

# Development of integrated prawn-fish-rice farming for sustainable livelihoods of the rural poor in Southwest Bangladesh

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Bangladesh is considered to be one of the most suitable countries in the world for integrated prawn-fish-rice farming, because of its favorable agro-climatic conditions. Integrated prawn (*Macrobrachium rosenbergii*) farming is currently one of the most important sectors of the national economy. During the last two decades its development has attracted considerable attention because of its export potential. The freshwater prawn, locally known as *golda*, is a highly valued product for international markets; almost all prawns are, therefore, exported, particularly to the USA, Japan and Europe. The export of prawns and shrimp was estimated at 46,533 t in 2005 with a value of US\$380 million of which 27 percent was prawns (DOF 2006). Freshwater prawn farming is mostly concentrated in southwest Bangladesh, mainly in Khulna, Bagerhat and Satkhira districts because of the availability of wild fry, available low-lying agricultural land, a warm climate, fertile soil, and cheap and abundant labor. The total area under cultivation of prawns was estimated to be around 30,000 ha (Williams 2003).

A large number of small and marginal farmers, less than 0.41 ha of land including ponds, are associated with prawn-fish-rice farming in the Bagerhat district. Integrated prawn farming in rice fields is a common practice for these farmers to help them improve sustainability, productivity and profitability. Integration of prawns and fish with rice is the most efficient way of increasing production per per unit area of land. Prawn-fish-rice farming provides not only additional income from the yield of prawns and fish, it also improves the rice yield (Uddin *et al.* 2001). The present study sought to broadly understand integrated prawn farming, the development of which has been shown to lead to poverty reduction. The aim of this paper is to illustrate how sustain-



Fig. 1. Map of Bangladesh showing the study area Fakirhat – ‘the Kuwait of Bangladesh.’

able livelihoods are achieved through integrated prawn-fish-rice farming. This article is based on published sources, together with the results of primary data collected in the Fakirhat area of the Bagerhat district (Figure 1). A total of 50 farmers and 200 associated groups were surveyed through questionnaire interviews and participatory rural appraisal tools from October 2005 to June 2006.

## History of Development

In Bangladesh, freshwater prawn farming first started in the southwest region in the early 1970s (Mazid 1994). Locals learned to catch postlarvae from people on the Indian side of the Ichamati River. After the 1971 war, Hormuz Ali of Basantapur village noticed people on the Indian side fishing with nets. Crossing the river, he found that they were catching something of value, so he studied their techniques, bought a net and began to catch postlarvae prawns in the waters near his village (BOBP 1990).

Around 1978, a few well-off local farmers in the Bagerhat area began to experiment with stocking prawns in carp ponds built on their land. These early innovators experimented with various technical aspects and profited well from their success (Kendrick 1994). Finally a few pioneers, sometime between the late 1970s and the mid 1980s, developed the first prawn farms in low-lying agricultural land and

rice fields. The name most frequently raised as the father of freshwater prawn farming is Keramat Ali of the Fakirhat area in Bagerhat district (Rutherford 1994).

In the late 1980s, the farming practice began to be adopted widely in the original location in the Fakirhat area, where prawns are grown along with carps and rice (Kamp and Brand 1994). By about 1987, a few local farmers converted their low-lying lands and rice fields into prawn farms (Kendrick 1994). Since then, the pace of adoption has in-



A typical gher for prawn-fish-rice farming.

creased dramatically as more and more farmers watched their neighbors profiting from prawn cultivation and decided to become involved. The news spread to other areas, and farmers in other parts of Bagerhat district began to adopt this new technology. The number of prawn farms and farmers continue to be the highest in the Fakirhat area.

Potential returns for prawn farming are good and farmers have been attracted by its potential as an income generator. For the people of Fakirhat, proudly called the *Kuwait of Bangladesh*, prawn production is reported to have increased subsistence farmer income considerably (Kendrick 1994, Rutherford 1994).

