



## SHRIMP CULTURE PACKAGES IN SOUTHWESTERN BANGLADESH

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### Abstract

**Context:** The study was conducted under the technical support of ATDP-II in Bagerhat District, from July to November 2005 on traditional, closed, and semi-intensive culture packages of penaeid shrimp (*Penaeus monodon*).

**Objective:** The objective of the study was to compare the management, technical and economic aspects of three different shrimp culture packages.

**Materials and Methods:** Post larval nursing was done for 30 days at a density of 50 PL/m<sup>2</sup>. Culture was done for 120 days at a density of 2.11, 7.37 & 11.56 individuals/m<sup>2</sup> in traditional, closed, and semi-intensive ponds respectively. Shrimp PL were fed CP feed (40 % protein) at a rate of 2kg for 100,000 PL, but no supplementary feed was used in traditional ponds.

**Results:** The highest average daily growth (0.263±0.026 g/day) was found in traditional culture; while in closed, and semi-intensive system it was lower (0.226±0.023 and 0.239±0.022 g/day respectively) due to high stocking density and feed competition. Survival rates were found 49.14±5.94, 57.94±8.01 and 60.07±10.98 % which yielded 327.23±24.14, 1158.07±134.76, 1991.57±232.70 kg/ha in traditional, closed, and semi-intensive ponds respectively. Net income was calculated 47932.18 Tk/ha from traditional, 178779.2 Tk/ha from closed, and 312736.8 Tk/ha from semi-intensive culture.

**Conclusion:** The study suggests that instead of horizontal expansion of traditional shrimp cultivation, healthy management and improved culture technique are very much important to increase shrimp production in Bangladesh.

**Keywords:** *Penaeus monodon*, culture package, production, income.

### Introduction

Coastal aquaculture in Bangladesh is mainly based on shrimp culture. Due to being a profitable business, the rapid commercialization of shrimp culture has occurred in the coastal areas of the country. Greater Khulna region is known as the main zone of shrimp cultivation and about 75% of country's shrimp production is obtained from these regions (Huq *et al.* 2004a).

According to Islam *et al.* (2005), most of the ghers are practiced in almost traditional ways, which is characterized by a large-sized gher (up to 100 ha), low stocking density, no feeding and fertilization, and poor management of water quality. As most farmers follow this extensive-traditional method, the average production of shrimp in our country is as low as 150-250 kg/ha, whereas in other countries, it reaches even 1,500-3,000 kg/ha (FAO 1997). Better management practices have been advocated to improve this situation and to obtain a sustained production and profits (Wahab 2003).

Karim (2003) reported that mainly two types of shrimp culture systems, extensive-traditional and improved-traditional, with different degrees of management are found in Bangladesh. Since different methods require different degrees of management, the production rates also differ remarkably with the method applied (Wahab *et al.* 2001). Now-a-days, trends are being changed and the farmers are aware of taking care about the culture of penaeid shrimp with some sustainable degrees of management initiatives. Despite the apparent economic success of shrimp farming, the question of sustainability has become a great issue in recent years as it contributes to the degradation of coastal environment and may threaten the sustainability of shrimp production (Islam *et al.* 2004). So, it is high time to implement sustainable shrimp culture techniques in Bangladesh.

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Throughout the country, the government initiated a joint venture project (ATDP-II: Agro-Based Industries and Technology Development Project) with USAID to work for uplifting the status of different agricultural sub-sectors and a major part of this project was to promote the production of privately owned shrimp farms located in south-west part of the country that can succeed in an open competitive market environment. With an aim to notice the environmentally sound and economically beneficial shrimp culture method, this study was carried out in a number of commercial shrimp farms which run under the technical support of ATDP-II in Bagerhat District, the southwest coastal region of Bangladesh. The specific objective of the study was to compare the technical and economic aspects of different methods of shrimp culture, and to observe their feedback.

### Materials and Methods

The experiment was conducted at a number of commercial shrimp farms run under the technical support of ATDP-II in Bagerhat district, located in the southwest region of Bangladesh. All the data regarding shrimp production from three different culture systems operated with different management regimes were collected fortnightly from the gher owners as well as ATDP-II extension workers from July to November 2005. Three ghers for each culture system were selected randomly. Modified traditional ghers were found to be characterized by large size (0.5-1.2 ha), whereas closed and semi-intensive ghers ranged from 0.2-0.45 ha and 0.32-0.42 ha respectively. Major differences in management of three culture systems and different steps of culture are discussed in the following sub-sections.

Two weeks before stocking, the ponds were thoroughly drained and sun dried. In the meantime, closed and semi-intensive ghers were enclosed with fine mesh nylon net to restrict the access of crabs, frogs, snakes or any other probable predators and disease carriers. All the three culture systems were treated with lime and fertilizer. Agricultural lime [dolomite;  $\text{CaMg}(\text{CO}_3)_2$ ] was applied at the rate of 400 kg/ha. This was usually followed by fertilization (7-10 days after liming) with urea and TSP, applied at the rate of 20 and 7 kg/ha respectively.

