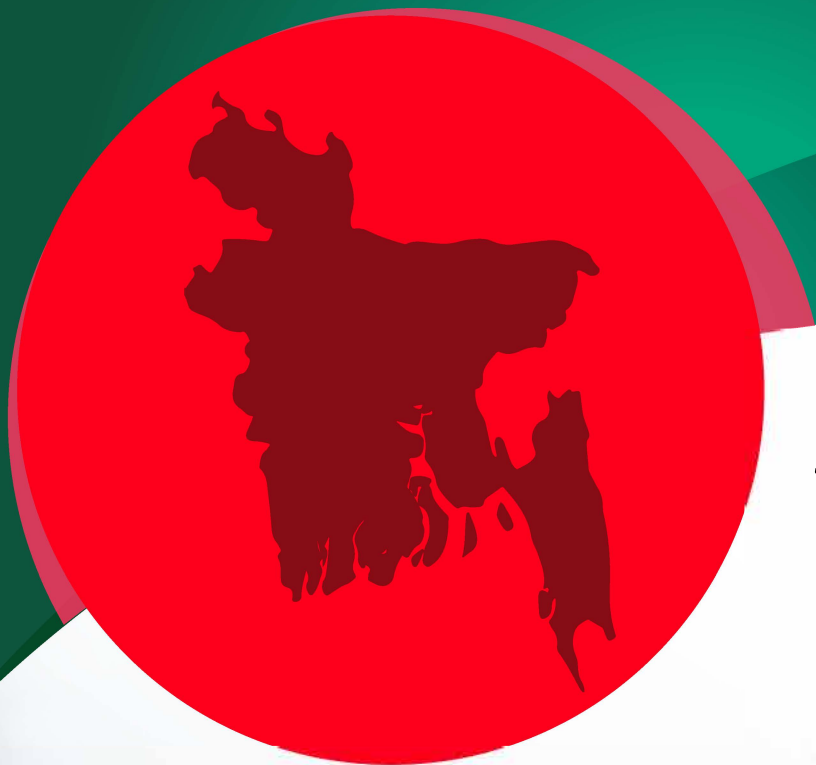


Volume 8
Number 2
Year 2006
ISSN 1529-0905



Journal of
**BANGLADESH
STUDIES**



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PROBLEMS AND PROSPECTS OF SHRIMP AND RICE-PRAWN GHER FARMING SYSTEM IN BANGLADESH

Basanta Kumar Barmon, Kondo Takumi and Fumio Osanami

ABSTRACT

The second largest export industry in Bangladesh is the shrimp industry and its contribution is about 4.7% to GDP and 9.38% of total exports. Given its importance to the economy, the present study attempts to explain the problems and prospects of shrimp/prawn gher farming system in Bangladesh. Case studies and secondary data were used in the present study. The findings indicated that the shrimp-gher farming system has a negative impact on the environment, ecology, land degradation, livestock, and water quality, whereas the rice-prawn gher farming system is friendlier to environments, ecology, and water quality and helps alleviate poverty. The rice-prawn gher farming system has significant impacts on land for modern varieties (MV) paddy production. The yield of MV paddy production under rice-prawn gher farming system is almost the same as the yield in other parts of Bangladesh where the farmers usually produce only year-round MV paddy. The rice-prawn gher farming system is providing a sufficient amount of rice, fish and vegetables to small, marginal and landless farmers that would not be possible under shrimp gher farming. The rice-prawn gher farming system will be sustainable if the government takes necessary steps for its development.

Introduction

The shrimp/prawn producing unit in Bangladesh is locally known as “gher” farming. Gher farming is a combined form of aquaculture and agriculture. Shrimp/prawn gher farming system has significant impacts on agriculture and the economy of Bangladesh and has created many diversified local job opportunities like mud snail traders, prawn fingerlings traders, ice factory, depot owners, etc. A large number of male and female workers supply their labor in this sector. The basic components of one’s standard of living such as food consumption, medical care, education, housing, and clothing have improved after the introduction of the gher revolution. Now the people in this industry can have three meals a day which was not possible in the recent past. They can also afford to send their children to school for education (Barmon et al, 2004). The agricultural system as well as cropping patterns have changed since the development of export-oriented shrimp and freshwater rice-prawn gher farming that have influenced the land contractual agreement from traditional sharecropping to fixed cash rent system as well as land ownership of gher farming. It is obvious that farmers of developing countries have faced indecision at the early stages of any agricultural technological progress and innovation for agricultural development (Byerlee, 1996). For example, at the early stage of the green revolution the farmers of Bangladesh were faced with indecision to adopt MV of rice for lack of sufficient knowledge of using chemical fertilizer,

unavailability of irrigation systems, and a changed taste of rice, which played as the main decision-making criteria (Field survey, 2004). But the opposite scenario was found in the case of shrimp/prawn gher farming in Bangladesh.

