



A PRO-POOR ANALYSIS OF THE SHRIMP SECTOR IN BANGLADESH

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GLOSSARY OF TERMS AND ACRONYMS

Term	Definition
Aratdar	Commission agent or intermediary who buys and sells products
Bagda	Salt water shrimp
BDT	Bangladesh Taka
Beel	Floodplain
BF	Bulk frozen
BFFEA	Bangladesh Frozen Food Exporters Association
Bheri	Pond
Bigha	A unit of land that corresponds to 1/3 of an acre or 0.135 hectares
Boro	Late dry season rice harvested May-June
BPDB	Bangladesh Power Development Board
BRAC	Bangladesh Rural Advanced Committee
By-catch	Other marine or fresh-water creatures that are caught in the nets while fishing for another species
BWDB	Bangladesh Water Development Board
Chatal	Auction for shrimp in Khulna
Dadon	Loan extended to the shrimp farmers by faria.
Dalal	An intermediary who leases land from landowners and then sub-leases it to tenant farmers
DoF	Department of Fisheries
DSE	Dhaka Stock Exchange
EEF	Entrepreneurs Equity Fund
EPB	Export Promotion Bureau
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
Faria	Intermediary who buys and sells products
Fertilizer	Organic and inorganic fertilizers are used to increase biotic matter and promote growth; these typically consist of urea and compost or animal fertilizer
FDA	Federal Drug Administration
Fingerlings	Juvenile shrimp and prawns, slightly larger size than fry
FfF	Future for Fisheries Project
FOB	Free on Board: A situation where the seller is required to deliver and load the goods on board a ship or airplane specified in the contract of sale; the seller is not required to obtain insurance. In the balance of payments, the import figures are adjusted to an f.o.b. basis to make them comparable with exports.
FPL	Fish Preservers Limited
Fry	Baby shrimp and prawns
Gher	Ponds inside polders used for the cultivation of fish or shrimp
GNAEP	Greater Noakhali Aquaculture Extension Project
GoB	Government of Bangladesh
Golda	Fresh water prawn
HAACP	Hazard Analysis and Critical Control Point
ICAPMS	International Conference on Aquaculture Production and Marketing of Shrimp-Finfish & Bangladesh Seafood Expo November 2004
IQF	Individually quick frozen
Khas	Government owned lands which are under the supervision and control of the Ministry of Land; these lands are typically allocated to the landless for cultivation
Mahajan	Money-lender
Pateel	Cylindrical earthenware container used by aratdar for carrying fry
Patrilineal	A system where rights are traced through male lineage through the paternal line
PDTO	Peeled de-veined tail on

P&D	Peeled and de-veined
PL	Post-larvae
Polder	Area of low-lying land reclaimed from the sea by construction of a perimeter dike
Polyculture	The cultivation of more than one species of fish or shrimp simultaneously
Producer surplus	The excess of revenue received by a supplier of a commodity over the minimum amount he or she would be willing to accept to maintain the same level of supply
Rents	Returns
Rent-seeking	Behavior that improves the welfare of one individual or agent at the expense of another; the most extreme example of rent-seeking is that of a protection racket, in which one group receives payment without creating any welfare-enhancing output
Samity	An association of fry aratdar.
Side-payments	Payment of a separate lump-sum to secure a particular outcome
Spot market	A market in which goods are traded for immediate delivery
SIPPO	Swiss Import Promotion Programme
Thana	District
Upazila	Sub-district
Variable cost	Costs that vary directly with the rate of output and include: labor costs, raw materials costs, fuel and power, etc.

EXECUTIVE SUMMARY

This report has been prepared by the Greater Access to Trade Expansion (GATE) Project for the USAID/Bangladesh Mission to explore the nature of production and the terms and conditions of employment along the shrimp value chain in Bangladesh. The primary objectives of the report are to identify opportunities to improve market outcomes, raise productivity and wages, and foster pro-poor growth in the sector.

Shrimp export and cultivation in Bangladesh has undergone rapid expansion over the last two decades. Shrimp is a particularly valuable export crop generating substantial revenues and foreign exchange, earning in excess of \$360 million annually and accounting for 4.9 percent of exports in 2004. After the garment industry, shrimp production ranks second in Bangladesh in terms of the sector's ability to earn foreign exchange. Not only does this crop earn valuable foreign exchange, but the sector also employs significant numbers of rural workers and provides a livelihood for households throughout much of Bangladesh. Our study estimates that as many as 1.2 million people may be directly involved in shrimp production with an additional 4.8 million household members supported by the industry.

To better distribute gains along the chain, increase production, raise productivity, and benefit the poor, this report employs several intersecting and overlapping frameworks to analyze the costs and returns within this sector.

A pro-poor livelihoods approach considers the entirety of production and earnings for the poor and assesses how shrimp and prawn fit into a household's strategy for income and employment. This study also uses a value chain approach, focusing on the institutional arrangements that link producers, processors, marketers, and distributors, while recognizing that power differentials among actors may influence outcomes along the chain. Included within the value chain approach is a gender analysis of the chain—highlighting the different positions of men and women across the chain and addressing issues of power reflected in the production and exchange relationships.

DATA COLLECTION

A total of 188 individuals were interviewed representing each node in the value chain. The semi-structured questionnaire garnered information about employment, wages, prices, profits, costs, and returns. In addition, 25 key informant interviews were conducted with individuals representing government, the private sector, and non-governmental organizations. Finally, focus group discussions with male and female workers and farmers were held in Khulna, Chittagong, Cox's Bazar, and the Greater Noakhali region (Feni, Noakhali, and Laksmipur). Primary data was compared with secondary data and analyses to verify findings.

SHRIMP PRODUCTION

There are two kinds of shrimp that are cultivated in Bangladesh—saltwater shrimp (bagda) and freshwater shrimp (golda). Of the two, bagda dominates the market although golda commands a higher price.

Bagda shrimp can be caught at sea and sold for processing and export. Brood mothers are often caught this way and sold on to hatcheries which produce about 50 percent of the fry used by farmers. However, trawling for shrimp and harvesting brood mothers can lead to over-fishing and increase pressure on fisheries, which in turn, threatens the food security of coastal people and contributes to the erosion of biodiversity in the region.

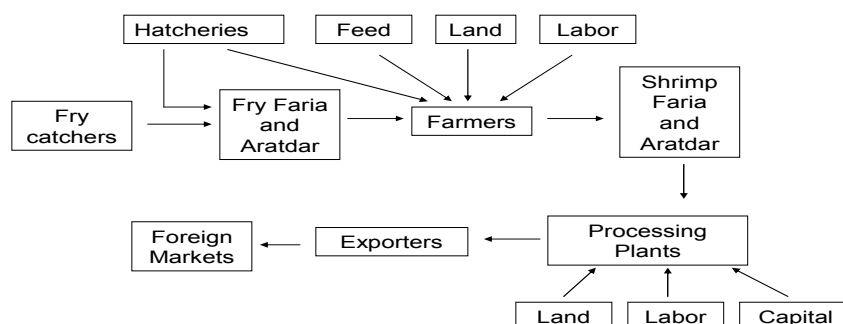
Both bagda and golda shrimp are also farmed. The majority of shrimp exported from Bangladesh are farmed. Farm methods range from traditional to semi-intensive production in Bangladesh. Traditional shrimp farms require few inputs and produce low yields. Shrimp fry are caught in ponds and grown from March to June. The majority of shrimp cultivated in Bangladesh are grown using traditional methods. Modified traditional production uses more inputs and increased technology. These modifications may include: the use of electric pumps to bring in salt water; the practice of mixing shrimp with other products such as fish, or sequentially cultivating salt or rice; and, the adoption of partial processing and post-harvest management techniques. Semi-intensive production requires greater inputs and investment such as regulated water temperature, supplementary feed, and better infrastructure. Less than 125 hectares of land are estimated to be farmed using semi-intensive methods in Bangladesh. Although this method of production leads to significantly higher yields, it is also associated with higher environmental costs.

THE SHRIMP VALUE CHAIN

The shrimp sector is a buyer-driven chain where producers, particularly small producers, have little ability to influence the price at which they sell their product and are frequently locked into contracts that limit the price they receive. At lower ends of the chain, among fry collectors and intermediaries, bargaining is limited and few agents are more than price-takers. At higher ends of the chain, among the larger farmers and processors, there is more opportunity for negotiation.

Figure 1 provides a simple flow diagram of the sector that traces how inputs are transformed into outputs and how shrimp are grown, processed and exported. Fry are caught in the surf and in rivers and estuaries, or produced in hatcheries, and then sold on to intermediaries. Faria and aratdar are the intermediaries who buy and sell fry and shrimp and provide informal credit to fry catchers and farmers.

