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Study the production performance of carp poly-culture in earthen ponds at BAPARD by using natural feeds in winter season

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Abstract

An experiment was conducted to compare the production performances of different carps i.e. Rohu (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus cirrhosus*) and Silver carp (*Hypophthalmichthys molitrix*) in different stocking densities of poly-culture by using natural feeds in winter season. Three treatments each with three replications were maintained and the stocking densities of carps were 32, 64 and 128 per decimal in T₁, T₂ and T₃ respectively. The ratio of stocking for Rohu, Catla, Mrigal and Silver carp were 5:1:1:1. The water quality parameter such as pH, temperature, dissolved oxygen and transparency were observed fortnightly. The obtained results showed that the highest weight was gained at 470.12±0.76 g in treatments T₁ by Silver carp, followed by Mrigal (401.70±0.31g), Catla (410.10±0.30 g) and Rohu (450.10±0.30 g). Similarly, the highest length was obtained in treatment T₁ by Silver carp at 37.10±0.30 cm followed by Rohu at 25.75±1.13 cm Catla at 28.47±2.50 cm and Mrigal 24.33±1.20 cm. However, both the weight gain and the length gain were the lowest in treatment T₃ for all species. On the other hand, the highest SGR% was found in treatment T₂ for Mrigal (2.10) and the lowest SGR% was in T₃ for Rohu (1.37). The highest survival (%) of the fishes was found in treatment T₁ than those of treatments T₂ and T₃. Furthermore, the highest production was obtained in treatment T₃ (12.35 kg/dec.) followed by T₂ (11.56 kg/ dec.) and T₁ (10.19 kg/dec.). The BCR was calculated 1:1.28 for T₁, 1:0.75 for T₂ and 1:0.03 for T₃. The findings of this experiments revealed that among three treatments, the stocking density 32 per decimal (T₁) is the most suitable.

Keywords: Production performances, stocking densities, winter season, natural feed, SGR, survival and BCR

Introduction

Bangladesh is a delta and most of its 1,47,570 km² area (BBS, 2011) is mainly composed of alluvial deposits borne by the Ganga-Padma, Meghna and Jamuna-Brahmaputra rivers and their branches. Bangladesh is a country blessed with vast fisheries resources including rivers, flood plains, lakes, ponds, ox-bow lakes, etc. which are full of 260 different fish species (DoF, 2014) [8]. The total annual fish production in Bangladesh was estimated at 42.77 Lac MT in 2017–18 fiscal year, of which 2.4 million MT (56.24%) were obtained from inland aquaculture (DoF, 2019) [9]. Natural feed is the best feed for fish. It is healthy. It is a money saver. It gives healthier fry, more successful spawns and better coloration than any prepared feed on the market. Plankton is essentially feed come from green water that grows on suspended urea and TSP in the water column. Optimizing production in pond fish culture by the use of fertilizers is an important task. Fertilizer is helpful for the increase of natural food of fish i.e. plankton, benthos and periphyton. Plankton is the basic food of all the organisms living in the water. Fishes and other aquatic organisms depend on this basic food directly and indirectly. Extensive work on water quality and pond fertilization has been conducted elsewhere (Boyd, 2008) [6] but very few of them have relevance to carp culture. The physicochemical characteristics of pond water are of great importance and essential in case of fish culture and fisheries management. The physicochemical properties play the most important role in governing the production of phytoplankton i.e. primary production in fishponds (Banerjee, 1967) [7]. As for example, Hopher *et al.* (1971) [11] found in Israel that if there applied no fertilizers in fish pond, the cost of production per ton was 935 dollars and after applying fertilizers, the cost of production of

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fish per ton was 691 dollars. Poly-culture is the practice of culturing more than one species of aquatic organism in the same pond. Poly-culture gives higher production than monoculture in extensive systems because more available natural food is utilized by different fish species efficiently Wahab *et al.* (2001) [25]. Poly-culture may produce expected results if fish with different feeding habits are stocked in proper ratio and combination (Halver, 1984) [12]. In Asian poly-culture, a wide variety of fish species are cultured of which rohu (*Labeo rohita*), catla (*Catla catla*) and mrigal (*Cirrhinus cirrhosus*) are very popular Rahman *et al.* (2006) [20]. The farmers prefer to stock Common carp as a bottom feeder instead of mrigal because common carp grows faster than mrigal and the overall production is higher when combined with rohu and catla in polyculture ponds Wahab *et al.* (2002) [26]. Poly-culture is more productive, capital intensive and profitable activity compared to other culture systems (Dev, 2009) [10].