There are some international organizations and researchers who have conducted research regarding the environmental and ecological aspects of brackish water based on shrimp gher farming. A few organizations and researchers have conducted research on fresh water based rice-prawn gher farming, focusing only on cost-benefit analysis and ecological aspects. However, the problems and prospects of shrimp and rice-prawn gher farming in southwest Bangladesh have been less well studied. Therefore, the present study explains the problems and prospects of shrimp and rice-prawn gher farming in the aforementioned area. The findings of the study are expected to be helpful as benchmark information for economists, researchers, as well as policy makers and will provide useful information for further development of shrimp and rice-prawn gher farming in Bangladesh.

This paper first explains the problems and prospects of shrimp and rice-prawn gher farming system in the southwest Bangladesh. Next, the paper briefly discusses the methodology. Scenario of shrimp/prawn in global and Bangladesh and abroad is briefly discussed, followed by a discussion of the impacts of shrimp and prawn farming in Bangladesh. Advantages of rice-prawn gher farming over shrimp farming in Bangladesh

are delineated in the next and, finally, conclusions are drawn based on the results and discussions.

Methodology of the Study

Primary, secondary and some case studies are used in the present study. Secondary data were collected from various published and unpublished sources of Government and Non-government agencies.

Scenario of Shrimp/Prawn in Bangladesh and Abroad

Global farmed Shrimp and Prawn Production

Shrimp and prawn are commercially produced in 50 countries, which cover an area of more than one million hectares. Moreover, 80 percent of shrimp aquaculture is carried out in the Asian countries. Thailand, China, Indonesia, India, Vietnam and Bangladesh are the major shrimp/prawn producing countries in Asia. The global commercial shrimp/prawn production of 2002 is presented in Table 1.

It is evident from this table that Bangladesh is the fifth largest shrimp/prawn producing country in terms of quantity, whereas in terms of monetary value such cultivation is ranked as the eighth highest in the world. Production of farmed shrimp has grown at the astonishing rate of 20-30% per year in the last decade. There are about 9,000

shrimp farms in Bangladesh, which constitute about 18 percent of the total shrimp farms and 12 percent of the global area under shrimp cultivation (EU, 2002).

Shrimp and Prawn Farming Scenario in Bangladesh

Modes of Shrimp and Prawn Farming in Bangladesh

In Bangladesh, there are two types of gher farming; one is brackish water based shrimp farming and another is fresh water based rice-prawn farming. Shrimp gher farming is large in size and scale, and needs saline water, whereas prawn gher farming is comparatively small in size and scale, and needs fresh water. Traditionally, brackish water based shrimp is cultured in the coastal and peri-coastal regions, and freshwater-based prawn is cultured in the upper areas of Bagerhat, Khulna and Satkhira district. At present there are several production modes of shrimp/prawn in Bangladesh are as follows:

Traditional Shrimp Production

The present shrimp culture involves traditional gher farming method in Bangladesh. In this method, the flow of saline water into the enclosed areas is controlled by small wooden sluice gates.

Table 1: The Top 20 Farmed Shrimp/Prawn Producing Countries by Volume and Value in 2000

Country	Production (M Ton)	Value ('000 US\$)
Thailand	299,700	2,125,384
China	217,994	1,307,964
Indonesia	138,023	847,429
India	52,771	393,938
Vietnam	69,433	319,392
Equador	50,110	300,660
Philippines	41,811	271,385
Bangladesh	58,183	199,901
Mexico	33,480	194,184
Brazil	25,000	175,000
Malaysia	15,895	124,577
Colombia	11,390	91,120
Sri Lanka	6,970	78,342
Taiwan	7,237	60,483
Honduras	8,500	59,500
Venezuela	8,200	34,030
Australia	2,799	27,557
Madagascar	4,800	24,000
Nicaragua	5,411	17,423
USA	2,163	14,513

Source: Ahmed, et al. (2002)

These sluice gates are opened to allow the entry of saline water into the gher from February to April and at that time the juveniles of various varieties of coastal finfish and post larvae of shrimps that breed in the sea enter into the gher with the saline water. These sluice gates are closed after April for the shrimp to grow to harvestable size. Usually the shrimps grow to harvesting size within 4-5 months. In the lower regions of Bagerhat, Khulna and Satkhira districts, the local variety of paddy (*Aman*) is cultivated in the wet months from July-December after the harvesting of shrimp.

