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ORIGINAL RESEARCH ARTICLE

Seasonal Variation in Hydrological Parameters of Krishnagiri Dam, Krishnagiri District, Tamil Nadu, India

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ABSTRACT

In this present study, hydrobiological characteristic features of the Krishnagiri reservoir Dam, the dates for the present study were collected from 3 sampling stations for the period of 6 months in both premonsoon and monsoon seasons. Physico-chemical factors like pH, temperature, EC, alkalinity, hardness, nutrients PO_4, NO_3, SiO_3, TDS and heavy metal sediments were estimated by the standard methods. Total hardness and TDS, EC, Cl and Alkalinity showed higher values than the other parameters estimated in the study area.

Key words: Dam, Hydrobiological characteristics, Premonsoon seasons, Monsoon seasons and Physico-chemical factors.

1. INTRODUCTION

Aquatic environment form the transitional zone between land and water, where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in and on it [1]. They are usually formed in the depressions (subjected to flooding) and ground water seeps. Enhanced appreciation of lakes in the recent past has led to the signing of many international agreements for protecting them, among which the Ramsar convention is the most important.

Aquatic ecosystems are transitional zones between land and water are efficient in filtering sediments. They can intercept run-off from land before it reaches the water and help in filtering nutrients, wastes and sediments from floodwaters. In certain lakes, plants are so efficient in removing wastes that artificial wastewater treatment systems use aquatic plants for the removal of pollutants from water. Lakes remove nutrients (especially nitrogen and phosphorus), particulates and total biological oxygen demand from flooding waters for plant growth and help prevent eutrophication or over-enrichment of other forms of natural waters [2]. However, overloading a aquatic environment with nutrients, beyond its threshold, impairs its ability to perform basic functions.

Dams near urban centers are under increasing developmental pressure for residential, industrial and commercial facilities, increasing population and economic growth create high demand for real estate in sub-urban localities is suitable becomes exhausted, pressure intensifies to develop lakes for residential housing, manufacturing plants, business office complexes and similar uses. They are often the final refuge for wildlife in an increasing urban environment and support many upland animals displaced by development [3]. With accelerating development of adjacent uplands, the role of urban lakes in flood protection and water quality maintenance becomes critical. Urban and industrial development increases the amount of surface water run-off from the land after rainfall. This raises flood heights and increases the flow rate of rivers, increasing the risk of flood damage. Increased run-off brings with it various substances that degrade water quality, such as fertilizer chemicals, grease and oil, road salt, sediment, etc. Effluents from some sewage treatment plants built to handle the needs of growing communities also reduce water quality. But, passing through lakes, cleansing action takes place as many pollutants are removed, retained or utilized by the lakes. Urban lakes in certain instances functions as recharge areas [4]. This is especially true in communities where ground water withdrawals are heavy. Thus,

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urban lakes are essential for preserving public water supplies.

2. MATERIALS AND METHODS

2.1. Sampling design

Totally three sampling sites were fixed to study about the hydrological features of Krishnagiri reservoir (i.e. physico-chemical and biological parameters) during four seasons Premonsoon Monsoon, post Monsoon and summer respectively period from June-2010-2011.

2.2. Collection of samples

To study the hydro biological features of Krishnagiri reservoir the samples were collected from three different zones.

2.3. Selection of sampling sites

Totally 3 sampling sites have been selected in this water body of which one is from east of the reservoir (road side) other one is west which collects municipal waste and the area 3 covers north of the dam where the human settlements is more situated on the south of the dam where normal human activities takes place.

Site: 1

This site is located on the east (road side) of the reservoir. This site is deep infested with a number of green algae particularly in all the seasons. Human activity at this site is limited to occasional bathing, cloth washing and the inlet areas where the chemplast industrial wastes are mixed into the dam. Water is drawn from this area for irrigation and gardening purposes.

Site: 2

It is the farthest site located at the north region of the water body. This site is used for fishing. At this site the human activity is the term of bathing, clothing, washing and fishing is common. There is an outlet to receive the domestic and run off.

Site:3

It is located on the south side of the reservoir near this site where maximum bathing and cloth washing was observed. The water here was generally supplied for irrigation.

2.4. Water sample collection

Water samples were collected from the above three sampling location for the analysis of Physico chemical and trace metal analyses. Water samples were collected in pre cleaned polypropylene container of two litre capacity and transported to the laboratory in an ice box for further analyses.

