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Limnology of some ponds of Government Fish farm, Amalnala at Bailampur near Gadchandur in Rajura Tahsil of Chandrapur District of Maharashtra, India with reference to its fisheries potential.

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Abstract

Water quality management constitute an integral aspect of aquaculture operation. Limnology is the study of physical, chemical and biological factors of any water body, whether it may be freshwater, brackish water or marine water. The water quality is characterized by various physic-chemical parameters. These parameters change widely due to many factors like source of water, type of pollution, seasonal fluctuations, etc. The present investigation was carried out in Six rearing ponds at Government Fish Farm, Amalnala, Bailampur, near Gadchandur in Rajura Tahsil of Chandrapur District of Maharashtra, India during Summer season from March, 2019 to May, 2019 for a period of three months, in order to study its limnology. Its further study was stopped due to some problems created during sampling. Each pond is size of 40x20x5m. During the period of study, various physico-chemical parameters of six ponds were studied. Their range was found as: Depth of ponds was ranged between 1 meter to 1.5 meters. The ambient temperature was between 33 to 41.5 ^{o}C and pond water temperature was noted between 28.5 to 36 ^{O}C. pH ranged as 7.0 to 8.5, Total dissolved solids was ranged between 116 to174 ppm, Electrical conductivity was ranged as 230 to 346 µS/cm, Dissolved oxygen concentration was between 104 to 352 mg/l, Free carbon dioxide was between 44 to 220 mg/l. Total alkalinity was ranged as 1400 to 2600 mg/l, Total acidity was between 150-450 mg/l and Total hardness was in between 100 to 250 mg/l. Total 11 parameters was studied. From this study, it may be concluded that, the range of physico-chemical characteristics of ponds are within range recommended by FAO for the good fish production. These ponds are suitable for the culture of fishes and prawns. Fish culture includes Indian major carps like Catla, Rohu and Mrigala and Prawn culture include Giant freshwater prawn *Macrobrachium rosenbergii*.

Key words: Limnology, Amalnala fish farm, Fishery potential.

1. Introduction

Aquaculture continues to increase in volume and value of output in many countries of the world, filling the gap between the supply and demand for fish and fishery products, improving nutrition, creating new or additi-onal employment and contributing to the household economy, particularly in rural areas [1]. Aquaculture has a tradition of about 4000 years. It was began in China, possibly due to the desires of an emperor to have a constant supply of fish. Another possibility is that aquaculture developed from ancient practices for trapping fish with the operations steadily improving from trapping-holding to trapping-holding-growing and finally into complete husbandry practices [2].

A number of aquaculture practices are used worldwide in three types of environments (Freshwater, brackish water and marine water) for a great variety of culture organisms. Freshwater aquaculture is carried out either in fish ponds, fish pens, fish cages or on a limited scale in rice paddies. Brackish water aquaculture is done mainly in fish ponds located in coastal areas. Marine culture employs either in fish cages or substrates for molluscs and sea weeds such as stakes, ropes and rafts [1].

Water quality management constitutes an integral aspect of aquaculture operation. Since the maintenance of healthy aquatic environment for the production of food organisms in ponds is of primary importance for higher yield [3]. Limnology is the study of physical, chemical and biological factors of any water body; it may be fresh water, brackish water of marine water. According to Stickney [4], the aquaculture animals perform best when they are not subjected to stressed environment. Part of the secret of controlling stress is found in maintaining good water quality. Aquaculturist need to have a good working knowledge of water quality and its effect on aqua-cultural species. There are relatively few methods that have proven useful in improving water quality in ponds. These include site selection to ensure a water supply of adequate quality, control of suspended solids in incoming water, limiting to neutralize acidity, fertilization to enhance phytoplankton growth, regulation of stocking and feed rates, control over feed quality and feeding techniques, mechanical aeration, mechanically induced water circulation, water exchange, herbicide and algaecide applications and treatment of effluents by sedimentation or wetlands [5]. Shigeno [6] reported that the maintenance of the quality of water is pre-requisite for all culture systems for better yield. The important physico-chemical factors which influence on the pond productivity individually or synergistically are depth, temperature, pH, electrical conductivity, total dissolved solids, dissolved oxygen, free carbon di-oxide, total alkalinity, total acidity, total hardness and dissolved nutrients [7].