Salt Production System

This production system is only practiced in southeastern Cox's Bazar region in Bangladesh. The shrimp and salt are produced successively in the same coastal plots. These plots are used as salt beds during November to April and as shrimp production units during May to December. Salt beds are encircled with low earthen dikes where seawater is brought in, preserved and evaporated during the dry months between November and April. From May to early December salt cannot be produced due to rain and at this time these salt beds are used for brackish water shrimp and finfish culture.

Freshwater Based Rice-Prawn Farming

Rice-prawn gher farming is a new agricultural technique applied to the production of both fisheries and agricultural sector in Bangladesh. This method of prawn production is very popular in southwest Bangladesh (Khulna, Bagerhat, Satkhira, Jessore, and Barisal district) and the people of these areas have more or less adopted this technique.

Gher is the physical construction used for freshwater prawn farming and is a modified rice field having high wide dikes and a canal inside the periphery of the dikes that retains water during the dry season. At the early stage of gher farming most of the farmers cultivated prawn in the ponds, but recently the farmers cultivate fish with prawn. In additions, rice, vegetables and fruit trees are also grown under gher farming system.

The gher cycle begins in May/June when the farmers release prawn post larvae into the gher.

Before this, farmers repair the gher dikes and trenches. This repair work is done almost every year. Farmers use lime during gher preparation to reduce soil acidity. During the growth period, the farmers give supplementary feed to the prawn. Traditionally, only mud snail meat was used as prawn feed, but nowadays farmers use a wide range of homemade and commercial supplementary feeds.

Carp fish fingerlings are released into gher in May/June and cultured for nine months as long as sufficient water is retained in the gher. Usually, no specific supplementary feed is provided for the fish. Fish share the feed supplied to the prawns. The farmers also grow vegetables in the gher during both winter and summer seasons. Some farmers grow vine-type vegetables up trellises inside the gher.

In the gher farming system, farmers usually grow *boro* rice on gher *chatal* (the land inside the gher) during the winter season between January and April. Farmers irrigate the paddy field from the canal using indigenous hand made tools such as *doone*, and basket. Some large farmers use pumps. Sometimes farmers do not irrigate the paddy field. Usually the gher farmers use small amounts of chemical fertilizer for *boro* paddy production. They also use different types of feed in the gher unit during the prawn and carp fish production. But the prawn and carp do not eat all of the supplied feed. The leftover feed fertilizes the paddy field. After harvesting *boro* paddy, the gher is used predominantly for prawn and fish cultivation.

Rapid Expansion of Shrimp/prawn Farming in Bangladesh

Geographically Bangladesh enjoys a series of natural advantages for shrimp/prawn culture. Its soil, water, climate and local cultural heritage are suitable for shrimp/prawn production. Before the shrimp/prawn culture practices that exist today traditional gher aquaculture was practiced only in the coastal belt and offshore areas in southwestern Bangladesh from the 1970s. The commercial shrimp/prawn farming started during the mid 1980s driven by high international market demand.

The trend and/or expansion of shrimp/prawn gher farming is presented in Table 2. The total cultivable

Table 2: Expansion of Shrimp/Prawn Area in Bangladesh from 1983-84 to 2000-02

Year	Khulna Region (ha)	Chittagong Region (ha)	Bangladesh (ha)
1983-84	32,239	19,531	51,812
1984-85	39,976	23,437	64,246
1985-86	62,448	24,781	87,300
1986-87	NA	NA	NA
1987-88	69,053	24,781	94,010
1988-89	80,418	27,514	108,280
1989-90	NA	NA	NA
1990-91	NA	NA	NA
1991-92	NA	NA	NA
1992-93	NA	NA	NA
1993-94	NA	NA	NA
1994-95	104,624	29,792	137,996
1995-96	110,000	30,000	140,000
1996-97	NA	NA	NA
1997-98	NA	NA	NA
1998-99	107,962	29,792	141,353
1999-2000	136,655	30,118	166,377
2000-01	156,290	34,958	196,078

