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A comparative study on freshwater prawn (*Macrobrachium rosenbergii*) farming using wild source and hatchery produced post larvae (PL)

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Abstract

This study was conducted in the south-western part of Bangladesh. The information was collected through interviewing of 75 prawn farmers. Average stocking density and production in Khulna and Bagerhat region using wild post larvae (PL) were 7000 PL, 6750 PL and 167 and 159 kg/acre respectively and survival rate varied from 45 to 90 and 40 to 85% respectively. For hatchery produced PL the average stocking density, survivability and production in Khulna and Bagerhat region were 9000 PL, 53% and 124 kg/acre and 9250 PL, 55% and 120 kg/acre respectively. Results of the study identified net profit of 25924 BD taka in Khulna and 17742 BD taka in Bagerhat by using wild PL as well as 10581 BD taka in Khulna and 12163 BD taka in Bagerhat as a net profit by using hatchery PL. Lack of finance and appropriate technology, lack of proper feeding, scarcity of quality hatchery PL, scarcity of wild PL according to demand, diseases and inadequate extension work were major problems of prawn culture.

Keywords: *Macrobrachium rosenbergii*, prawn farming, production, Bangladesh

1. Introduction

Bangladesh is considered one of the most suitable countries in the world for freshwater prawn farming because of its favorable agro climatic condition ^[1]. About twenty-four species of freshwater prawns, including 10 species of *Macrobrachium* spp. are found in Bangladesh ^[2], among them only *Macrobrachium rosenbergii* is commercially cultured ^[3, 4, 5]. Over the last two decades, prawn farming has come to farmer's attention because of its easy operation, significant export potential and lower susceptibility to diseases compared to marine shrimp (*Penaeus monodon*). The freshwater prawn, locally known as *golda* (*M. rosenbergii*), is one of the largest export frozen food commodities in the fisheries economy of Bangladesh aquaculture. Almost 95% or more of the total production of *golda* is exported currently and the rest is catered to local market. In fiscal year 2010-11 Bangladesh earned about 3568.2 cores BD taka from exported sales of *M. rosenbergii* ^[6]. The freshwater prawn farming was first started in the southwest region in the early 1970s ^[7] at Fakirhat sub-district in Bagerhat district ^[8]. The expansion of prawn farming has been dramatic and since 1990 adoption has accelerated, spreading to the other southwest district such as Khulna and Satkhira. In recent years (since 2000) the increase in demand for prawn in the international market has attracted many fish farmers to prawn cultivation in different parts of Bangladesh ^[9]. At present the entire southern belt, i.e. greater Jessore, Khulna, Narail, Bagerhat and Satkhira, is home to about 82,000 prawn farms which cover an area of about 64,000 hectares ^[10].

In addition, culture practice of this species is increasing day by day ^[11] and culture area has been expanding on an average of 10-20% per annum ^[6, 12, 13]. For example, the prawn culture area extended from 6,000 ha in 1994 ^[14] to an estimated 50,000 ha ^[13] and 56248 ha in 2010 ^[15]. With the increase in the farm areas, there has been a concomitant increase in demand of the seed of prawn in the coastal areas. A variability of seeds poses to be an obstacle in the development of the commercial culture of this species in the country. So long the demand of seed was used to be met from the natural collection, but of late, the natural sources are drastically reduced and now hatchery-produced seed is meeting a significant part of the demand ^[16]. The objective of this present study was to know the production performance of prawn farming using wild and hatchery sourced post larvae.

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2. Methodology

2.1 Study area and duration

The study area, Khulna and Bagerhat district lies between 21°41' N-89°45' E and 21°49' N-89°98' E in south-western and north-eastern part of Bangladesh. These two districts are well-known shrimp and prawn production zone in the southwestern part of Bangladesh. The case study was carried out in Dumuria and Fultala upazila of Khulna district and Fakirhat and Mollarhat of Bagerhat which are main prawn production areas (Figure 1). The study was conducted with a duration of five months from July, 2012 to November, 2012 during the season of prawn farming and marketing.