Gopalganj district is a part of the south-west region of Bangladesh. It is developed by the alluvial flow of the

Modumothi River. The livelihoods of a considerable proportion of rural people in this area depend entirely on fishing in inland open water bodies (mainly floodplain areas and ponds). Availability of ponds in this area has the great potentiality of fish production applying natural feed in poly-culture system. Maximum pond in the rural areas become unused that can be brought under culture system due to feed cost. Therefore, the present study was conducted to know the contribution of natural feed during winter season (most of the water remain unused). The study is expected to provide some valuable information to the fish farmers. It is expected that the findings of the work will be helpful to prepare a guideline for a sustainable carp poly-culture practices.

Materials and Methods

Study area

The present experiment was carried out for a period of 150 days from November/2019 to March/ 2020. It is located at the Pond of BAPARD campus, Gopalganj (located at 22.9833°N 89.9917°E). (Fig. 1).

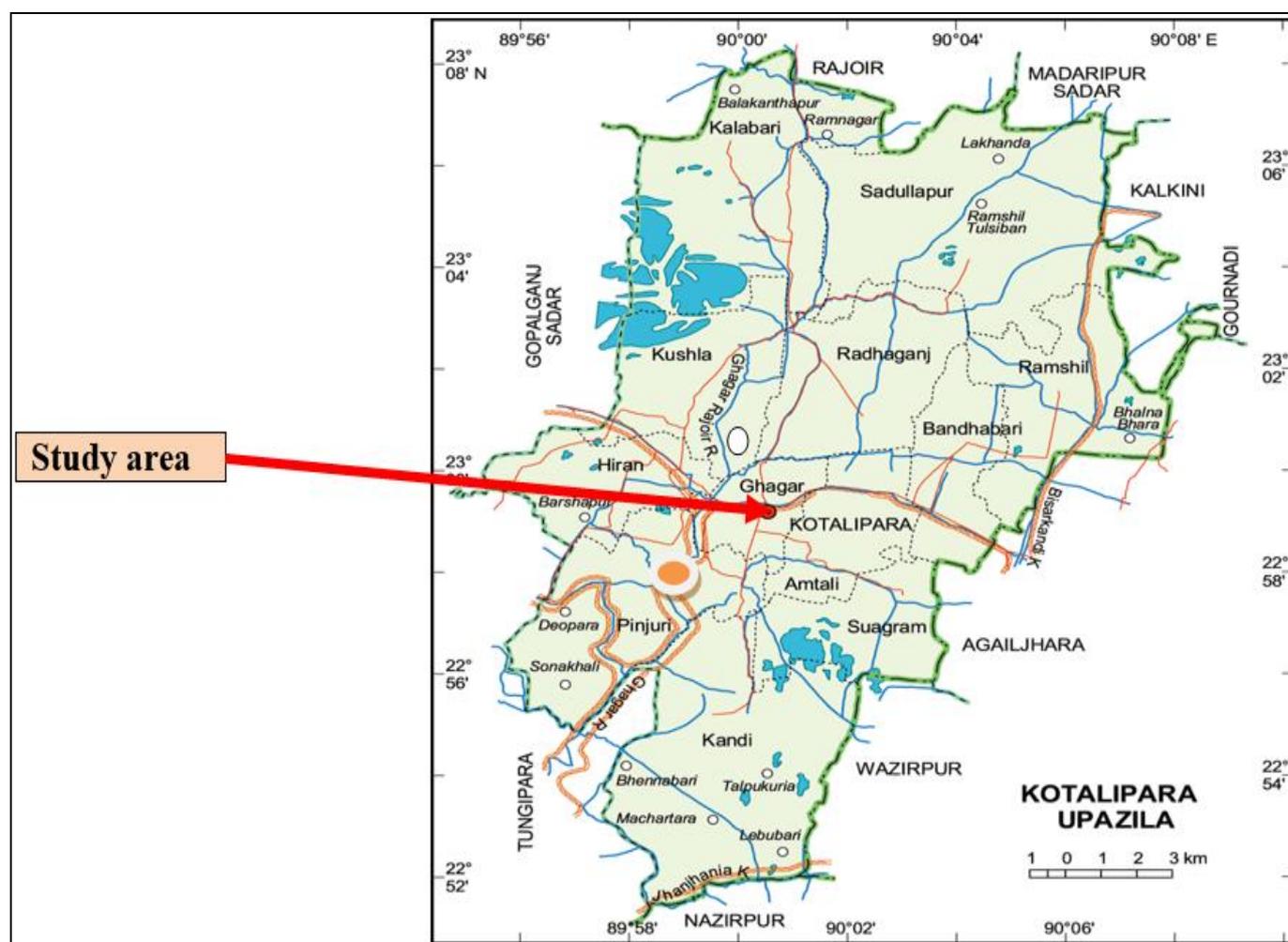


Fig 1: Map of Kotalipara Upazilla showing the study area in Gopalganj district

Experimental design

Three different stocking densities (32 nos/dec., 64 nos/dec. and 128 nos/dec.) for T₁, T₂ and T₃ respectively) of rohu, catla, mrigal and silver carp with a ratio of 5:1:1:1 were assessed using three replication for each treatment.

Pond preparation

The ponds were drained out completely and aquatic weeds were removed manually. Liming was done in all ponds at the

rate of 1 kg/decimal. One week after liming the ponds were filled with water and fertilized with urea and TSP at the rate of 200 gm/decimal and 100 gm/decimal respectively. TSP was soaked overnight, then urea and TSP were dissolved together and spread manually on pond water surface at sunny day (10-10.30 am). To enhance the growth of natural food for the carps, fertilization was done with urea (200 gm/dec) and TSP (100 gm/dec) ten a month. The ponds were same in size (10 dec.) and similar in shape and depth.



Pictorial view of lime application



Pictorial view of fertilization

Collection of experimental fish