Figure 1. Flow Diagram of the Shrimp Value Chain



- Fry Catcher**
 Fry collectors sift through the surf for post larvae. Approximately 425,935 individuals caught fry in 2005. A little over 40 percent of all fry catchers are men, 30 percent women, and another 30 percent girls and boys. Lacking land and assets, the fry collectors are the most vulnerable workers along the chain. Fry collectors typically borrow money from fry faria in the lean season and commit to selling the fry to that lender at a price determined by the lender. Many spend years locked in a cycle of debt and earn little more than \$1 per person per day. As fry catchers sift for the shrimp fry, they also catch unwanted fish. This by-catch is wasted and contributes to the loss of biodiversity in the region.
- Fry Faria, Aratdar, and Commission Agents**
 Over 30,000 intermediaries purchase fry and sell them on to other intermediaries. Fry faria buy fry from catchers or hatcheries throughout the year. They sell the fry to an aratdar. Fry aratdar typically buy fry from the fry faria and sell fry to the commission agent. Often faria and aratdar are indebted to intermediaries higher up the chain and are committed to sell fry exclusively to that lender. These contracts are sanctioned through strict social codes and occasionally enforced by violence.
- Nursery**
 In some cases, fry pass through nurseries before being delivered to the farms. Nurseries are where the fry are adapted to the farm production environment. The majority of the fry goes directly to farms, however, and are not acclimatized in nurseries.
- Farming**
 Shrimp are farmed using primarily traditional and some modified practices. There are approximately 150,000 farms producing shrimp and prawn, and employing over 600,000 workers. Many of these workers are unremunerated family members while others are hired for temporary or seasonal work. Shrimp fry are seeded in the ponds, and feed may be administered to promote growth and weight gain.

- **Shrimp Faria, Aratdar, and Commission Agents**
Shrimp faria and aratdar purchase shrimp from the farmers and sell them on to other intermediaries. They may offer conditional loans to farmers and buy shrimp from the farmers at a price that they determine. Shrimp aratdar buy shrimp from the farmer or faria, sell to the commission agents who aggregate the shrimp, and then sell to the processors and exporters. Commission agents are typically medium to large size entrepreneurs.
- **Processor/Exporter**
There are 130 processing plants in Bangladesh. Of these, 65 are in operation. Most plants clean, preserve, and package shrimp. A number of plants are also beginning to cook or semi-cook the shrimp to increase the value added of the product.

Approximately 30,000 workers are employed in shrimp processing factories, over 60 percent of whom are women. The work is laborious and repetitive, and health concerns abound for the workers, including reports of arthritis, urinary tract infections, repetitive strain, and diarrhea due to cool, damp work environments, stress, and exposure to parasites.

There have been numerous complaints about the working conditions including violation of the 8 hour workday; forced and unpaid overtime; failure to provide healthcare, childcare, and maternity leave; failure to observe the right to organize; as well as health and safety violations. There are also concerns that children are working in some of the plants, although no reliable estimates exist as to the numbers of children employed.

Other issues that affect the shrimp sector include transportation, feed mills, financing and credit, as well as standardization and regulation. The sector relies on roads and boats to move fry to farms and mature shrimp to exporters. About 16-20 percent of the total weight of shrimp is lost in the transfer from multiple intermediaries to the processing plants. Improving transportation infrastructure and handling processes could increase overall productivity in the sector. New health and hygiene standards require increased investment to meet foreign buyers' demands, but also represent an opportunity to increase the value added and upgrade facilities. Shrimp feed is an important input to the sector but most feed is of low quality. Expanding local production of shrimp feed could reduce costs for farmers, increase backward linkages in the sector, and generate new jobs and income in rural areas. Finally, extension of credit and financing could help smaller players within the chain and reduce reliance on oppressive lenders.

GENDER ISSUES WITHIN THE VALUE CHAIN

This report employs a gendered value chain analysis to highlight the different positions and contributions of men and women across the value chain. This analysis enables us to uncover the economic, organizational, and asymmetric relationships among actors located along different points within the industry.

A gender analysis of the chain affords another means to examine the power of actors to engage in the sector as well as the terms and conditions of their engagement. Power is

socially determined and frequently gender-segregated. Social norms, sanctions, and proscriptions frequently affect an individual's ability to enter labor markets, acquire productive assets, invest in their own or other's human capital, and lend and borrow money.

The shrimp value chain reveals a highly sex-segmented labor market. Women and men cluster in different activities in the value chain and their time is used unequally. Women and girls comprise 40 percent of all fry catchers and 62 percent of all processing plant workers. Very few women are intermediaries.

Men and women also receive different wages along the value chain. Women fry catchers and sorters earn about 64 percent of what male fry catchers and sorters earn. While women receive 82 percent of men's wages in pond repair and casual agricultural labor, they only receive 71 percent of men's wages in the packing section of the processing plants and a mere 60 percent of men's wages in cooking/breeding section of the processing plants.

Inequality in women's participation is also evident in the security of their tenure and the work relationships they engage in along the value chain. In most segments of the value chain where women are employed, a greater proportion of female time is in temporary or casual employment. In farming, although there are more men reported to be working, 73 percent of women's labor time is concentrated in temporary or casual employment as compared with 31 percent of men's time. Similarly, in processing, where estimates reveal that women outnumber men, 92 percent of the women's labor time used is considered temporary or casual.

Women concentrate in temporary, casual, and flexible labor primarily because of their subordinate social and economic status. Women are seen as secondary wage-earners whose income supplements that of male earners. Additionally, their dual role as mothers and caregivers limits their engagement in productive and remunerated activities and is seen as a reason why their participation in paid employment must be secondary. The primacy of male earnings confers more protected status upon men and allows women's employment to be seen as a buffer against risk and not part of an essential and co-equal strategy to generate household earnings. Where women's earnings are secondary, and in labor markets where tasks are highly gendered, women typically command lower wages. Finally, women are actively recruited as cheap, compliant labor that can be hired and fired more easily; a host of gendered social norms reinforce their compliance.

CONCLUSIONS

Shrimp is an important export for Bangladesh and through its production provides livelihoods for the poor, small farmers, as well as many intermediaries and exporters. However, the profits that are generated from shrimp exports are not broadly shared throughout the chain—there are marked differences in the benefits accruing to middlemen and exporters in contrast to the returns realized by farmers and fry catchers. Moreover, gender disparities permeate the chain leading to occupational segmentation, wage inequality, and increased job insecurity for women.

It is clear that the most vulnerable actors in the chain occupy the least secure employment, depend on open-access resources, and have limited opportunities to upgrade their production or change the terms and conditions of their labor and product exchange. Women are not visible in many activities, in particular as *faria* and *aratdar* and as management in processing. Instead, they are concentrated in the more flexible and insecure nodes of the value chain as fry catchers, farm laborers, and workers in shrimp processing plants. Insecurity in the chain is synonymous with low incomes and a greater vulnerability to poverty.

In order to increase the opportunities and benefits from trade, there is an urgent need to raise productivity and improve production methods in the shrimp sector. Additionally, efforts need to be made to reduce indebtedness lower down the value chain and free up producers to sell in local markets without being tied to lenders. There are an excessive number of intermediaries in the sector. These intermediaries perform an important function injecting informal credit into a system that faces substantial credit constraints at lower levels of the chain and aggregating inputs and product over disperse geographical areas. Yet, the density of intermediaries is also illustrative of substantial inefficiencies in the sector. Indebtedness binds fry-catchers and farmers into sub-optimal contracts with intermediaries reducing their returns and depressing incomes. Additionally, significant loss or spoilage occurs as the fry or shrimp pass through multiple intermediaries before reaching the farm or processing plant. Finally, social and environmental costs hamper growth in the sector. These costs can be addressed through improved aquacultural practices and better legislation and enforcement. As a result, national policies concerning the sector need to be revisited and a broader consultative process among all stakeholders developed.

RECOMMENDATIONS

The policy action matrix below provides a summary of the key recommendations that emerge from the report.

Policy Action Matrix for Pro-Poor Development of Shrimp Sector *

Constraints	Actions	Activities	Indicators	Gender Indicators	Responsible Agencies
Low Productivity of Farms	Shift more farmers to modified traditional practices	<ul style="list-style-type: none"> Provide extension services to farmer households (trainers and trainees should be both male and female) Train farmers to diversify production in small farms and encourage polyculture of fish and shrimp/prawn species Develop feed mills 	<ul style="list-style-type: none"> Improved yields Lower stocking densities Increased adoption of feeding Addition of grow-out ponds Switch to 2-phase production Increase in the number of nurseries in operation Increase in the number of feed mills in operation 	<ul style="list-style-type: none"> Increase in yields for female-headed and maintained households Increase in number of women engaged/employed in nurseries Increase in number of women engaged/employed in feed mill production Increased use of remunerated female labor in post-harvest sorting 	<ul style="list-style-type: none"> USAID through programs Department of Fisheries NGOs
Indebtedness	Provide credit	<ul style="list-style-type: none"> Disburse flexible credit linked to the adoption of modified and more environmentally sustainable cultivation practices 	<ul style="list-style-type: none"> Reduced dependency on aratdars and faria for financing (reduced amount of borrowing through aratdars and faria) Higher sales prices Fewer tied sales 	<ul style="list-style-type: none"> Credit disbursed to women and women-headed households Reduced differential between sales prices received by men and women farmers 	<ul style="list-style-type: none"> USAID through programs Other donor agencies Department of Fisheries NGOs
High numbers of intermediaries	Reduce numbers of faria and aratdar	<ul style="list-style-type: none"> Provide credit Expand depots Link larger farms with processing plants 	<ul style="list-style-type: none"> Increased take-up of small credit lower down the chain Increase in credit disbursed for activities that link into the chain (nurseries, feed mills) Increase in number of farmer associations dealing directly with processing plants Increase in the numbers of depots functioning Increased volume of sales in depots Increased numbers of farmers with direct links to processors 	<ul style="list-style-type: none"> Increase in the number of women receiving credit Increase in number of farms owned and managed by women with links to processors 	<ul style="list-style-type: none"> USAID through programs Other donor agencies Department of Fisheries Processing plants NGOs

* Many of these activities are project based. The indicators would be relevant monitoring and evaluation criteria for these projects.

