

A Comparative Study Among Three Different Types of Productive Ponds of Bankura District of WB, India

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Abstract Pisciculture is a proficient commercial means of upkeep for rurals of Bankura district (particularly in Onda Block of Ramsagar village) of West Bengal, India. Due to various natural and anthropogenic causes, fish mortality has become a great trouble of Bankura town nowadays. In this present study we have tried to find out the causes of fish mortality and variation of yield (fish production) of some ponds of Bankura town in relation to various physico-chemical and hydro-biology (plankton) parameters. Also we tried to study the effects of phytoplankton as well as of zooplankton on fish production.

Keywords Bankura town, Phytoplankton, Zooplankton, Physico-chemical parameters.

Introduction

Pisciculture is an important factor for economical development of Bankura district, which is one of the backward districts of West Bengal. Still Bankura has ranked first in pisciculture (particularly in spawn production) within West Bengal (According

to the Office of the Additional Director of Fisheries, Bankura, West Bengal, India ; www.bankura.org.in/site/Fisheries.htm). The village Ramsagar of Onda Block (Onda Block consists of rural areas with 15 g panchayats, Ramsagar is one of them) of Bankura district is a widely known destination with more than 250 hatcheries. The fish-breeding industries of Ramsagar and the surrounding zone requires special attention, as it provides a transaction of about Rs 6-7 crores through spawn production of about 50,000 million (in about 250 hatcheries) per annum. About 1,500 to 2,000 numbers of workers are directly involved in this production system, many other enterprises have also grown by correlated activities. Spawn purchasers from different parts of India use to come here every year to purchase various types of fish spawn. Water is one of the most precious natural resources present on the earth and it is very important for survival of flora and fauna. Quality of water is equally important as the quantity available while considering the total percentage of water present on earth as 97% in ocean and 3% as a fresh water (considering glaciers) out of which 2% as fresh water in the form of surface and subsurface water bodies and is usable for human consumption. Water quality is directly related to the physical, chemical and biological property of water (Gawande and Phadatare 2016). For the fish culture at the water bodies with economic importance the farmers manicure the physico-chemical factors as per conventional method. Thus we can maintain the biological factors for culture purpose. In non-manicured water bodies, the physico-chemical factors are abruptly disturbed and as a result the biological factors are affected in certain cases (Majumder et al. 2016). During the last several decades, due to continuous discharge of industrial wastes and domestic sewage

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Fig. 1. The satellite view of three different sampling sites of Bankura town of West Bengal.

the water quality of the Indian water bodies has been deteriorating (Krishnan et al. 2007). The primary productivity of a water body is the manifestation of its biological production (Odum et al. 1971). It is an ultimate outcome of photosynthesis (Kaneez et al. 2011). Gross primary production depicting the total amount of organic matters produced and net primary productivity referring to the amount of organic matter produced of a particular level are the two divisions of primary productivity. Various plant communities such as phytoplankton, periphytic algae, benthic algae and macrophytes undergo photosynthetic fixation of carbon in the inland aquatic ecosystem. The degree of productivity in the aquatic ecosystem is reflected by the primary productivity i.e. the production by phytoplankton. Changes of phytoplankton, flora and their densities are indicated by change of watercolor or its intensity. Air temperature, water temperature

and light intensity are key factors for controlling the proliferation of algal bloom. The metabolic rate of living organisms is greatly controlled by temperature (Gupta et al. 2008). The factors regulating the growth and the succession of planktons are light, temperature, inorganic and organic micro-nutrients and the intraspecific or interspecific competition as well as the predatory characters among themselves. Aquatic environment depicts ecological features that lead to the establishment of a very dynamic ecosystem in which the plankton community plays a key role. Among all these plankton *Euglena* sp. plays a dominant role. *Euglena* sp. is a eukaryotic microalgae that has been the subject of scientific study for quality control of water since decades (Ellis et al. 2015). Different PAR intensities not only induces changes in the growth rates of *Euglena* sp. but also affects its pigment composition, chlorophyll fluorescence

