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Growth and production performances of threatened small indigenous fish Gulsha (*Mystus cavasius*) in cage system in the River Brahmaputra, Mymensingh, Bangladesh

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Abstract
One of the important cultivable small indigenous fish which deserves immediate attention for commercial farming is the gulsha, *Mystus cavasius*. A preliminary study of growth and production performance of gulsha in a cage in the river Brahmaputra was carried out for a period of seven months during November 2012 to May 2013. Three treatments depending on the density of fish per cubic meter viz. 500, 600 and 700 were tested with the cage size of 3.0 m^3. Fish were fed with pelleted supplementary feed (containing 30% crude protein) at the rate of 5-15% of body weight. In terms of growth and survival, relatively highest performance was found in the Treatment-1 compared to other treatments. The total production was found highest in the stocking density of the Treatment-1 (8.14 kg/m^3) compared to other treatments. The total production of Treatments- 2 and 3 showed significant differences but there was no significant differences was observed in Treatment-1 and 2. However, total production in the Treatmen-1 showed highest production level, which could be applicable for the farmers reducing monetary investment for fingerling and feed purchase. Overall, cage with a size of 3.0 m^3, stocking higher priced Gulsha at the rate of $500/m^3$ setting in the river during winter season could be a noble technology for the aquaculture farmer in Bangladesh.

Keywords: Production, Gulsha, cage, Indigenous fish, Brahmaputra River.

1. Introduction

Bangladesh is bestowed with inland and open water resources. Just a few decades ago capture fisheries from open water was the main source of fish for fulfilling the protein requirement of one of the largest population in the world. However, capture fisheries is now drastically decreasing due to various man-made and natural causes. Owing to the recent decline in capture fisheries, a prominent livelihood of the rural poor and an increase in the demand for fish protein, there exists a potential for aquaculture to fill this void. Traditional aquaculture in Bangladesh has focused in pond and gher systems that necessitate the ownership of a pond/water body. The rural resource poor does not have access to resources such as land, excluding their participation in such ventures. Cage aquaculture, however, overcomes this constraint as participants need only access to the various water bodies available throughout inland Bangladesh.

Cage aquaculture is a relatively new concept introduced in Bangladesh experimentally. Though the country has vast water resources and climatic conditions, which can consider as ideal for aquaculture, but the aquaculture activities still concentrated largely on pond culture of Indian major carps and Chinese carps [1]. A widespread and profitable culture of fish and prawns in cages has developed successfully elsewhere in Asia, Europe and America in the last two decades [2, 3]. However, in Bangladesh, underutilized vast irrigation canals and other open water bodies could offer tremendous scope for increasing fish production through cage aquaculture, which will increase fish production, animal protein intake and income generation of the poor and marginal farmers.

It is not a traditional form of fish culture in Bangladesh, but recent research efforts have been spurred by the belief that cage culture could have a significant impact on an aquaculture production and on the nutritional standards of family members if managed by women [4].

Bangladesh has some unsuccessful history regarding cage aquaculture technology. Because primarily, it was started with little technical knowledge and make the intervention failed due to lack of appropriate technology and suitable culture species and type of feed. To make it fruitful and successful, this technology should be standardized through implementation of various research projects covering all issues related to cage aquaculture technology. Therefore, proposed research projects have been taken into consideration to assess the growth and production performance of Gulsha in cage in the river Brahmaputra.

2. Methodology

The experimental study of growth and production performance of Gulsha in cage in Brahmaputra river was carried out for a period of about 7 months from 25-10-2012 to 18-05-2013 crossing both winter and summer season.

2.1. Experimental site

The experiment was carried out for seven months during November 2012 to May, 2013 in the Brahmaputra River at Khagdohar Ghat, Mymensingh district.

2.2. Construction of net cages

The size of each cage was 3.0 m^3. The cages were rectangular shaped, made of iron framework and were covered by a high density polyethylene net. The mesh size of the net was 1 cm. Iron rods were welded to construct a rectangular shape frame and nets were attached to the rod with the help of nylon twine. One edge of the side of each cage was kept open which was tied with nylon threads in such a way that it could be opened to deliver feed in the cage.

2.3. Installation of the cages

The cages were installed by several bamboo bars. The cage was fixed with bamboo poles inserted into the river bottom. The cages were tied fixed with the frame by nylon ropes at the time of suspension, about 1 feet of the upper portion of the cages were always kept above the water level. For easy management, the cages were numbered as 1 to 9 and were divided into three treatment groups viz. T-1, T-2 and T-3.

2.4. Experimental Fish

Gulsha fry were used in this experiment. Fish fry were collected from Satata Matsha Hatchery & Fishery, Tarakanda, Mymensingh. All the fish were the same age group having mean weight of 1.04±0.54, 1.30±0.29 and 1.18±0.33g of T-1, T-2 and T-3, respectively. Prior to start of the experiment, the fingerlings were acclimatized to the new environment in floating cages for seven days. Then the fish were stocked in the cages according to the experimental design.

