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# Effects of artificial feeds on production of fishes in polyculture

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**Abstract**
A study on the effects of artificial feeds on the growth and production of fishes in polyculture in 6 ponds along with some limnological conditions was conducted. Species of Indian and Chinese major carps (*Labeo rohita, Catla catla, Cirrhinus mrigala, Hypophthalmicthys molitrix*) and catfishes (*Clarias batrachus, Clarias gariepinus*) were stocked in 6 ponds. Stocking rate in both cases were 32044 fingerlings per hectare. Ratio of species of Rui : Catla : Mrigal : Silver carp : African Magur : Local Magur = 25% : 25% : 5% : 25% : 14% : 6%. Fertilization and artificial feeds were given in 3 ponds (treatment I) and only fertilization was done in other 3 ponds (treatment II). Average yield/ha/yr was 7.903 m.ton in case of fertilization and artificial feeding application and 3.374 m.ton in case of only fertilization application.
Urea, TSP and cowdung were applied fortnightly at the rates of 400 kg/ha/yr, 2000 kg/ha/yr and 4000 kg/ha/yr respectively. Wheat bran, rice bran and mustard oil cake were given daily as an artificial feed in treatment I. Whereas treatment II was conducted without any artificial feed. Ratio of artificial feed was wheat bran : rice bran : oil cake = 2 : 2 : 1 (by wt). Absence of artificial feed in 3 ponds under treatment II seriously affected the growth and production of fish.

**Key words** : Artificial feeds, Fertilization, Water quality, Polyculture

## Introduction

Fertilization is one of the most important techniques to increase the fish production. Through fertilization natural food of fish i.e. plankton is increased. On the otherhand artificial feed application is the another most important technique to increase the fish production. Plankton constitutes the foundation of food chain in aquatic ecosystem. Inorganic fertilizers increase mainly the phytoplanktonic population of pond water. Organic fertilizers increase mainly zooplankton. The greater is the plankton biomass, the larger is the standing crop.

The composition of supplementary diets should be simpler and less expensive. In order to be economically beneficial the efficiency of supplementary diets must be as high as possible. This depends to a large extent on the level of feeding and the composition of the diet (Hepher and Pruginin 1981).

In view of the above facts the author felt necessary to study the effects of fertilization and feeds on composite fish culture and fish production along with

limnological conditions in 6 experimental ponds with the following objectives: (i) To study the effects of artificial feeds on the growth and production of fishes in polyculture system. (ii) To study the limnological conditions of the experimental ponds under two treatments.

## Materials and methods

The study was conducted for a period of 3.5 months from August to November'92 in six ponds at the campus of Bangladesh Agricultural University, Mymensingh. All the ponds were rectangular in size having an area of 0.004 hectare. All the ponds were situated side by side in the same area.

### *Study of limnological conditions*

Water quality parameters were determined following standard methods (APHA 1971) and data of rainfall and sunshine were collected from Bangladesh Agricultural University Weather Yard. Plankton was studied according to Rahman (1992), Prescott (1962), Needham and Needham (1962) and Pennak (1953).

### *Supplementary feeds*

Three ingredients such as wheat bran, rice bran and mustard oil cake were applied as supplementary fish feed once daily in the morning between 0800 and 0900 h. The required amount of feed was mixed with a little amount of water to make it into a thick `dough' rolled into balls. The balls were then thrown into the ponds.

Feed was supplied everyday at the rate of 5% of the total fish biomass. Fish sampling was carried out at an interval of 15 days in order to calculate the increase in total wt. and to adjust the amount of feed.

### *Experimental design*

The experiment was done according to the following experimental design.

| Treatments | Description of the treatment | Ponds |
|---|---|---|
| Treatment I | Aritificial feeding (wheat bran: rice bran: mustard oil cake = 2:2:1 by wt.) and fertilization (cowdung, 4000 kg/ha/yr; urea, 400 kg/ha/yr; and T.S.P., 2000 kg/ha/yr. | 1, 2, & 3 |
| Treatment II (control) | Only fertilization (cowdung, 4000 kg/ha/yr; urea, 400 kg/ha/ T.S.P., 2000 kg/ha/yr. | 4, 5, & 6 |

## Results and discussion

The results of the experiment regarding the physico-chemical and biological parameters such as water temperature, air temperature, transparency, rainfall, sunshine, dissolved oxygen, free $CO_2$, pH, total alkalinity, $PO_4$-P, $NO_3$-N, plankton,

and productions of fishes have been presented in Tables 1 and 2 and have been discussed below.

