

Effects of Organic and Inorganic Fertilizers on the Growth Performance of Carps in Earthen Ponds through Polyculture System

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Abstract

Aquaculture is the fastest-growing food-producing sector in the World and has exhibited continuous improving in total production throughout the recent decades. A carp polyculture experiment was carried out to evaluate the growth performance of major carps in semi-intensive fish culture system. Two earthen ponds located at Kadirganj of Boalia thana under Rajshahi district of Bangladesh were selected to study the effect of fertilizer (organic as cowdung and in-organic as triple super phosphate) in supplemented ponds on the growth of carps. Pond -01 was fertilized with cowdung and TSP at the rate of 1728 and 20 kg/h respectively, at 10-day intervals. Pond -02 was without fertilizer. Each pond was stocked with 30% *Labeo rohita*, 20% *Catla catla*, 15% *Cirrhinus mrigala*, 15% *Hypophthalmichthys molitrix*, and 20% *Cyprinus carpio* with a total stocking density of 10000/ha. Both ponds were supplemented with mustard oil cake, rice bran and maize bran at the rate of 2.5 kg/ha for each, given for a period of six months as daily basis. The net fish production was found to be 2605 and 1795 kg/ha/year in pond -01 and pond -02, respectively. The results showed that fish production was significantly higher in pond -01 than pond -02 ($P < 0.05$). Pond -01 showed 1.45 times greater fish production than that of pond -02. The results of this study provided invaluable information for the sustainable aquaculture, as well as providing an important baseline for future studies within Bangladesh and surrounding developing countries.

Key words: Carp polyculture, earthen pond, organic and inorganic fertilizer

Introduction

Aquaculture is the fastest-growing food-producing sector in the World. Asia dominates aquaculture production of the world, and contributes around 87% to the global cultured fin-fish production of 25.7 million tones in 2005 (De Silva *et al.*, 2006). Aquaculture production is mainly a rural activity, where around 73% of rural households connect in some form of freshwater aquaculture in Bangladesh

(Mazid, 1999). The majority of this production was produced in semi-intensive polyculture ponds. The 'polyculture' is a system in which consists of fast growing fish species with complementary diets, in order to improve the biomass produced by the pond, and if possible, to benefit from synergic effect between the different fish species. In Bangladesh, aquaculture habitually has been absorbed polyculture of

three Indian major carps including *Catla catla* Hamilton (1822), *Labeo rohita* Hamilton (1822) and *Cirrhinus mrigala* Hamilton (1822), or occasionally with other exotic carps such as *Hypophthalmichthys molitrix* Valenciennes (1844), *Ctenopharyngodon idella* Valenciennes (1844) and *Cyprinus carpio* Linnaeus (1758) (Azim and Wahab, 2003).

Bangladesh is an agro-based country and among different sub sectors of agriculture, fisheries sector plays an important role in contributing 3.74% of GDP which is about 20.87% of total agricultural earning and about 4.04% of the export earning (DOF, 2009). Fish is an important component of human diet, as it is a rich source of animal proteins. Fish as a food can be expected to gradually resolve the threatening problem of malnutrition. Keeping in view the nutritional (Gerking, 1966) as well as medicinal value of fish meat, it is a need of the time to utilize all the available resources to develop fish industry through simple agricultural practices.

In Bangladesh, there are about 1.5 million ponds of different sizes covering an area of about 146,955 hectares of land of which about 52% is under extensive fish culture (DOF, 1991). Even though, fish culture in ponds is not a new practice in the country, the rate of fish production is still not satisfactory. Improper management and production technology e.g., high or low stocking, inadequate manuring and feeding etc. have been considered responsible for low production of fish. The main production systems for freshwater aquaculture in Bangladesh are extensive and semi-intensive pond polyculture of Indian and Chinese major carps which account for 80% of the total freshwater aquaculture production. The remaining 20% are mainly

from catfish, tilapia, small indigenous species (SIS) of fish and rice fish farming (ADB, 2005). However, integrated semi-intensive culture system seems to be the most acceptable due to the fact that various agricultural wastes and low value feedstuff can be utilized as a cost-effective source of fish feed. Fertilizers increase the level of primary productivity, dissolved oxygen, pH and total phosphorus (Qin *et al.*, 1995). They increase fish production without risk of dietary diseases and also play an important role in the formation of soil structure. The growth of fish is strongly correlated with increase in phytoplankton and zooplankton productivity as a result of fertilization. Under polyculture system, the use of organic and inorganic fertilizers provides basic nutrients and elements required for the production of phytoplankton and zooplankton which serve as a major source of food for fish (Javed *et al.*, 1990). Supplementary feeding plays a vital role in semiintensive system, offering the best means to enhance fish production within shortest possible time. Javed *et al.* (1993) reported that supplementary feed exerted a significant effect on the body weight, fork length and total length of fish species. Keeping in view the significance of fertilization and supplementary feeding, the present study was conducted to assess the growth performance of carps in integrated semi-intensive ponds.