Constraints	Actions	Activities	Indicators	Gender Indicators	Responsible Agencies
Environmental costs	Provide extension services and strengthen regulatory framework	<ul style="list-style-type: none"> • Train and provide technical assistance to improve environmental management • Train and provide technical assistance to reduce by-catch of fry-catchers • Encourage greater use of hatchery produced fry • Shift fry-catchers to other economic activities • Promote seed certification • Promote bio-filters • Introduce appropriate technology traceability measures • Support the development of an independent oversight body • Review and harmonize existing regulations and ordinances 	<ul style="list-style-type: none"> • Increased number of farms adopting improved environmental management techniques • Reduced contamination of shrimp and prawn • Increased use of hatchery fry • Rise in the number of fry catchers engaged in other economic activities • Increased number of farms using certified seed • Increased number of farms using bio-filters • Increased number of hatcheries, farms, feed mills, depots, and processing plants using appropriate technology traceability measures • Adoption of legislation that harmonizes existing laws and ordinances 	<ul style="list-style-type: none"> • Equal proportion of men and women trained in environmental management • Increase in the number of men and women fry catchers engaged in new economic activities • Increase in the number of farms owned and managed by women using certified seed • Increase in the number of farms owned and managed by women using bio-filters • Increase in the number of farms owned and managed by women adopting appropriate technology traceability measures 	<ul style="list-style-type: none"> • USAID support to policy development • Other donor agencies • Department of Fisheries • Processing Plants • Exporters • NGOs
Social costs	Reduce informal employment and improve the terms and conditions of work in the chain	<ul style="list-style-type: none"> • Develop a welfare fund for workers in the sector • Encourage ethical trading initiatives • Review industry minimum wage laws 	<ul style="list-style-type: none"> • Number of workers eligible for welfare fund benefits • Number of processing plants covered by ethical trading certificates • Formation of a shrimp minimum wage board • Application of an industry-wide minimum wage for processing and export jobs 	<ul style="list-style-type: none"> • Proportion of women workers and fry catchers receiving welfare fund benefits • Reduced differential in wages received by men and women in processing plants • Increased proportion of women workers in processing plants covered by ethical trading certificates 	<ul style="list-style-type: none"> • USAID support to policy development • Government of Bangladesh • Processing Plants • Exporters

INTRODUCTION

This report has been prepared by the Greater Access to Trade Expansion (GATE) Project for the USAID/Bangladesh Mission to explore the nature of production and the terms and conditions of employment along the shrimp value chain in Bangladesh. The primary objectives of the report are to identify opportunities to improve market outcomes, raise productivity and wages, and to foster pro-poor growth in the sector.

Shrimp cultivation and export in Bangladesh have undergone rapid expansion over the last two decades. Between 1983 and 2003 the volume of shrimp and prawn cultivated in inland aquaculture has increased more than 14 times (DoF data for 1983-2003). Over the same period, the area of ponds dedicated to shrimp and prawn production has more than tripled. In 2003, the Department of Fisheries estimated that there were approximately 203,071 hectares of coastal shrimp farms producing an average of 75,167 metric tons of shrimp annually and an average of 235 kg/ha/year.* Shrimp is a particularly valuable export crop generating substantial revenues and foreign exchange, earning in excess of \$360 million annually and accounting for 4.9 percent of exports in 2004. After the garment industry, shrimp production ranks second in Bangladesh in terms of the sector's ability to earn valuable foreign exchange. The sector also employs significant numbers of rural workers and provides a livelihood for households throughout Bangladesh. The Bangladesh Shrimp and Fish Foundation estimates that there are over 600,000 people employed directly in shrimp aquaculture who support approximately 3.5 million dependents. Our preliminary estimates indicate that there may be as many as 1.2 million individuals engaged directly in production and exchange throughout the shrimp value chain and a further 4.8 million household members whose livelihood is linked to the sector.

Despite the rapid growth of Bangladeshi shrimp cultivation, the global frozen fish and seafood market continues to be dominated by Thailand, Indonesia, China, and Ecuador. Significant innovations in production and processing in these countries have increased the value added associated with their exports and the market share that they command. Unfortunately, the same is not true for Bangladesh. Production and processing innovations remain unrealized. Furthermore, stricter import requirements and compliance regulations in importing countries have meant that Bangladesh must invest in improving the safety and quality of their fish and seafood exports to avoid products being detained and rejected at point of entry into foreign markets.† A recent IFPRI (2003) report notes that: "The only way Bangladesh can improve its export position in the shrimp market is to improve the safety and quality of its exports."

Bangladesh has the potential to increase production, raise productivity, upgrade processing facilities, and draw further land into shrimp cultivation. Yet, significant challenges remain to ensure that shipments meet standards set by the importing

* These data are for 2003-2004. The Future for Fisheries project reports that yields per hectare per year are 193 kg/ha for shrimp and 335 kg/ha for freshwater prawn in 2001-2002 (World Bank, "Future of Fisheries").

† Bangladesh shrimp has been rejected at the port of entry into the European Union and the United States for salmonella, as well as other bacterial and antibiotic contamination. Additionally, some shrimp have been contaminated with urea (an organic waste product) that has been used to accelerate shell-shedding and promote more rapid growth.

nations. Additionally, if growth in the industry is to benefit the poor it is important to improve the terms and conditions of employment, production and exchange, as well as the social and environmental outcomes in the sector.

OBJECTIVES

This report analyzes shrimp and prawn production in Bangladesh. The goals of the analysis are threefold:

1. Provide a detailed summary of the shrimp sector value chain in Bangladesh.
2. Identify where women and men are located in the value chain and explore any gender differences in returns, wages, and profits.
3. Develop policy and programmatic recommendations to maximize opportunities for vulnerable groups—in particular the resource poor, landless, women, and minorities.

APPROACH AND METHODOLOGY

The report employs a gender value chain analysis and pro-poor livelihoods approach to the shrimp sector in Bangladesh. In addition, the social and environmental impacts throughout the shrimp value chain are described in order to portray a holistic picture of the sector. Primary data were collected in focus groups and key informant interviews held between September 2005 and November 2005 and used to analyze and map the market channels from production through processing and distribution.

VALUE CHAIN ANALYSIS

Value chain analyses focus on the institutional arrangements that link producers, processors, marketers, distributors, and consumers. Supply chain analyses focus on the way goods move from producers to consumers; the exchange of payment, credit, and capital among actors; price signals, pricing behavior, and value added; the dissemination of technology; and, the flow of information across the chain. A value chain analysis augments this approach by identifying and exploring the spaces where returns are generated. Value chain analyses recognize that various configurations of actors may influence capabilities, possess different levels of bargaining power, and subsequently affect outcomes along the value chain.

Additionally, this report uses a gendered value chain analysis—highlighting the different positions and contributions of men and women across the value chain and uncovering the economic, organizational, and asymmetric relationships among actors located along different points of the industry.