2.5. Water Sample analysis

Physico-chemical parameters of water samples were analysed by following the standard methods given in APHA (2000). Colours of the water samples were determined visually. pH were estimated by using Digital pH meter Elico-Li-120. Temperature was measured by using standard mercury thermometer. EC was measured by using conductivity meter. Turbidity was estimated with the help of Turbido meter. Dissolved nutrients like phosphate concentration were obtained by Argentometric Method, Nitrate-nitrogen was measured by nitrogen reduction column method and silicate was estimated by molybdo silicate method. Ions like Ca, Na, K, SO_4 were determined by Titrimetric method. Alkalinity was estimated by EDTA Titrimetric method. Metals such as Fe, Pb, Cu, Cd and Zn were estimated by AAS method (Perkin Elimer 5000 AAASCAN USA).

3. RESULTS AND DISCUSSION

Environmental conditions in most of the tropical aquatic ecosystem are also largely governed by marked seasonal changes induced by the monsoonal cycle [5]. Understanding of the hydrography and nutrient cycling in the pond water were complicated by the continual mixing of water masses with different Physico-chemical properties. Monthly variations of different environmental features in the Krishnagiri reservoir ecosystem depend on the fresh water discharge, which in turn is chiefly controlled by the pattern of rainfall in the study areas. Environmental conditions in most of the tropical pond and lake are also largely governed by marked seasonal and spatial changes induced by the monsoonal cycle [3]. Temperature is one of the most important parameter for the biochemical and physiological process in the aquatic organisms. In the present study, atmospheric and surface water temperature values were found to be varied from 21^{o}C to 29^{o}C at all three stations (**Table 1**) I, II, III during premonsoon season. During the monsoon season the atmospheric and surface water temperature values were ranged from 23^{o}C to 28^{o}C at all three stations I, II, III. Among the three stations, the highest temperatures were found to be noticed at stations II and I during premonsoon and monsoon seasons, respectively.

The values of the total dissolved solids were found to be varied from 5891 to 6951 when the water samples analyzed for three stations during premonsoon seasons. During monsoon season the total dissolved solids was found be varied from 511 to 4950. Among the three stations compared during premonsoon season the values were found to be fluctuated in all the three stations. But the highest values were noticed at station II (6951). Among the three stations compared during monsoon season, the highest values were noticed only at the station I (4950). It is predicted from

this study that the accumulation of the total dissolved solids more in amount may be due to the poor dilution factor through rain water. And the accumulation of total dissolved solid more in amount at the station during monsoon seasons may be due to the chemplast discharge at the entry point of station I and thus it is indicated that the discharged originated from the chemplast is non-available one even then the rain water was received during the monsoon season. In natural water TDS is composed mainly of carbonates and bicarbonates, Cl^-, SO_4^{-S}, PO_4^{-P}, NO_3^{-N}, Ca^+, Na^+, K, Fe^{++}. Patel *et al.* [6] reported that the dissolved solids may influence the turbidity of waters and in turn affects the light penetration. The TDS values in all the stations were showed higher than the permissible limit throughout the study period. Electrical conductivity is a good and rapid method to measure the total dissolved solids and is directly related to total solids. The EC values were recorded from 730 to 8850 mic mho^{-1}cm at station III. 2400 to 9930 mic mho/cm at station II and 8755 to 8880 mic mho/cm at station I during monsoon and premonsoon season, respectively. Highest value of conductivity at station II may be due to high concentration of ionic constituents in the Dam. It is noticed that the electrical conductivity values are fully coincided with the values of total dissolved solid.

Measurement of negative log of hydrogen ion concentration is represented as pH. The pH concentration of the Dam water was found to be alkaline in nature. The hydrogen ion concentration showed from 7.02 to 7.95 during the study period in all the stations. High pH of 7.40 was recorded during the pre monsoon at station III and pH of 7.95 and 7.51 were record during the monsoon season at station II and III respectively. Alkalinity is a measure of the capacity of water to absorb hydrogen ion; the most common constituents of alkalinity are carbonates, bicarbonates and hydroxide ions. The Alkalinity of the water samples were ranged between 195 to 521 mgl^{-1} at stations III and 299 to 780 mgl^{-1} at station II during the monsoon and premonsoon season respectively. The maximum concentration was noticed at station II during premonsoon season. Thus the total alkalinity of the water increases with an increase in pH and calcium. More over alkalinity of the water samples in both the stations were found to be exceeded than the permissible limits of [7].

The salinity values were ranged from 20ppm to 28ppm at all three stations during premonsoon season and salinity was ranged from 10.5ppm to 12.5ppm at all three stations during the monsoon season (**Table 1**). Among the three stations compared the highest range was noticed at station I (28 ppm) and at station II (12.5) during the premonsoon and monsoons seasons, respectively. During the premonsoon season the highest total hardness was noticed at station III (1670). During the monsoon, the highest range was noticed at station 1 (2020) through station II (7840 and station III (181).