All the carp fingerlings were collected from Sonali Fish Farm and hatchery (Pvt) Limited, Kotalipara, Gopalganj.

Water quality parameters

Water quality parameters of the experimental ponds were recorded throughout the study period. The water temperature (°C), dissolve oxygen (ppm) and hydrogen ion concentration (pH), ammonia (NH₃) and Nitrite (NO₂) were monitored at the beginning and end of the experiment by using proper instrument.

Estimation of growth performance

Sampling was done 15 days interval from each pond by cast net and the weight of fish was recorded by using electric balance (Model:FKS-5000). After harvesting of fishes final weight were recorded and following parameters were used to evaluate the growth and production of the fishes.

Mean length gain (cm) = Mean final length (cm) – Mean initial length (cm)

Mean weight gain (g) = Mean final weight (g) – Mean initial weight (g)

$$\text{Specific growth rate (SGR \%)} = \frac{\log_e W_2 - \log_e W_1 \times 100}{T_2 - T_1}$$

Here, W₂= the final live body weight (g) at time T₂ day

W₁=the initial live body weight (g) at time T₁ day

T₂= time duration at the end of the experiment

T₁ = initial time of the experiment (day).

Fish production = No. of fish harvested × final average

Weight Data analysis

The recorded data were entered into the spreadsheet in MS Excel 2010 and then summarized properly before statistical analysis. After entering the data, the descriptive statistical analyses were done by MS Excel. The inferential T-test was carried out using SPSS (Statistical Package for Social Sciences) version 22.

Results

Water quality parameters

Water quality parameters of the (Dissolved oxygen, pH, water transparency and temperature) were recorded fortnightly during the study period. The mean values of water quality parameters are presented in the Table 1. The pH values of pond water were found to be fluctuated and ranged from 7.71 to 7.90. The Dissolved oxygen concentrations under different treatments were found to be fluctuated around 4.56±0.50, 4.33±0.53 and 4.15±0.57 in the three treatments T₁, T₂ and T₃. Transparency ranged from 27 to 30 cm and the mean values were 30.69±1.07, 34.11±0.97 and 32.61±1.02 cm in T₁, T₂ and T₃ respectively.