Maharashtra has a wide potential for aquaculture. Its coastal belt is of 720 Km. length. Coastal area includes Raigad, Ratnagiri and Sindhudurg Districts. In these districts, brackish water and marine water aquaculture is possible and Fresh water aquaculture area in Maharashtra is West Maharashtra, Marathawada and Vidarbha regions. These areas also have great potential for fishery. Therefore, this study has been taken up in order to know about the limnology of some fresh water ponds of Government Fish Farm, Amalnala, at Bailampur near Gadchandur in Rajura Tahsil of Chandrapur District of Maharashtra, India with reference to its fisheries potential.

2. Materials and Method

The Government Fish Farm is located just below the Amalnala dam at Bailampur. It is 5 km. from Gadchandur and is in Rajura Tahsil of Chandrapur District of Maharashtra, India. Amalnala dam was constructed on Amalocalalla river in 1985. It is an earth fill dam. Its capacity is 21,200 km^3 (5100 cu mi). Its water is used for irrigation. Gadchandur is surrounded by many Cement factories including Manikgarh Cement, Ultra-tech Cement, Dalmia Cement and Maratha Cement Works (Ambuja Cement). The total area of

Figure 1: A view of a rearing pond at Amalnala

Government Fish Farm, Amalnala is around 12 hectare. The ponds are established in 8.3 hectare. These ponds are very old ponds, about 38 years old. It was excavated in 1983 by the Government of Maharashtra under Department of Fisheries Development. There are total 17 ponds including 1 breeding pond, 8 nursery ponds and 8 rearing ponds along with a Chinese Circular Hatchery Unit. Recently it is renovated by Government of Maharashtra. The study was carried out in six rearing ponds. Each pond is a small and rectangular water body is of 400 sq.m. (40 m x 20 m x 5 m) area (Figure1). 1 to 1.5 meters water was available in some of these ponds (Rearing ponds) during Summer season too. The sub-surface water samples were collected from various ponds during March, 2019 to May, 2019 for a period of three months. Further study was not possible due to some problems created during sampling. The pond water samples was collected in the morning time between 10.00 a.m. to 12.00 p.m. Parameters like depth, ambient and water temperature, pH, electrical conductivity, and total dissolved solids water analyzed on ponds and dissolved oxygen, free carbon di-oxide, total alkalinity, total acidity and total hardness was analyzed in the laboratory. Standard methods of APHA, AWWA and WPCF [8] and Khanna and Bhutiani, [9] were followed for the analysis of water samples.

3. Results and Discussion

Table 1: Range of variation in physico-chemical characteristics of some ponds of Government Fish Farm, Amalnala, Bailampur during Summer season.

Sr. No.	Water parameters	Range of variations
1	Depth (meters)	1.00 to 1.50
2	Ambient temperature (^{O}C)	33 to 41.5
3	Pond water temperature (^{O}C)	28.5 to 36
4	pH	7.5 to 8.6
5	Electrical conductivity (µS/cm)	230 to 346
6	Total dissolved solids (ppm)	116 to 174
7	Dissolved oxygen (mg/l)	104 to 352
8	Free Carbon di-oxide (mg/l)	44 to 220
9	Total alkalinity (mg/l)	1400 to 2600
10	Total acidity (mg/l)	150 to 450
11	Total hardness (mg/l)	100 to 250

Depth:
The depth of water in six different rearing ponds was ranged between 1 to 1.5 meters. According to Baluyut's [1] report, a pond water depth of 1 to 1.5 meters is considered best for the culture of Carps, Tilapia and Prawns.

Temperature:
Temperature is an important parameter of any water body. It affects on the growth of aquatic animals. In the present study, two types of temperatures was recorded, viz., 1. Ambient temperature and 2. Pond water temperature. The ambient temperature was ranged between 33 to 41.5 ^{o}C and pond water temperature was between 28.5 to 36 ^{o}C. The temperature in all these ponds was influenced by seasonal change in ambient temperature. Ideal temperature 24 to 30^{o}C holds good for fish culture in ponds according to the guidelines for water quality management for fish culture in Tripura [10].

pH:
pH is an important limiting factor in fish culture. It indicates the acid-base balance of the water. The survival and growth of fish is also depends upon the pH of water. The ideal pH for the growth of fishes is between 7.0 to 8.5. Above and below this is stressful to the fishes. In the present study, pH was ranged between 7.5 to 8.6. Similar results were reported by Bhavimani *et al*. [10] and Kamal *et al*. [11].