The early innovators tended to be large and middle size farmers, but increasing numbers of small and marginal farmers are also producing prawns (Rutherford 1994). The expansion of prawn cultivation has been dramatic and, since 1990, adoption has accelerated, spreading to other southern districts, such as Khulna, Satkhira and Jessore. Since the early 1990s, prawn farming has become one of the most financially attractive investment opportunities in many areas of Bangladesh (Ahmed 2001).

## Gher Systems

The cultivation of prawns in modified rice fields, locally referred to as *ghers*, was originated by farmers (Rutherford 1994). According to Kamp and Brand (1994), *gher* farming is a “quiet, indigenous technological revolution,” suitable for the cultivation of prawn, fish and rice. *Gher* farming can be considered a method of combining aquaculture and agriculture in one plot. The Bengali term *gher* is an enclosure made for prawn cultivation by modifying rice fields through building higher dikes around the field and excavating a canal inside their periphery to retain water during the dry season (Kendrick 1994). Inasmuch as *ghers* have been converted from rice fields, their boundaries often follow existing rice fields, although some farmers may choose to subdivide a field. Sometimes there are canals between neighboring *ghers*, but in intensively developed areas, *ghers* are often laid out back to back, uninterruptedly covering hundreds of hectares (New 1995). Many are provided with a small

thatched shelter, perched on the dike, where a night guard can be stationed, because theft or the fear of it is rampant. The average *gher* size in the study area was found to be 0.29 ha, with thousands of tiny *ghers* and only a few large units. The principal water sources for *ghers* are rainfall, ground water and sometimes river water through canals. During the rainy season the whole water body is used for the cultivation of prawns and fish. However, when the weather is dry then only the trenches are used for fish and rice is planted in the central plot (Ahmed 2001).

## Production Technology

The concept of *gher* farming makes it possible to incorporate a wide variety of crops together with prawns, fish and rice. While prawns are produced for export markets, fish and rice are grown for local markets and household consumption. Prawn culture in *ghers* is fully dependent on wild postlarvae that are stocked when they become available in May or June and are harvested primarily from November to January. The average stocking density of postlarvae is 20,984/ha.

Various carp species are cultured with the prawns and harvested throughout the year. They include the Indian major carps catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhina mrigala*) and exotic carp including silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*). The average annual stocking density of fingerlings is 2,462/ha. In general, farmers did not attempt to stock any specific ratio of carp species.

Almost all farmers cultivated *boro* rice inside the *gher* during the dry season from January to April. The majority of farmers (62 percent) avoid cultivating *aman* rice during the monsoon when the prawns are in the *gher*. Farmers suggested that *aman* rice competes with the prawns for living space and placed demands on the limited capital of the farmers during the prawn growing season. *Aman* rice is also thought to pollute the water when the stalks are left to rot. In addition, farmers believe that the use of pesticides for rice negatively affects prawn growth.

A variety of feeds are used for prawn farming but the preferred feed is the freshwater snail, *Pila globosa*. An average 65 kg/ha/day of snail meat is offered from June to October. In general, chopped snail meat is fed in the morning and evening. The supply of snails is not regular so farmers also use a mix of cooked rice, rice bran, oil cake and fishmeal. These feeds are also used for fish.

Most of the respondents (92 percent) used fertilizers in their *gher*, mainly cow-dung, urea and triple super phosphate (TSP) at varying frequencies. On average, annual fertilization rates were 1,511 kg/ha of cow-dung, 455 kg/ha of urea and 223 kg/ha of TSP. The purpose of using fertilizers in the *gher* is to create conditions that help increase the production of good quality natural feeds, phytoplankton, zooplankton and benthos; thereby, increasing prawn and fish production.

Productivity of *gher* systems is variable. The average annual yield of prawns (heads-on) and fish were estimated at 465 and 832 kg/ha. A number of interdependent factors affected growth rate and productivity of prawns and fish,

including stocking rate, the quality and quantity of feed supply, water quality and other aspects of *gher* management. Total rice production has probably decreased as a result of widespread conversion of rice fields into *ghers*. However, at the farm level, many farmers reported increased rice productivity as a result of *gher* construction, as the *gher* dikes now keep saline water out of the fields. Average rice production was estimated at 2,230 kg/ha/crop. Productivity of rice in *ghers* was estimated including the area of canal and water for prawn farming so actual yields will be higher, typically by 20 to 25 percent.