Table 1: Water quality parameters in different treatment during experiments

Treatments	pH	Ammonia	Dissolved oxygen	Temperature (°C)	Transparency
T ₁	7.80±0.10	0.25±0.25	4.56±0.50	20.25±0.20	30.69±1.07
T ₂	7.75±0.11	0.50±0.25	4.33±0.53	20.23±0.19	34.11±0.97
T ₃	7.71±0.14	1±0.25	4.15±0.57	20.15±0.21	32.61±1.02

Growth performance of carps

The obtained results showed that the highest weight was gained at 470.12±0.76 g in treatments T₁ by Silver carp, followed by Mrigal (401.70±0.31g), Catla (410.10±0.30 g) and Rohu (450.10±0.30 g). Similarly, the highest length was obtained in treatment T₁ by Silver carp at 37.10±0.30 cm followed by Rohu at 25.75±1.13 cm Catla at 28.47±2.50 cm

and Mrigal 24.33±1.20 cm. On the other hand, the highest SGR% was found in treatment T₂ for Mrigal (2.10) and the lowest SGR% was in T₃ for Rohu (1.37). The highest survival (%) of the fishes was found in treatment T₁ than those of treatments T₂ and T₃. The BCR was calculated 1:1.28 for T₁, 1:0.75 for T₂ and 1:0.03 for T₃.

Table 2: Production performance of carp poly-culture under different stocking densities and management practices

Parameters		Treatments		
		T ₁	T ₂	T ₃
Stocking Density (dec.)	Rohu	20	40	80
	Catla	4	8	16
	Mrigal	4	8	16
	Silver carp	4	8	16
Initial length (cm)	Rohu	6.06±0.00	6.06±0.00	6.06±0.00
	Catla	6.41±0.00	6.41±0.00	6.41±0.00
	Mrigal	6.20±0.00	6.20±0.00	6.20±0.00
	Silver carp	5.40±0.00	5.40±0.00	5.40±0.00
Initial weight (g)	Rohu	25.50±0.12	25.50±0.12	25.50±0.12
	Catla	20.40±0.15	20.40±0.15	20.40±0.15
	Mrigal	21.30±0.17	21.30±0.17	21.30±0.17
	Silver carp	23.25±0.11	23.25±0.11	23.25±0.11
Culture duration (days)=150 days				
Final length (cm)	Rohu	25.75±1.13	21.39±1.69	17.30±1.73
	Catla	28.47±2.50	22.18±1.40	18.58±2.43
	Mrigal	24.33±1.20	20.33±1.20	16.13±1.40
	Silver carp	37.10±0.30	30.17±0.43	25.80±0.41
Final weight (g)	Rohu	450.10±0.30	309.13±0.20	200.16±0.24
	Catla	410.10±0.30	300.17±0.21	210.11±0.61
	Mrigal	401.70±0.31	310.62±0.12	206.80±0.32
	Silver carp	470.12±0.76	320.18±0.96	220.75±0.87
Survival rate (%)	Rohu	75	60	40
	Catla	75	50	75
	Mrigal	50	50	50
	Silver carp	75	75	50
SGR (%)	Rohu	1.91	1.67	1.37
	Catla	2.00	1.80	1.55
	Mrigal	1.95	2.10	1.79
	Silver carp	1.97	1.75	1.50
Production (kg/dec.)	Rohu	6.75	7.20	6.41
	Catla	1.23	1.20	2.52
	Mrigal	0.80	1.24	1.65
	Silver carp	1.41	1.92	1.77
Total production=		10.19	11.56	12.35

Table 3: Economic analysis for carp production in ponds reared for 150 days

Components	Treatments		
	T ₁	T ₂	T ₃
Expenditure (Tk./dec.)			
Fingerlings cost	320/-	640/-	1,280/-
Feed cost	-	-	-
Urea (10.00 Kg)	160/-	160/-	160/-
TSP (5.00 Kg)	110/-	110/-	110/-
Lime cost (5.00 Kg)	80/-	80/-	80/-
Medicine	-	-	160/-
Total expenditures (Tk/dec.)	670/-	990/-	1,790/-
Income			
Gross return (Tk/dec.)	1528.50/-	1,734	1,852.50/-
Net return (Tk/dec.)	858.50/-	744/-	62/-
BCR (Benefit Cost Ratio)	1:1.28	1:0.75	1:0.03

Urea per Kg 16/- rate, TSP per Kg 22/- rate and Sale price = Taka 150/-kg (Average)

