Feasibility of carps fry raising in Kaptai lake creeks

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Abstract: Experiments were conducted in three creeks in Kaptai Lake at Langadhu Upazilla of Rangamati Hill District for eight weeks (60^{th} days) to evaluate the growth, survival and production performances of carps fry. Five-days-old hatchling stocked at 01 million/ha at Islamabad was defined as treatment-1 (T_1), Hazachara as treatment-2 (T_2) and Vaittapara as treatment-3 (T_3). The initial length and weight (4 lakh hatchling/kg) of hatchling, stocked in all the experimental creeks were the same. Growth of carps fry in terms of length/weight of rohu and mrigal were the highest in T_3 and the lowest in T_1. The highest weight (g) and highest specific growth rate (SGR) of catla fry were 9.63±8.98 and 3.71±1.91 in T_1. The highest length (cm) (7.93±1.33) of catla was found in T_3. Specific growth rate (SGR) of rohu and mrigal in T_2 and T_3 was significantly higher than T_1. Survival rate of rohu in T_1 was significantly higher than T_2 and T_3. In general growth performance of catla fry was comparatively higher than rohu and mrigal. Among the three treatments, T_3 was the best stocking density considering the highest growth of the rohu and mrigal fry in the creeks. The result reveals that gross and net productions (kg/ha) of fry were higher in T_1 than T_2 and T_3. In addition, higher number of fry produced in T_3 than those in T_2 and T_1. Even, consistently higher net benefits were obtained from T_1 than those from T_2 and T_3. The findings of the study will help in economically feasible methodology for carp seed production in creeks.
Keywords: Creeks, carps fry, hatchling, stocking density, production, benefits.

Introduction

The inland fisheries recourses are among the richest in the world with only China, India and Indonesia producing more inland fish than Bangladesh. Among the total fish production of 25,63,296 MT inland water contributes 80.59%. Kaptai Lake is the important inland water resources of Bangladesh comprise about 68,800 hectares. Commercial fishing in this lake started with 1200 metric tons in 1965/66 and has reached up to 8,248 metric ton at present (DoF, 2009). But Now-a-days, the contribution of Kaptai lake fisheries is largely limited with unwanted species. The most valuable major carp's species (Rui, Katla, Mrigal, Calibaush and Mohasoal) have declined devastatingly from the initial 81% as recorded in 1965/66 to about 5% at present and low valued small forager fish (Kechki, Chapila, Mola etc.) have boomed from the initial 3% in 1965/66 to about 92% now. Particularly the low valued small pelagic forage fish, the clupeids. Predatory carnivores are more of less steady. Although about 60 million fingerlings costing approximately Tk. 65 million were stocked over the last four decades, population of Indian major carps has alarming decreased to 4% from initial 81%. So, it is essential to increase the production of Indian major carps in Kaptai Lake (Alamgir and Ahammad, 2008). Findings of BFRI indicate that cage culture and pen culture are feasible and profitable in the Kaptai Lake and are becoming popular to local people. It is estimated that pen culture alone in the lake can produce an additional quantity of 3,200 ton of fish and at the same time can generate employment opportunity for local woman and youths particularly the educated unemployed youths.

Mostly diversified Kaptai Lake is surrounded by uneven triangular water body named as creek. Creeks are the arms of the lake, found mostly uneven. The depression of hill slope connected with the main lake and become inundated with enormous hilly streams or be the backwater during monsoon, is called the creek, Three sides of arms of the creek should be surrounded by hilly land while the rest remain directly linked with the main body of the lake. From a survey report, there are 1200 numbers of creek can be used for fish culture and its area is about 3887 hectares (Alamgir and Ahmed, 2005). The production capacity of this creek is 2100 kg/hectare that is 5 to 7 times more than the Kaptai Lake. The present production of 8000 metric ton can be increased to about 1900 metric tons. The adaptation of cage and pen culture techniques in the creeks of the reservoir might be capable to meet the stocking material requirements through producing fingerlings at local environment that can ensure to obtain high yield, better survival, reduce fingerlings purchasing costs at least 50%, reduce dependency for fingerlings from outside entrepreneurs, create avenue to support additional fish production utilizing the same water resource, additional protein source, indirect way of fertilization of the lake, and generating employment opportunity as well. The ultimate goal of this study is to determine of the growth, survival and economically viable methodology of carp seed production under poly culture management.