Mr. Keramat Ali - the father of freshwater prawn farming.



A farmer with harvested prawn.

## Livelihoods of Rural Poor

The livelihoods of a large number of rural poor are involved with prawn farming and its associated activities. According to DOF (2002), there are 600,000 people employed in this sector in Bangladesh. Figure 2 is a diagram of the integrated prawn production process, where different groups of people are involved in different activities. The following groups of people were identified in prawn production and marketing systems:

**Prawn farmers.** A large number of people earn their livelihood in prawn farming. It is reported that almost all the small and marginal farmers were poor and a few farmers (10 percent) were from the middle class. Many prawn farmers were highly dependent on moneylenders. It seems certain that the rich were getting richer as a result of prawn farming. Large farmers, who had built *ghers* on their own land with their own capital, required no loans and benefited the most. Medium sized farmers also did well. However, poor farmers with small *ghers* benefited the least. In contrast, a few key informants stated that small farmers benefited the most, because their situation had been so desperate before prawn farming and now they are living better.

**Women.** The role of women in the prawn-related activities is potentially important. Women are involved in a great variety of integrated prawn farming activities, such as preparation of feeds, feeding of fish and prawns, *gher* management and prawn harvesting and marketing. The workload of women has increased as a result of integrated prawn farming. Women noted that they would like to do more work in prawn farming because of its high economic return; however, it was not possible as a result of their household work obligations. Prawn farming activities of women have enhanced their position in families and society. They now tend to play a stronger role in economic decisions of their households, attend social functions, accept family planning methods and providing advice to sons or daughters on selection of spouses.

**Children.** Poverty causes a large number of children to be involved in integrated prawn farming and associated activities. It was found that almost all children over 12 years

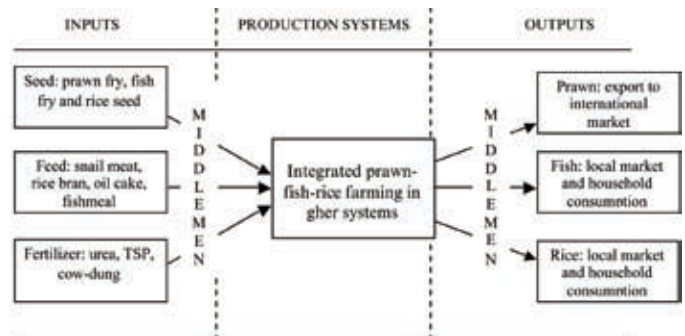


Fig. 2. Integrated prawn production processes in *gher* systems.



A local trader with prawns which are exported to the international market.



A child with export quality prawn.



A woman with harvested prawn.

of age in prawn farming families are directly engaged in feeding, fertilizing and harvesting. Daily harvest of fish for family consumption is done by women with the help of children. Children are also involved in catching and trading postlarvae, harvesting and processing snails and trading prawns. Though primary education is being made compulsory in Bangladesh so that every child can become literate, the scope for taking advantage of universal primary education often could not be utilized because of poor household economic conditions, children contributing household labor or having outside employment, or simply that the costs of schooling are too high.

**Postlarvae catchers.** In Southwest Bangladesh, the prawn culture industry depends almost entirely on wild postlarvae, because hatchery production is limited and farmers consider them to be of lower quality. A large number of fishermen are known to be engaged in catching postlarvae in the coastal

area from April to June. Most of the poorer catchers have no other livelihood alternatives. Catching of postlarvae is a substantial part of their income. Fishermen operate their nets twice a day during high tide and average 5.33 hours a day fishing (Ahmed *et al.* 2005). Postlarvae catchers contribute substantially to the economy and to a part of the foreign exchange earnings, though they benefit little.