2.2 Sampling framework

A total of 75 farmers and their farm were selected randomly from the case study area for questionnaire interviews. Primary data were composed employing effective techniques such as personal interview (home visit), focus group discussion (FGD), and crosscheck interviews with key informants such as conscious farmers, Upazila Fisheries Officers and relevant NGO workers. FGD was used to get an overview of particular issues such as existing farmer preference for PL, stocking density, survivability, production system, yield and economic returns, constraints of prawn farming etc. A total of five FGD sessions were conducted with farmers. Secondary data were collected from various government and fisheries affiliated institutions and also collected from websites and published literatures.

2.3 Statistical analysis

The collected data were subjected to descriptive analysis by means of the computer software, Microsoft Excel 2007.

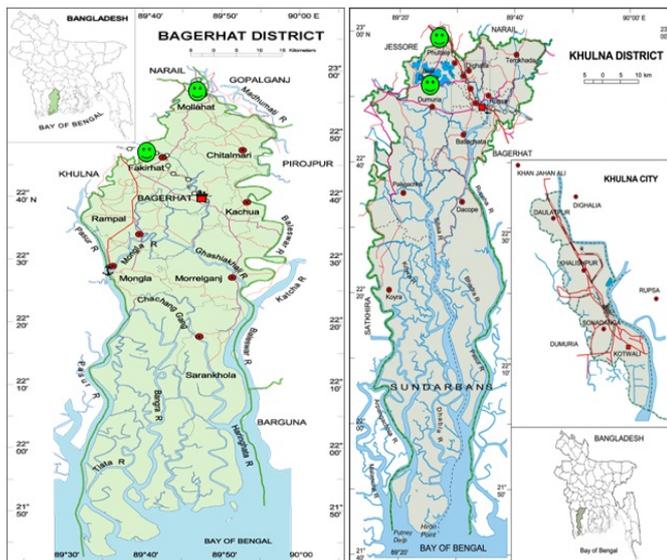


Fig 1: Map of Khulna and Bagerhat district, showing the study area by a green circle.

3. Results and Discussion

3.1 Gher size, ownership and involvement in farming

The average sizes of *gher* were found 2.20 and 2.50 acres in Khulna and Bagerhat district respectively. The maximum and minimum *gher* sizes were 8 and 0.26 acres found in Khulna and Bagerhat respectively. Majority of the farmers had their own *gher*, however on an average 35.67% farmers had both loans and leased *gher*. The average time duration involvement in prawn farming was found about 7 years and the maximum

and the minimum values were 16 year and 2 year. According to the 64 interviewee 6 farmers started farming before 16 years, 11 farmers before 10 years, 14 farmers before 8 years, 19 farmers before 5 years, farmers before 3 years and 6 from 2 years.

3.2 Source of Post Larvae (PL)

The major source of prawn fry is nature. The seed is collected at the advanced post larval stages. Coastal tidal rivers, estuaries, Bay of Bengal and Sundarban mangrove swamps are the main natural sources of PL. In the surveyed area wild sources of prawn fry were reported to come from Koyra River, Vodra River, Shakbaria River, Shibs River, Baleswar River, Haringhata River, Passur River, Salta River etc. in the southwest region of Bangladesh.

3.3 Farmer preferences for wild PL and hatchery PL and costing

Farmers believed that seeds collected from nature have much better performance in terms of growth and survivability than the hatchery produced seeds. Therefore they like to stock seed from riverine source, though its price is much higher than the hatchery seed. However, as the farmers purchased seed from local fry traders and not directly from the source they had to believe that seeds are collected from nature but the case may be not like that. The study revealed that 72.5% farmers of Khulna and 78% of Bagerhat districts were found to use natural seed in their farms. Others used hatchery produced seed. The average prices of naturally collected seeds in Khulna and Bagerhat were found 2100 BD taka and 2151 BD taka per thousand PL. The average prices of hatchery produced seeds in Khulna and Bagerhat districts were found 1970 BD taka and 1920 BD taka per thousand PL. In the pick season the price rises up to up to 3500 BD taka per thousand PL whereas in off season it stays at 1500 BD taka per thousand.