Source: Department of Fisheries, 2003

Note: NA indicates Not Available

land under shrimp/prawn production was 51,812 hectares in 1983-84, whereas the area was 196,078 hectares in 2000-01 out of which about 156,290 hectares (about 80%) of land is situated in greater Khulna region, covering Satkhira, Bagerhat and Khulna districts while only 20 percent (34,958 hectares) is in the Chittagong region. Gher farming has expanded about five times (from about 32,000 hectares to 156,000 hectares) in Khulna region from 1983-84 to 2000-01 but has less than doubled in the Chittagong region (from 19,000 hectares to 34,000 hectares). However, the total gher farming areas have expanded about four times (from about 52,000 hectares to 196,000 hectares) in Bangladesh. The two areas predominately cover the 750 kilometers of coastline in Bangladesh, which is environmentally and geographically favorable for shrimp/prawn aquaculture on a commercial basis (Department of Fisheries, 2003.)

Global Market Structure of Shrimp/Prawn from Bangladesh

Shrimp/prawn production is a 100 percent export-oriented industry in Bangladesh. This industry has

grown gradually over the years due to high demand in international markets. Export of shrimp/prawn from Bangladesh has increased from Tk1,555 million in 1983 to Tk14,477 million in 2001-02 (Table 3). The global market structure of shrimp/prawn from Bangladesh is presented in Figure 1. The figure shows that European Union (EU), USA and Japan are the dominant international markets for Bangladeshi shrimp/prawns. Bangladesh has earned about Tk9,194 million (50.46%) from EU, Tk6,659 million (36.55%) from USA, and Tk1,355 million (7.44%) from Japan by exporting shrimps in 1999-2000.

Importance of Shrimp/Prawn in the Economy of Bangladesh

The economy of Bangladesh mainly depends on the agriculture sector, readymade garments (RMG), fisheries, and hides and skins. Fishery is one of the major sub-sectors, which makes a considerable contribution to the national economy of Bangladesh. Prawn (*Macrobrachium rosenbergii*) and shrimp (*Penaeus monodon*) together represent the second largest exportable items contributing to foreign exchange earnings of Bangladesh. The contribution

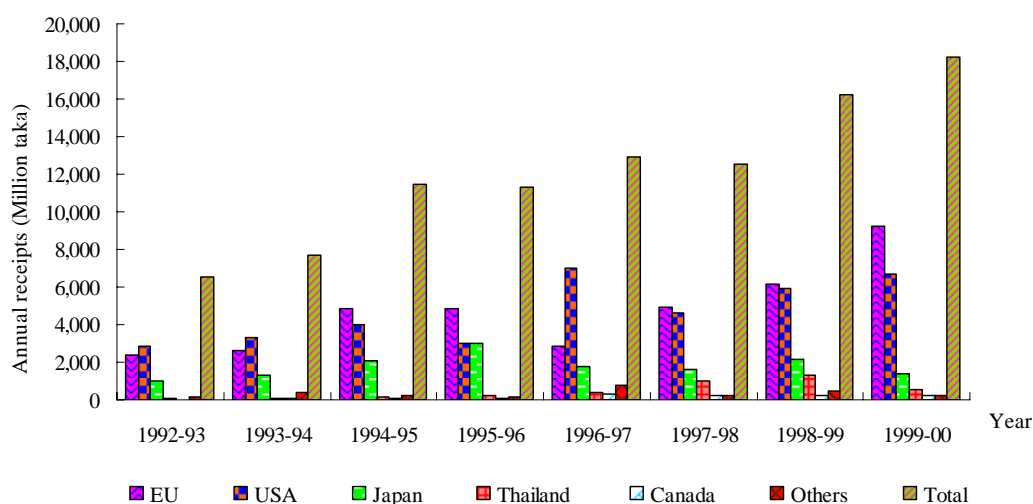


Figure 1: Annual shrimp/prawn export receipts from different countries, 1992-93 to 1999-2000

Source: Annual export receipts, Statistics Department, Bangladesh Bank, 2002.

of this sector is about 4.7% of GDP and 9.38% of the total export (Aftabuzzaman, 1998). This sector grew at the rate of around 9 percent per annum during the last decade (Bhattacharya et al., 1999). Shrimp/prawn has replaced raw jute (so called golden fiber in Bangladesh) as an important export item and contributes nearly half of the export items in the primary goods category.