Electrical conductivity:
The electrical conductivity of pond water was ranged between 230 to 346 µS/cm. in various rearing ponds during the period of study. Zebib and Teame [12] reported electrical conductivity with mean value 284 and 358 µS/cm. in Korrir and Laelay Wukro dams in Northern Ethiopia.

Total dissolved solids:
In the present study, the total dissolved solids was ranged between 116 to 174 ppm. According to Deepak and Singh [13], total dissolved solids concentration below 200 mg/l is promoted for fish culture even in healthier spawning condition. Our results are similar with the study of Deepak and Singh [13].

Dissolved oxygen:
Dissolved oxygen is a measure of amount of gaseous oxygen dissolved in water. It plays vital role in the biology of culture organisms. Of all the dissolved gases in water, Oxygen is most important for the survival of organisms under aquaculture. Higher level of oxygen indicates that the ponds are productive while the low level of dissolved oxygen and nutrients indicate the poor productivity of ponds [14]. In the present study, the dissolved oxygen was ranged between 104 to 352 mg/l. This indicates that Amalnala fish ponds are productive in nature.

Free carbon di-oxide:
The free carbon di-oxide in water is the by-product of metabolism. Higher level of carbon di-oxide in water is toxic to the aquatic organisms [10]. It has also been shown that free carbon di-oxide concentration is always associated with low level of oxygen. There is an observation is that, when DO level is low then CO_2 level will be high and when CO_2 level is low then DO level will be high [3]. In the present study, the concentration of free carbon di-oxide was ranged between 44 to 220 mg/l. i.e., Free Carbon di-oxide was low during the period of study as compare to dissolved oxygen level.

Total alkalinity:
Aquatic animals do not have a significant physiological requirement for water born bicarbonate or carbonate, but total alkalinity is an important environmental variable in aquaculture because it interacts with other variables that affect the ecosystem [5]. In the present investigation, the total alkalinity was reported between 1400 to 2600 mg/l.

Total acidity:
The capacity to react with a strong base to a fixed pH is called as 'Acidity of water'. Acidity in water result in change of its quality which may be due to strong or weak acids and also due to the presence of some hydrolyzing salts. In the samples of industrial wastes, the acidity is due to the presence of hydrolysable metal

ions whereas in freshwater, the acidity is due to the presence of free carbon di-oxide [9]. In our study, the total acidity of fish ponds at Government Fish Farm, Amalnala, Bailampur was range between 150 to 450 mg/l.

Total hardness:

The concentration of divalent cations in a water sample provides the value for a parameter called 'Hardness'. The dominant divalent cations are Calcium and Magnesium. Like total alkalinity, the total hardness is determined through a titration process and is also reported in milligrams per litre or ppm of $CaCO_3$. Soft water is defined as having a hardness of 0 to 55 mg/l. Values between 55 to 201 mg/l are considered to be Slightly hard (56-100 mg/l) or Moderately hard (101 to 200 mg/l.). Very hard water has a hardness ranging from 201 to 500 mg/l. Anything above 500 mg/l is considered to be extremely hard [4]. Kumar *et al.* [15] reported that the total hardness between 380 to 480 mg/l in Akshar Vihar ponds in Bareilly, Uttar Pradesh. Yadav *et al.* [16] was studied a fresh water ponds of Orai in Uttar Pradesh and noted the total hardness ranged between 236.57 mg/l to 290.25 mg/l. In the present study, the total hardness of Government Fish Farm, Amalnala, Bailampur was ranged between 100 to 250 mg/l.

4. Conclusion

From this study, it may be concluded that-

1. The Fish ponds are productive in nature. Water quality should be maintained.
2. These ponds are suitable for the culture of the culture of fresh water fish like Indian major carps, viz., Catla, Rohu and Mrigal.
3. In these ponds, it may be possible of culture of fresh water prawn like *Macrobrachium rosenbergii* along with fishes.

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Conflict of interest

No conflict of interest influenced in this research.

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