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Limnological studies of Gudavi Wetlands, Sorab, Shimoga Karanataka

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Abstract

A study on the water quality of three freshwater ponds connected in series at Gudavi village near Shimoga is studied for of physico-chemical factors. The DO was 8.81 mg/l in Kallambi, 3.84 mg/l in Vaddekere and 7.78 mg/l in Gudavi pond respectively and such a variation is attributed to the fecal (guano) droppings discharged by about 12,000 resident birds which include Egrets, Cormorants, Ibises, Herons, water fowls and other wetland dependent species in the Vaddekere of the sanctuary. A comparative study of nutrients and BOD levels in the three consecutive ponds revealed that the Vaddekere pond is most polluted. Due to this reason the water quality in the Vaddekere was altered and the emergent trees on the pond which were used for roosting and nesting by the birds are affected and evidenced by dying of trees. The death of island trees will lead to loss of roosting and nesting sites for Gudavi birds. Hence an urgent action plan to protect the trees or replanting new trees in the water bodies by creating islands every year is suggested.

Key words: *Limnology, Guano droppings, waterfowls, wetlands and Gudavi.*

Introduction

The natural freshwater which is available to man in the form of reservoirs, ponds and lakes is spread in an area of 0.72 million ha was reduced to about 0.65 million ha in the country (Saxena, 1996). It means there is a decline of 0.07 million ha of water spread area. According to a survey conducted by NEERI revealed that about 70% of the available water in India is polluted (Agarwal *et al.*, 1982). For limnological study evaluation of physico-chemical factor is a basic step in that each factor contributes in making up of specific ecosystem, which determines the trophic dynamics of the water body. The management of any aquatic ecosystem is a means of conservation of freshwater habitat with an aim to maintain the water quality or to rehabilitate the physico-chemical characteristics of water.

The lentic water systems are popularly referred as wetlands. These wetlands should be scientifically studied as potential productive areas. In a meeting on wetlands held at Ramsar, Iran in 1971 major emphasis was given to water fowls. It was well established that wetlands are very essential for migratory birds and other aquatic biota (Mahajan, 1981, 1988). Lentic wetlands are important not only for water fowls but also for various purposes viz, their role in flood control, reducing sediment load, recycling of biogenic salts, source of irrigation water, animal husbandry, aquaculture refuge for rare and endangered fauna and as agents for recharging ground water. In view of the above importance some ecological aspects of Gudavi wetlands is carried out and discussed in the present paper.

Materials and Method

Study Area

Gudavi wetlands are located in the Sorab taluk of Shimoga district, at about 13 km away from Sorab city and 0.5 km from Gudavi village. These wetlands occupies the water spread area is about 33 hectares. Remaining area is moist deciduous forest species interspread with grassy patches.

Gudavi wetlands lies between latitude of 14^0 25' 59" to 14^0 26' 41" and longitude 75^0 6' 43" to 75^0 1' 28". These

are connected in series, they are Kallambi, Vaddekere and Gudavi ponds. The rainfed water from Kallambi flows for a distance of 2 km through irrigation channel and enters into the Vaddekere. The outflow of water from Vaddekere enters into Gudavi pond, from there it is used for irrigation at the downstream croplands. Vaddekere and Gudavi ponds are separated by a common bund.

Sampling and Analysis

The water sampling has been carried out during breeding season with an interval of 15 days from June 2000 to February 2001. The parameters like air and water temperature, dissolved oxygen, biological oxygen demand, carbon dioxide, chlorides, calcium, phosphates and sulphates are determined according to standard methods (APHA, 2000 and Trivedi and Goel, 1984).

Results and Discussion

The important factor which influence the plankton dynamics in the pond water are temperature and light intensity (Hosmani, 2002). The change in physico-chemical characteristics are brought about by the fluctuation in climate conditions. The water temperature during the study period was around 24.96 ^{0}C in Kallambi, 24.57 ^{0}C in Vaddekere and 25.02 ^{0}C in Gudavi ponds respectively. It was always 1 ^{0}C below the ambient temperature. The temperature in the range 15 ^{0}C to 30 ^{0}C is found to be suitable for algal productivity, Hence the existing temperature triggered the algal photosynthesis inturn enhanced the fish productivity which is one of the main source of food for birds living in the wetlands of the sanctuary. One of the very interesting subject to note that always the water temperature remained lower than air temperature in all ponds at all seasons. The pH values varied around 7.63 ± 0.52 in Kallambi, 6.77 ± 0.94 in Vaddekere and 7.35 ± 0.85 in Gudavi water samples respectively (Table 1 to 3). In Kallambi pond the water pH was always alkaline during study period from June 2000 to February 2001. Where as it was acidic during September and October in the other two ponds and it was 6.5 to 6.0 in Vaddekere and 6.4 and 6.0 in Gudavi ponds respectively. However, it remained alkaline in later part of the season. Since all enzymes are pH dependent and will directly enhance metabolic activities (Hosetti, 1987). Hence, it is essential to maintain alkaline pH or around neutral to support sustainable fish and algal productivity in these ponds.

