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Research Article

Prefeasibility Evaluation and Management Proposal on the Biological, Physical and Chemical Parameters of Seven Water Bodies Intended for Fish Culture at Latitude: 10° 09' 12.00'' N Longitude: 76° 23' 17.39'' E

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Abstract

Evaluation report and ecological constrains around industrial area is the thrust of this research. It provides the description of area and methods of sample collection. The report suggested that the area is stratified with phytoplankton diversification which is suitable for fish species culturing. The pyshio parameters presented in this area is also conclusive for fish variety. In conclusion the mitigating and management solution also included.

Keywords: Phytoplankton; Salinity; Management; Evaluation report

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Introduction

Earth's water resources, including rivers, lakes, oceans, and underground aquifers, are under stress in many regions. Scientists widely predict that global climate change will have profound impacts on the hydro biological cycle, and that in many cases these effects will make existing water challenges worse. The water bodies of the current study were located in the industrial area of Cochin International Airport at latitude: 10° 09' 12.00" N longitude: 76° 23' 17.39" E. These water bodies are confined with a water lodge capacity of 1 lakh litre/hectare. Highly productive water ecology which contains many cultured fish species which was natural selected is found in these water bodies. Natural ecosystem was constantly influenced by oils from air spill ways and other pollutants. These water bodies have been used as Private Property Resources (PPRs) where restricted access is allowed to inhabitants of the surrounding communities. Many developing countries have realized that it is wiser to encourage culture-based fisheries or extensive aquaculture in their inland water bodies which are more compatible to the traditional practice of sharing nature's wealth among many, even if it means that less income is generated. The growing trend of converting them into intensive aquaculture systems is to be viewed with caution because of the impacts on the environment and the socio-economic problems created. Stocking measures undertaken for this ecosystem need to have sound biological bases with a specific strategy. Since some species are difficult to breed, there is always a tendency to stock the ones that are readily available. The major management measures, such as stocking, fishing effort management and size at capture, are generally determined arbitrarily. Scientific advice is required on the determination of these parameters through a modeling approach. As enhancement in all forms is a delicate management option, it should be exercised with care, especially when the water bodies contiguous with natural ecosystems are involved, as subtle changes in the habitats and biotic communities could be triggered.

The qualitative and quantitative studies of phytoplankton have been utilized to assess the quality of water [1-4]. Phytoplanktons are the primary producers forming the first trophic level in the food chain. Diversity of *planktonic* organisms is quite high in fertile standing water bodies. Phytoplankton diversity responds rapidly to changes in the aquatic environment particularly in relation to silica and other nutrients [5,6]. Several phytoplankton species have served as a bioindicators [7-10] and it is a well suited tool for understanding water pollution studies [11]. The major problems effecting standing water bodies have been recognized for at least two decades, but their quantification and classification of environmental managers has proved elusive. Although, a number of studies have been carried out on ecological conditions of freshwater bodies in various parts of India [12-15], information on relationship between physicochemical parameters and plankton indicators of water pollution is limited [16-20]. Studies on *planktonic* composition and morphometric, physical and chemical characterization of water bodies are necessary to obtain basic knowledge on the biodiversity in a given region. So the present study was carried out in order to determine the composition, density and diversity of Phytoplankton of the ponds in the geographical area and the influence of physico-chemical variables on them.

Materials and Methods

Study area

Seven ponds were selected in the nearby area of Cochin International Airport Authority (CIAL). These water bodies contain stagnant water flow which has got interconnectivity channels between them. Embankments are constructed for separating the ponds and has got natural vegetation includes herbs and small stem plants. The location is nearby to national high way and adjacently situated airport complex. Anthropogenic activities are restricted in this area and are rich in natural flora and fauna. The source of pollution is from the runaway oil and road transport chemical exposures.

Collection of samples

Water samples were collected from seven ponds during the month of August, 2018. Samples were collected during morning hrs between 9.00 and 11.00 A.M. 50 liters of surface water was filtered through standard plankton net. The collected plankton samples were transferred to polyethylene bottles and preserved with 5% formalin.

Biological analysis

Plankters were studied under microscope and identified with the help of standard references [1,21]. Quantitative analysis was made using a plankton-counting cell (Sedgwick rafter). Phytoplankton species richness, diversity and evenness were carried out using the method of [22,23].

Physico-chemical analysis

Temperature (air and surface water) was recorded on the spot using Centigrade thermometer. pH, Salinity, Alkalinity, Carbonate, Bicarbonate, Hydroxide, Total Hardness, Calcium, Magnesium, Ammonia, Nitrite, Nitrate, Turbidity, Sulphide, Sulphate, Phosphate, TDS, DO, BOD, COD was done using standard method [24]. The physicochemical parameters were determined in order to observe their influence on phytoplankton density (Tables 1 and 2).