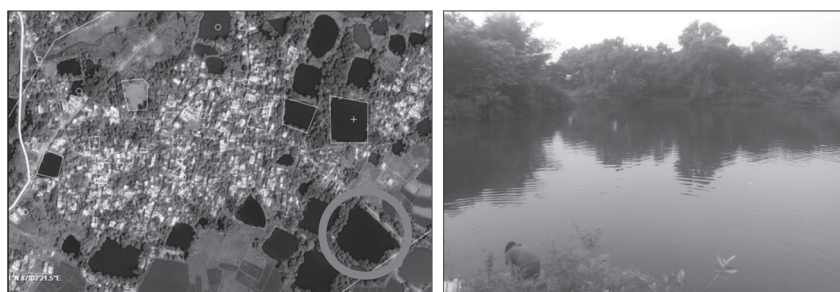


Fig. 2. Satellite and physical view of pond Daser bandh (High productive) of Rajgram, Bankura.

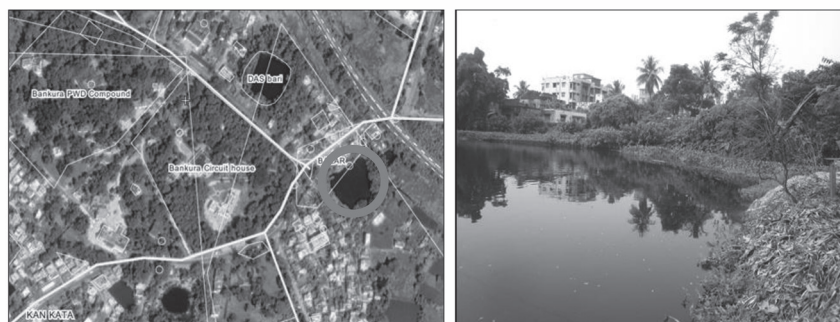


Fig. 3. Satellite and physical view of pond behind Puspa Sweets (Moderate productive), Bhairabsthan, Bankura.

parameters and antioxidant activity (Wu et al. 2015). We have noticed that, in warmer shallow and eutrophic water bodies Euglenophytes bloom is a common phenomenon. Sewage outfalls are commonly prone to Euglenophyceae growth. Interfaces such as sediment-water and air-water boundaries are particularly exposed to Euglenoids. Chlorophyll *a*, chlorophyll *b*, chlorophyll *c*, carotene, euglenorhodone, β -carotene, zeaxanthin, flovoxanthin, flavicin are major pigments found in *Euglena* sp. (Walne et al. 1990). A variety of environmental factors are responsible for distribution of a species.

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Materials and Methods

The total fieldwork was carried out consecutively for six months from July to December, 2017 at three different sites of Bankura town (Figs. 1–4). The three sites are : High productive site: The pond Daser bandh (Fig. 2) of Rajgram, Bankura. Moderate productive site: The pond behind Puspa Sweets (Fig. 3) of Bhairabsthan, Bankura. Less productive site: The pond of Sahanapally (Fig. 4), Bankura.

For the analysis of physico-chemical parameters (like water pH, dissolved oxygen (DO), free and dissolved CO_2) the water samples were collected in the morning between 6.00 AM to 7.00 AM from each of three collection sites. The main aim of the present study is to investigate the causes of variations in fish yield among these three ponds. All these three ponds are being used by the villagers for their common purposes and fishing also.

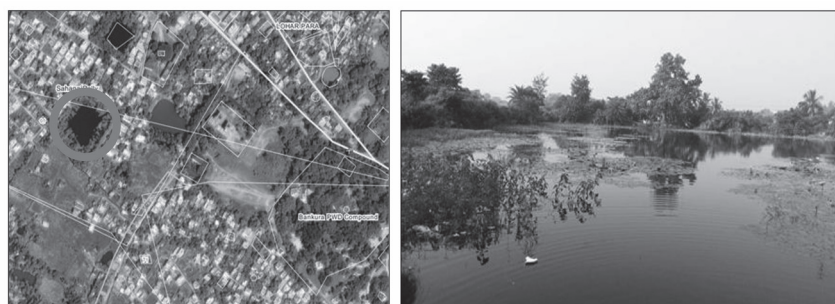


Fig. 4. Satellite and physical view of pond of Sahanapally (Less productive), Bankura.

Table 1. The physico-chemical and hydro-biological parameters of three different types of productive ponds of Bankura district of WB, India from July to December, 2017 are being summarized here. The values of different physico-chemical parameters are Mean \pm SE where N=12.