**Postlarvae traders.** A number of individuals are engaged in trading postlarvae in the Faltita market of the Fakirhat area, which is particularly well known for this activity during April to June. Trading is a seasonal business and traders are involved in prawn trading, fish trading and prawn farming the rest of the time. Postlarvae traders are mostly from the lower middle class, and postlarvae trading is a substantial part of their income. With a few exceptions, the catchers never directly communicate with prawn farmers, market communication normally being made through intermediaries and traders. Postlarvae traders possess capital and have the means to control fishermen, suppliers and middlemen. They are reported to have improved their social and economic conditions.

**Snail collectors.** The use of snail meat as prawn feed is widespread in the study area and snail populations are reported to have declined significantly. Snails are now harvested from seasonal floodplains and river areas in neighboring districts. A wide variety of people, including women and children are involved in snail harvesting during the monsoon from June to October. On average, snail collectors are engaged for 5.4 hours daily in their task (Ahmed 2001). The snails are collected using a triangular concave mesh netting attached to a short pole. The nets are used to scoop the snails off the surface. The net is operated with a boat by a single harvester. Overall, the supply of snails has generated a number of employment opportunities in catching, processing, transport and trading activities.

**Snail traders.** Snail trading has become a popular business in the study area. A large number of rural poor are involved in snail trading. Their job is to collect snails from the neighboring districts and sell them to the prawn farmers. Boats, trucks and trailers are used to transport snails to prawn farming areas. Snail traders employ women and children as day laborers for processing snails. Processing involves breaking the operculum and removing the meat from the shells with a small curved knife. The traders sometimes sell their snail meat on credit to farmers. On the other hand, rich farmers may advance money to snail traders to try and ensure a regular supply of snail meat, though supplies of snail meat are irregular as the catch depends on weather conditions and snail production level.

**Prawn traders.** A number of persons are engaged in prawn trading in the Faltita market during the season from November to January. Their premises are modest; they might have a small rented tin shed warehouse/office equipped with a portable ice chest in a market. Their role is to collect prawns from farmers and supply them to processing and export companies within 1-2 days of purchase. Finally, companies export frozen headless prawns to international markets through the port of Mongla in the Bagerhat district. Prawn

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Wild fry catching in the coastal area.



Fry trading in local market.

trading is seasonal and traders are involved in fish trading, postlarvae trading and other businesses during the rest of the year. Prawn traders belong largely to the middle class, as reflected in their access of capital.

**Intermediaries.** A large number of rural poor are involved as intermediaries in postlarvae trading, snail trading and prawn trading. They work with small amounts of capital. They typically work from a boat, rickshaw or a cargo-carrying tricycle. In general, postlarvae traders sell to prawn farmers through intermediaries. Intermediaries often take temporary credit from fry traders, buying fry one day and paying the next day or the day after that. In prawn trading, they carry heads-on prawns from remote villages to the prawn traders in the market centers and sometimes take small amounts of credit from prawn traders to ensure the supply of prawns from farmers. They also often obtain temporary credit from the farmers, buying prawns one day and paying one or two days later.

**Day laborers.** A large number of landless poor are involved as day laborers in this sector. Prawn farming day laborers are reported to have benefited from greater paid employment opportunities and higher wages than are avail-

able in other sectors. Both casual day laboring opportunities and more secure contractual employment opportunities have increased, in particular for work as guards of *ghers* for a monthly wage. Most day laborers report experiencing real benefits from the higher wages and increased wage-earning opportunities brought about by *gher* expansion, suggesting active involvement about 310 days a year. Although wage rates fluctuate during the year with seasonal labor demand, wages in prawn farming areas appear to be double those in nearby rice producing areas.

## Socio-economic Benefits

Integrated prawn production in *gher* systems infused unprecedented amounts of cash into the local economy. Clearly there have been visible qualitative and quantitative changes in the standard of living, food consumption and level of economic activity in the Fakirhat area. The main benefits from prawn farming were an increase in economic solvency and improved social status in the community. Before prawn farming, a large number of farmers lived below the poverty line and after converting their land to *ghers*, most of these households are now at least eating fish and rice.

Many farmers have experienced dramatic improvement in their living standards because the land that they have converted into *ghers* was previously not utilized; lying so low that no crops could be grown. A few small farmers have managed to avoid high interest loans from moneylenders and increased cash income has provided the opportunity for more investment in productive resources. With a few exceptions they have hopes and expectations of achieving a much better life after a few more years of integrated prawn production.