The DO is a vital factor used in qualifying water samples. Most of the desired fishes may not survive if the DO falls below 4 mg/1. In the present study DO was always above 5 mg/ 1 in Kallambi and Gudavi tanks. It was recorded an average 8.81 mg/l in Kallambi and 7.78 mg/l in Gudavi tanks, but in contrast to the two ponds, Vaddekere pond always showed low levels of oxygen except during January 2001. It was below 3 mg/ 1 in September 2000 to December 2000 and a maximum of 6.5 mg/ 1 in January 2001, when there was no bird activity. Such a drastic low levels of DO in Vaddekere during breeding seasons are attributed to biodegradation of guano dropped by birds (Dayananda, 2001).

The minimum DO which supports most of the desired fish species is above 4 mg/1. The reduced DO level in Vaddekere pond revealed that water is pollute by oxygen demanding materials(Hosetti and Patil, 1998; Hosetti and Kumar, 2001) added through fecal pollution. This might be attributed to the reason that in

Vaddekere pond there were about 12,000 birds residing on emergent trees and discharged excreta. The uric acid and other organic matter which was present in excreta needed more oxygen to stabilize the waste biologically.

A humus material can be utilized by living organisms. But, once, it is discharged into an aquatic ecosystem, it will be consumed and oxidized by a variety of facultative organisms. The facultative organisms utilize the dissolved oxygen for the process of biodegradation. If all the oxygen is depleted then facultative aerobes also disappear. The quality of water will be further degraded, it will change into a saprobic system. Then water is considered to be polluted and evidenced by presence of oxygen demanding materials. Thus, the BOD is the amount of Oxygen required to oxidize biodegradable substance in an aquatic ecosystem under saprobic situations.

Biological oxygen demand is an indirect measure of organic load present in any aquatic systems. In the present study the 5 day BOD values 5.82, 21.82 and 10.6 mg/l recorded for Kallambi, Vaddekere and Gudavi ponds respectively. According to drinking water standard BOD should be less than 6 mg/l, but it was above the drinking water standard in Vaddekere and Gudavi ponds. The relatively high BOD levels in Vaddekere pond was due to the discharge of fecal matter by large number of birds. The high BOD in Gudavi tank attributed to two reasons. The water from Vaddekere entering into Gudavi tank gets diluted and hence low BOD values were recorded in Gudavi pond.

In tropical slow flowing polluted rivers and in stagnant water bodies a group of microbes dominated by algae and bacteria play a key role in process of purification in a symbiotic manner. That is bacteria degrade organic matter into simpler molecules of nutrients and release oxygen available back to the bacteria for use, ultimately leading to up gradation of water quality evidenced through reduced BOD and increased DO levels (Hosetti et al., 1995). Another reasons are human activities like washing and bathing in Gudavi pond which are also responsible for high phosphates and BOD. The study on BOD level of the water sample of the three ponds revealed that, it is necessary to reduce the BOD level by artificial management, such as removing of sediment in summer and managing the water retention time at least in Vaddekere pond where birds reside during breeding seasons in large numbers.

The CO_2 level was 33.6, 61.5 and 34.9 mg/ l recorded in the ponds, Kallambi, Vaddekere and Gudavi respectively. The higher amount of CO_2 was recorded and may affect the pH levels. Hence the water was acidic. The increase in the amount of CO_2 indicates that the ponds are inadequately aerated (Kumar, 1996; Singh, 1997). It also indicates that these ponds are filled with large amount of silt and sediments. The bacteria and fungi living in their sediments undertake decomposition of organic substances and also release CO_2 during the respiration processes.

