

## COMMERCIAL CULTURE POTENTIALITY OF STRIPED SNAKEHEAD FISH *CHANNA STRIATUS* (BLOCH, 1793) IN EARTHEN PONDS OF BANGLADESH

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### ABSTRACT

A study was conducted to evaluate the commercial culture potentiality of striped snakehead *Channa striatus* fish in the earthen ponds in Jessore, Bangladesh. Monoculture was carried out in three earthen ponds of Afil Aqua Fish Ltd by collecting naturally available fingerlings with a length and weight of  $11.75 \pm 0.75$  cm and  $45 \pm 10$  g, respectively for a period of 180 days. Stocking density of fingerlings was 40 fish/decimal and were fed with hatchery originated live fish fry of Bata (*Labeo bata*), Mrigal (*Cirrhinus cirrhosus*) and Silver carp (*Hypophthalmichthys molitrix*) at the rate of 1 to 3% of the total body weight and a supplementary feed combination of rice polish, mustered oil cake and fish meat at the rate of 3 to 5% of the total body weight. In situ water quality parameters viz. water temperature, dissolve oxygen, pH were obtained from  $26.5 \pm 5$  to  $31.5 \pm 1.5$  °C,  $6.75 \pm 0.25$  to  $8.2 \pm 0.1$  mg/L and  $7.8 \pm 0.1$  to  $8.5 \pm 0.1$ , respectively. The final weight of fish was  $850 \pm 60$  g and net production was  $32.98 \pm 0.5$  kg/decimal. The total production of remaining unutilized white fish Bata (*Labeo bata*), Mrigal (*Chirhinus cerosus*) was  $500 \pm 0.5$  kg. The survival rate and feed conversion ratio (FCR) was  $97 \pm 2\%$  and 1.56, respectively after six months of rearing. Cost benefit ratio (BCR) was 1.85 and found significantly higher than Thai koi (*Anabus testudineus*) (1.53) and Tilapia (*Oreochromis mossambicus*) (1.22) from the same region and indicated its culture and economic feasibility.

**Keywords:** *Channa striatus*, Monoculture, Live Feed, Survival, Production, Profit.

### INTRODUCTION

*Channa striatus*, locally known as “Shoal”, is a commercially important species and along with other species of the genus *Channa*, it contributes 4.2% of the total fish production in Bangladesh (FRSS 2008). The flesh of Shoal fish is firm, white, and practically boneless and has the most agreeable flavor. It is one of the main food fishes in Bangladesh, Indo-China and Malaysia (Davison 1975) and cultivated in India, Pakistan and Thailand (Muntaziana 2013). The heavy dark skin is usually sold separately which is good for soup (Davison 1975). Its flesh is claimed to be rejuvenating and widely consumed for its nutritional value as well as for its beneficial effect in wound healing (Mat *et al.*, 1994, Wee 1982). It is also well known for its therapeutic effect and pain reduction due to osteoarthritis (Michelle *et al.*, 2004). It is also an excellent source of dietary protein for human (Gam *et al.*, 2005).

The fish is not threatened in Bangladesh (IUCN 2000). It inhabits freshwater ponds, streams; prefers stagnant muddy water and grassy tanks, breeds almost throughout the year in the flood plains with low water in the monsoon (Talwar and Jhingran 1991, De Silva 1991). Artificial breeding have been attempted for this species by several researchers with considerable success (Duong *et al.*, 2004, Haniffa *et al.*, 2000). The availability of this fish was recorded from the Bookbhara baor (oxbow lake) in Jessore (Mohsin *et al.*, 2009)

and Chalan beel in Rajshahi (Galib *et al.*, 2009). The fish is carnivore and predatory (Ranman 2005).

Snakehead culture is not practiced in well-defined way in Bangladesh as the Indian major carps (IMCs). The published articles, news is scant and the production of this fish from the natural water bodies is declining day by day. Consequently, seeds of this species are often collected from the natural habitat which is unpredictable and may seriously deplete the natural stock in near future. The higher market price and consumer demand along with the stated advantages make the species a good candidate for aquaculture.