**Table 1.** Fortnightly limnological conditions of the ponds under two treatments

| Factors | Treatment I (± s.d.) | Treatment II (± s.d.) |
|---|---|---|
| Air temperature ($^oC$) | 29.96 | 29.96 |
| Water temperature ($^oC$) | 28.93 ± 2.53 | 29.06 ± 2.64 |
| Transparency (cm) | 24.53 ± 6.93 | 33.25 ± 5.98 |
| Rainfall (mm) | 0.86 ± 0.50 | 0.86 ± 0.50 |
| Sunshine period (hrs) | 6.74 ± 2.13 | 6.74 ± 2.13 |
| Dissolved $O_2$ (mg/L) | 4.14 ± 1.58 | 4.10 ± 1.36 |
| Free $CO_2$ (mg/L) | 6.13 ± 0.89 | 5.88 ± 0.55 |
| PH | 6.95 ± 0.23 | 6.71 ± 0.18 |
| Total alkalinity (mg/L) | 139.88 ± 30.80 | 97.88 ± 13.09 |
| $PO_4$-P (mg/L) | 0.48 ± 0.68 | 0.63 ± 0.96 |
| $NO_3$-N (mg/L) | 2.11 ± 0.39 | 2.03 ± 0.57 |
| Phytoplankton density ($X10^3$ cells/L) | 18620.71±3416.99 | 13931.00±2135.43 |
| Zooplankton density ($X10^3$ cells/L) | 2672.14±491.29 | 2157.86 ± 804.73 |

**Table 2.** Estimated yield of fish of the ponds under different treatments

| Treatments | Pond no. | Yield of fish ton/ha/yr | Average yield ton/ha/yr | Percent increment of yield of treatment I over treatment II |
|---|---|---|---|---|
| Treatment I (Fertilization + artificial feeding) | 1 | 8.997 | 7.903 | 234.23% |
| | 2 | 7.593 | | |
| | 3 | 7.120 | | |
| Treatment II (Only fertilization) | 4 | 3.274 | 3.374 | |
| | 5 | 3.387 | | |
| | 6 | 3.460 | | |

### *Limnological conditions*

***Temperature($^oC$)*** : During the period of investigation fortnightly average air and water temperature ranged from 24.7 to 32.2$^o$C and 23.2 to 31.3$^o$C and the mean values were 29.94 ± 2.34$^o$C and 28.93 ± 2.53$^o$C respectively.

***Transparency (cm)*** : Fortnightly average transparency ranged from lowest 13.1 cm in the month of November to highest 40 cm in the month of September. The high values of water transparency in September were probably due to increased volume of water and decreased concentration of plankton. Saha and Sinha (1969) recorded the highest values of transparency in August and September during increased rainfall.

***Rainfall (mm)*** : During the period of investigation rainfall ranged from 0 to 1.32 cm. The highest rainfall was recorded in the month of September which was 1.32 cm and the lowest rainfall was recorded in the months of October, November which was 0.00 cm.

***Sunshine period (hrs)*** : During the period of investigation sunshine period varied from 3.25 to 9.0 hrs. Period of sunshine was highest (9.0 hrs) in the month of October and it was lowest (3.25 hrs) in the month of August.

***Dissolved oxygen (mg/L):*** The dissolved oxygen showed fortnightly variations in all the ponds during the study period. Its concentrations varied from 1.9 to 6.8 mg/L in the ponds under treatment-I & 2.4 to 6.5 mg/L in the ponds under treatment II.

The high values of dissolved oxygen content were found in November and low in August. The highest value of dissolved oxygen was probably due to low temperature. The low values of dissolved oxygen was due to greater consumption of oxygen by organic matter and suspended substances and also due to reduced photosynthetic activity of phytoplankton as the weather was cloudy.

***Free carbondioxide (mg/L)*** : The free carbondioxide content of the ponds under different treatments were not hazardous to fishes. Mean values under treatments I & II were 6.13 ± 0.89 and 5.88 ± 0.55 respectively. At very lower values or even at 0 mg/L of free $CO_2$ the photosynthetic activities of phytoplankton occur normally. High concentrations of free $CO_2$ toxic to fish are usually accompanied by low values of dissolved oxygen. In general, free $CO_2$ in excess of 20 mg/L may be regarded as harmful to fishes, although lower values may be equally harmful in waters of low oxygen content (less than 3 to 5 mg/L) (Lagler 1972).