Chlorides are gradually considered as nutrients. Presence of high levels of chlorides indicates that the water is polluted. The chlorine level was 54.2, 56.1 and 49.2 mg/l in the water samples from Kallambi, Vaddekere and Gudavi ponds respectively. In drinking water samples usually chlorine is around 20 mg/l. In contrast to this the three ponds showed chloride three times more than that of drinking water standards.

Such high levels of chloride perhaps originated from agricultural activity. Large amount of fertilizer and manures used in agriculture might have percolated in these ponds. The fecal discharge of birds is also responsible for increase in chlorides in Vaddekere(Hosetti *et al*., 1995). According to Thresh *et al*. (1944) it is advocated that the presence of high chloride is an indication of pollution of animal origin. Chlorides are antibiotic in nature and the presence of large amount of chloride is lethal to pathogenic bacteria and chloride around 29 mg/l is considered to be favorable for freshwater community. However, chloride itself along with phosphate and nitrates makes the water eutrophic (Schmitz, 1996).

Calcium was 22.7, 23.4 and 20.7 mg/l in respective ponds. The levels of calcium in all these three ponds are comparable. Under high chloride levels the impact of calcium ions is yet to be studied. In freshwater ponds relatively high levels of calcium may be originated from the soil. Calcium is a micronutrient required for all organisms for metabolic activities (Gautam, 1995).

Phosphates are important macronutrients essential for plant growth. It was 0.37, 2.00 and 1.48 mg/l recorded in Kallambi, Vaddekere and Gudavi ponds respectively. Phosphate contents considered to be nutrients of major importance in the production process. It was within irrigation standards in both Kallambi and Gudavi ponds and it was very high in Vaddekere pond. Higher levels of phosphates are originated from the guano discharged by the birds. Due to this particular reason the Vaddekere pond became eutrophic (Kumar, 1996). The eutrophic nature of pond is evidenced by large growth of floating hydrophytes which include Lemna major, Lemna minor, Pistia, Salvinia , Trapa, etc. Due to availability plenty of phosphates and other nutrients the hydrophytes grown and occupied large surface area in the second and third ponds, the light penetration was checked and the algal photosynthesis also hampered(Hosetti and Latha, 1996) and low level of oxygen was recorded in such places as we found in Vaddekere pond samples. This change has also checked the free movements of the Ducks viz. Coot, Grey duck, Moorhen and Jacanas in these ponds.

The major sources of sulphate in natural water are rocks, fertilizers and waste discharges from industries. The amount of sulphate in water is a factor of concern in determining the magnitude of problems that can arise from reduction it into hydrogen sulphides. In the present study, the sulphate varied around 0.06, 0.07 and 0.08 mg/l recorded in Kallambi, Vaddekere and Gudavi ponds respectively. In this study sulphate recorded a highest concentration of 0.08 mg/l in Gudavi pond, which is well within the tolerance limit prescribed by ISI standards. Hence, it can be concluded that the ponds under study are oligotrophic (based on sulphate content), However the Vaddekere was always eutrophic with reference to other nutrients viz. phosphates, nitrates and chlorides.

The data on the evaluation of water quality revealed that due to guano droppings by large number of birds in small area of Vaddekere the water quality was deteriorated. Due to changes water quality in the Vaddekere the roosting trees viz, *Vitex leucoxylon*, *Kirganelia reticulate* and *Phyllanthus polyphyllus* are also affected. In order to avoid this there is need to plant more trees so that the birds aggregation can be spread and thereby pollution of water in Vaddekere may also be controlled. Now, it is good to exploit the water from the Vaddekere and the Gudavi for irrigation purpose for the crop land situated in the downstream regions.

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Table- 1. The Physico - Chemical characteristics of water from Kallambi pond.