Materials and Methods

Study area and creeks preparation: The experiment ware conducted at Langadhu Upazila of Rangamati Hill Tracts through eights weeks in creeks of 01, 1.1 and 1.2 ha. The creeks were constructed by fencing off the mouth of the come with small meshed knotless polythene net that filled by reservoir backwaters. The structure of fence was built using bamboo, nylon twine and rope, polythene lining and sand bags. For convenience of access and netting site of creek, reclamation including removal of submerged timber logs fastened in the slope and bottom, roots, dense hedges and jungles and all emergent and submerged weeds has been done during dry season (March-April) when water level recedes at the lowest and prior to construction of creek. Repeated netting was done also to remove submerged weeds, unwanted fish and check through and remains of submerged timber logs uncleanness.

Fry collection and stock: The fry of catla, rohu and mrigal obtained from Raipur government carps hatchery at Laxmipur were used for experimental purpose and five-days-old hatchling stocked (01 million/ha) at three different treatments *viz.* Islamabad (T_1), Hazachara (T_2) and Vaittapara (T_3) respectively.

Feeding and management: The fry were provided with supplementary diet with comprising conventional mixture of rice bran (50%) and mustard oil cake (50%) in equal proportion by weight. Feeding was done four times the

total body weight of initial biomass of spawn stocked per day during initial five days followed by eight times in subsequent days, by broadcasting the mixture in two rations during morning (7-8 a. m.) and afternoon (4-5 p. m.).

Sampling: Sampling was done by using fine mesh size net every 15 days interval from each creek. Growth, length, weight and health condition were measured by using digital balance, measuring scale and eye estimation.

Final harvest and estimate the survival of fry: Final harvesting of fry was on 60th (8 weeks trial) day of rearing by repeated netting. Mean growth (length in cm and weight in gm) was recorded by taking average of random samples from each creek and analyzed of the final catch.

Studies of water quality and environmental conditions: Monitoring of water quality parameters were done on regular basis in every 15 days interval and special emphasis were given on water level. Primary production of surface water was measured and correlation-regression analysis was performed also to find out the probable linkage with monthly growth performance and yield. Extent of availability of natural food was checked in each month following plankton biomass analysis.

Economic and Statistical analysis: Data on fish growth, production and feed utilization efficiency were analyzed. AVOVA, DMRT and regression analyses were performed for significance test. At end of the project period economic viability was assessed thorough financial analysis of the whole expenditure.

Results

The physico-chemical parameters of water in the experimental creeks were in the following ranges during the study period: Water temperature 28.6-31.3 ^{0}C; dissolved oxygen 5.05-8.3 mg/l; P^{H} 7.4-8.6; CO_2 2.52-4.6 mg/l; total hardness 65.2-120.3 mg/l; total alkalinity 70.3-135.8 mg/l in T_1, T_2, and T_3 respectively (Table 1).

Growth in terms of length and weight of rohu and mrigal fry were the highest in T_3 and the lowest in T_1. The highest weight (g) values and highest specific growth rate (SGR) of catla fry were 9.63±8.98 and 3.71±1.91 in T_1. The highest length (cm) values (7.93±1.33) of catla were found in T_3. The initial length and weight (4 lakh hatchling/kg) of hatchling, stocked in all the experimental creeks were the same. Specific growth rate (SGR) of rohu in T_2 was significantly higher than T_1 and T_3. Specific growth rate (SGR) of mrigal in T_3 was significantly higher than T_1 and T_2. Survival rate of rohu in T_1 was significantly higher than T_2 and T_3. Growth performance of catla fry was comparatively higher than rui and mrigal among three treatments. Among the treatments evaluated, T_3 was the best stocking density considering the highest growth of the rohu and mrigal fry in the creeks. Average survival rate of rohu, catla and mrigal of T_1, T_2 and T_3 were 70.3%, 72% and 68.3%. Survival rate of rohu in T_1 was significantly higher than T_2 and T_3. The maximum and minimum survival obtained in rohu was 75% and catla 65% in T_1. The growth, survival and specific growth rate details of carps fry under different treatments over the 8-weeks experiment are summarized in Table 2.