A gendered value chain analysis addresses power within the production and exchange relationships. In economic terms this analysis explores monopoly and monopsony* power to set market prices, the power to bargain with buyers and sellers, as well as indebtedness and sub-optimal contracting. The analysis will also explore gender

* Monopsony describes a situation where there is only one buyer for a given product. A monopsonist acts like a monopolist determining prices and exerting power over sellers.

specific considerations such as social mobility and social sanctions that govern men and women's access to markets as well as their entitlements and capabilities.*

PRO-POOR LIVELIHOODS APPROACH

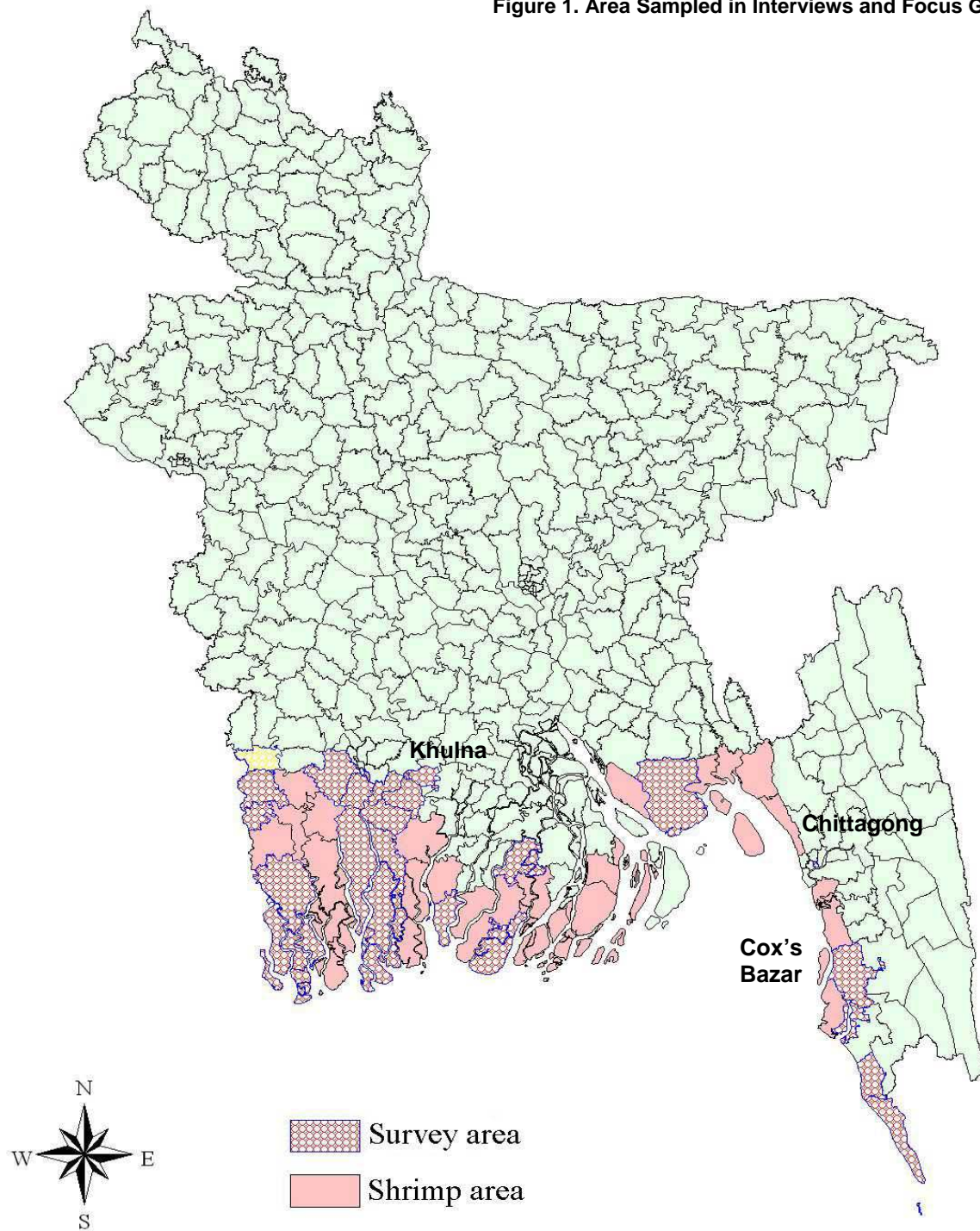
A pro-poor and livelihoods approach is used throughout this report. A pro-poor approach explores how growth in the sector can benefit the poor ensuring that rents and returns are better distributed across the value chain. The livelihoods analysis considers the entirety of production and earnings for the poor and assesses how shrimp and prawn fit into a household's strategy for generating income and securing employment. Although we do not undertake a detailed household or intra-household analysis of poverty, the livelihoods analysis focuses on the most vulnerable actors in the chain—primarily male and female fry catchers, small shrimp and prawn farmers, and rice-field pond farmers. Another vulnerable group comprises inshore fishermen, catching small fish for drying and processing into feed by their employees, usually women.

DATA COLLECTION

The data collection for this report included a series of key informant interviews using a structured questionnaire to elicit information about wages, prices, profits, productivity, cost structure, and returns along the value chain. Data were collected for production; marketing, transportation and storage; processing; pricing; as well as for the terms and conditions of employment. Interviews and focus groups were conducted at each node in the value chain and the number of individual or collective interviews held were chosen to be representative according to the density of agents undertaking each type of activity in Khulna, Chittagong, and Cox's Bazar (see Figure 1).

* This draws on Sen (1999). According to Sen, entitlements describe the bundle of resources that an individual or group commands for the purpose of consumption, production, or exchange. These entitlements will depend on the resources owned or available for use (including public goods) as well as on the conditions of exchange (such as relative prices, the type of market, and mode of exchange). Capabilities summarize an individual's or group's freedoms and abilities to deploy their resources. A capabilities approach focuses less on the nature of the resources available to individuals or groups but emphasizes what they are able to do with these resources.

Figure 1. Area Sampled in Interviews and Focus Groups



A total of 188 individuals were interviewed using the semi-structured questionnaires and an additional 25 key informant interviews were conducted with individuals representing government, the private sector, and non-governmental organizations (See Annex 2). Focus group discussions with male and female workers and farmers were also held along the shrimp value chain in the Khulna, Chittagong, Cox's Bazar, and Greater Noakhali regions (Feni, Noakhali and Laksmipur).

Table 1. Number of Individuals Interviewed in Focus Group and Key Informant Interviews

Type	Number
Fry catcher	13
Fry faria	10
Fry aratdar	19
Shrimp farmer	30
Shrimp faria	16
Shrimp aratdar	21
Commission agent	15
Shrimp nursery	2
Shrimp hatchery	15
Transporter	6
Retailer and wholesaler	7
Shrimp processor	20
Exporter	10
Shrimp trawler	1
Cargo biman	1
Input dealer	1
Commission agent (MS)	1
Total	188

Source: DATA Inc. "Shrimp Survey Methodology," Dhaka, November 2005.

The data collected do not constitute a statistically representative sample of all shrimp and prawn producers and processors in Bangladesh. They are, however, illustrative of the types of the production and marketing that takes place in the shrimp value chain in the areas sampled in Bangladesh. In addition to primary data, secondary sources were used regarding environmental and social impacts of shrimp production and to verify data. Where possible, the findings were verified by triangulating our data and information with those from other sources. We note that there are substantial differences in estimates of the area given over to shrimp and prawn ponds, productivity, employment, earnings, prices, and wages in the official data and secondary sources. Additionally, spoilage, theft, and under- or over-invoicing complicate the analysis. Not all shrimp produced reach processing for export. Some are consumed domestically—with as much as 10 percent being sold for consumption. A significant quantity of shrimp is also lost as a result of poor handling. Micro data and national accounts data do not add up. Data recorded by the Department of Fisheries do not match the national accounts. Where possible, we have attempted to cross-verify our findings with key informants in industry, government, and the non-governmental sector to resolve these inconsistencies.

The primary data were used to map the market channels from production through processing and distribution (see Figure 2 in the Shrimp and Prawn Value Chain

section). The market channels provide an overview of the value added along the value chain and indicate where the greatest returns are concentrated.

OVERVIEW OF THE SHRIMP SECTOR

Bangladesh is a nation uniquely positioned to cultivate and harvest fish—situated at the confluence of numerous rivers and tributaries, and occupying the delta of three major transboundary rivers, the Ganges, Jamuna, and Brahmaputra. Currently, Bangladesh is the world's fourth largest producer of inland fish. The fisheries sector generates over \$360 million a year and contributes almost 5.0 percent of GDP at constant prices^{*} and about 5.6 percent of total exports.

Export oriented shrimp culture has undergone rapid horizontal expansion in Bangladesh since the mid 1980s. This sector has benefited from a growing global demand for shrimp and a series of stimulus measures to increase Bangladesh exports and diversify the export base.[†] Shrimp culture received critical support from the World Bank in 1985 when a credit of SDR20.6 million was extended to the Government of Bangladesh. The project was intended to intensify existing production, construct embankments and boundaries that would eliminate salt-water seepage, and promote efficient water exchange to flush out salts from soils for paddy cultivation.[‡] Unfortunately, the environmental costs were greater than had been predicted and a series of projects were subsequently implemented in an attempt to mitigate these costs.

In addition to providing a valuable source of foreign exchange, fish and fish products are critical for food security in Bangladesh, where about three quarters of the animal protein consumed comes from fish that are caught in the rivers and flood waters.² According to Asaduzzaman and Toufique³ about 8 percent of the total population in Bangladesh depends on the fisheries sector for their livelihoods, and almost three quarters of all households engage in subsistence fishing in the flood plains or cultivate fish in ponds during the rainy season.[‡] Many households engage in both rice cultivation and aquaculture in the paddy fields over the course of the year. INFOFISH⁴ estimates that there are approximately 1.3 million rural household ponds where fish aquaculture is practiced. Although subsistence shrimp capture has been practiced for hundreds of years, small farmers are increasingly adding shrimp and prawn cultivation for export to their crop rotations.

In the early 70s, the industry accounted for less than one percent of total exports. Initially, the majority of shrimp was caught at sea. The shrimp sector began to expand rapidly in the mid 1980s⁵, and by 1986, the sector accounted for a little over 10 percent of all exports and the proportion of marine caught shrimp had declined significantly.