After a short break of 3-5 days subsequent to fertilization, the ghers were flooded with river water screening either through a micromesh or mosquito net to prevent entry of predators and other undesirable aquatic organisms, even their eggs or larvae. The screen was maintained at outlet also to prevent escape of fry. Unlike modified traditional system in which water exchange was based on pumping, every closed and semi-intensive ghers had water reservoir, water supply (inlet & outlet) and water treatment (bleaching – 600kg/ha) amenities.

Subsequent to water supply single stocking was done in two types of culture system other than the modified traditional system. Hatchery-produced shrimp post larvae (PL) were nurtured at a density of 50 PL/m<sup>2</sup> for 30 days in nursery ponds. Later on, the juveniles were shifted in pre-prepared grow-out ponds 7-8 days following the introduction of water, when the pond water had turned greenish and reared for 120 days at a density of 2.11, 7.37 and 11.56 individuals/m<sup>2</sup> in three respective systems of modified traditional, closed and semi-intensive culture. Prior to stocking in semi-intensive ghers, only PCR (Polymerase Chain Reaction) checked virus free PLs were taken and acclimatized to the water in the gher for about 30 min to suit in the new aquatic environment.

Nursery ponds in all types of culture system were treated with CP (Charoen Pokphand, Thailand) fine crumble feed with 40 % protein level at a rate of 2kg for 1,00,000 PL. Grow out ghers of modified traditional system were rarely treated with supplemental feeding. Shrimps in closed and semi-intensive culture were fed CP pellet feed with 38 % protein level 6 times a day at 3.5% of their total body weight. Feeding rate varied according to the requirement and it was reduced to 2% of the total body weight as the shrimp gained weight after every successive days.

**In-culture Management:** The physico-chemical parameters of the experimental ponds were monitored regularly by the ATDP-II extension workers. Closed and semi-intensive ghers were subsequently fertilized with chemical fertilizers on an irregular basis since the farmers did not follow the recommended doses of fertilization. Modified traditional ghers were replenished partially with new flood during the period of partial harvesting and re-stocking cycle; the water volume of other two systems was partially swapped over in each month throughout the culture period with treated water stored in reservoir. To minimize oxygen depletion due to high stocking density, aerator was used in semi-intensive ghers.

**Data Analysis:** Recorded hydrographic data and shrimp growth (weight) data were collected fortnightly from the gher owners as well as ATDP-II extension workers. Data regarding the total number of shrimp harvested from each gher were also collected and the survival rates were determined in order to calculate the shrimp production in each gher. Finally all these data were assembled together and used for cost-benefit analysis.

## Results

Growth, survival and per hectare yield of coastal shrimp raised under three different culture packages were determined successfully and the data are presented in Table 1. The mean final weights of shrimp found to be  $31.56 \pm 2.67$ ,  $27.12 \pm 2.64$ , and  $28.68 \pm 2.09$  g with survival rates  $49.14 \pm 5.94$ ,  $57.94 \pm 8.01$  and  $60.07 \pm 10.98$  % in modified traditional, closed and semi-intensive ghers respectively.

Table 1. Shrimp production performances in three different culture packages

Parameter	Modified traditional		Closed		Semi-intensive	
	Range	Average <sup>1</sup>	Range	Average <sup>1</sup>	Range	Average <sup>1</sup>
Initial wt (g) <sup>1</sup>	4.16-4.98	4.52±0.31	4.16-4.98	4.52±0.31	4.16-4.98	4.52±0.31
Final wt (g) <sup>2</sup>	26.98-34.66	31.56±2.67	23.78-32.35	27.12±2.64	24.51-33.93	28.68±2.09
ADG <sup>3</sup> (g/day)	0.224-0.289	0.263±0.026	0.198-0.270	0.226±0.023	0.204-0.283	0.239±0.022
Survival (%)	38.40-55.35	49.14±5.94	45.53-66.37	57.94±8.01	48.56-72.90	60.07±10.98
Yield (Kg/ha)	279.74-359.38	327.23±24.14	1015.44-1381.40	1158.07±134.76	1701.99-2356.13	1991.57±232.70

<sup>1</sup> after 30 days, <sup>2</sup> after 120 days, <sup>3</sup>Average Daily Growth, <sup>4</sup>Mean±SD

Table 2. Hydrographical parameters of the experimental ponds

Parameters	Measured value			Recommended range
	Modified traditional	Closed system	Semi-intensive	
Temp. (°C)	25-34	26-34	25-33	22-32 (Ling 1969); 25-30 (Boyd and Fast 1992)
Depth (m)	0.5-1.2	0.8-1.5	1.2-1.5	1.0-1.5 (Huq <i>et al.</i> 2004b)
DO (mg/l)	4-5	4-5	5-6.5	4.5-9.9 (George 1961); 5.1-8.7 (Islam <i>et al.</i> 1998)
Transp. (cm)	25-35	24-33	25-34	25-35 (Khandaker 2003)
pH	7.5-8.4	7.6-8.5	7.5-8.4	7-9 (Boyd and Fast 1992)
Salinity (ppt)	8-20	10-20	10-20	15-25 ppt (Boyd 1989)