A range of associated groups has also benefited from this sector. Improvement of socio-economic conditions has occurred for all of the sectors discussed above. Snail shells are used for poultry feed, fishmeal and fertilizer and have generated employment opportunities. Additional employment opportunities also have been generated in ice and processing plants, feed manufacturing and in the transportation sector.

The socio-economic conditions for day laborers are comparatively better than for postlarvae catchers and snail collectors because of higher income and greater employment opportunities. The socio-economic conditions of snail collectors are extremely poor because of meager income and the lack of other employment opportunities. The socio-economic conditions of prawn traders are the best because of higher income. Figure 3 shows the average daily income of farmers and associated groups.

## Conclusions

The development of integrated prawn-fish-rice farming plays an important role in the economy of southwest Bangladesh, earning valuable foreign exchange and contributing to increased food production, diversifying the economy and increasing employment opportunities. Integrated prawn farming is now a profitable business. There has been a steady increase in the production of prawns, fish and rice by small and marginal farmers and integrated prawn farming promises to remain a growth sector for the economy. Considering

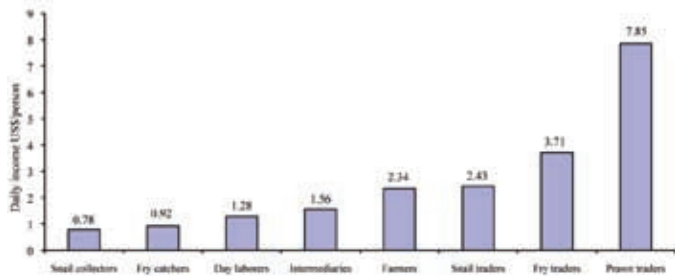


Fig. 3. Average daily income of prawn farmers and associated groups.

the role of integrated prawn farming, a much greater benefit can be obtained if future government policies encourage improvement of productivity and expansion of integrated prawn farming, as well as the implementation of a workable strategy to encourage further gainful participation of the rural poor.

### Note

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## FARMING BATH SPONGES

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years of growth would guarantee a reliable and sufficient source of sponges to the market.

Survival of farmed *Coscinoderma* sp. and *R. odorabile* varied among the six farming sites (Figure 6), being highest at Pelorus 2 with 100 percent and 97 percent alive after 15 months. These survival results are outstanding and again highlight the potential of commercially farming bath sponges at the Palm Islands. At the remaining five sites, most sponge mortality occurred during the first few months. During that period, sponges are healing their cut surfaces so some mortality may result from pathogens infecting their exposed tissues.

### Indigenous Australians

Besides developing the best farming method and selecting good farming sites, current research is addressing a range of other issues critical to underpinning the establishment of commercial sponge farms in Torres Strait and the Palm Islands. These include determining the optimal explant size for best farm production, investigating the abundance and size frequency patterns of wild populations to establish seed-stock harvest regimes, determining the genetic structure of sponge populations and connectedness for setting appropriate translocation protocols and establishing exactly what sponges are removing from the water column for food. Thus, as a complete package, research will support the establishment and regulation of sponge farming with a knowledge base for best practice farm production, as well as sustainable environmen-

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Fig. 7. A Torres Strait Islander sponge diver, monitoring the farming experiments.

tal management.

While regulatory approvals from environmental managers are yet to be granted for either location, the data look positive. The farming response in both locations has been great, with sponges growing quickly and showing high survival in the best treatments. Indigenous Australians at the Palm Islands have ground truthed the experimental data with market analysis and development of a business plan. They have also developed a commercially viable model that will provide employment for 32 people in a community that currently endures over 90 percent unemployment. In Torres Strait the community has begun a similar process to arrive at a commercial production model that will work for them. Sponge farming has the potential to become more than a new sustainable marine industry for Australia. It could also present a platform for training, employment and economic development in communities that have limited opportunities for commerce and enterprise (Figure 7).

### Notes

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