Results and Discussion

The fluctuation of phytoplankton density and physicochemical

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characteristics of water at ponds are depicted in Table 3. Altogether twenty nine species of phytoplankton were identified form the study area in which the *Bacillariophyceae* dominated with 7 species such as *Mastogloia danserii*, *Diatomella balfouriana, Tabellaria fenestrate, Synedra sp, Mastogloia sp., Diploneis sp.,* and *Centronella reichelti.* It was followed by 6 species of *Chlorophyceae* such as *Pediastrum duplex*, *Draparnaldia sp, Draparnaldiopsis sp, Kirchneriella sp., Sphaerocystis Schroetari,* and *Scendesmus quadricauod* and 5 species of *Zygnematophyceae* such as Closterium leibleinii, *Closterium setaceum*, *Micrasterias foliacea, Cosmarium, Gymnozyga moniliformis*. These 3 families are dominant in the study area. Two species for *lobosa* and *Cyanophyceae* was observed such as Arcella discoides and *Centropyxis* aculeate and *Cylindrospermum sp,* and *Oscillatoria sp*., respectively. The other families which constitute single species are *Chlorellaceae, Diatomaceae, Dinophyceae, Cyanophyceae, Gastropoda, Desmidiaceae*, Phylactolaemata, Tubulinea, and Chrysophyceae. High density of phytoplankton species diversity and physicochemical parameters exhibited in PA 2 and this may be due to physicochemical factors greatly influenced by phytoplankton population. The water temperature and transparency had a direct relationship with phytoplankton population. Dominance of class *Chlorophyceae* in pond might be due to high dissolved oxygen and fair amount of pH, alkalinity and total hardness. The availability of dissolved oxygen is one of the most critical factors for the survival of the aquatic organisms [25]. Dynamics in the phytoplankton biomass are the result of the complex interaction of physical, chemical and biological processes. The availability of nutrients influences the diversity of the phytoplankton. From the studies it is clearly observed that there is high nutrient influx in PA 2 and PA 4 while comparing with other ponds. Phytoplanktons are the primary producer and play a vital role in food chain of aquatic ecosystem. Due to this reason, phytoplanktons are usually used as an ecological indicator to assess the ecological health and the stress effects of chemical contaminants on aquatic ecosystems and they are also necessary to sustain a healthy aquatic ecosystem.

The water system in the pond was mainly influenced by rainfall since the sampling was done after monsoon rains. The high variations in electrical conductivity expressed as Calcium, Magnesium and Bicarbonates in monsoon season may be because of the rains which export the ions from the catchment area to the lake ecosystem. Similar trend was reported by Burman, et al. [26]. The nutrients like phosphates, nitrates and sulphates increase in the monsoon because the rains brought these nutrients from the catchment. Maximum TDS and turbidity in monsoon season is due to the rain which transports soil and other organic matter from the watershed to the lake. The availability of dissolved oxygen is one of the most critical factors for the survival of the aquatic organisms.

Table 1. *Biological species present in the pond.*

	PA1	PA2	PA3	PA 4	PA 5	PA 6	PA 7
Phytoplankton	Closterium leibleinii	*Pediastrum duplex*	Centropyxis aculeata	Micrasterias foliacea	Chlorella sp.	*Cosmarium*	Sphaerocystis Schroetari bloom
		Dinobryon stipitatum	Draparnaldia sp	Mastogloia sp.	Oscillatoria sp.	Gymnozyga moniliformis	Staurostrum dorsideniferum
		Difflugia lebes	Pleurodiscus sp	Diatomella balfouriana	Micrasterias foliacea	Closterium leibleinii	Centronella reichelti
		Mastogloia danserii	Cylindrospermum sp	Diplomesis sp.		Closterium setacerum	Scendesmus quadricauod
		Diatomella balfouriana	Draparnaldiopsis sp	Closterium setacerum		Sphaerozoma granulata	
		Tabellarian fenstrata		Kirchneriella sp.			
		Arcella discoides		Cylindrospermum sp.			
		Hyalinella punctata		Prorocentrum sp.			
		Closterium setacerum					
		Synedra sp					
		Staurastrum dorsideniferum					
Zooplankton	Wolga spinifera(Rotifera)	Nematoda sp	Branchionus havanaensis	Monostyla lunaris	Aquatic insecta	Branchionus havanaensis	
	Monostyla lunaris	Copepod naupli		Wolga spinifera	Insect eggs		
	Tintinnopsis sp			Dipleuchlanis sp.	Insect larvae		
	Cyclopoid sp				Cyclopoid sp		