Calcium is also an important micronutrient in the aquatic environment and its concentration may vary according to the influx of the material present in the aquatic media. The Viswanath and Anandamoorthy [8] also reported that the high concentration of calcium might be contributed to the geological formation. Magnesium is a necessary constituent of chlorophyll without which no ecosystem could operate. The concentrations of magnesium were varied from 14 to 375 mgl^{-1} at station III. The maximum concentration (375 mgl^{-1}) was noticed during premonsoon at station III and in monsoon minimum concentration (14 mgl^{-1}) was recorded at station III (**Table 1**). Sodium is one of the important cations occurring in the ground water required for the natural softening of water.

Sodium concentration was found to be higher at station II (832) during premonsoon than the values registered at station II during monsoon (130). Among the three station compared during the monsoon, the highest range was noticed at station I (715). Sodium acts as a deflocculating agent and displaces the divalent cations like Ca and Mg and cumulatively the soil loses its productivity. Potassium plays a vital role in metabolism of fresh water environments and considered to be an important macronutrient [9]. In the present study the concentration of potassium was high at station III (60) through station III (52) and II (48) during premonsoon and in the monsoon season the potassium concentration was high only at the station I (35) where as the iron content was found to be more only at station II (0.10) during premonsoon and the station I (0.08) during monsoon.

Luoma [10] reported that the availability of iron depend on the redox potential, temperature and pH. With regard to free ammonia it is present naturally in surface water and wastewater. It is produced largely by domination of organic nitrogen containing compounds and hydrolysis of urea. Free ammonia concentration was found between 1.22 to 3.11 mgl^{-1} at station I, where as the concentration of free ammonia was ranged

between 0.03 to 4.21 mgl^{-1} at station II and 0.03mgl^{-1} to 1.00 at station III during monsoon and premonsoon season, respectively. Ammonia in the form of ammonium salts is one of the most important nitrogenous plant nutrients and the concentration of which is known to determine the fertility of the pond. In general Ammonia values were found to decrease with increasing depth and the seasonal variations is more pronounced than that of the spatial variations. However, Reddy [11] through pond water reported that the higher values in shallow depth and the monthly variations are attributed mainly due to the discharge of terrestrial raw water. The concentrations of nitrite and nitrate were found to be more at station II (0.21) and I (0.26) during premonsoon respectively, while these values were found to be more only at station I (0.27) during monsoon. Among the three stations compared during monsoon the nitrite value was found to be 27 and the nitrate value was found to 205.

The nitrate value found in the three stations might be attributed for the influence of the growth of the phytoplankton population in co-ordination with the presence of nitrate and the phosphate Rubha *et al*. [12] also reported that the phytoplankton production may be due to the oxidation of organically derived to the cellular production of nitrite during assimilation of nitrate. This was due to addition of nitrogenous nutrients mainly by land run off during the study period.

Chloride contents in station I were ranged from 707 to 1762 mgl^{-1} and higher concentration were recorded at station II ranged between 470 to 1940 mgl^{-1} during monsoon period and premonsoon period (**Table 1**). High concentration of chloride values recorded during premonsoon might be due to decomposition of organic matter. Fluoride is the most exclusive bone-seeking element owing to its activity for calcium phosphate [13]. The fluoride concentration showed more or less similar trends (0.4) in all the station during the premonsoon and in the monsoon (i.e.) similar values was found at station I while it was varied at the station II and III with (0.2). Low concentration of fluoride below 0.5 mg/l causes dental carries and higher concentration beyond 1.5 mg/l causes dental and skeletal flurosis. Surface water generally contains less than 0.5 mgl^{-1} fluorides. However, when it is present in a greater concentration, it becomes a pollutant [3].

Sulphate is ecologically important for growth of plants and its short supply may inhibit the development of plankton [14]. Sulphate (593) and phosphate (3.69) were found to be more at station II during premonsoon period over the other two stations and both these values were found to be more at station I during monsoon period. The sulphate concentration in station I (433) and phosphate were recorded (3.16) in station I during monsoon season. Heron [15] has indicated that the phosphate increase may be due to decreased concentration of phytoplankton and zooplankton excreta. Lower concentration during premonsoon may be due to higher consumption by macrophytes. High phosphate content might be attributed due to drainage in the lake ecosystem [3]. The Phosphate concentration in general increased at all the stations during monsoon and premonsoon seasons. Variations of phosphate in all the stations might have been promoted by the liberation of inorganic phosphate from bottom under high oxygen tension and also enhanced by turbulence. The dissolved oxygen is one of the important parameter in water quality assessments. Its presence is essential in aquatic ecosystem for biochemical changes and metabolic activities of organisms. The dissolve oxygen contents were found to be more at station III and I during the premonsoon and in monsoon these contents were high at station II with similar trends of values were noticed at station II and III. This is in conformity with the earlier reports [16].