^{*} These data are provisional for 2004-2005. Source: National Accounts, Sectoral Shares of GDP at Constant Prices, Table 8.5, Monthly Statistical Bulletin, Bangladesh Bureau of Statistics, April 2005.

[†] Japan, the US, and Europe are the primary markets for shrimp worldwide and important new markets are also opening in Southeast Asia and the Far East. Over 90 percent of all shrimp traded on the international market is consumed in Japan, the United States, and countries in the European Union. The demand for shrimp in the US and Europe expanded significantly in the 1990s and continues to grow, fueling the expansion of shrimp cultivation in Latin America and Asia.

[‡] See also Kleih et al, "Livelihoods in Coastal Fishing".

Currently, shrimp and prawn contribute about 4.9 percent of all exports, more than 80 percent of which is cultivated or caught in inland waterways. As the sector expanded, the number of fish and shrimp processing plants grew concomitantly. In the early 1970s there were 13 processing plants. By the mid 1980s there were 54 plants and currently there are 130.⁶ Not all of these plants are currently operational.

Although shrimp production and cultivation in Bangladesh has proven to be dynamic and growth rates have been positive and sustained, fish and fisheries products are typically a high-risk food export, subject to careful inspection for pathogens, natural toxins, bacteria, and other possible contaminants.⁷ Additionally, concern was raised about contamination from banned antibiotics (nitrofurans, chloramphenicols) that occur primarily in hatcheries and through the feed supply and grow-out systems.

In 1996, the Food and Agricultural Organization developed a program to provide targeted support and technical assistance to the sector based on the Hazard Analysis Critical Control Point (HACCP) endorsed by the US Food and Drug Administration.*

Despite these measures, the European Union imposed a ban on shrimp imports from Bangladesh in 1997, in response to inspection failures in a number of processing plants. Between 1997 and the end of 1998, the volume of shrimp exported dropped by 20 percent.⁸ By December 1998, shrimp exports had fallen by almost a quarter. The ban deprived Bangladesh of their largest shrimp export market and set in motion a series of changes throughout the sector, spurring investment in technology, hygiene practices, and new processing techniques. Cato and Subasinge⁹ report that by 2003 the shrimp industry had invested \$17.6 million in processing plant upgrades. By 2002, of the 65 plants licensed for export, 45 had secured EU approval.¹⁰ Despite these investments, there is evidence that a number of processing plants have failed to implement adequate changes in securing their supply of shrimp and that the risk of contamination remains significant. The antibiotic contamination has been the focus of the recent EU inspection and their primary concerns center on inadequate laboratory testing. Unfortunately, in the absence of comprehensive inspection for these banned antibiotics throughout the chain, it is unlikely that improvements in handling in the processing plants will control the problem.

Another factor limiting growth in the sector is low yields. Low levels of productivity typify shrimp production in Bangladesh. Average yields indicate that farms produce less than 550 pounds or 250 kg per hectare. In contrast, countries with a larger export market than Bangladesh that use more intensive techniques have significantly higher yields. Bangladesh yields 17 times less shrimp than Thailand, seven times less than China and five times less than India.¹¹ Substantial room exists to upgrade production, improve management and harvesting techniques, and increase returns.

Finally, in 1994, Bangladeshi shrimp were exposed to the White Spot Syndrome virus (WSSV), a virus which continues to compromise output and reduce yields.* Losses

* HACCP is a regulatory system required for food imports to the major importing nations. For more information consult: <http://www.cfsan.fda.gov/~lrd/haccp.html>

induced by the virus can be significant—in some cases farmers lose their entire crop of shrimp.

SHRIMP AND PRAWN PRODUCTION PROCESSES

Currently, 36 shrimp species are harvested and cultivated in Bangladesh.¹² The two main varieties of shrimp are bagda (shrimp) and golda (prawn). Chittagong-Cox's Bazar and Khulna-Shatkira-Bagerat regions dominate shrimp production. These two regions account for approximately 95 percent of the total area dedicated to shrimp culture.

Brackish water aquaculture is widespread throughout Satkhira, Khulna, Cox's Bazar, and Bagerhat. *P. monodon* and *M. rosenbergii*, the two major species of bagda and golda are cultivated in these areas. *M. rosenbergii*, the most popular freshwater prawn, is largely produced in the southwest region of the country.

METHODS OF SHRIMP PRODUCTION

The Bangladesh Frozen Food Exporters Association estimates that there are about 37,397 shrimp farms in Bangladesh.[†] ATDP II¹³ reports that the overwhelming majority of these farms is less than 2 hectares in size, but the average size is around 4.5 ha, since farms in Chittagong district are much larger. The average size of a farm is decreasing, however, since external leaseholders are surrendering leases and land holdings are being subdivided as there is a growing appreciation of the advantages of smaller farms.¹⁴ Although some farms have adopted modified traditional farming techniques, and a few use semi-intensive farming techniques, the majority employ rudimentary traditional cultivation techniques.

Traditional Extensive Production Process. Since the early 1950s, traditional methods of bagda and golda capture have been practiced in the coastal districts of Bangladesh, encompassing Cox's Bazar, Chittagong, Khulna, Shatkira, and Bagerhat. Traditional shrimp farming in Bangladesh is carried out in paddy fields during the dry season, when the salinity of the soil and water in the coastal region makes rice culture impossible. Traditional practices require few inputs and have low yields. The traditional form of production developed in these areas because they had adequate water salinity year-round and largely stable temperatures, an abundance of shrimp fry (post-larvae), and readily available and cheap labor.

The traditional shrimp production system was referred to as the “bheri”, or pond method, and has subsequently been modified to take place in the large areas behind polders or dams known as “ghers” (farms). Usually the ghers are connected to estuaries and canals through channels and sluice (wash) gates allowing farmers to manage the flow of brackish or tidal water. In the months of February to April, tidal waters, carrying the shrimp post-larvae (PL) or fry, flow into the gher at high tides, and then drain out during low tide. Shrimp fry are trapped inside the gher by bamboo barriers placed at points where the water enters and exits. The trapped shrimp fry are allowed to grow from

* Viral contamination in shrimp farming areas affects both cultivated shrimp and biodiversity in areas under cultivation (Bhattacharya et al, 2005). Some analysts claim that the source of the virus was infected brood stock (mother shrimp) purchased by shrimp hatcheries and harvested from the Bay of Bengal (Kalam Azad, “Virus attack”).

† The Shrimp Foundation estimates that this figure may have risen to 60,000 farms by 2006. Official statistics, however, have yet to be revised and the numbers reported are much lower.

March to June. Trapping the shrimp fry, as practiced in the initial stages of shrimp culture in Bangladesh, has been largely replaced by artificial stocking of shrimp fry or post larvae collected from the wild or produced in hatcheries. During the growing period, farmers change the water using the tidal cycles. Very few farmers have pumps or mechanical devices to draw in or drain water.

Golda shrimp fry generally take eight months to grow to reach marketable size. Bagda can be harvested more frequently. It is important to note, however, that golda is frequently a by-product of the harvest along with other brown and white shrimp. In the Khulna region, bagda harvesting is completed by July after which the land is used for paddy cultivation. The golda harvest peaks in mid-October through mid-December. Other crops are harvested in the off-season. For example, in the region surrounding Khulna, rice is grown during the rainy season for a period of up to 3-4 months from August onwards. In Chittagong and Cox's Bazar the typical crop rotation is shrimp and salt production. Farmers here use the land for salt production from December to May and grow shrimp from June-September. The residual salt, which increases the salinity of the gher, does not affect the bagda production.

Simple efforts are taken to prepare the shrimp ghers and usually no food or extra nourishment is provided to the fry. Consequently, traditional farming requires low investment, and yields are also low as a result. Loss rates may also be high.

Productivity is low and variable, ranging from 100-250 kilograms per hectare. Despite the low levels of inputs, costs per hectare are not insignificant and include rent or imputed rent as well as labor costs. Traditional methods incur estimated costs of almost 30,000-60,500 BDT per hectare per year.^{*} Average returns range from between 5,000 and 57,500 BDT per hectare per year.

As market demand has increased, so too has the land assigned to traditional shrimp cultivation.¹⁵ In 1982-1983, brackish water shrimp farming covered about 52 thousand hectares. By 2000-2001, the area under cultivation had increased to 141 thousand. Total annual production was less than 21 thousand metric tons of shrimp in 1991-1992, a figure that rose to 65 thousand metric tons in 2000-2001, representing a more than three-fold increase in total shrimp production.¹⁶ This output growth was mainly the result of the expansion of the area under cultivation rather than any application of modern technology and improved management practices.

Modified Traditional Production Process. A few farmers, most notably those receiving technical assistance through donor-led projects, are practicing modified traditional methods of cultivation scaling up inputs and technology. Traditional methods of shrimp farming have been modified to increase yields and improve water management techniques. Some of these modifications are described below:

- Use of nursery-nourished and adapted fry to increase survival rates.