No works mention worthy have been conducted in Bangladesh to promote its rearing and culture technique. The fish is being cultured at some different parts of the country in a very sporadic way. After a course of searching it was revealed that the current experimental site has initiated culture practice of this valuable fish. The aim of the current study is to determine the culture potentiality of this fish species in the earthen pond and to find the constraints and prospect of this species in Bangladesh aspect.

### MATERIALS AND METHODS

The study was conducted in an aquaculture farm named Afil Aqua Fish Ltd. at Boromandertola, Sharsha in Jessore district of Bangladesh. This study was done to evaluate the economic feasibility of *C. striatus* culture. For this aspect *C. striatus* was

cultured in monoculture system in three same sized culture ponds and sold. To get an overview of the actual profit from the *C. striatus* monoculture, rapid growing monoculture of Thai koi (*Anabrus testudineus*) and Tilapia (*Oreochromis niloticus*) was also considered from the same ecological area. Fortunately it was able to do within the same farm as these were running simultaneously.

The area of each striped snakehead fish stocking ponds was 65 decimal with  $1.5 \pm 0.1$  to  $1.8 \pm 0.1$  m depth. Live food fish (fingerlings of some low value fish, *Labeo bata*, *Cirrhinus cirrhosus* and *Hypophthalmichthys molitrix*) stocking pond was prepared with an area of 30 decimal with 0.5 to 0.8 m depth. Ponds were completely dried, ploughed and embankments were repaired by eradicating bushes and extra aquatic weeds. Lime was used at one kg per decimal to improve pH of water and also the pond productivity. Inorganic fertilizers urea 300 g/decimal and triple super phosphate (TSP) 700 g/decimal were applied after 5 days of water intake to increase the plankton density in pond waters. After 5 days of fertilization cow dung 5 kg/decimal was applied. Then after two days mustered oil cake 2 kg/decimal was applied. In the next 7 days Horra (Metal chain) was pulled every day to prevent the fertilizers from being settled down which may create gas in pond bottom. Then the pond water became greenish color with the abundance of phytoplankton and zooplankton and was ready for the stocking of desired fish fingerlings.

Fingerlings were collected from beels (natural depression) and baors (oxbow lakes of Jessore district, especially from Boromandertola, Jhikorgacha, Jessore after the complication of parental care with a length of  $11 \pm 0.75$  cm and weight of  $45 \pm 10$  g. About 7800 seeds were collected within 4 to 5 consecutive days and the price was 0.06 US\$ per fingerling and at least 500 fingerlings were carried in each earthen pots with 10 to 12 L water holding capacity. As *C. striatus* fish is very hardy there was no need of special oxygen supply. The stocking density was 40 fingerlings/decimal, and fingerlings were stocked directly into the culture pond with proper conditioning in the month of April and then fingerlings were cultured in the same pond for 6 months up to harvest.

The fingerlings were fed on live fry of Bata (*Labeo bata*), Mrigal (*Cirrhinus cirrhosus*) and Silver carp (*Hypophthalmichthys molitrix*). The fry of Bata, Mrigal and Silver carp were collected from 30 to 40 hatcheries of Jessore district and reared in another pond to feed the culture species at least 10 to 15 days ahead of *C. striatus* fingerlings stocking. They were stocked at 2,000 to 3,000 pieces per decimal and were fed with mustered oil cake and commercial feed (nursery-1) at the rate of 20% of body weight for the first week and it was gradually decreased with extension of culture period. The initial and final lengths of three live feed species (fish fry) were recorded  $2.5 \pm 0.25$  and  $2.75 \pm 0.50$ ,  $2.5 \pm 0.75$  and  $5 \pm 1.5$ ,  $5.5 \pm 1.75$  and  $6.25 \pm 1.25$  cm, respectively during the culture period. Live feed was supplied at the rate of 1 to 3% of total biomass of *C. striatus* fish and it was adjusted after every bi-weekly sampling.

A supplementary feed made of rice polish, mustered oil cake and fish meat at the ratio of 10:10:01 also applied. Normally it was found that excess or uneaten feed remain

floating up to 3 to 4 hours which allowed adjusting feeding regime accordingly. The *C. striatus* fish are usually nocturnal feeder. This supplementary feed was applied every day in the evening by using 7 to 8 feeding tray at different side of the pond at the rate of 3 to 5% of total body weight of fry.