It is concluded from this study that the station I which receives the effluents of chemplast and the station II which receives agricultural and fish pond wastes have been subjected for the more influence of physico chemical parameters during the premonsoon and monsoon seasons in the stations I and II except the variations in dissolved oxygen presence. Among the various Physico-chemical parameters analyzed along with seasonal variation of premonsoon and monsoon periods. The physical parameter namely atmospheric temperature, surface water temperature, total dissolved solid and electrical conductivity, values were found to be recorded more at the station II where it receives more amount of discharges from agricultural and fish pond waste.

The same trend of values was found be lesser in quantity in the monsoon period. It is predicted from this study that the reduction of the values of the physical parameter may be due to the dilution factor of rainy water. However, the presence of physical parameter attributed at station I during monsoon may be due to the discharges of chemplast diluted at the meeting point station I. Similarly the values of chemical parameters namely pH, alkalinity, total hardness, calcium, sodium, iron, free ammonia, nitrite, nitrate,

chloride, sulphate and phosphate were found to be more in the meeting point of agricultural and fish pond waste diluted at station II during the premonsoon period. During the monsoon period these chemical parameter were found to be more in the discharging meeting point of chemplast at station I. These values were found to be higher than other two stations. Among the premonsoon and monsoon seasons compared, most of the physico chemical parameter was noticed to be higher in the premonsoon period. Among the three stations compared during the premonsoon, the stations II and I showed higher values.

Salinity, magnesium, potassium and nitrate were found to be higher only at the station I where it received the effluence from the chemplast during premonsoon period. However the values of Physico chemical parameter were not found to be varied in all these station during monsoon period except the station I as it showed higher amount of Physico-chemical parameters. The dissolved oxygen was found more at station III during premonsoon period and at station III during monsoon period. Agarwal [3] also reported, supported by many investigations that the theories of the dissolved oxygen increases the photosynthesis activity of phytoplankton. The variations of the Physico chemical parameter analyzed for the water samples in all the stations in the two seasonal variations may depend upon the various level of pollutants diluted into the Krishnagiri reservoir Dam. The sampling stations I, II and III were fixed for the present study to know the variations among the various kind of pollutants like chemplast waste (alcoholic waste) and agriculture and fish pond waste in comparing with the waste away from these pollutants (station III).

Table 1: Seasonal variations of Physico-chemical variables (mgl^{-1}) recorded in the study area during '2010-2011

S.No	Parameters	Premonsoon			Monsoon		
		Station I	Station II	Station III	Station I	Station II	Station III
	Physical parameters						
1	Atmospheric temperature (^oC)	21	29	22	28	23	25
2	Surface water temperature (^oC)	24	28	25	27	24	27
3	Total Dissolved Solids (TDS)	6216	6951	5891	4950	1680	511
4	Electrical Conductivity (EC) (mic mho^{-1} cm^{-1})	8880	9930	8850	8755	2400	730
	Chemical parameters (mg/l)						
5	pH	7.12	7.02	7.40	7.02	7.95	7.51
6	Alkalinity	641	780	521	660	299	195
7	Salinity	28.0 ppm	20.0 ppm	25.0ppm	10.5 ppm	12.5 ppm	12.0 ppm
8	Total hardness	2412	2492	1670	2020	784	181
9	Calcium (Ca)	507	673	407	540	177	49
10	Magnesium (Mg)	275	188	375	105	82	14
11	Sodium (Na)	624	832	472	715	130	70
12	Potassium (K)	60	48	52	35	14	8
13	Iron (Fe)	0.02	0.10	0.02	0.08	0.02	0.01
14	Free Ammonia (NH_3)	1.22	4.21	1.00	3.11	0.45	0.03
15	Nitrite (NO_2)	0.05	0.21	0.03	0.27	0.07	ND
16	Nitrate (NO_3)	326	292	252	205	46	36
17	Chloride (Cl)	1762	1940	962	707	470	73
18	Fluoride (Fl)	0.4	0.4	0.4	0.3	0.2	0.2
19	Sulphate (SO_4)	514	593	332	433	101	19
20	Phosphate (PO_4)	0.23	3.69	0.32	3.16	0.17	0.01
21	Dissolved Oxygen (O_2 mgl^{-1})	4.052	2.364	4.390	2.026	4.052	2.026

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