Table 1. Ranges of water quality parameters of weekly samples over the 8 weeks experiment of three different creeks

Treatments	Parameters (range)							
	Air temp (^{0}C)	Water temp (^{0}C)	pH	CO_2 (mg/l)	Total Alkalinity (mg/l)	Total Hardness (mg/l)	Transparency (cm)	DO (mg/l)
T_1	29.2-32.2	28.6-31.3	7.4-8.4	2.52-4.5	105.1-120.4	70.3-80.4	32-50	5.05-6.2
T_2	30.5-31.5	29.6-30.1	7.6-8.3	3.24-4.6	70.3-134.6	65.2-120.3	34-56	5.67-6.7
T_3	30.9-32.4	29.7-31.2	7.8-8.6	3.83-4.1	80.7-135.8	71.2-110.5	39-60	6.92-8.3

Table 2. Growth performance of carps fry under poly culture management after 8 weeks of rearing in three different creeks

Treatments	Stocking density	Creek size (hectare)	Carp species	After 30 days		After 60th day		Survival rate (%)	SGR(%/day) at 60th days
				Length (cm)	Weight (g)	Length (cm)	Weight (g)		
T_1 (Islamabad)	1 million /ha	1	Rohu	3.50±0.78	2.43±0.45	5.94±0.86	5.29±0.96	75	2.61±0.87
			Catla	4.65±0.73	2.60±0.45	7.27±2.89	9.63±8.98	65	3.71±1.91
			Mrigal	3.49±0.88	2.24±0.50	5.45±1.17	4.89 ±0.77	71	2.64±0.88
T_2 (Hazachara)	1 million /ha	1.1	Rohu	3.49±0.73	2.49±0.75	6.37±0.62	5.85±0.87	74	2.92±0.86
			Catla	4.18±1.39	3.21±0.72	7.27±1.71	6.55±1.74	69	2.35±1.00
			Mrigal	3.49±0.81	2.43±0.32	6.16±1.10	5.96±0.94	73	2.98 ±0.50
T_3 (Vaittapara)	1 million /ha	1.2	Rohu	4.14±0.78	2.76±0.60	7.74±1.01	6.47 ±0.84	67	2.90±0.68
			Catla	4.15±0.90	2.87±0.54	7.93±1.33	7.19±1.40	70	3.06±0.78
			Mrigal	4.05±0.90	2.62±0.48	7.80±0.89	6.67±0.68	68	3.17±0.64

Table 3. Average survival, gross production, net production and production of carps fingerlings under poly culture management after 8 weeks of rearing in three different creeks

Parameters	Treatments		
	T_1	T_2	T_3
Survival average (%)	70.3	72	68.3
Gross production (kg/ha)	2,343.3	2,640	2,732
Net production (kg/ha)	2,340.8	2,637.25	2,729

Production of fry (No./ha)	7,03,000	7,92,000	8,19,600

Table 4. Costs and benefits from the nursing of carp fry in 1 ha, 1.1 ha and 1.2 ha creeks for rearing period of 8 weeks

Items	Treatments		
	T_1 (Tk.)	T_2 (Tk.)	T_3 (Tk.)
A. Cost			
Creeks lease (Tk. 25,000/ha/yr)	4,166	4,583	5,000
Lime (Tk. 20/kg)	5,000	5,500	6,000
Cow dung (Tk. 7/kg)	14,000	15,400	16,800
Sumithion (Tk. 1300/1L)	3,250	3,575	3,900
Rotenone (Tk. 300/Kg)	2,250	2,475	2,700
Hatchlings (Tk. 10,000.00/million)	10,000	11,000	12,000
Feed			
a. Wheat flour (Tk. 35/Kg)	1,412	1,540	1,652
b. Mustard oilcake (Tk. 45/Kg)	14,125	15,250	16,960
c. Rice bran (Tk. 20/Kg)	10,500	11,560	12,600
Labor (Tk. 260/day)	28,600	28,600	28,600
Harvesting	20,000	20,000	20,000
Miscellaneous	5,000	5,000	5,000
Total cost	1,18,303	1,24,483	1,31,212
B. Gross benefit			
Fry	7,03,000	7,92,000	8,19,600
Net benefits (B-A)	5,84,697	6,67,517	6,88,388

*1 US$ = Tk. 80.00, ** Price of fry was Tk. 1.00/piece (T_1, T_2 and T_3).

The gross and net productions (kg/ha) of fry (catla, rohu and mrigal polyculture) after 8 weeks of rearing were 2,343.3 and 2,340.8; 2,640 and 2,637.25; 2,732 and 2,729 in T_1, T_2 and T_3 respectively. However, gross and net productions differed among the three treatments (Table 3). Despite this, number of fry per hectare was produced in T_3 (8,19,600), T_2 (7,92,000) and T_1 (7,03,000) (Table 4). Total cost of production (Tk/ha) of T_1, T_2 and T_3 were 1,18,303, 1,24,483 and 1,31,212. The net benefit (Tk/ha) of T_1, T_2 and T_3 were 5,84,697, 6,67,517 and 6,88,388 respectively (Table 4).