Total export earning of all exportable products, fish and fisheries products, shrimp/prawn products and their contribution to the national economy are presented in Table 3. The table shows that shrimp/prawn is the most dominant item of the total amount of exported fisheries' products. From the table, it can be seen that the country has earned about Tk144,777 million from shrimp/prawn exports and this accounted for about 88 percent of total national export earning from fish and fisheries products in 2001-02, (table 3) and about 8.84 percent of total national exports (DOF, 2003). The quantity of shrimp/prawn and foreign earning are also presented in figure 2 and shows that the quantity of shrimp/prawn as well as income from exporting shrimp/prawn has increased rapidly over the years. Shrimps and prawn are now called "**white gold**" in Bangladesh.

Shrimp/prawn gher farming has created remarkable employment opportunities and about 10 million people are directly or indirectly employed in a

series of upstream and downstream activities related to shrimp/ prawn culture such as harvesting, culture, processing and exporting (DOF, 2003, Planning commission, 2004, Barmon et al, 2004). The shrimp/prawn industry consists of distinct sub-sectors such as shrimp/prawn gher, shrimp hatcheries or post larvae (PL) collection, feed processing mills and shrimp/prawn processing and exporting plants. All these sub-sectors are linked together and constitute a horizontal integration of activities that create independent employment opportunities for males and females.

Impacts of Shrimp and Prawn Farming in Bangladesh

Environmental and Ecological Impacts

Impacts of Shrimp Farming

A large number of research articles and reports have been published on the impact of shrimp gher farming on the environment in the coastal region of Bangladesh (Rahman et al, 1995; Sobhan 1995; Nijera Kori 1996; Asaduzamman et al, 1998; Habib 1998; Nabi et al 1999; Aftabuzzaman 1998; Rahman 1998; Bhattacharya et al 1999; Toufique 2002; and Chowdhury, et al. 2006). They argue that export-oriented shrimp production has a drastic negative impact on the environment, ecology, society, livestock, agricultural production, man-

Table 3: Total earning from all export products, fish and fisheries products, shrimp/prawn products of Bangladesh, from 1983-84 to 2001-02

Year	Total export earning (Taka, Million)	Total export earning from shrimp/prawn (Taka, Million)	Total export earning from fishery product (Taka, Million)	% of total export earning from fisheries product	% of export earning from shrimp/prawn product	% of fisheries export earning from shrimp/prawn product
1983-84	20,136	1,555.0	1,960.8	9.74	7.72	79.30
84-85	26,225	1,994.5	2,332.5	8.89	7.61	85.50
85-86	27,396	2,693.1	3,562.5	13.00	9.83	75.60
86-87	33,682	3,417.5	4,240.5	12.59	10.15	80.59
87-88	41,161	3,611.7	4,541.2	11.03	8.77	79.53
88-89	42,686	3,820.5	4,787.7	11.22	8.95	79.80
89-90	51,415	4,143.1	4,787.7	9.31	8.06	86.54
90-91	60,272	4,512.2	5,266.2	8.74	7.49	85.68
91-92	74,198	4,557.3	5,243.5	7.07	6.14	86.91
92-93	88,215	6,040.3	7,002.9	7.94	6.85	86.25
93-94	98,739	7,877.3	9,209.6	9.12	7.89	85.83
94-95	136,970	10,456.7	13,069.4	9.54	7.63	80.01
95-96	144,521	11,063.9	13,409.4	9.28	7.66	82.51
96-97	171,554	11,889.1	14,574.1	8.50	6.93	81.58
97-98	229,408	11,814.8	13,878.1	6.05	5.15	85.13
98-99	245,619	11,622.1	13,793.3	5.62	4.73	84.26
99-00	247,420	16,121.5	17,813.2	7.20	6.52	90.50
00-01	324,198	18,851.5	20,327.5	5.77	5.81	92.74
01-02	309,363	14,477.6	16,371.4	4.76	4.68	88.43

Source: DOF, 1995-96, 1996-97, 1998-99 and 2001-2002.

Note: 1US\$=65.85 Taka, November, 2005.