***pH*** : Fortnightly average pH values as recorded were in alkaline range in all the ponds which indicate suitability for fish culture.

***Total alkalinity (mg/L):*** The average mean values were 139.88 ± 30.80 mg/L under treatment I and 97.88 ± 13.09 mg/L under treatment II. According to Mairs (1966) water bodies having total alkalinity 40 mg/L or more are considered more productive than waterbodies of lower alkalinity. According to Boyd (1982) total alkalinity should be more than 20 mg/L in fertilized ponds.

***Phosphate-phosphorus (mg/L):*** The ranges of phosphate-phosphorus were 0.13 to 2.12 mg/L under treatment I and 0.11 to 2.93 mg/L under treatment II. The values of phosphate-phosphorus were more of less same in the months of August, October and November but were higher in all the ponds during the month of September. Rain might had increased the amount of $PO_4$-P in September. High values of $PO_4$-P in September were due to low concentration of phytoplankton as maximum of the days were cloudy, so consumption rate of $PO_4$-P was also low. Moyle (1946) from a study of a large number of lakes and ponds, gave the phosphorus fertility scale as 0.00-0.02 mg/L (low), 0.02-0.05 mg/L (fair), 0.05-0.10 mg/L (good), 0.10-0.20 mg/L (very good), and above 0.20 mg/L (excessive).

***Nitrate-nitrogen (mg/L):*** The ranges of $NO_3$-N were 1.63 to 2.61 mg/L under treatment I and 1.23 to 3.13 mg/L under treatment II. The cause of the higher values of phosphate-phosphorus and nitrate-nitrogen might be due to regular fertilization done in the ponds.

***Plankton***

Plankton is the basic food of all the organisms living in the water. Directly or indirectly fishes and other aquatic organisms depend on plankton. Fertilization is the cheapest and simplest means for increasing aquatic productivity. Fortnightly variations of phytoplankton and zooplankton have been shown in Fig. 1. The plankton population showed an increase with the fertilizer application in all the ponds. The fluctuations in abundance of both phytoplankton and zooplankton were not similar in the ponds under treatments I and II.