In general no sampling was done but for the experimental purpose the sampling of *C. striatus* fish fingerlings was done at 15 days interval to adjust the feeding rate, to observe the health condition and to keep the record of length and weight of fish. Fishes were caught by seine net and about 10% of each species were sampled. Various water quality parameters were recorded bi-weekly throughout the culture period. Water temperature was recorded from the study area with the help of a Celsius thermometer ( $^{\circ}\text{C}$ ). The transparency of water was measured by a secchi disc of 20 cm in diameter. To determine the dissolved oxygen, water samples were collected in dark bottles and measured the amount of DO by using DO meter (HANNA instruments, Model: HI 9146). pH of pond water was determined by color comparative disc through HACH Test Kit (Model FF-2). To keep the pond environment congenial for fish farming and to avoid potential *C. striatus* fish disease application of lime at 500 g/decimal, TSP at 30 g/decimal, sodium chloride salt at 1.5 kg/decimal were applied once in every month.

At the end of October the *C. striatus* fish were harvested at good marketable size and price. By dragging net and drying the pond, fishes were harvested. Some uneaten live food fish like Bata, Mrigal and Silver carp in the culture pond were also attained marketable size and they were also collected with *C. striatus* fish and sold in market. The record of their average weight, length, number and total amount of production were kept. Survival rate, specific growth rate (SGR), weight gain, food conversion ratio (FCR), Benefit cost ratio (BCR) were calculated to evaluate fish growth by using following formula:

$$\text{Survival rate (Pauly 1980)} = \frac{\text{No. of total fry obtained}}{\text{No. of total fry stocked}} \times 100$$

$$\text{SGR (\%/ day) (Brown 1957)} = \frac{\text{Log } eW_2 - \text{Log } eW_1}{T_2 - T_1} \times 100$$

Where,  $W_1$  = Initial body weight (g) at time  $T_1$  (day) and  $W_2$  = Final body weight (g) at time  $T_2$  (day)

Average weight gain (g)/day at different months (Brown 1957)

$$= \frac{\text{Weight (g) in present month} - \text{Weight (g) in previous month}}{\text{Days of month}}$$

FCR (Castell and Tiews 1980)

$$= \frac{\text{Total feed used (kg)}}{\text{final body wt (kg) - initial body wt (kg)}}$$

For 1 year tenure there is no discount factor, hence benefit cost ratio should be,

$$\text{BCR (Greene and Stellman 2007)} = \frac{\text{present value of benefit}}{\text{present value of cost}}$$

## RESULTS AND DISCUSSION

### Water quality parameters

The water temperature was recorded from  $26.5 \pm 1.5^{\circ}\text{C}$  to

31.5 ± 1.5°C in three culture pond which is more or less similar to recorded temperature ranges from 26.0 to 35.0 and 22.0 to 34.0°C, respectively (Rahman 2005, Kunda et al., 2008). pH ranged from 7.8 ± 0.1 to 8.5 ± 0.1 considered as suitable range for fish culture and agreed with the ranges of pH found from 6.3 to 8.9, 7.55 to 7.84, respectively (Ahmed 2004, Ali et al., 2004). The dissolved oxygen was found 6.75 ± 0.25 mg/L to 8.2 ± 0.1 mg/L at morning during the entire study period agreed with recorded dissolved oxygen ranged from 2 to 7.04 and 4.3 to 6.9, respectively, in fish culture pond (Ahmed 2004, Ali et al., 2004). The water transparency was between 20.05 ± 0.5 cm to 29.75 ± 0.25 cm. The level of transparency from 40 to 54 cm was also acceptable for fish culture (Mumtazuddin et al., 1982). Ammonia nitrogen the total (NH<sub>3</sub>-N) concentration was found to vary from 0 to 0.025 ± 0.005 mg/L in the culture pond, which is more or less similar to recorded ammonia-nitrogen value to range from 0.203 to 0.569 mg/L (Asaduzzaman et al., 2006).