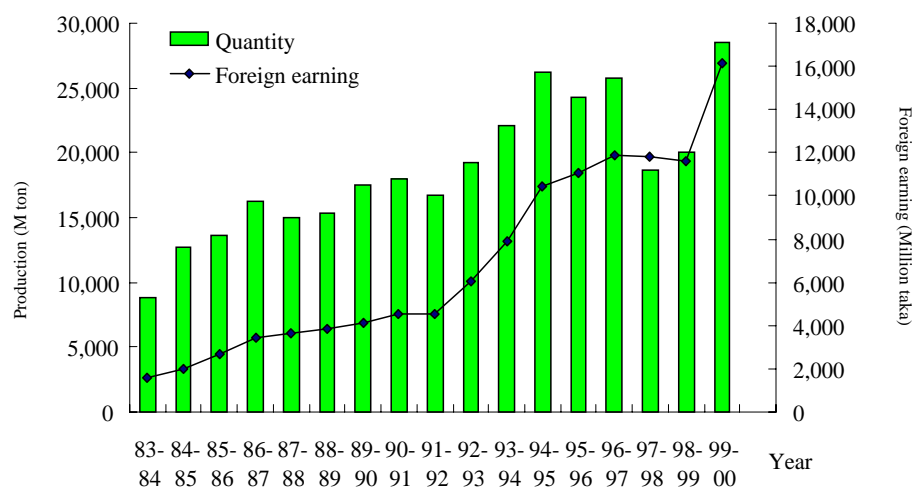


Figure 2: Export of shrimp/prawn and income from exporting of Bangladesh, 1983-84 to 1999-2000

Source: Export Promotion Bureau, BBS, 1999 and 2002.

grove forests as well as human health in Bangladesh. Many of the environmental and ecological problems associated with shrimp farming have also been criticized in India (Alagarwamy 1995; SCI 1996; Patil and Krisnan 1997; Kutty 2001; Ravichandran and Rao 2001). The impact of shrimp gher farming on the environment and ecology of Bangladesh are summarized below:

a. Impact on the Environment

The agricultural land has been degraded since the introduction of shrimp gher farming in Bangladesh. Shrimp gher farming has other negative environmental impacts including mangrove deforestation, salinization of soil and water, depletion of wild shrimp and fish larvae stocks, coastal water pollution and loss of agricultural lands. The salt intrusion has caused many problems such as loss in crop production, fresh water crisis and related gastro-intestinal diseases, loss of green vegetables, fodder etc. More than 30% of the net cultivable land of Bangladesh is located in the coastal areas and are not being utilized for agricultural production mainly because of salinity problems (Wahab, 2003). Paddy yield has also been reduced because of soil salinity problems (Chowdhury et al, 2006).

b. Impact on Ecology

The shrimp gher farming system has also significant negative impacts on the ecology in Bangladesh like in other shrimp production countries. The ecological effect of acid sulphate destroys food resources, displaces biota, releases toxic levels of aluminum, precipitates iron (which smothers vegetation and microhabitat) and alters physical and chemical properties of water. Loss of biodiversity due to shrimp production is also of real concern. Fry is the main input of shrimp gher farming that is collected from the sea and rivers. When the harvesters collect wild post larvae (PL) from seas, a large number of finfish and other fries of fish are caught, most of which perish. Their study found out that about 1,340 other fries are caught during the collection of a single prawn PL (Deb et al, 1994 and Williams and Khan, 2002).

Impacts of Prawn Farming

The rice-prawn gher system has also significant impacts on environment and ecology like shrimp

gher farming system in Bangladesh (Kendrick, 1994; Koori, 1996; Ambary, 2000; Abedin et al 2000; Islam et al 2001; and Boutique 2002). The impacts of rice-prawn gher farming system on environments and ecology are presented below:

Impact on Environment and Ecology

The rice-prawn gher farming system also has a negative impact on the ecology and livestock. Fish diversity and fish catch has decreased in the swamplands, canals and rivers, because of siltation or blockage of fish migration routes, water pollution as well as decreased swampland area due to gher construction (Abedin et al, 2000; and Islam, 2001). They conclude that indigenous fish are disappearing day by day, and some indigenous varieties have already become extinct. Along with indigenous fish, tortoise and frogs are also disappearing. Another study was conducted by Islam et al (2001) and concluded that fish availability is decreasing due to over-fishing of PL.

The main input of prawn production--mud snail--has two direct significant negative impacts on the ecology and human health. People have collected mud snails (*Pila globosa*) intensively from swamplands, canals and rivers to use as feed for prawn production; as a result, the mud snail has already disappeared in greater Khulna district. Now the farmer is importing mud snail from other districts as well as from India. This unplanned intensive harvest of mud snail has a negative impact on the ecology (Kendrick, 1994; Chowdhury, 1999; Datta, 2001; and Islam, 2001). Dutta (2001) suggests that mud snails play an important role in wetland ecosystem and soil chemistry. Williams and Khan (2001) mentioned that the women and children who crush the mud snail for prawn feed suffer from skin irritations and respiratory complaints. In addition, the farmers often dump the shell of mud snails at the edge of roads or in nearby canals thereby polluting the local waterway and sometimes blocking the natural drainage system. However, recently this shell is being used as an input for poultry feed and lime. The grinding process of the shells creates dust that also causes respiratory problems for human health because the grinding mills are mainly located in the residential areas (Barmon, 2006).