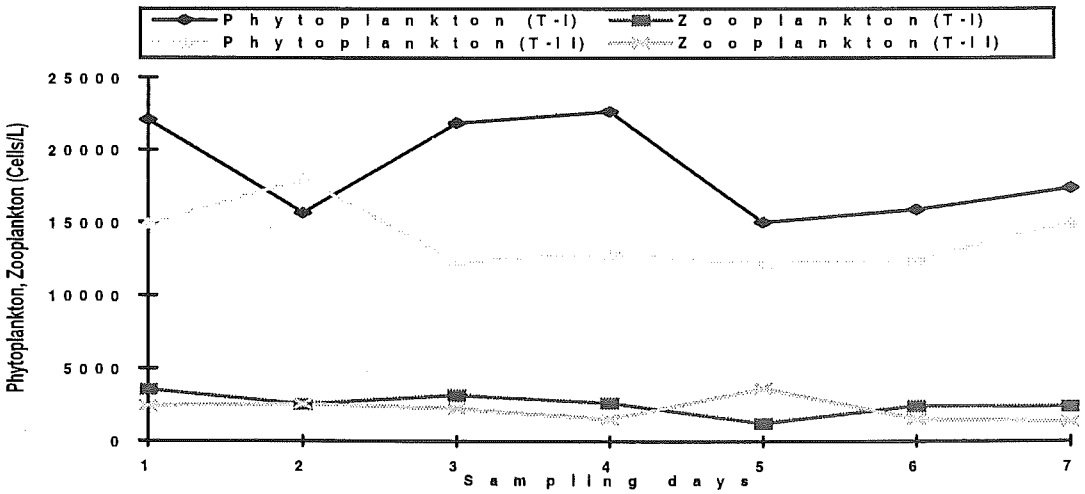


**Fig. 1.** Fortnightly variations of density of phytoplankton and zooplankton of the ponds under treatments I & II.

*Fish production*

Production of fishes has been shown in Fig. 2 where all the species showed the higher yields in treatment-I which was probably due to supplementary feed application. Similar results were found by Lakshmanan *et al.* (1971) and Murty *et al.* (1978). Partially similar results were found by Hossain *et al.* (1997) who got best growth performance of mirror carp, tilapia and Thai sharpunti in treatment III which received both fertilization and artificial feeding. The production of fish of different ponds under two treatments have been presented in Table 2. It is seen from the table that average yield of all species of fish was 7.903 ton/ha/yr under treatment I when the average yield of fish was 3.374 ton/ha/yr under treatment II. The percent increment of fish yield under treatment I over treatment II was 234.23%, that is artificial feeding increased fish yield more than double. In pond nos. 4, 5 & 6, (treatment II) total yields were not satisfactory due to the absence of artificial feed. Kuronuma (1968) conducted an experiment for 5 months by stocking 1.41 metric tons of carp fingerlings in 6 net cages of which 3 were 181 $m^2$ and the rest 29 $m^2$ and 9.4 tons of fish were harvested by supplying 13.1 tons of feed and the net production was 29 $kg/m^2$.

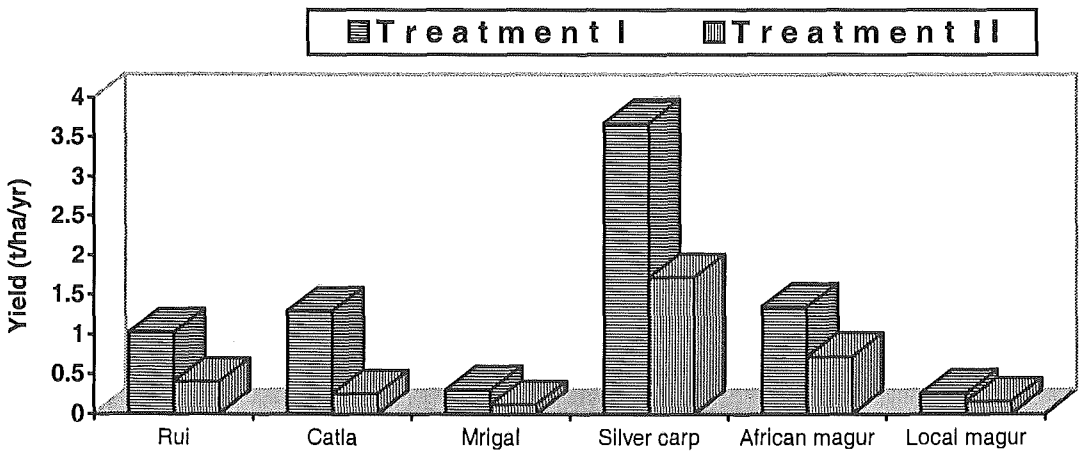


**Fig. 2.** Species-wise estimated yield (t/ha/yr) under treatments I and II.

Faluroti and Omorinkoba (1987) found maximum estimated yield of fish about 1.5 ton/ha/75 days in a pond, which is similar to that of the present experiment; in an experiment entitled 'Performance of fertilization and supplementary feeding on fish production under a polyculture system in warm water fish ponds' in Nigeria.

Ahmed and Sheri (1994) found in an experiment of culture of *Channa marulius* that best growth was in the group where organic and inorganic fertilizers, artificial feed and Tilapia as forage fish were supplied followed by next best growth in the group where fertilizers and artificial feed were added.

Ghosh *et al.* (1984) conducted an experiment entitled 'Effects of feeding rates on production of common carp and water quality in paddy-cum-fish culture' in which

the fish were fed on a mixture of rice bran and mustard oilmeal (1:1) at the rates of 2, 4, and 6% of total body weight and found that the growth of individual fish and fish yield increased with the increasing feeding rates.

## Conclusions

Average yield was 7.903 M.ton/ha/yr in case of fertilization and artificial feeds application and 3.374 M.ton/ha/yr in case of only fertilization. Absence of artificial feed in 3 ponds under treatment II seriously affected the growth and production of fish. The fish yield under treatment I (fertilization + artificial feeding) was 234.23% higher than that under treatment II. Finally it can be concluded that in fish culture artificial feeding should be done along with fertilization because artificial feeding increases fish production very significantly.

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