text{NO}_3\text{-N}$ different from 3mg/l to 9 mg/l. The concentration of sulphate of pond water was recorded as 31mg/L and 42mg/L respectively.

The sulphate content was greater in summer season at Vennilingapuram pond decrease for the duration of winter season at Devarkulam pond. The sources of sulphates consist of the dissolution of soil and rock. Phosphate is the key nutrient also causing eutrophication leading to enormous algal growth. The outcomes of the present study confirmed that maximum phosphate concentration was found in the month of February 0.48 mg/l at Vennilingapuram pond and minimum in April 0.2 mg/l at Devarkulam pond (Table 2&4). It is evident from the data that seasonally phosphate concentration in the pond was greater in winter observed by a decline in summer season. Highest seasonal values have been suggested during winter and lowest for the duration of summer is in the conformity with the findings of a number people [33-36].

In the present study an affiant has been made on plankton diversity and density of two irrigation water bodies, placed nearby Tenkasi district diversity value was determined

as below 3. In Devarkulam pond, the obtained diversity values have been normally low. The discovered zooplankton numbers had been subjected to evenness also calculated by pielou's evenness index. It was shown by the vales calculated. All the values for pielou's index during the month of February have been less diversity, the vales calculated as for the evenness. During summer, increasing temperature enhances the rate of decomposition due to which the water will become nutrient wealthy similarly due to concentration followed by evaporation in summer season the nutrient concentration increases and abundant food present in form of photosynthesis [37].

Registered phytoplankton had been belong to 15 species of unique groups like as Chlorophyceae (5 species), Bacillariophyceae (5 species), and Cyanophyceae (5 species) (Figure 1&2). In the investigation period group Chlorophyceae was dominated over the rest of the phytoplankton population data has given in the table No: 1. It was seen that density of phytoplankton was maximum in April, minimum is recorded phytoplankton in the month of March has given figure (2&3).



The discovered phytoplankton have been calculated using the Shannon's wiener index. In Vennilingapuram, the market diversity value was determined as 2.9953 during april. In Devarkulam pond, the obtained diversity values have been normally greater or less similar in the month of March' (2.9820). The observed phytoplankton numbers were subjected to pielou's evenness index. All the values for pielou index during March the value calculated as fortheevenness 2.6871. Other month showed only bad distribution organisms of Devarkulam pond also showed even presence of organism. All the evening values of Devarkulam pond were 2.6281. Based on the observed variety of species it was subjected to calculate margalef richness index. Except the values acquired April during month of Devarkulam pond, all these values have been below 1 (Table 5 to 10).

Registered zooplanktons were belonged to 15 species of different groups like as Rotifera (5 species) Cladocera (5 species) and Copepods (5 species). In the investigation duration group Cladocera was dominated over rest of the Zooplanktons population (Figure 3&4). The determined zooplankton had been calculated using the Shannon's wiener index. In Vennilingapuram, the market diversity value was found as 2.9252 during March. In Devarkulam pond, the obtained diversity values had been commonly low. The observed zooplankton numbers were subjected to evenness also calculated by pielou's evenness index. It was shown by the vales calculated. All the values for pielou index during February the value calculated as for the evenness 2.4818. Other month showed only poor distribution of organisms of Devarkulam pond also showed even presence of organism. All the evening values of Devarkulam pond were below 2.5. Based on the observed number of species it was subjected to calculate margalef richness index. Except the values obtained April during month of Devarkulam pond, all these values were below 1.

(Hassan *et.,al* [38] suggested minimum density of plankton during monsoon and maximum during summer season in Euphrates River, Iraq. Similarly, Laskar and Gupta [39] stated minimal density of plankton during monsoon and maximum summer season in Chatla Lake, Assam. Barak [40] suggested the peak of plankton for the duration of April while lowest peak in July and August in village pond at Imalia (vidisha) India. This find out about of the tropical climate community indicates two-period seasonality as was observed in the Eastern Mediterranean freshwater ecosystems [41], in which rainy season communities had been greater diverse and abundant [42] in contrast to the diverse central European small lakes [43, 44].

The Shannon-Weaver index was used to observe diversity in a specific way which actually establishes the records entropy of the species distribution. This index considers the quantity of species and evenness of their distribution; and increase in evenness corresponds to a greater Shannon-Weaver value than there should be, which was supported through our results. This index also exhibits the trophic status and pollution load of the water body. Our calculation of the Shannon index is similar to that for Chatlalake [45] in the Ganga River valley. There is a contrary relationship between species dominance and diversity; when dominance increases the diversity decreases. As can be seen from out calculation, when there was maximum diversity value in April, the dominance was the lowest.

IV. CONCLUSION

Physical analyses of both the water samples showed that pH remains simply above the neutral level, and so unique odour was found. Chemical analysis of water showed that manganese and Alkalinity pH remains zero. The current study showed that phosphate level in both the water samples was unequal. Comparison of Vennilingapuram and Devarkulam pond, the Vennilingapuram pond was slightly polluted. Devarkulam pond all parameters had been inside the permissible limits. Phytoplankton and zooplanktons communities might also be used as an indicator of ecological status. In the Vennilingapuram pond phytoplankton and zooplankton community is still regarded to normal status. Chlorophyceae is the most diverse and excessive abundance type because it possesses a wide range of environmental variables. Copepods is the most abundance category in zooplankton communities. Diversity index of plankton various from unstable to stable moderate. Diversity and abundance of plankton communities is essentially reflecting the resource supply to ecosystem. The results point out that the Devarkulam pond is not polluted and can be used for domestic and irrigation purpose. Data envisaged that the present day status of the pond lies simply below the levels of eutrophication. A few efforts like diversion of sewage, presentation of leaching of nutrients from catchment region through plantations would definitely yield excellent results.

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