^{*} \$1=65 BDT

- Use of electric pumps to control saline water flow. (This is particularly important for bagda production in areas where tidal seawater is not readily available.)
- Preparation of land before starting production and enriching the soil with lime.
- Production of both bagda and golda either sequentially or simultaneously in the same gher. To meet the salinity requirement for the bagda PL, a canal is dug alongside the bank of the gher to create a controlled environment with saline water and the bagda PL are nursed here for some time. When the bagda PL reaches its next mature stage, the gher is filled with fresh water and the bagda and golda are mingled and cultivated together.
- Post larvae are introduced gradually to maximize the opportunities for continuous production. The fry are typically added at one month intervals and when the first “serve” matures, shrimp at other stages are added to be harvested later. Bagda is harvested every three months and golda takes approximately eight months to mature.
- Introduction of polyculture by promoting the mixed production of shrimp and other fish. Some carp can be cultivated to enhance the total production. Some farmers claim that polyculture also reduces viral contamination. Extra feed is provided to ensure that all varieties thrive under mixed production.
- Mixed crop production of golda and rice. Usually boro or other types of IRRI are cultivated in this process. According to the farmers interviewed for this report, any reduction in rice production attributed to shrimp cultivation is insignificant. Extra feed is provided to maintain mixed production.
- Partial processing and post-harvest management techniques. Some farmers sell shrimp heads in the local market for domestic consumption or for use as fish or poultry feed. The head of large golda is traded in the market at BDT 18 to 36 per pound (8-16 BDT per kg).
- Intensification of production processes. Some action-oriented projects have been launched by the FAO, UNDP, IDA, etc., with the objective of increasing yields and improving production techniques.

Modified traditional practices incur higher costs for pond preparation, dike construction, feeding, and limited aeration. Survival rates and productivity are higher, as are returns. A farmer cultivating one hectare of land using modified traditional practices could expect average returns of 117,000 BDT per hectare per year.

Semi-intensive Production Process. Less than 125 hectares of land in Bangladesh is under semi-intensive methods, which require aeration, pumping, water exchange, and intensive feeding. Most of the farmers who apply semi-intensive production techniques are located in Khulna, although a few may be found in Chittagong and Cox’s Bazar.

Semi-intensive shrimp production requires regulated water temperatures and water management. These farms require adequate supplies of saline water and electricity. In semi-intensive production processes, the stocking density of shrimp is usually more than the normal carrying capacity under traditional shrimp production system, i.e. 5 per square meter. As a result, semi-intensive production requires a greater supply of fry, high quality supplementary feed, improved infrastructure, improved water, post-

harvesting management, and requires that farmers understand the complexities of these processes. Semi-intensive shrimp production produces significantly higher yields. A farmer practicing semi-intensive methods of shrimp cultivation could expect an average profit per hectare of 382,000 BDT per year. But the process also requires a significant investment of funds, time, and technical assistance.

Semi-intensive production is also dependent on an uninterrupted supply of electricity, technology (pumps, temperature gauges, etc), technicians, training, and expertise. The supply of electricity is mainly required for water management in the gher. In 1994, the Bangladesh Power Development Board (BPDB) transferred 2000 kilometers (1240 miles) of electric line to the Rural Electrification Board (REB) to supply power to shrimp producing areas. Although further expansion of the rural electrical grid is required, the country is currently not in a position to allocate additional funds to this.

Under semi-intensive shrimp production methods, variation in the salinity of water, levels of dissolved oxygen, pH, and the quantity and quality of feed can all influence productivity. This system requires skilled and unskilled labor, marine biologists, engineers, hydrologists, and other technical experts. Effective management through continuous supervision, monitoring and control of shrimp production is essential to guarantee the higher yields from semi-intensive shrimp production. Semi-intensive production is a more capital-intensive process and as a result has been associated with larger adverse environmental effects due to water management techniques that divert natural flows, heavy organic loading, and increased waste discharge. Researchers report that approximately 20,000 hectares of coastal land may be suitable for semi-intensive shrimp production in Bangladesh.

Table 2 provides a summary for representative methods of farming in Bangladesh.

Table 2. Typology of Shrimp Production in Bangladesh

	Traditional	Modified Traditional	Semi-Intensive
Average Pond Size	4.5 hectares	2.5 hectares	3.0 hectares
Stocking Density Post Larvae/m ²	3.5-7.5	2.0	5.0
Water Management	Mostly tidal	Mostly tidal with some pumping and aeration	Pumping and aeration
Fry Sources	Wild	Wild and hatchery	Wild and hatchery
Feeding ¹	Natural feeding with occasional fertilization	Fertilization with supplementary feed	Fertilization with supplementary feed
Survival rates (%)	15-30	45-70	80+
Production kg/ha/yr	100-250	600	2000
Cost (BDT/Ha/yr)	30,000-60,500	93,000	320,000
Cost (BDT/Kg) ²	300-173	155	160
Returns (BDT/Ha/yr) ³	5,000-57,500	117,000	380,000

Notes: ¹ Most of the shrimp feed is locally produced and some of it is homemade.

² These costs take into account lease costs and imputed land rents, labor and security payments.

³ These returns assume a price of 350 BDT per kilogram. The price includes margins paid as debt repayment on loans.

⁴ \$1=65 BDT

Source: Based on data from ATDP II Cost Benefit Analysis, INFOFISH, Bhattacharya et al (2005), and the GATE Value Chain Analysis; prices and yields are estimated for 2004-2005.

Marine Shrimp. Shrimp grows naturally at sea and fishermen catch shrimp along with other fish using motor-driven as well as non-mechanized boats, nets, and employing cold storage systems on land. Most of the hatcheries obtain the bagda brood-mother shrimp from this system. The shrimp harvested in open systems are sold both to the domestic and foreign markets.

Bangladesh enjoys the scope for extensive marine shrimp capture throughout its long coastal areas. In the Bay of Bengal the coast line continues for 440 miles. About 87 trawlers and 44 thousand mechanized and non-mechanized boats are currently engaged in marine fishing.¹⁷ Marine fishing is controlled and guided by the Marine Fisheries Ordinance 1983 and Rules 1983.

Unfortunately, due to inadequate enforcement and insufficient marine patrols, a large number of fishing boats violate regulations and the marine catch is evidently over-fished. Although the share of trawling in the total marine catch is small, comprising only 6.4 percent in total marine fisheries, and 1.3 percent in total fish production¹⁸, the impact that such activities can have is significant.¹⁹ Many of these trawlers use dragnets that deplete a wide range of fisheries and result in significant by-catch. Although significant quantities of the fish and shrimp caught are sold for consumption a non-trivial quantity is sold for fish-meal.^{*} The use of dragnets contributes to over-fishing in the Bay of Bengal and increases pressure on fisheries, which in turn threatens the food security of thousands of coastal people who rely on fish as the main source of protein and other vital nutrients in their diets. In addition to the loss of biodiversity as by-catch, some trawlers also harvest brood mothers for sale to hatcheries. Where marine fisheries are harvested unsustainably or in an unregulated fashion, the populations of shrimp fry are likely to be depleted.

PRAWN PRODUCTION

Fresh water prawn production occurs primarily in southwestern Bangladesh, with a growing area in the central part of the coast in Noakhali and Patuakhali. There are two culture systems: one in ponds using polyculture with carp and another in paddy fields (ghers). Farm sizes are typically smaller, averaging 0.28 hectares. An estimated 30,000 hectares are under freshwater prawn production in some 105,000 farms. Approximately 70,000 farmers are involved in gher systems and the remainder in ponds. Most farms are operated as integrated systems, with rice culture and vegetables on the gher banks.

The ponds or ghers are typically prepared from February-April and stocked with post larvae and/or juveniles from April-August. The stocking density for the ponds is usually 40-150 PLs per decimal[†].²⁰ Some are reared separately in nurseries before stocking as juveniles. In the southwest region, most PL stocked are from the wild, but the Noakhali system is almost exclusively hatchery PL. A variety of homemade and commercially processed feeds may be used throughout the production cycle. Most prawn in ghers are harvested between November and December, while those cultured in pond systems

^{*} This type of fishing is referred to as biomass fishing. After the higher valued commercial component of the catch is removed for sale, the remaining catch is converted to fishmeal to feed farmed shrimp and other farmed fish species (Hagler, "Shrimp, the Devastating Delicacy").

[†] A decimal is 1/100 of an acre or 0.004 hectares.

may be harvested through to June of the following year. Some farmers with perennial ponds harvest continually throughout the year.