3.4 Season and duration of fry availability

Prawn seed marketing starts in the month of March- April. The demand of fry rises from April to May; the peak season of fry marketing is May to July. The maximum harvest from nature occurs during the mentioned time of the year at the time of high tide. Hatchery produced seeds are available between March to September. Indian black marketed fry was reported to come at the end of the culture season, June to August. Prawn fry is available almost all the year round.

3.5 Stocking density

The peak season of PL stocking is March-May and culture duration extends up to December- January. Major portion of the production was quarterly harvested from November to January. The main water sources for prawn farms were found to be rainfall and sometimes, ground water (i.e. shallow or deep tube well). Production of prawn depends on stocking of larvae or fry at the optimum density and rate of feeding. In Khulna highest and lowest stocking density for wild fry per acre were found 10000 and 4000 respectively, with an average of 7000 PL acre⁻¹ (Table 1). In regard to hatchery produced fry the stocking range was 12000-6000 with an average of 9000 PL acre⁻¹ in Khulna (Table 2). In Bagerhat the stocking range was found 9000-4500 for wild fry where the average density was 6750 PL acre⁻¹ (Table 1). In case of hatchery produced fry the highest and lowest stocking density were found 13000 and 5500 respectively with an average density of 9250 PL acre⁻¹ in Bagerhat (Table 2).

Table 1: Stocking densities, survivability and other management for wild PL

Considerations		Region	
		Khulna	Bagerhat
Stocking density (acre ⁻¹)	Average	7000	6750
	Max.	10000	9000
	Min.	4000	4500
Survivability (%)	Average	68	63
	Max.	90	85
	Min.	45	40
% of farmers keeping periphery canal		97	100
% farmers repairing periphery canal		100	95
% of farmers using lime		100	100

Table 2: Stocking densities, survivability and other management for hatchery PL

Considerations		Region	
		Khulna	Bagerhat
Stocking density (acre ⁻¹)	Average	9000	9250
	Max.	12000	13000
	Min.	6000	5500
Survivability (%)	Average	50	55
	Max.	60	65
	Min.	40	45
% of farmers keeping periphery canal		97	100
% farmers repairing periphery canal		100	95
% of farmers using lime		100	100

Prawn culture in *gher* systems still remains dependent on wild post larvae [6, 17, 18]. Traditionally, farmers prefer to stock wild post larvae rather than hatchery-produced fry because, until recently, the production of the hatchery post larvae has been limited and farmers consider them to be of lower quality. The survival of wild post larvae is reported to be much higher than that of hatchery-produced fry. The average annual stocking density of post larvae is 20680 ha⁻¹, ranging from 10000 to 30000 [5, 19, 20] that is similar to this study. Most farmers directly stock post larvae without rearing in nursery systems. However, in recent years a few farmers have started to use *hapa* (i.e., net enclosure) or separate small ponds for nursing the post larvae to improve survival rate.