Discussion

Dissolved oxygen, pH, water transparency and temperature were recorded fortnightly during the study period. The mean values of water quality parameters are presented in the Table 1. The pH values of pond water were found to be fluctuated and ranged from 7.71 to 7.90. In treatment T₁, T₂ and T₃, the average pH of water were 7.80±0.10, 7.75±0.11 and 7.71±0.14, respectively. For pond fish culture, the suitable ranges of pH are 6.5 to 8.5^[6]. The present findings agree with the findings of (Ahmed, 2004)^[2] who found that pH ranged

from 6.6 to 8.9 in different treatments. Again, the Dissolved Oxygen concentrations of different ponds were ranged from 3 to 7. The Dissolved oxygen concentrations under different treatments were found to be fluctuated around 4.56±0.50, 4.33±0.53 and 4.15±0.57 in the three treatments T₁, T₂ and T₃. Roy (2001)^[21] considered 5.0 to 7.0 mg/l of dissolved oxygen content of water is fair or good in respect of productivity and water having dissolved oxygen less than 5 mg/l to be unproductive. No significant difference ($P>0.05$) was observed among the three treatments (Table 1). Temperature of pond water was found to be almost similar in different treatments without any significant difference. In T₁, T₂ and T₃ treatments it had figures of 20.25±0.20 °C, 20.23±0.19 °C and 20.15±0.21 °C, respectively. Bhatnagar and Devi (2013)^[4] suggested that the desirable water temperature for carp poly-culture in pond from 20 to 30 °C which was more or less similar in the present study. Transparency ranged from 27 to 30 cm and the mean values were 30.69±1.07, 34.11±0.97 and 32.61±1.02 cm in T₁, T₂ and T₃ respectively. Boyd (1982)^[5] suggested that transparency from 15 to 40 cm was good for fish culture. The variation in transparency was due to plankton production and rain induced turbidity. Similar transparency values were recorded by Miah *et al.* (1997) and Wahab *et al.* (1995)^[16, 24].

The obtained results showed that the highest weight was gained at 470.12±0.76 g in treatments T₁ by Silver carp, followed by Mrigal (401.70±0.31g), Catla (410.10±0.30 g) and Rohu (450.10±0.30 g). Similarly, the highest length was

obtained in treatment T₁ by Silver carp at 37.10±0.30 cm followed by Rohu at 25.75±1.13 cm Catla at 28.47±2.50 cm and Mrigal 24.33±1.20 cm. However, both the weight gain and the length gain were the lowest in treatment T₃ for all species. Mean Length gain (cm) of fishes in this present study was agreed with the findings of Saha *et al.* (1999)^[22]. Weight gain (g) as observed in this study appeared to be suitable for fish culture which agreed with the findings of Miah *et al.* (1998)^[19]. On the other hand, the highest SGR% was found in treatment T₂ for Mrigal (2.10) and the lowest SGR% was in T₃ for Rohu (1.37). The result of the study is about same to the findings of Miah *et al.* (1998)^[19]. The highest survival (%) of the fishes was found in treatment T₁ than those of treatments T₂ and T₃. Similar result also observed by Miah *et al.* (1997)^[17]. The variation of production of fishes was found in three treatments. Between three treatments, the higher production of fish was recorded in T₃, followed by the production of T₁ and T₂. Kadir *et al.* (2006)^[15] obtained 1970 kg/ha production in poly-culture during 150 days culture period. Sagor (2008)^[23] obtained the average production of carp's 1676 kg/ha/year. Haque (2010)^[14] reported good results from the poly-culture of Indian carps in three treatments with the productivity ranging from 2618.85±57.5 to 2747.47±116.47 kg/ha/year. The BCR was calculated 1:1.28 for T₁, 1:0.75 for T₂ and 1:0.03 for T₃. In traditional poly-cultures system of carps in Bangladesh the production range was 3119 to 4067 kg/ha/year Hossain *et al.* (1997) and Mazid *et al.* (1997)^[13, 18]. Awal *et al.* (1995)^[1] stated that a net production of native, exotic and mixed carp poly-culture system were 1196, 1617 and 982 kg/ha per 6 months, respectively. So, the level of fish production in the present study was more or less similar to the result quoted above.

Conclusion

During winter season most of the ponds are remain unused due to low water level and unavailability of fish fingerlings. Therefore farmers are not agreed to invest any inputs in their ponds during winter season. So it was observed that carp poly-culture using natural feed (inorganic fertilizers) can be done during lean season in winter. The fertilizer treatments effect was found to be significant and strongly influenced water quality and primary production. In the end of the experiment, it was suggested that low stocking density with highest BCR T₁ had more viable for carp production in poly-culture by using natural feed in winter season.

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