→ ↓ Sampling sites Parameters observed	Pond Daser bandh of Rajgram, Bankura (High productive)	Pond behind Puspa Sweets of Bhairabsthan, Bankura (Moderate productive)	Pond of Sahanapally, Bankura (Less productive)	BSI standard
Shape of the pond	Almost of trapezium shape	Almost of round shape	Almost of trapezium shape	–
Latitude	23°12'56'' N	23°13'51.1'' N	23°14'01'' N	–
Longitude	87°02'22.1'' E	87°03'14.4'' E	87°02'42'' E	–
Air temp (°C)	31 \pm 5.2	35 \pm 4.1	33 \pm 3.3	–
Water temp (°C)	29 \pm 1.6	31 \pm 1.8	30 \pm 1.5	<40C
pH	8.11 \pm 0.68	7.60 \pm 0.71	7.67 \pm 0.54	6.5–8.2
Dissolved O ₂ (mg/L)	4.21 \pm 0.56	1.74 \pm 0.25	0.64 \pm 0.05	Upto 6.0
Free CO ₂ (mg/L)	355 \pm 26.5	365 \pm 23.8	372 \pm 28.1	–
Dissolved CO ₂ (mg/L)	402 \pm 38.2	398 \pm 34.6	376 \pm 38.6	–
Qualitative analysis of plankton	zooplanktons observed but to a meager amount	Phytoplankton huge in number but very little zooplankton observed	Very little phytoplankton and zooplankton observed	–

The hydrogen ion concentration (pH), dissolved oxygen, free CO₂ and dissolved CO₂ were determined following standard methods of APHA-AWHA-WPCF (2005). The values were compared with standard values of BIS, Bureau of Indian Standards (2003), Khanna and Bhutiani (2008). A Celsius thermometer (scale ranging from 0°C to 100°C) was used to measure air and surface water temperature. pH of water was measured directly using a digital electrode pH meter (Systronics, Model No. SYS-335). The planktons were collected with a modified nylon bolting silk plankton net (No. 25 mesh size 50 μ) with a round metallic frame of 0.625 sq.m. area was used for collection of planktons. Collected samples were transferred to the labeled vials which contain 5%

formalin solution. The plankton was observed and documented using Magnus Trinocular Microscope (Model MLX TR) attached with Nikon Coolpix Camera. The chemicals used (during the experiments) for analysis of the parameters was with highest purity available or of analytical AR grade.

Results and Discussion

We all know that the water pH is a critical factor that determines many biological and chemical factors. The pH values were recorded here ranging from 7.60 to 8.11, marginally neutral to basic. At moderate and less productive sites we found slightly low pH value (Table 1), the reason may be organic matter decom-



Fig. 5. Fishing activities at pond Daser bandh of Rajgram (High productive), Bankura.

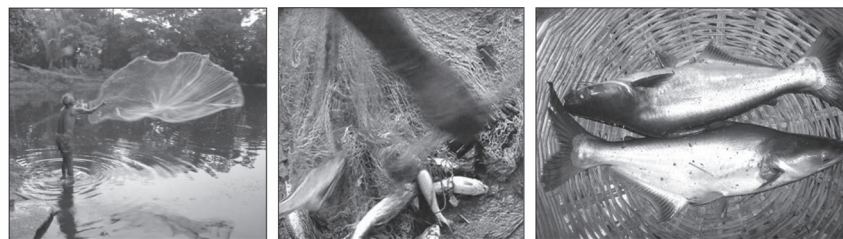


Fig. 6. Fishing activities at pond behind Puspa Sweets (Moderate productive), Bhairabsthan, Bankura.

position (Majumder et al. 2016).

It is also known that the dissolved oxygen (DO) plays a crucial role in sustaining flora and fauna in aquatic ecosystem. Among the three ponds, the pond of Daser bandh shows the highest (4.21 mg/L) level of DO in comparison to the other two sites (Table 1). A huge number of phytoplankton (mainly *Euglena* sp.) was observed at the moderately productive site and comparatively less amount of *Euglena* sp. at the less productive pond site. The DO level should increase at moderately productive site as the phytoplankton density is huge there, but the overall biomass and the O_2 consumption level is really very high at this moderately productive site. As the timing of water collection was 6-7 AM ; the level of DO was consequently lower due to low sunlight. Furthermore, bloom of the phytoplankton and some algae has a blanketing effect on the fish pond, thereby preventing the entry of sunlight into water that greatly affects the growth of beneficial algae by hampering photosynthesis. As a result DO level also depletes.