Impact of Shrimp and Rice-prawn Gher Farming on Livestock

The impact of rice-prawn gher farming on livestock

is unambiguous. Kendrick (1994), Williams and Islam (1999) and Williams and Khan (2001) argued that livestock has decreased mainly due to unavailability of grazing land and unavailability of fodder crop. On the other hand, Barmon et al (2003) concluded that this farming system has a positive impact on livestock. Livestock and poultry in rice-prawn farming areas have increased compared to shrimp gher farming areas. Before rice-prawn gher farming had started, landlords or rich farmers had a large number of cows, and buffaloes and hired local boys to take care of the cows but most of the small, landless and marginal landowners had no cows or sometimes a few of them. Livestock was not equally distributed among the people. Now, more or less, the people are rearing more than two to three cows for milk and cow-dung. Instead of unavailable grazing fields, the gher farm owners and even landless farmers collect feed (grass) from the embankments and store by-product of paddy (straw) for cattle feed. The farmers use the stored straw in the rainy season when feed is not available.

Economic Impact of Shrimp and Rice-prawn Gher Farming System

a. Impact on Agricultural and Household Income

Both the shrimp and rice-prawn gher farming systems have significant impacts on agricultural and household income in Bangladesh. The average income from shrimp gher farming system is several times higher compared to other agricultural farming systems in Bangladesh. Income from year-round only shrimp and year-round rice-shrimp farming are two times and 2.5 times higher, respectively, than that of year-round rice farming system in coastal Bangladesh (Islam, 2003). However, contradictory results are also found in shrimp gher farming system in the coastal areas of Bangladesh (Rahman, 1996; and Patwary, 2000). The shrimp gher farming system has increased income for rural women in terms of fry collection from the river and sea. It is estimated that about 73% of the income from fry collection come from female fry collectors (BCAS, 2001).

On the other hand, the farmers of rice-prawn gher farming system have gained more agricultural income as well as household income compared to traditional and modern variety (MV) paddy in southwest Bangladesh. The agricultural income of rice-prawn gher farming system is seventeen times

higher than that of MV paddy farming, and the household income of rice-prawn gher farmers is double compared to other rural peoples of Bangladesh (Barmon et al, 2004a, 2004b).

b. Impact on Employment

Both shrimp and rice-prawn gher farming systems have created employment opportunities for female and male worker in southwest Bangladesh. About 840,000 workers were employed in shrimp farm-related work, which was estimated to be about 79 person-days per hectare per year (Frankenberger, 2002). Among them, 285,000 persons were involved in PL collection from the wild (BCAS, 2001).

The rice-prawn gher farming system has created more employment opportunity compared to MV paddy farming both for male and female labors. The rice-prawn gher farming system is a labor intensive enterprise compared to paddy farming. Per unit labor use in gher farming was higher than per unit *boro* and local *aman* paddy production. The income of gher farmers has increased due to a high demand for hired labor in gher farming systems. The gher farming system also plays a pivotal role in absorbing the surplus labor force in the rural areas (Barmon et al, 2004c).

c. Impact on Landholding Patterns and Land Tenurial Systems

The shrimp farming system has significant impacts on landholding patterns and land tenurial system in southwest Bangladesh. Marginal and small farmers are exploited by the politically and financially strong large farmers. Marginal and small farmers have to sell their small agricultural farmland very cheaply. Sometimes the strong farmers capture nearby farmers' small plots without any payments or sometimes they pay a very small amount of money as land rent. As a result, small and marginal farmers are deprived of conventional farming. Therefore, the small and marginal farmers are diminishing from the agricultural sectors mainly due to the introduction of shrimp farming and the involvement of large numbers of so called politicians and large farmers. A large number of small and marginal farmers have already migrated to other places for employment and better living (Field survey, 2005).

The rice-prawn gher farming system has significant

impacts on institutional change in land tenurial arrangement. The land tenurial arrangement has changed from traditional sharecropping to fixed rent system after the introduction of the rice-prawn gher farming system. The rice-prawn gher farming system is a capital intensive enterprise and needs proper management for optimal production to protect from viral diseases, as well as poaching of prawns. Moreover, the landlords and the tenants cannot predict the main output before harvesting. As a result, the land tenurial arrangement has converted from traditional sharecropping system to fixed rent system. The land rent depends on its productivity, distance from the river, and altitude. Land rent has increased over the years because of large scale participation of marginal and landless farmers, as well as profitable enterprises compared to paddy farming.