	Calanoid sp				Calanoid sp		
	Plumatella casmiana				Tintinnopsis sp		
	Copepod eggs				Copepod eggs		
	Copepod naupli				Copepod naupli		
	Polycheate larvae				Penilia avirostris		
	Penilia avirostris						
	Nematoda						
	Fish larvae						
	Fish egg						
	Aquatic insect						
Others	Microplastics	Microplastics	Microplastics	Microplastics	Microplastics	Microplastics	Microplastics

Table 2. *Distribution of plankton in the ponds.*

	PA1	**PA 2**	**PA 3**	**PA 4**	**PA 5**	**PA 6**	**PA 7**
Zygnematophyceae	+	+		++	+		
Chlorophyceae		+	++	+			++
Chrysophyceae		+					
Tubulinea		+					
Bacillariophyceae		++++		+++			+
Lobosa		+	+				
Phylactolaemata		+					
Desmidiaceae		+					+
Gastropoda			+				
Cyanophyceae			+	+	+		
Dinophyceae				+			
Chlorellaceae					+		
Diatomaceae						+	

Table 3. *Physio-chemical parameters at ponds.*

SL No	**Parameters**	**Unit**	**PA 1**	**PA 2**	**PA 3**	**PA 4**	**PA 5**	**PA 6**	**PA 7**
1	pH		6.40	6.31	6.31	6.09	6.35	6.49	6.47
2	Salinity	Ppt	0	0	0	0	0	0	0
3	Alkalinity	Mg/L	25	25	25	20	15	15	25
4	Carbonate	Mg/L	0	0	0	0	0	0	0
5	Bicarbonate	Mg/L	25	25	25	20	15	15	25
6	Hydroxide	Mg/L	0	0	0	0	0	0	0
7	Total Hardness	Mg/L	50	50	30	30	30	60	30
8	Calcium	Mg/L	12	12	4	4	4	12	14
9	Magnesium	Mg/L	38	38	26	26	26	48	26
10	Ammonia	Mg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL
11	Nitrite	Mg/L	0.0554	0.0645	BDL	BDL	BDL	BDL	BDl
12	Nitrate	Mg/L	0.055	0.0942	BDL	BDl	BDl	BDL	BDl
13	Turbidity	NTU	4.09	7.81	15.22	19.36	17.57	17.57	5.58
14	Sulphide	Mg/L	BDL	0.0053	0.0008	0.0072	BDL	BDL	BDL
15	Sulphate	Mg/L	32.595	33.481	10.300	10.012	16.076	17.557	5.4791
16	Phosphate	Mg/L	0.0052	0.0497	0.0038	0.0104	0.0132	0.0095	0.0038
17	TDS	Mg/L	120	100	40	40	50	50	45
18	DO	Mg/L	3.6	5.2	5.2	7.6	6.4	6.4	5.6
19	BOD	Mg/L	1.6	0.8	4	2.4	2.4	3.2	2.8
20	COD		NIL	NIL	NIL	NIL	NIL	NIL	NIL
21	Total Coliforms	MPN/100 Ml	1100	1100	460	290	240	240	240
22	Fecal Coliforms	MPN/100 ML	1100	1100	460	290	240	240	240

23	Total Plate Count	CFU /ML	1X	7.8	1	2.5	2	3.8	3
24	E coli	MPN/100 Ml	NIL	NIL	NIL	NIL	NIL	NIL	NIL
25	Salmonella	MPN/100 ml	NIL	NIL	NIL	NIL	NIL	NIL	NIL
26	V. cholera	MPN/100 ml	NIL	NIL	NIL	NIL	NIL	NIL	NIL
27	S. aureus	CFU/ml	NIL	NIL	NIL	NIL	NIL	NIL	NIL

Conclusion

For management there is a general consensus that any significant improvement in yield in future can be achieved only through enhancement measures. These measures involve human intervention in these ecosystems with a view to increasing their productivity. Aside from improving the production of absolute biomass from the water bodies, access to the fisheries or their monetary and aesthetic value could be developed. The common modes of enhancement followed are to increasing the stock (stock enhancement), introducing new species to broaden the catch structure (species enhancement) and, improving the water quality through artificial eutrophication (environmental enhancement). Enhancement offers delicate management options to be exercised with care, especially where the water bodies contiguous with natural ecosystems are involved. This can trigger complex, intricate and often subtle changes in the habitats and biotic communities. The nature and extent of the enhancement will determine the overall sustainabilty and environment-friendliness of the fishery. Introduction of fish for exclusive use in culture systems is considered harmless and this is based on the premise that the fish remain confined to the ponds and do not affect the natural fauna. Improvement of the nutritive quality of water by the selective input of fertilizers is a very common management option adopted in intensive aquaculture. However, scientific knowledge to guide the safe application of this type of enhancement and the methods used to reverse environmental degradation are still inadequate.

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