2.5. Experimental design

The designs of experiments are as follows:

Table 1: Stocking density of Common carp in net cages in three different treatments.

Species	Treatment	No of replication	Stocking density (m^3)
Gulsha (*Mystus cavasius*)	T-1	3	500
	T-2	3	600
	T-3	3	700

2.6. Feeding

The fish species in all the treatments were fed first with pre-starter feeds with 30% crude protein for the first month and starter-1 feeds with 30% crude protein on the second month then starter-2 with 30% crude protein on the 3rd month until harvest. Feeding adjustment was done every two weeks based on a feeding rate from 30% down to 8% of the average body weight. The amount of feeds used per treatment was recorded daily.

2.7. Periodical sampling

The weight of fish was taken in account as an important index of growth. Hence, the sampling was done monthly twice by getting the bulk weight of 100 fish samples. Individual weight of 100 fish samples were measured on the initial and final sampling.

2.8. Monitoring of water quality parameters

The water quality parameter such as temperature (°C), p^H, dissolved oxygen (mg/l), transparency (inches) and ammonia (mg/l) were recorded weekly interval throughout the experimental period at 9 am to 10 am by using a water testing kit. The samples were always collected from the sub-surface of with minimum disturbance of water.

2.9. Harvesting

After 210 days the cage was shifted from the culture site and brought to the land area. The fishes were harvested by hand picking. Then total number and weight of fishes were recorded and survival, production were also calculated.

2.10. Data analysis

A statistical test on the treatment means was done using the procedure for randomized block design. When means were significantly different, the Duncan Multiple Range Test at the 5% level was used.

3. Results

The physico-chemical parameters of River Brahmaputra water viz., temperature, transparency, pH, dissolved oxygen and total ammonia of are presented in Table 2. The values of temperature, transparency, dissolved oxygen, pH and total ammonia were 17.0 – 28.0°C, 90 – 104 cm, 5.65 – 7.48 mg/l, 7.69 – 8.00 and 0.00-0.02 mg/l, respectively. The water quality parameters studied during the experimental period were found suitable for fish farming and could not have hampered the normal fish growth.

Table 2: Water quality parameters of River Brahmaputra during experimental period

Parameter	Value
Water Temperature (°C)	17.0 – 28.0
pH	7.69 – 8.00
DO (mg/l)	5.65 – 7.48
Transparency (cm)	90 – 104
Total ammonia (mg/l)	0.00-0.02

On the basis of final growth attained, it was observed that the highest average weight was found in treatment-1 (Table 3). At harvest, the average weights attained by gulsha were 24.67±1.76, 22.33±1.45 and 20±1.15g, in treatments-1, 2, and 3, respectively. The harvesting weight of fish did not show any significant difference ($P<0.05$) among the treatments, but the harvesting weight of treatment-1 was higher than other treatments. The survival rate of fish varied from 52 to 66%. The mean survival rates of gulsha were 66±3.14, 60±4.58 and 52±4.90 in treatments-1, 2, and 3, respectively shown in table-3. The highest survival rate was observed in treatment-1 which followed by treatment-2 and 3. There was negative relationship found between the survival and stocking density. The more the stocking density lowers the survival (Figure 1).

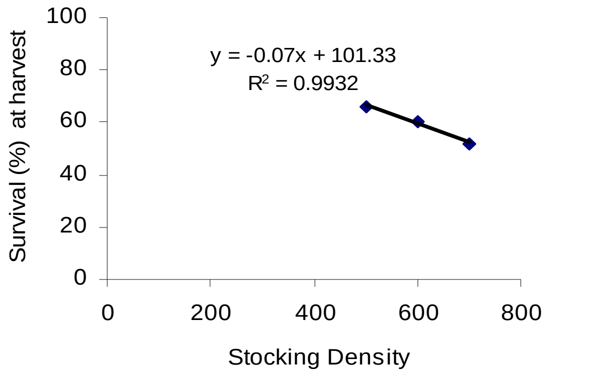

Fig. 1:Relationship between stocking density and survival (%)

The productions obtained in cages were 8.14±0.22, 8.03±0.44 and 7.34±0.17 kg/m^3 from treatments-1, 2 and 3, respectively (Table 3). Figure 2 shows that the highest production was obtained from treatment-1 where the lowest in T-3. The production of gulsha in treatments-1, 2 and 3 were found insignificantly when tested statistically.

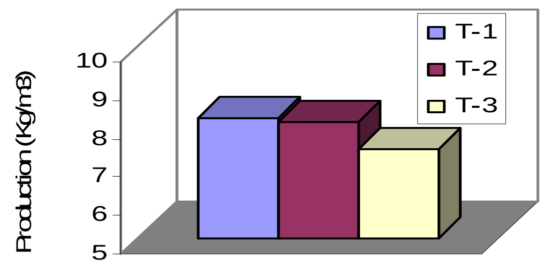

Fig 2: Production (kg/m3) of fish at different stocking densities

Table 3: Harvesting wt., Survival, and Production of gulsha under different treatments

Treatment	Harvesting Wt.(g)	Survival (%)	Production/m^3/kg
T_1 (500/m^3)	24.67±1.76^a	66±3.14	8.14±0.22^a
T_2 (600/m^3)	22.33±1.45^a	60±4.58	8.03±0.44^a
T_3 (700/m^3)	20.00±1.15^a	52±4.90	7.34±0.17^a

* Dissimilar superscript indicates significant difference at 5% level of probability

Correlation matrix among stocking density, harvesting weight, survival and production of fish is shown in Table 4. Stocking density showed an inverse relationship with survival. It means that if stocking density increased, then survival of fish decreased. While, harvesting weight citied positive correlation with production and survival. Whereas, production also showed positive correlation with survival.