Women are more visible in prawn production, in part because donor-assisted projects are family-focused and livelihoods based (see Box 1). As a result, women have entered into a variety of economic activities such as dike cropping, prawn feed preparation and distribution, paddy husking, poultry rearing, tree nursery production and vegetable production in homesteads, snail harvesting and breaking, prawn harvesting, gher cleaning, and weeding.²¹ In the GNAEP project area, 52 percent of all culture ponds are operated by women in the household^{*}.²²

Box 1. Donor-Supported Prawn Production in Bangladesh

The CARE Greater Options for Local Development through Aquaculture (GOLDA) Project operated in southwestern Bangladesh (in the districts of Bagerhat, Khulna, Jessore, Gopalganj, and Satkhira) between 1996 and 2001. The project provided technical assistance and undertook action-oriented research to improve outcomes for small-scale freshwater *gher* farmers to increase their incomes. The project assisted approximately 15,000 small farmers.²³

The Greater Noakhali Aquaculture Extension Project (GNAEP) is currently being implemented by the Department of Fisheries with support from DANIDA and is focused on promoting small scale aquaculture in the greater Noakhali Region. Both projects targeted small and resource-poor farmers. GNAEP has a distinctly pro-poor livelihoods approach that focuses on polyculture to meet food security needs and generate income. Carp and prawn are cultivated in mixed systems in both ponds and paddy fields. GNAEP also builds both forward and backward linkages engaging communities in feed production (locally produced using rice bran, wheat flour, mustard oil seed cake, molasses, and dried fish), sorting, and providing support to hatcheries and nurseries. The project is also implementing a simple traceability system based on the highly decentralized tracking of inputs such as PL and feed.

Source: DANIDA Private Sector Development Program, <http://www.psdbangladesh.com>; <http://www.gnaec.org>; Alam 2001; Kendrick 1994.

THE SHRIMP AND PRAWN VALUE CHAIN

The shrimp sector in Bangladesh is clearly expanding. It is a sector that provides significant economic opportunities to middle and upper level participants in the value chain and livelihood opportunities to the rural poor who are overwhelmingly the participants in the lower segments of the value chain. Shrimp are grown in ponds or ghers from fry that are caught in the wild or supplied by hatcheries. A variety of intermediaries ensure that fry reach the farmers. The mature shrimp are sold on to more intermediaries who ensure they eventually reach the processors and exporters.

The shrimp sector is a buyer-driven chain where producers, particularly small producers, have little ability to influence the price at which they sell their product and are frequently locked into contracts that limit the price they receive when compared with prices that they could freely obtain in spot markets[†] or with buyers elsewhere. In Bangladesh, small suppliers such as fry catchers and small farmers tend to be

^{*} PROSHIKA estimate that a similar percentage of women are engaged in prawn cultivation in their projects (Rahman, "Women's Participation").

[†] Spot markets, a market where commodities are bought, sold, and delivered immediately, typically report higher prices than prices received in the factory or in the depots.

dependent on larger, dominant buyers, or are locked into contracts where they must sell to particular buyers. Intermediaries such as fry faria and aratdar and shrimp faria and aratdar inject informal credit into the system and engage with suppliers and farmers setting the terms of exchange. The market for credit is imperfect. These lenders act as quasi-monopsonists*—once credit has been extended, the borrower must sell their product to the lender.

At lower ends of the chain among fry collectors and faria, bargaining is limited and few agents are more than price-takers. At higher ends of the chain, among the larger farmers and processors there is more opportunity for negotiation. For example, buyers for major supermarkets negotiate with processing plants establishing relationships and committing to future contracts in a repeated bargain that confers some leverage upon the seller.

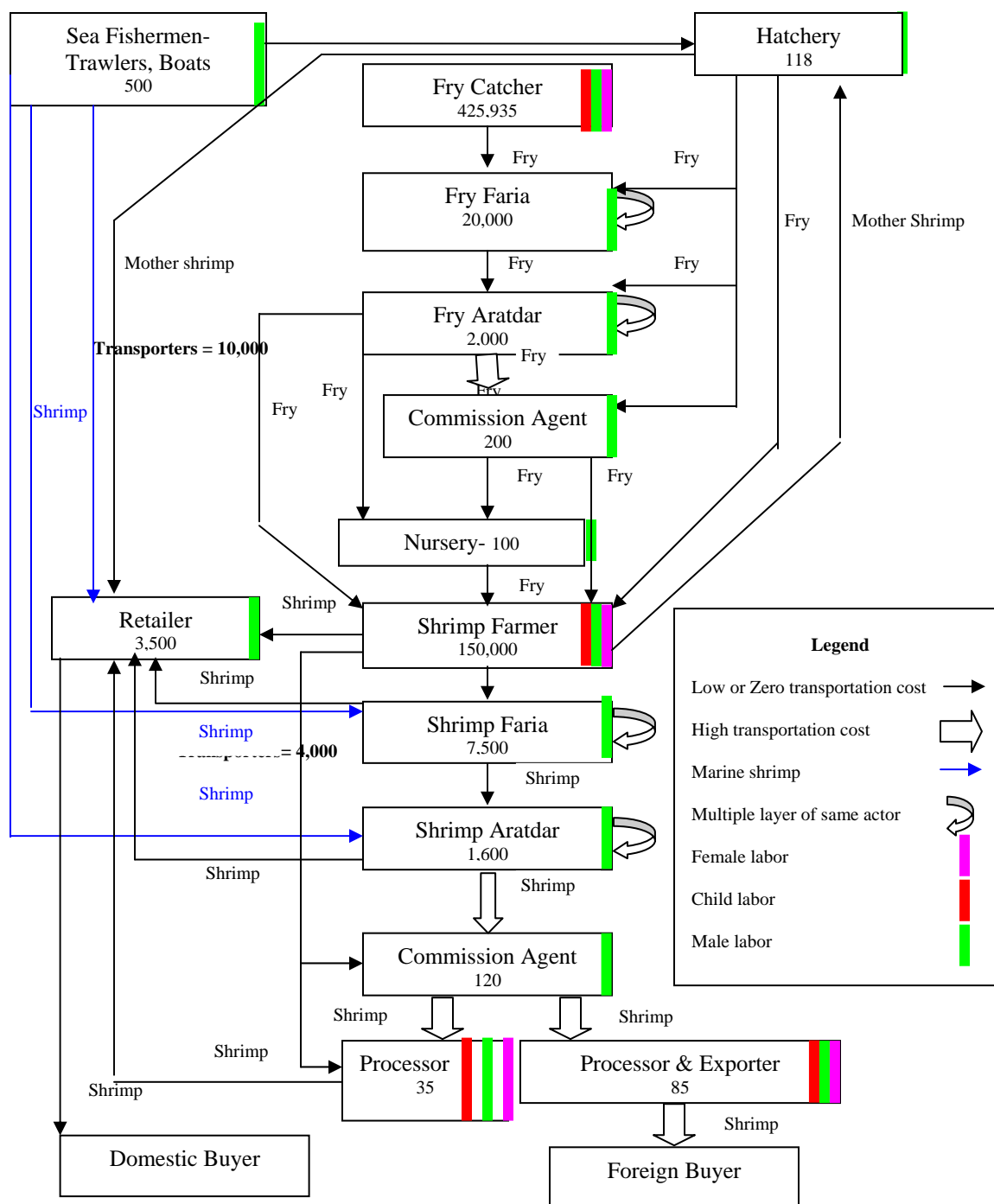
Furthermore, barriers to entry, poor infrastructure, inadequate communications, and significant transaction and transport costs limit the markets where producers and traders sell. The types of exchange observed along the shrimp value chain are indicative of unequal bargaining power at a number of key points: fry catching and sale; small-farmer shrimp production and sale; and, even consolidation in the depots.

Women, men, and children work throughout the chain, but women and children are located in segments of the chain where employment is more flexible and insecure—most notably in fry catching, and casual labor in farming and shrimp processing. Female employment is characterized by highly gendered and informal employment relations where women make up the bulk of the casual and contingent labor supplied throughout the chain.

The shrimp value chain is complex, with a variety of actors and intermediaries at each node of the chain. Below is a depiction of each node in the chain. Activities within each node, as well as power relationships defining interactions between players, will be described in this section of the report.

* Monopsony describes a situation where there is only one buyer for a given product. A monopsonist acts like a monopolist determining prices and exerting power over sellers.

Figure 2. Actor Based Marketing Flow Chart of Participants/Firms



Note: For the sake of simplicity, the feed system is not addressed explicitly in this diagram. Feed enters the value chain through a variety of mechanisms from fish caught in inland waters that are ground into meal, snails that are gathered and sold to intermediaries and farmers, through feed mills, and from in home-produced inputs that are combined from fin-fish, wheat bran, rice bran, and oil cake.

FRY CATCHING

The first link in the chain is collecting the shrimp fry. Fry catching takes place in at least 12 districts and about 40 thanas throughout Bangladesh. According to 2001 DoF data,

fry collectors are mostly located in the Barisal region, particularly from Patuakhali with about 48 percent, followed by a further 31 percent in the Khulna region, and 21 percent in Cox's Bazar. Currently, we estimate that approximately 425,935 individuals are fry catching during the peak season. Most fry catchers reside along the beaches or rivers. Many have migrated from other parts of the country. Both men and women work in fry catching with women and girls comprising approximately 40 percent of the workforce. Children frequently accompany fry catchers and participate in catching and sorting activities. During the peak season, women and girls participate more visibly in fry catching (see Box 2).