### Stocking density

Stocking density is an important factor in terms of growth, feeding and survival rate. In the present study, higher growth rate was found at the stocking density 40 fingerlings/decimal or 2 fingerlings/L giving the best result in terms of length gain, weight gain, specific growth rate and health condition which is similar to highest growth and survival in *Clarias* at stocking density of 4 larvae/L (Barua 1990).

### Feeding

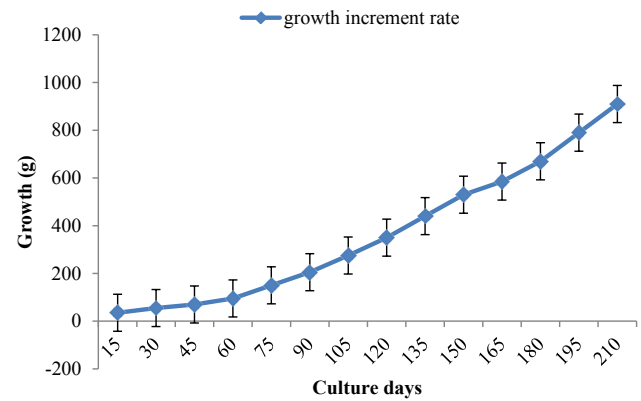
To rear striped snakehead fish it was required 1,105 kg live fish and 2,490 kg supplementary feed in each culture ponds. The feed conversion ratio (FCR) was 1.56. Snakehead fed with a formulated feed at the rate of 5% body weight had an FCR value of 1.0 (Qin and Fast 2003). Live fish are the most favorite diet, and rations up to 50% of body weight/day are readily consumed by the fingerlings which reveal that, growth rate as well as survival is satisfactory only when fresh freshwater trash fish is served as feed.

### Growth, production and survival rate of *C. striatus*

The specific growth rates (SGR %/day) were 14.65 ± 1.55, 7.85 ± 0.95, 11.1 ± 2.1, 7.77 ± 0.8, 6 ± 0.6, 3.4 ± 0.54, 4.45 ± 0.35 from the month April to October respectively. Significantly higher SGR (%/day) was obtained 1.8% day<sup>-1</sup> here. SGR of catla, rohu, mrigal and mahseer in different treatments under a polyculture system were 1.09 to 1.12%, 1.13 to 1.14%, 1.10 to 1.12% and 1.15 to 1.16%, which are lower than those in the present study (Rahman et al., 2007). The higher SGR values in this study might be due to the consumption of both natural and supplementary feed for growth.

Average growth rate of fish in weight at different culture days is shown in Figure 1; the initial average weight of *C. striatus* fish was 45 ± 10 g while the final average weight was 850 ± 60 g.

Productions (Gross and net) of *C. striatus* found in this study were 2,143.70 ± 1.8 kg and 35.31 ± 0.5 kg/decimal. A gross production of 1,370 to 1,535 kg per decimal was found in the culture of small indigenous catfish (*Mystus cavasius*)



**Figure 1:** Growth rate of *C. striatus* fish at per sampling day (M ± SD).

for 6 months (Kohinoor et al., 2004). The production of remaining unutilized white fish Bata (*Labeo bata*), Mrigal (*Chirhinus cerosus*) which were used as feed of *C. striatus* was 500 ± 0.5 kg.

The survival rate of *C. striatus* was 97 ± 2% and mortality was 3 ± 2%. Highest survival rate 96.66% in mosquito larvae fed groups in his experiment (Kumar et al., 2008).

### Cost and profitability analysis

An economic analysis was performed to estimate the net profit from the *C. striatus* culture. The total production cost of *C. striatus* was 4,215.77 US\$, total income was 6,905.35 US\$ and benefit was 2,689.58 US\$. Average cost of production was 57.38 US\$ per decimal and per decimal average return was 48.62 US\$. Cost benefit ratio was 1.85. So, production of *C. striatus* was profitable. Cost of fingerling, labor cost, feed cost, fertilizers and chemicals cost and culture period included in the profit frontier had a significant influence on the profit of *C. striatus* monoculture in the study (Table 1).