Table 3. Cost-benefit analysis of three different shrimp culture packages

Costs (Tk)	Modified traditional	Closed	Semi-intensive
Gher prep.	3000	5,000	7000
Shrimp seed	13500	36,000	67500
Lime	1750	3600	2800
Fertilizer	1000	1000	2400
Feed	-	99,000	270000
Feeding trays		720	720
Bleaching pow.	1500	30000	30000
Labour	2500	5000	8000
Farm manger	8000	8000	16000
Harvesting	500	800	700
Basket	450	300	1000
Spade	320	320	320
Transport	800	500	500
House repairing	800	800	2000
Others	1000	1000	4000
Total input	62,450	2,22,040	5,62,940
Gross income	110382.18	400819.2	875676.80
Net income	47932.18	178779.2	312736.8
Return invest.(%)	176.75	180.51	155.55

The hydrographic parameters monitored regularly were within the culturable range (Table 2). Thus the variation in survival rates among three culture systems can be attributed due to different management schemes taken which ultimately resulted variation in shrimp production as well (Table 1). The total expenditure in each culture system was also affected by different degrees of management. Gher preparation, feeding, and fertilization costs were higher in semi-intensive system. On the other hand, seed, labour, and harvesting costs were higher in modified traditional system. Costs of these items in closed system were patchy, but the total cost was more or less midway to the other two systems (Table 3).

According to the current market price of shrimp, economic returns were calculated separately for each culture type from the cost-benefit analysis (Table 3) which divulges an increase of gross income, net income, and return on investment with the increase of intensity in different culture methods.

### Discussion

Three different shrimp culture packages were compared and the results indicate a visual difference on shrimp production and its financial return among those packages. Survival rate of the shrimps and yield (kg/ha) were higher in the semi-intensive culture compound to the other two systems.

Traditional farms were characterized according to Kungvankij *et al.* (1985) by low stocking densities (e.g. 5,000/ha) and hence low yield (100-300 kg/ha/yr), irregular pond size and shape, relatively low technical management inputs as well as comparatively small investment. A gradual improvement of this status has penetrated over years into the present shrimp culture practices in Bangladesh and the farmers still could not escape out fully from the periphery of traditional way of culture they used to follow once upon a time. Now the time has changed and it has brought such technological approach through which much higher yield can be obtained from even a small pond. Islam *et al.* (2005) demonstrated average shrimp production  $204.46 \pm 62.65$ ,  $155.88 \pm 10.64$  and  $83.47 \pm 48.53$  kg/ha/cycle from small (1-5 ha), medium (6-10 ha) and large (>10 ha) ghers respectively. Similarly highest average shrimp production ( $1991.57 \pm 232.70$  kg/ha) was obtained in 150 days from currently studied small sized (0.32-0.42 ha) semi-intensive ghers. They attributed this higher yield of shrimp in small ghers to large extent due to better management in these ghers which indicated more intensive approach over there. In the present experiment, such type of intensification through high input and care reduced mortality of shrimp in semi-intensive ghers, hence yielded higher production. Masud *et al.* (1997) reported 76% and 58 % survival rate against the stocking density of 25 and 35 PL/m<sup>2</sup> respectively. The current study showed the highest survival rate ( $60.07 \pm 10.98$  %) was recorded in semi-intensive system with a gradual decrease in closed ( $57.94 \pm 8.01$  %) and then in modified traditional ( $49.14 \pm 5.94$  %) system. Although different stocking densities were decided for different culture packages depending upon past experience and practices, but the optimization of stocking density is important for the intensification of culture to minimize feeding competition, thus increasing survival rate and growth.

Nuruzzaman (1993) reported that the ghers (1-2.5 ha) those were managed well yielded 189 kg/ha per year in Khulna district, 221 kg/ha per year in Bagerhat district, and 126 kg/ha per year in Cox's Bazar district, whereas large ill manageable ghers (>25ha) produced lower yield of 122, 74, 57 kg/ha per year respectively. So this management variation in shrimp culture is the core responsible factor for its yield variation.

### Conclusion

For uplifting the status and to promote the production of privately owned shrimp farms, the present study concludes that the farmers should be commercial and scientific enough to use farm inputs such as fertilizers and supplementary feeds throughout the culture period to shape the industry in a more profitable format and to succeed in an open competitive market environment. Instead of horizontal expansion of shrimp cultivation,

healthy management and improved culture technique are very much important to increase shrimp production in Bangladesh. For this type of intensification in shrimp culture method, the farmers need adequate technical and management knowledge which should be supplied to them through proper guidelines.

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