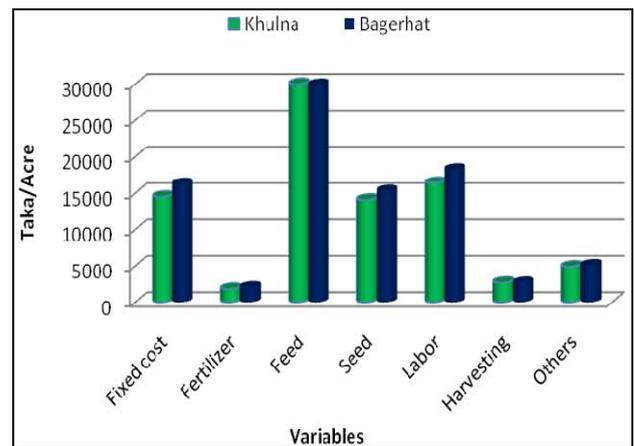
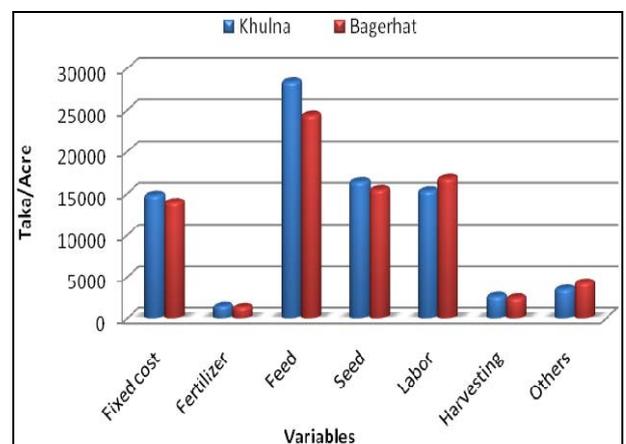
3.6 Rate of survivability

The available information suggest that the rate of survival is very poor in hatchery PL than that of wild PL. For wild PL, the minimum and maximum survivability were found 45 and 90% respectively with an average survivability of 68% in Khulna (Table 1). In case of hatchery PL the survivability range was 40-60% with an average of 50% in Khulna (Table 2). In Bagerhat, for wild sourced PL, the minimum and maximum survivability were found 40% and 85% respectively. Average survivability was 63% (Table 1). In case of hatchery PL, the survivability range was found 45-65% with an average survivability of 55% in Bagerhat (Table 2). The results are similar according to the findings of [21], who found that the survival rate of prawn PL in earthen ponds varied from 54.3% to 89%. Siddiqui and Al-Hinty (1993) [22] reported that the survival rate of fresh water prawn varies from 51% to 93% that is similar to this study for both type of PL. The study results found that the survivability of wild PL of prawn is better than that of hatchery PL. This might be explicated to their natural origin, greater capability to adapt new environmental condition and to use natural feed properly. Besides this, wild PL was habituated with adverse environmental condition, so they become stronger than

hatchery PL. Survivability of Prawn PL depends on a large number of factors. Water quality is the basic factor for survivability of PL of Freshwater prawn.

3.7 Average costing involved in prawn farming for one acre

Average total costs for per acre for wild PL of prawn farming were found 93486 BD taka and 97372 BD taka in Khulna and Bagerhat respectively. Average total costs for per acre for hatchery PL of prawn farming were found 82579 BD taka and 78693 BD taka in Khulna and Bagerhat respectively. Major costs are associated with feed, fertilizer, seed, lease and labor (Figure 2a & 2b). In the item of labour cost both self and hired labor costs were included. Comparatively labor cost was higher in Bagerhat region than Khulna region. In southwest Bangladesh, annual prawn production costs are cost of seed, feed, fertilizer, labor (family and hired), harvesting and marketing, and miscellaneous. Fixed costs include depreciation (water pump, net, feed machine, etc), land use and interest on operating capital [23]. Within variable costs, seed and feed dominate all other costs averaging 39% and 33% of total costs respectively [24]. Muir (2003) [5] reported that prawn production costs comprise 28% of seed, 21% of feed and only 4% of labor. Despite the benefits of prawn farming, the costs of inputs are high and are often beyond the financial capacity of most small and marginal farmers.