The cost benefit ratio of Thai koi (*A. testudineus*) and Tilapia (*O. niloticus*) was found 1.53 and 1.22, respectively which was less than the BCR of *C. striatus*. BCR of Tilapia was 1.25 in study of profit efficiency of Tilapia monoculture in Trishal upozila of Mymensingh district (Rahman et al., 2005) and BCR for Thai koi was 1.08 in study which are much more similar to the present study (Hasan et al., 2010) (Table 2).

### CONCLUSION

Freshwater aquaculture entrepreneurs and fish farmers in Bangladesh are involved mainly in carp and other catfish culture. Fish farmers are lacking the knowledge about the rearing and feeding of the snakeheads. The results of the current study suggest that *C. striatus* is a suitable and potential species for small scale fish farmers and commercial culture. Further study is required before the technique is recommended to the ultimate users. Because of over-exploitation and various ecological changes in the aquatic ecosystem, *C. striatus* may become extinct from the natural habitats. Under the prevailing situation, the findings obtained from the present study would be immensely helpful for the development of aquaculture and conservation of this important fish. Further studies are also recommended to

**Table 1:** Analysis of cost and profitability of *C. striatus* fish culture

Expanses in production area	Amount	*Cost(US\$)/unit	*Total cost(US\$)/unit
<b>a. Management expense</b>			
1. Pond lease cost	(65+30) or 95 decimal	6.15/decimal	587.25
2. Labor cost (provides protection, feed supply, weed cleaning etc.)	1 person	61.58/month	431.02
3. Net dragging or doing horra (in every month)	6 times	1.85/time	11.10
4. Harvesting cost	1 time		61.58
5. Transportation and marketing			98.52
6. Others (a)			7.39
<b>Partial total</b>			1,196.86
<b>b. Cost of pond preparation</b>			
1. Pond repair	8 labor	1.23/labor	9.84
2. Pond drying and removal of other fishes			14.78
3. Lime application (1 kg/dc)	65 kg	0.15/kg	9.75
4. Fertilizer	65 kg	0.32/kg	20.80
5. Water supply			68.97
6. Medicine			8.62
<b>Partial total</b>			132.76
<b>c. Seed of <i>C. striatus</i></b>	2600 piece	0.06/pc	156.00
<b>d. Live feed</b>	1025 kg	0.99/kg	1,014.75
<b>e. Feed of live feed</b>	250 kg	0.25/kg	62.50
<b>f. Supplementary feed</b>	2490	0.43/kg	1,070.70
<b>g. Feed transportation and others</b>			19.70
<b>Total expense (a+b+c+d+e+f+g)</b>			4,215.77
<b>Production and income</b>			
<b>i. Production of <i>C. striatus</i> (3% mortality rate and average wt of each fish)</b>	2143.70 kg	2.96/kg	6,345.35
<b>ii. Production of white fish</b>	500 kg	1.12/kg	560.00
<b>Total income (i+ii)</b>			6,905.35
<b>Actual income (total income-total expense)</b>			2,689.58
<b>Cost benefit ratio</b>			1.85

\*1US\$=79.0789 BDT; Source- <http://www.usd.fxexchangerate.com/bdt/>. [31.01.2016]

**Table 2:** Comparison of the culture potentiality between *C. striatus*, Thai koi (*A. testudineus*) and Tilapia (*O. niloticus*) fish.

Factors	<i>C. Striatus</i> aquaculture	<i>A. testudineus</i> aquaculture	<i>O. niloticus</i> aquaculture
Stocked fry/decimal	40	834	250
Net production (kg/decimal))	32.98	58.33	80.00
Production cost (US\$/decimal)	57.38	63.51	76.52
Production cost (*US\$/kg) fish	1.63	1.09	0.96
Total Return(*US\$/decimal)	106.00	96.98	93.53
Income (*US\$/kg) fish	3.20	1.67	1.17
Net return (*US\$/decimal)	48.62	33,47	17.07
Benefit cost ratio	1.85	1.53	1.22

\*1US\$=79.0789 BDT; Source- <http://www.usd.fxexchangerate.com/bdt/>. [31.01.2016]

determine more appropriate stocking densities and culture techniques of this important fishery.

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