Month of Sampling 2000-01	Air Temp. ^{0}C	Water Temp. ^{0}C	pH	DO mg/l	BOD mg/l	CO_2 mg/l	Cl mg/l	Ca mg/l	TA mg/l	PO_4 mg/l	SO_4 mg/l
June	25.5	23.0	7.5	8.04	6.76	36.44	48.96	32.00	84.0	0.32	0.01
July	23.6	21.7	7.0	6.86	6.00	29.80	66.03	26.70	67.0	1.02	0.03
August	22.1	21.0	7.5	7.48	5.25	32.0	54.40	25.06	78.0	0.48	0.05
September	25.0	23.0	7.0	9.66	4.80	35.2	65.32	22.40	85.0	0.15	0.08
October	27.0	26.2	7.2	8.26	3.90	28.0	17.04	19.23	50.0	0.40	0.08
November	28.6	26.5	8.0	10.11	5.25	34.12	61.33	20.00	82.0	0.15	0.04
December	28.5	27.0	8.0	10.0	7.00	36.02	64.00	21.00	23.0	0.12	0.06
January	30.2	27.5	8.0	10.11	7.50	35.0	61.00	18.00	21.0	0.50	0.10
February	30.0	28.8	8.5	8.75	5.92	36.02	50.15	20.00	90.0	0.22	0.10
Mean ± SD	26.72 ± 2.85	24.96 ± 2.81	7.63 ± 0.52	8.81 ± 1.22	5.82 ± 1.14	33.62 ± 3.01	54.24 ± 15.33	22.71 ± 4.46	64.44 ± 26.85	0.37 ± 0.28	0.06 ± 0.03

Table- 2. The Physico - Chemical characteristics of water from Vaddekere.

Month of Sampling 2000-01	Air Temp. ^{0}C	Water Temp. ^{0}C	pH	DO mg/l	BOD mg/l	CO_2 mg/l	Cl mg/l	Ca mg/l	TA mg/l	PO_4 mg/l	SO_4 mg/l
June	26.0	23.8	6.0	5.04	22.34	66.60	41.20	27.03	98.00	1.78	0.07
July	23.6	21.5	6.0	5.28	26.04	70.00	53.00	22.20	88.00	1.84	0.04
August	23.1	22.3	6.0	4.62	20.20	62.00	68.00	21.08	69.00	2.06	0.08
September	25.0	21.0	6.5	2.40	28.00	61.60	71.00	22.14	90.00	2.13	0.12
October	28.4	27.0	6.0	1.72	24.00	72.00	36.92	24.34	75.00	2.18	0.10
November	28.6	27.0	7.2	2.20	24.00	70.00	68.16	24.04	100.0	2.20	0.10
December	29.5	28.0	8.0	3.00	18.00	48.00	63.00	21.50	81.00	2.00	0.06
January	29.0	26.0	8.5	6.53	12.00	42.00	48.13	25.00	21.00	1.86	0.06
February	-	-	-	-	-	-	-	-	-	-	-
Mean ± SD	26.65 ± 2.38	24.57 ± 2.58	6.77 ± 0.94	3.84 ± 1.63	21.82 ± 4.73	61.52 ± 10.26	56.17 ± 12.34	23.41 ± 1.90	77.75 ± 23.65	2.00 ± 0.15	0.07 ± 0.74

Table- 3. The Physico - Chemical characteristics of water from Gudavi pond.

Month of Sampling 2000-01	Air Temp. ℃	Water Temp. ℃	pH	DO mg/l	BOD mg/l	CO_2 mg/l	Cl mg/l	Ca mg/l	TA mg/l	PO_4 mg/l	SO_4 mg/l
June -	26.0	24.5	7.0	8.20	12.11	17.10	28.68	22.08	80.0	2.50	0.05
July-	23.6	22.0	7.5	8.75	12.73	22.00	34.20	18.33	67.0	1.86	0.10
August-	23.1	22.2	7.0	7.83	10.15	24.00	36.00	20.68	64.0	2.02	0.09
September-	25.0	21.0	6.4	11.20	17.20	26.40	76.68	17.63	85.0	1.18	0.07
October-	27.0	27.0	6.0	6.80	10.80	52.00	25.56	24.04	40.0	1.12	0.10
November-	28.6	27.0	7.8	8.13	14.13	44.00	66.61	18.63	65.0	1.18	0.09
December-	28.5	28.0	8.5	5.00	6.15	51.00	67.61	20.63	67.0	1.50	0.07
January-	29.0	26.0	8.5	6.40	5.20	34.00	65.00	21.00	60.0	0.86	0.05
February-	29.2	27.5	7.5	5.28	6.93	44.00	43.02	24.04	80.0	1.12	0.10
Mean ± SD	26.66 ± 2.35	25.02 ± 2.67	7.35 ± 0.85	7.78 ± 1.71	10.6 ± 3.96	34.94 ± 13.19	49.26 ± 19.57	20.78 ± 2.33	67.55 ± 13.46	1.48 ± 0.53	0.08 ± 0.02