Discussion

Physico-chemical parameters a significant role in the maintenance of a healthy aquatic environment and production of natural food organism. Growth, feed efficiency and feed consumption of fish are normally governed by environmental factors (Fry, 1971 and Brett, 1979). The range of water temperature 28.6-31.3 ^{0}C in the experimental creeks are within the acceptable range for nursing of fry and fingerlings of warm water fishes that agree well with the findings of Haque *et al*. (1993, 1994), Kohinoor *et al*. (1994), Rahman *et al*. (2005). Consistently higher transparency was recorded in T_3, which might be due to the reduction of the plankton population by higher density of fish (Haque *et el*. 1993, 1994). Dissolved oxygen level was low in ponds stocked with a high density of fish compared to ponds where stocking density was low. Saha *et al*. (1988), Ahmed (1993), Rahman and Rahman (2003) and Rahman *et al*. (2005) also reported similar trends of dissolved oxygen in various carp nursery ponds. Fluctuations in DO concentrations might be due to alteration in the rate of photosynthesis caused by altering cloudy and sunny weather of the monsoon and also due to variation in the rate of oxygen consumption by fish and other aquatic organisms (Boyd, 1982). However, the DO level was within the acceptable range for fry rearing in all treatments. The observed P^H values agree well with the findings of Kohinoor *et al*. (1994), Chakraborty *et al*. (2003) and Rahman *et al*. (2005) are within the range of good water quality for rearing of fry/fingerlings in nursery pond. Total alkalinity levels indicating the productivity of the ponds were medium to high (Bhuiyan, 1970). The findings of the present study are in agreement with those of Islam (2002), Rahman and Rahman (2003) and Rahman *et al*. (2004, 2005).

The initial length and weight of hatchling, stocked in all the experimental creeks were the same. After 8 weeks treatments, the highest weight (g) values and highest specific growth rate (SGR) of catla fry is 9.63±8.98 and 3.71±1.91 in T_1. Among three treatments, final weight values and specific growth rate (SGR) of catla in T_1 was significantly higher than T_2 and T_3. Among the treatments evaluated, T_1 was the best considering the highest growth of the catla fry in the creek. The same food was applied at an equal ratio in all the treatments. The causes might include competition for food and habitat due to higher number of fish. Stocking density had previously been observed to have a direct effect on the growth of fish (Haque *et al*. 1993, 1994; Kohinoor *et al*. 1994, Islam, 2002, Islam *et al*. 2002, Rahman and Rahman, 2003 and Rahman *et al*. 2004, 2005). High stocking density of larvae in combination with abundant food in the rearing system might produce a stressful situation if not from the built-up of metabolites than from competitive interaction (Houde, 1975, Haque *et al*. 1994 and Rahman and Rahman, 2003).

In the present study, higher gross and net productions of fry were obtained from T_3 than those from T_1 and T_2. The results in the present experiment are very close to those of Saha *et al*. (1988) who obtained a gross production of 1,385.15 to 1,995.60 kg/ha by 8 weeks rearing of rohu (*Labeo rohita*) fry at 0.6 to 0.8 million/ha stocking densities. Rahman *et al*. (2003) also found 1,663.48-

2476.77 kg/ha productions after 8 weeks nursing of local sharpunti (*Puntius sarana*) hatchlings at stocking densities of 1.25 to 1.75 million/ha. Similar to the present study, Rahaman *et al*. (2004) obtained a production of 1869.1 kg/ha by rearing of *Labeo calbasu* fingerlings for 8 weeks at a stocking density of 0.8 million hatchlings/ha.

Finally, it could be concluded that the growth, survival, production and net benefit of carps fry were excellent by nursering in the creeks. The survival of fry is the most important aspect during nursery rearing. In the present study the numbers of fry recorded was high. Under the prevailing situation, production of quality seeds through application of our present findings might have important implications to enhance fish production in Kaptai Lake.

References

Ahmed K. K., (1999) Options for the management of Major Carp Fishery in the Kaptai Reservoir, Bangladesh. Ph. D. dissertation, School of Environment, Resources and Development, Asian Institute of Technology, Bangkok, Thailand, April, 1999.