Materials and methods

The experiment was carried out in two earthen ponds (pond -01 and pond -02), measuring 891 and 2227 m² respectively, located at Kadirganj of Boalia thana under Rajshahi district of Bangladesh. Before starting the experiment, ponds were prepared which includes removal of aquatic

weeds and undesirable biota. Aquatic weeds were removed manually. However, predator and unwanted fish was removed using Phostoxin tablet (locally known as gas tablet) at the rate of 4-5 pieces per decimal. Then agricultural lime (CaCO₃) at 250 kg/ha was applied. After preliminary preparations, pond -01 was initially fertilized with cowdung and triple super phosphate (TSP) at the rate of 1728 and 20 kg/ha respectively to stimulate primary productivity. However, pond -02 was without fertilizer. Each pond was stocked with 30% *Labeo rohita* (individual weight 4-5 g), 20% *Catla catla* (6-7 g), 15% *Cirrhinus mrigala* (4-5 g), 15% *Hypophthalmichthys molitrix* (4-6 g), and 20% *Cyprinus carpio* (4-5 g) with a total stocking density of 10000/ha. Fertilization of pond -01 with cowdung and TSP was at 10-day intervals at above mentioned rate. Both ponds were supplemented with mustard oil cake, rice bran and maize bran at the rate of 2.5 kg/ha for each, given for a period of six months as daily basis. After six months fish were caught and measured in terms of body weight.

Fish survival rate (S) was calculated as the number of fish harvested (Nf) as percentage of the number of fish stocked (Ni): $S (\%) = (Nf / Ni) * 100$

Data and statistical analyses were performed using Microsoft® Excel-add-in-DDXL, and GraphPad Prism 5 softwares. All data were checked for homogeneity of variance. Tests for normality of each group were confirmed with the Kolmogorov-Smirnov test. Where test for normality assumption was not met, then the non-parametric Mann-Whitney U test was applied to compare the mean value between two ponds. All statistical analyses were considered significant at 5% (P<0.05).

Results

The initial average body weight of *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, *Hypophthalmichthys molitrix*, and *Cyprinus carpio* averaged 4.3, 6.5, 4.6, 5.2 and 4.3 g for both ponds (Tab. 1). At final harvest, the average body weight was found to be 300.2, 415.7, 325.5, 400.1 and 315.6 g in pond- 02, while 600.4, 700.3, 550.1, 650.7 and 500.2 g in pond -01, respectively. There was a net body weight gain of 295.9, 409.2, 320.9, 394.9 and 311.3 g in pond -02 and 596.1, 693.8, 545.5, 645.5 and 495.9 g in pond- 01 for *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, *Hypophthalmichthys molitrix* and *Cyprinus carpio*, respectively (Tab. 1). The net fish yield for all the species together was calculated to be 1795 kg/ha/year in pond -02 and 2605 kg/ha/year in pond -01. The Mann-Whitney U test showed that the fish production was significantly higher in pond -01 than pond -02 (P<0.05). In deed, there was 1.45 times greater net fish production in pond -01 than that in pond -02. *Catla catla* showed the best growth in overall weight gain (Tab. 1).

Table 1. Growth performance and survival rate of carps in earthen ponds through polyculture system of the northwestern Bangladesh.

Ponds	Carp variety	IW	FW	AW	S	TP
Pond -01	<i>L. rohita</i>	4.3	600.4	596.1	97	2605 kg/ha/year
	<i>C. catla</i>	6.5	700.3	693.8	99	
	<i>C. mrigala</i>	4.6	550.1	545.5	97	
	<i>H. molitrix</i>	5.2	650.7	645.5	93	
	<i>C. carpio</i>	4.3	500.2	495.9	95	
Pond -02	<i>L. rohita</i>	4.3	300.2	295.9	98	1795 kg/ha/year
	<i>C. catla</i>	6.5	415.7	409.2	98	
	<i>C. mrigala</i>	4.6	325.5	320.9	96	
	<i>H. molitrix</i>	5.2	400.1	394.9	94	
	<i>C. carpio</i>	4.3	315.6	311.3	95	

IW = Initial average weight (g), FW= Final average weight (g), AW= Average weight gain (g), S= Survival (%), TP= Total fish production.

Discussion

The results of the present study show that average gain in body weight of all the fish species together was less in the pond without fertilizer than that in the pond with fertilizer. The fertilizer increased the primary productivity and finally caused a significant increase in fish yield in pond -01. The net fish production in pond -01 was found to be 2605 kg/ha/year; while in pond -02 it was 1795 kg/ha/year. So, the semi-intensive condition gave 1.45 times greater fish production than the simple extensive one. The yield of this semi-intensive polyculture system is similar to several production levels obtained in other semi-intensive polycultures in the South Asian region, e.g. Shahabuddin *et al.* (1994) obtained yields of 2000-3400 kg/ha/year and Mazid *et al.* (1997) recorded a gross production of 3600 kg/ha/year. However, the different in production between ponds in the present study are in line with those obtained by Sumitra *et al.* (1981), who reported a significant increase in fish yield due to the effect of organic fertilizer on the planktonic productivity of a commercial pond. Hassan *et al.* (2000) reported that cowdung fertilization exerted significant effect on the growth performance of major carps. These results are also in confirmatory with those of Aziz *et al.* (2002), who studied the growth performance of major carps in fertilized ponds supplemented with feed containing 28% crude protein and reported that a planktonic productivity of 22.14 mg/l produced an average fish yield of 7826.08 g. These authors, through the regression studies, calculated the contribution of primary productivity towards increase in fish yield to be 57.40%. In the present study, the enhanced production in pond -01 can be

justified by the fact that the fertilizer contributed to the fertility of the pond. This research would be useful for the sustainable aquaculture in Bangladesh as well as other Asian countries.

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