Dissolved and free CO_2 in water plays an im-

portant role in maintaining the aquatic life. Main sources of carbon dioxide are respiration of aquatic organisms and also mixing of air CO_2 with the water bodies. Due to the high affinity of CO_2 towards water, they can react to form carbonic acids and carbonates which alters the pH of water. In this study no such remarkable change is observed (Table 1) in free and dissolved CO_2 value.

From Fig. 2, it is evident that the Dasher bandh pond is almost of trapezium shape. The water is almost transparent and is ideal for fishing purposes. High yield of fishes (Fig. 5) is derived from this pond, every week during the early morning. Among the zooplankton populations Rotifers (mainly *Brachionus* sp.) and Copepods (mainly *Cyclops* sp.) are found predominantly. This pond is regularly maintained due to economic purposes.

From Fig. 3, it is evident that the pond behind Puspa Sweets is almost round shaped Moderate fishing practices (Fig. 6) are carried out here in this pond. Water is moderately turbid. Among planktons *Euglena* sp. are present in huge number. The presence



Fig. 7. Fishing activities at pond of Sahanapally (Less productive), Bankura.

of *Euglena* sp. in huge number may be one of the reasons for an improper yield in this pond. This pond is not well maintained from the fishery point of view. Organic wastes are casually dumped at the edges. Various household activities are also carried out here.

From the Fig. 4, it can be said that the pond of Sahanapally is almost of trapezium shape. Fishing activities are very rare in this pond because of its low yield (Fig. 7). Water is turbid no. notable zooplanktons were noticed, only protists were present, that too in a very meager amount. The presence of various debris and sewage products makes the pond unhealthy for aquaculture purposes.

It is known that the phytoplankton is natural food for various fishes and shrimps inhabiting the first producer level in energy flows. It acts as the primary producer of the water and also acts as one of the main life sources for almost all the animals. Phytoplankton produces the dissolved oxygen in the water. In the food chain, phytoplankton is eaten by herbivores (such as zooplankton), which consequently is eaten by larger carnivores (like fish and others). Factors supporting the phytoplankton growth are very complex and interacting between physical and chemical factors, such as dissolved oxygen, temperature, visibility and the availability of nutrients, nitrogen and phosphorus.

Conclusion

As we know that the zooplanktons are the connecting links between autotrophs and heterotrophs and its density is also directly correlated with pisciculture potentiality. So, it is necessary to maintain proper zooplankton community to grow the yield of any pond. Although, the algal bloom indicates high productivity of the water body concerned but excessive algal bloom causes serious economic losses to aquaculture; the same type of economic loss is been observed by the owner of the moderate productive pond (behind Puspa Sweets) of Bhairabsthan, Bankura. *Euglenophytes* bloom often leads to environmental degradation that hampers growth of fishes. Their bloom often creates water quality problems, the most severe of which being the oxygen depletion leading to mass mortality of fish.

Management of water body like pond essentially requires an understanding of physico-chemical and biological conditions. The aquatic environment in an area is controlled by the changes in factors such as light, heat, humidity and contamination of various effluents in the water body. It can also be said that the overall productivity of a water body is directly regulated by physico-chemical as well as biological parameters.

If the ponds are being manured in a proper way by using sludge and other materials regulating physico-chemical factors, it ultimately leads to the change of biological factors like plankton. A suitable phytoplankton population enriches the ecosystem with oxygen through photosynthesis during day light hours and lowers the levels of carbon dioxide, ammonia, nitrite, hydrogen sulfide, methane.

Here, from this work we can summarize that, the pond Daser bandh, amongst the three studied ponds of Bankura town, is comparatively higher productive; but with proper guidance (e.g., use of fertilizer, less use for household practices like bathing, washing-clothes) being provided to the owners and users of the other two ponds, then these two (comparatively lower productive) ponds may become more productive. So, more intensive study is required to correct the ponds of Bankura town to have favorable qualities like those of the ponds of Ramsagar village of Bankura district. If this can be done in a proper way, then, besides Ramsagar village we can proudly add the name of Bankura town also for its high potentiality in fish production.

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