Alamgir,M and Ahmed, S.U. 2005. Fish culture techniques in creeks in kaptai lake using pens. Extension Manual No. 33. Bangladesh Fisheries Research Institute. 16 p.

Alamgir,M and Ahmed, S.U.2008. Sustainable Management Techniques of Kaptai Lake Fisheries. BFRI, Mymensingh. 71 p.

Aziz, M.A. and Hossain, M.A. 2005. Fisheries in Trans-Himalayan Region: prospects for fish culture in Hill Districts of Bangladesh. FAO corporate documentary repository

Bhuiyan, B. R. 1970. Physico-chemical Qualities of some ancient tanks of Sibsagaer, Asam. Enviromental Health, 12: 129-134.

Brett, J.R. 1979. Environmental factors and growth. In: W.S. Hoar, D.J. Randall and J.R. Brett(Eds.), Fish Physiology, Environmental relations and behavior, Academic Press, New York: 599-677.

Boyd, C.E. 1982. Water quality Management for Pond Fish Culture. Elsevier, The Netherlands, 318 pp.

Chakraborty, B.K., Miah, M.I., Mirza, M.J.A. and Habib, M.A.B. 2003. Rearing and nursing of local sharpunti, *Puntius sarana* (Hamilton) at different stocking densities. Pakistan J. Biol. Sci., 6(9): 797-800.

DoF. 2009. Fish week Compendium, Department of Fisheries, Ministry of Fisheries and Livestock. Bangladesh.

Fry, F.E. 1971 The effect of environmental factors on the physiology of fish. In: W.S. Hoar, D.J. Randall and J. R. Brett (Eds), Fish Physiology, Environmental relations and behavior, Academic Press, New York: 1-98.

Haque, M.Z., Rahman, M.A. and Hossain, M.M. 1993. Studies on the effect of stocking densities on the growth and survival of Mrigal (*Cirrhinus mrigala*) fry in rearing ponds. Bangladesh J. Zool., 21(1): 51-58.

Haque, M.Z., Rahman, M.A., Hossain, M.M. and Rahman, M.A. 1994. Effect of stocking densitites on the growth and survival of mirror carp, *cyprinus cerpio* var. *specularis* in rearing ponds. Bangladesh J. Zool., 22: 109-116.

Houde, E.D. 1975. Effect of stocking density and food density on survival, growth and yield of laboratory reared larvae of sea bream, *Archosargus rhombidales* L. (Sparidae). J. Fish Biol., 7: 115-127.

Islam, M.S. 2002. Evaluation of supplementary feeds for semi-intensive pond culture of mahseer, *Tor putitora* (Hamilton). Aquaculture, 212: 263-276.

Islam, M.S., Dewan, S., Hussain, M.G., Hossain, M.A. and Mazid, M.A. 2002. Feed utilization and wastage in semi-intensive pond culture of mahseer, *Tor putitora* (Ham.) Bangladesh J. Fish. Res., 6: 1-9.

Kohinoor, A.H.M., Haque, M.Z., Hussain, M.G. and Gupta, M.V. 1994. Growth and survival rate of Thai punti, Puntius gonionotus (Bleeker) spawn in nursery ponds at different stocking densities. J. Asiat. Soc. Bangladesh Sci., 20: 65-72.

Rahman, A.K.A. 2005. Freshwater fishes of Bangladesh, 2nd ed. Zoological Society of Bangladesh, Department of Zoology, University of Dhaka, Dhaka, 394 pp.

Rahman, M.A. and Rahman, M.R. 2003. Studies on the growth and survival of sharpunti (*Puntius sarana* Ham.) spawn at different stocking densities in single stage nursing. Progress. Agricult., 14(1-2): 109-116.

Rahman, M.R., Rahman, M.A and Hussain, M.G. 2004. Effects of stocking densities on growth, survival and production of calbasu (*Labeo calbasu* Ham.) in secondary nursing. The Bangladesh Veterinarian, 21(1): 58-65.

Rahman, M.A., Mazid, M.A., Rahman, M.R., Khan, M.N., Hossain, M.A. and Hussain, M.G. 2005. Effect of stocking density on survival and growth of critically endangered mahseer, *Tor putitora* (Hamilton) in nursery ponds. Aquaculture, 249: 275-284.

Saha, S.B., Gupta, M.V., Hussain, M.G. and Shah, M.S. 1988. Growth and survival of rohu (*Labeo rohita* Ham.) fry in rearing ponds at different stocking densities. Bangladesh J. Zool., 16: 119-126.