**Fig 2(a):** Production costs for wild PL**Fig 2(b):** Production costs for hatchery PL

3.8 Prawn productivity

The average production of prawn was 167 kg acre⁻¹ in Khulna and 159 kg acre⁻¹ in Bagerhat for wild PL (Table 3). The

average production of prawn was 124 kg acre⁻¹ in Khulna and 120 kg acre⁻¹ in Bagerhat for hatchery PL (Table 4). Production of white fish was 98 kg acre⁻¹ in Khulna and 107 kg acre⁻¹ in Bagerhat with wild PL in case of hatchery PL. Production of white fish was 116 kg acre⁻¹ in Khulna and 119 kg acre⁻¹ in Bagerhat. Muir (2003) [5] reported that the average annual yield of head-on prawns in Bangladesh was reported to be 336 kg ha⁻¹ which is lower than the findings of the study. The present production levels suggested that the average

productivity of prawn has increased in recent years, probably as farmers have become more confident to increase stocking densities and feeding levels. Hoq *et al.* (1996) [25] reported that prawn production when reared together with fish, varied from 162 to 428 kg ha⁻¹. Nevertheless, most of the prawns are cultivated using extensive methods in Bangladesh and productivity is lower compared with other countries. Countries with a larger export market than Bangladesh use more intensive techniques and have significantly higher yields.

Table 3: Economic return from wild PL farming

District	Items	Production (Kg)	Unit Price (Tk.)	Single Return (Tk.)	Gross Return (Tk.)
Khulna	Prawn	167±45	654±97	109218±4365	119410±4722
	White fish	98± 17	104±21	10192±357	
Bagerhat	Prawn	159±39	654±97	103986±3783	115114±4308
	White fish	107± 25	104±21	11128±525	

Table 4: Economic return from hatchery PL farming

District	Items	Production (Kg)	Unit Price (Tk.)	Single Return (Tk.)	Gross Return (Tk.)
Khulna	Prawn	124±41	654±97	81096±3977	93160±4481
	White fish	116±24	104±21	12064±504	
Bagerhat	Prawn	120±35	654±97	78480±3395	90856±4004
	White fish	119±29	104±21	12376±609	

3.9 Profitability analysis

Net profit from prawn farming was found 25924 BD taka in Khulna district and 17742 BD taka in Bagerhat district by using wild PL from one acre (Table 5). In case of hatchery PL, 10581 BD taka in Khulna and 12163 BD taka in Bagerhat districts were found as a net profit (Table 6). In Bagerhat, net return is higher than Khulna for the hatchery produced PL. But for wild PL, net return is higher in Khulna than Bagerhat. It may be due to presence of different quality prawn hatcheries in Bagerhat so they can get PL easily. Again, due to close proximity to the Sundarbans availability of wild PL is higher in Khulna than Bagerhat.

Table 5: Profitability of Prawn farming using wild PL

Economic Indicators	Khulna	Bagerhat
TC (Tk/yr/acre)	93486±2982	97372±3268
GR (Tk/yr/acre)	119410±4722	115114±4308
NR (Tk/yr/acre)	25924±1740	17742±1040
Rate of Income (%)	21.71	15.41
BCR	1.28	1.18

Table 6: Profitability of Prawn farming using hatchery PL

Economic Indicators	Khulna	Bagerhat
TC (Tk/yr/acre)	82579±2974	78693±2568
GR (Tk/yr/acre)	93160±4481	90856±4004
NR (Tk/yr/acre)	10581±1507	12163±1436
Rate of Income (%)	11.36	13.39
BCR	1.13	1.15

Muir (2003) [5] reported that in southwest Bangladesh, the annual net return of *gher* farming is an average US\$1430 ha⁻¹. The combination of prawn, fish and rice cultivation in *gher* systems give particularly good potential returns. The annual gross revenue of prawn production average US\$1601 ha⁻¹ (69%), while that of fish and rice production is US\$330 ha⁻¹ (14%) and US\$389 ha⁻¹ (17%) respectively [6].

4. Conclusion

Culture of giant fresh water prawn plays an important role in the socio-economic condition of the people of Khulna and

Bagerhat district. People are solely engaged in prawn farming due to its higher market value. In spite of several problems, the practice of prawn farming has offered an opportunity to increase incomes of farmers and associated groups of this region. But government help is very important in the development of prawn sector of south-west part. Farmers need enough credit facilities, good aquaculture practice training, and available quality PL for the further development of this sector.

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