The landlords mainly engage in non-farm activities and a small portion of their total gher farm operates mainly for home consumption using permanent hired labor. Even though the rice prawn gher farming is a profitable enterprise, landlords do not operate total gher farm because the need for permanent hired labor disrupts prawn production at every step. As a result, the landlords rent out gher farms to marginal and landless farmers on fixed rent agreement basis.

The rice-prawn gher farming system has redistributed the landholding patterns due to the participation of marginal and landless farmers. Some marginal and landless farmers have become small landowners after the successful operation of rice prawn gher farming (Barmon, 2006). The impact of shrimp and rice-prawn gher farming system is presented in Table 4.

Advantages of Rice-Prawn Gher Farming over Shrimp Farming in Bangladesh

The major hurdles that shrimp farming has faced can be overcome by the adoption of freshwater prawn gher farming as an alternative in suitable locations where adequate freshwater is available. Supply and availability of prawn feed is the main constraint for steady production. At the early stages, the farmers mainly used mud snails as prawn feed, which was collected from swampland, canals, and rivers. As mentioned earlier, the continuous harvest of mud snails had a negative impact on the ecology. Now-a-days, the farmers are providing various home-made feed applying

learning-by-doing techniques. As a result, prawn production has had little negative impact on the ecology.

Rice-prawn culture is different from the conventional shrimp farming because of the difference in farm management system and the structure of the production unit. Rice-prawn gher farming is friendlier to the environment compared to shrimp farming. As mentioned earlier, agricultural land has been degraded and agricultural production reduced due to shrimp production in coastal areas in Bangladesh. However, the opposite effects are found in the case of rice-prawn gher farming that offers significant scope economies. The farmers produce mainly two agricultural products-prawn and MV paddy under rice-prawn farming system and the production process within each enterprise have positive externalities. On the one hand, this farming system provides sufficient amounts of rice that can meet local demands. On the macro side, this farming system is earning remarkable amount of foreign currency and contributing significantly to the Gross Domestic Product (GDP).

Moreover, almost all farmers are getting additional fish and vegetables for home consumption from rice-prawn gher farming than is not possible under shrimp farming. The main reason is that freshwater prawn responds well in polyculture with carp and tilapia (Zimmerman and New, 2000; Kurup, Ranjeet and Hari 2002). However, bottom-feeding fish should be kept away from polyculture with prawn production (Reddy, Ramakrishna and Rao 1988; and Kanaujia and Mohanty, 1996).

A large number of marginal and small farmers are engaged in rice-prawn gher farming system renting land from the landlords that is possible for shrimp farming. Landless farmers are also being benefited by rice-prawn gher farming system along with marginal and small farmers.

Conclusions

Shrimp/prawn is the second largest exportable industry in Bangladesh and has significant impacts on the national economy of Bangladesh. Both exportable shrimp and prawn are being produced in the gher farming system. The shrimp farming system has negative impacts on the environment, ecology, land degradation, livestock, and water quality, whereas the rice-prawn gher farming

system is friendlier to the environment, ecology, and water quality. The rice-prawn gher farming system has significant impacts on land fertile for MV paddy production. The yield of MV paddy farming under rice-prawn gher farming system is almost same as the yield in other parts of Bangladesh where the farmers usually produce

only year-round MV paddy. While the rice-prawn gher farming system is providing a sufficient amount of rice that helps meet the local demand for food, it also earns foreign currency that helps to contribute to the gross domestic product (GDP). The policy makers should thus take necessary steps

Table 4: Impacts of Shrimp and Rice-prawn Gher Farming System in Bangladesh

Particulars	Shrimp Gher Farming	Rice-prawn Ghe Farming
Employment status	Decreased	Increased
Income generating	Decreased	Increased
Income distribution	Inequality	Relatively less inequality
Social status	Decreased	Decreased
Livestock	Negative	Positive
Poultry	Negative	Positive
Paddy production	Negative	Positive
Vegetables production	Negative	Positive
Health	Negative	Negative
Ecology	Negative	Negative
Environments	Negative	Friendlier
Land degradation	Negative	Positive
Salinisation	Negative	Positive

Source: Field Survey, 2003, 2004 and 2006.

and implement policy for the development of environmentally and ecologically friendlier rice-prawn in Bangladesh.

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