Table 4: Correlation matrix among stocking density, harvesting weight, survival, and production of fish

Parameters	Density	Harvesting Wt. (g)	Survival (%)	Production/m3 (kg)
Density	1			
Harvesting Wt. (g)	-0.99339927	1		
Survival (%)	-0.9966159	0.980609	1	
Production/m^3 (kg)	-0.98653638	0.961265	0.996641	1

*Significant difference at 5% level of probability

The cost and benefit analysis of gulsha in net cages under three treatments are presented in Table 5. Variable costs towards cage preparation, fingerlings, feed and operational costs were taken into consideration while calculating cost of production. Cost and benefit analysis showed that T_1 generated the highest return over a period of seven months of Tk. 4810/cage (3m^3) and lowest net return Tk. 2410/ cage (3m^3) was found in T_3. The results of the study indicated that the best individual growth, production and net benefit of gulsha was obtained at a density of 500 fish/m^3.

Table 5: Cost and return analysis of fish production under different treatments (Tk./cage)

Inputs	T_1		T_2		T_3	
	Quantity	Cost (Tk.)	Quantity	Cost (Tk.)	Quantity	Cost (Tk.)
Cage preparation(3m^3)		3000		3000		3000
Fingerling (Nos.)	1500	1500	1800	1800	2100	2100
Feed (kg)	60	2400	68	2720	75	3000
Operational cost		500		500		500
Total cost		7400		8020		8600
Benefits						
Production of Fish: T_1: 24.42 kg/cage;T_2: 24.09 kg/cage and T_3: 22.02 Sell price • Gulsha : Tk.500/kg	24.42	12210	24.09	12045	22.02	11010
Net benefit/cage		4810		4025		2410

4. Discussion

The water quality parameters such as temperature, transparency, pH and dissolved oxygen studies during the experimental period were found suitable for fish farming and could not have hampered the normal fish growth [5].

In the present study, the effect of stocking densities on the growth of *M. cavasius* in cages was observed. The results indicated that the growth rate of *M. cavasius* varied in different stocking densities. The growth rate was the lowest in treatment-III, where the stocking density was the highest resulting in shortage of living space per fish. This agrees with the findings of Treatment-1 showed the best results in terms of growth and survival. [6] It is reported that the stocking rate of *Labeo rohita*, 10 fishes/m^3 in floating cages in ponds gave best result in terms of individual growth followed by 20 and 30 fishes respectively. While, [7] found that in case of *Cyprinus carpio* cultured in floating ponds, the best growth was recorded at lowest density (5 fishes/m^3) and least growth was recorded at a highest stocking density (20 fishes/m^3). While, [8] observed that low stocking densities 20 fish/m^3 gave the highest production of carps in net cages compare to the high densities of 80 and 150 fishes/m^3.

In a study [9] observed that in floating cages, common carp exhibited individual mean harvesting weights were negatively correlated with stocking density and the best individual growth and production of common carp was obtained at a lowest stocking density.

In another study, [10] found higher production in low stocking densities and lower production in higher stocking densities of carp. [11, 12] reported that the growth and production of fish are to a certain extent, dependent on the population density. Whereas, [13] reported that the harmful effects of higher stocking density on the culture of fish were the reduction of growth rate, increase of food conversion ratio and lowering of survival rate. The similar type of observation was reported by [14] who found that in cage culture of pangas, the stocking density of 40 fishes/m^3 gave the best growth in comparison with 50 and 60 fishes/m^3. In a recent study, [9] mentioned in his study that the best individual growth and production of common carp in cages was obtained at low stocking density of 80 fish/m^3.

5. Conclusion

In the present study, the total production of Treatment-1 (500/m^3) was supposed to be high as the stocking density was less however, total production in the Treatment-1 showed highest production level due to better individual growth performance, which could be applicable for the farmers avoiding higher investment for fingerling and feed purchase. The growth and production performance of Gulsha was found satisfactory though the experimental period continued from winter to summer. This indicates the suitable temperature level in the river system during the winter for production of fish in the cage system. Such potential ecological area and season of the rivers could be brought under broader aquaculture development programme for the resource poor people who do not have their own land and ponds. Overall, cage with a size of approximately 3.0 m^3, stocking higher priced Gulsha at the rate of 500- 600/m^3 setting in the quiet river during winter season could be a noble technology for the aquaculture farmer in Bangladesh.

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