Fry collectors sift the surf and estuaries for shrimp post larvae. They transfer their catch to earthenware or metal bowls which are carried back to the villages where the fry are sorted and counted by women and children using white enameled plates. While men and boys disproportionately catch from the sea, the capture of fry from rivers using push nets is typically undertaken by women and children. The transporting and sorting process undoubtedly results in a very large wastage of fry of both *penaeid* shrimps and other commercially important species, including fish. The shrimp fry then pass through a chain of middlemen before reaching the shrimp farmers.

About 50 percent of all fry is wild caught. The majority of the wild bagda PL catch comes from the Cox's Bazar region (accounting for about 40-60 percent of the total catch).^{*} Despite much higher levels of fishing effort, yields of bagda PL in the Khulna zone accounted for only 9 percent of all fry collected. The total catch was estimated to be 3,000 million PL of bagda fries in 2002.²⁴ The Future for Fisheries project estimates the total golda catch at around 300 million PL. It is commonly believed that 90 percent of golda PL comes from the wild, but hatchery production may now be around 30 million, which means that 270 million PL come from the wild. Approximately 60 percent of the golda PL comes from Khulna, 35 percent from Noakhali, and only 5 percent from Cox's Bazar.

According to this field survey, about 90 percent of the wild shrimp fry caught in the south-east zone (Chittagong Division) are transported to the south-west zone (principally the Khulna Division) since approximately 80 percent of the total bagda farms are in Khulna. Similarly, about 80 percent of the hatchery produced fries are transported to the Khulna Division, increasingly by air freight. The Future for Fisheries project reports that five cargo airbuses transport 35 million PL almost every day to Jessore airport between February and May.

It is important to note that although there are no estimates of the volumes, farmers and fry collectors report that fry also enter the Bangladeshi value chain from India and, to a lesser degree, from Myanmar, with faria and aratdar buying from producers and intermediaries across porous borders.

^{*} These estimates are for the past 5 years.

Box 2. Fry Catching and Farming in Cox's Bazar

Mohammed Mostafa is a fry catcher working in Cox's Bazar. Mohammed used to live in Noakhali, but was forced to migrate with his family after he lost his land to erosion. Mohammed works with his children in the morning sifting for fry in the surf during high tide. During the peak season, from January to June, Mohammed and his three young sons catch between 5,000 and 6,000 fingerlings per day. In the peak season, they earn approximately 350 BDT for 1000 fingerlings and make an average of \$30 a day during the 10 days when they can secure this quantity of fingerlings. In the lean season, from July to November, they catch approximately 1000 fingerlings per day and sell them for 200 BDT per 1000, making a little more than \$3 per day. Mohammed and his sons can sift the surf for about 16 days each month, during the new moon and the full moon period, when fry are most abundant. Mohammed's wife and their two daughters help sort the fry at home. The older boys go to school at night when they have finished their chores.

When Mohammed is not catching fry he rents 0.4 acres of land where he cultivates tomatoes, cucumber, and eggplant for three months of the year between December and February. The vegetables earn about 30,000 BDT at sale; he invests between 15,000 and 16,000 BDT in inputs, and pays 1,500 BDT in rent to the landowner. His farming nets him about \$65 in income a month as compared with the \$360 he and his family earn in the height of the peak fry season and \$49 in the low season. Despite these apparently high earnings in fry catching, Mohammed's family is poor and lives on less than \$1 per person per day. Fry catching is a critical component of Mohammed's livelihood. Yet he recognizes that the fry have been declining in abundance in the 5 years since he has been working as a fry catcher and is worried about this.

Notes: This assumes a conversion rate of 65 BDT per \$1.

The height of the peak season is from February through May.

These are gross receipts and do not take account of loan repayments or the purchase of equipment such as nets and storage receptacles.

Source: Survey data 2005.

TERMS AND CONDITIONS OF LABOR

In 1990, the FAO estimated that there were approximately 40,000 fry catchers in Cox's Bazar and another 120,000 working in the Khulna-Satkira region.²⁵ The reliance on wild caught larvae in Bangladesh has diminished, even as the number of farms and the area under aquaculture has risen. The Department of Fisheries estimated in 2002 that there were approximately 432,254 wild fry catchers operating throughout Bangladesh. Our data place this number at approximately 425,935 in 2005* reflecting the gradual shift to hatchery produced PL and the impact of the uneven application of a ban on fry collection.[†]

The fry catchers may be considered to be the most vulnerable workers/producers having the least power in the shrimp value chain.²⁶ Fry catchers are dependent upon largely open-access resources for their living sifting the surf or estuaries and rivers for fry. Most are landless and have few assets. Typically, they are poor and indebted with low levels of education. Although the potential earnings are high in the peak season, they are also particularly variable and debt repayments must be made using these earnings. Our data indicate that on average a fry collecting family earns a little over \$370 per person per year, which translates to little more than \$1 per person per day.

* This assumes that an average of 10.2 fry catchers are required to produce the fry for one metric ton of harvested shrimp and that 50 percent of fries are supplied from the wild. The Shrimp Foundation estimates that as much as 75 percent of fry in the chain now come from hatcheries. The Future for Fisheries project places this volume closer to 50 percent.

† Although the ban is said to be effective, it is clear that most fry collectors continue to operate. The ban may have increased their insecurity and raised the level of bribes and side-payments that they are required to pay local officials.

Net earnings may be much lower as this figure does not account for payment of bribes or the purchase of minimal inputs.

We estimate that 40 percent of workers in fry catching and sorting are women and girls and 60 percent are men and boys. Approximately 28 percent of all fry catchers are children under the age of 15. ICZMP²⁷ reports that the average age of a child fry collector is 12, but that girls may be as young as 10. A large number of these children do not attend school or are dropouts (74 percent).

Fry catchers have been adversely affected by a ban enacted in 2000 that was put in place to eliminate wild fry collection. Despite the ban, wild fry collection continues and fry catchers pay bribes to police and local law enforcement officials to enable them to continue collecting fry. Because women and children are more vulnerable, it is widely accepted that the ban may disproportionately affect them.²⁸

The lack of an efficient and open credit market locks many fry catchers into sub-optimal contracting arrangements where they borrow money from fry faria in advance of production and commit to selling their product to a specific intermediary at a price determined by that buyer. Many are indebted and spend years in cycles of debt. The contract is enforced by strong social codes and occasionally through violence as this quote from a fry faria focus group reveals:

A contract is made so that those who are given a loan must give fries to the loan giver. They are bound to follow the agreement and price is set at 50 BDT less per thousand [fry]. If anybody violates the conditions [of the loan] then he is judged by the *samity*,^{*} and if necessary, physical torture is done (Fry faria, Cox's Bazar, November 2005).

Additionally, fry collectors may receive fishing capital in the form of nets and buckets from the fry faria increasing their dependence upon a particular buyer.

HEALTH CONCERNS

A number of health concerns have been raised about fry catching. Fry collectors who sift the surf and estuaries for fingerlings spend significant amounts of time in the water. Some catchers report spending up to 8 hours immersed in the water of rivers and estuaries.²⁹ Skin infections, fungal infections, lesions, rashes, and cuts are frequent. Women fry collectors may suffer particular types of vaginal and fungal infections as a result of their activities. Unfortunately, little has been written on the types of ailments that fry catchers are exposed to—including water-borne diseases from fecal matter and exposure to pesticides through run-off.

ENVIRONMENTAL CONCERNS

Among the many concerns about fry catching is the potential loss of other biodiversity in the form of by-catch as the fry are sifted from the surf. The FAO³⁰ estimate that the rate of “wastage” is significant when compared with the total amount of bagda fry collected. Although the FAO report that there is a diversity of estimates for wastage, the consensus is that approximately 5,000 other fry are wasted for every 100 bagda fry. These other fry include olda chingri fry, macrobrachium rosenbergii and penaeus indicus (golda or white chingri fry), chaga or red chingri fry, and a number of fish fry.

^{*} A *samity* is an association of fry faria.

The fish fry include paisha, chauma, tengra (*Mystus* spp), and bekti. The fry catchers interviewed for this report estimated that approximately 40 percent of what they sifted was shrimp fry and 60 percent was by-catch. While many fry catchers claim that they return the by-catch to the sea, a non-trivial proportion is clearly lost. Additionally, the fry catchers recognize that shrimp fry are also lost during the sorting process. The respondents interviewed estimated that between 5 and 10 percent of shrimp fry were lost during the sorting process.

HATCHERIES

Hatcheries produce fry from mother shrimp under controlled conditions. The hatchery obtains the mother shrimp from farmers and marine fishermen. Bagda hatcheries need pipes and infrastructure to bring seawater inside the hatchery and to return it for disposal. For breeding purposes, the mother shrimp is kept in a dark quarantined room at a controlled temperature. Cleanliness and quietness are emphasized as critical factors for successful breeding. Consequently, access to the main breeding room is limited and only the key caretaker is allowed in this room to perform essential work.

In 2000, INFOFISH estimated there were about 44 bagda and 28 golda hatcheries, but the number of shrimp hatcheries was rapidly increasing. Currently in Bangladesh, there are approximately 55 hatcheries for bagda and 63 for golda. Most of the bagda hatcheries are located in the Cox's Bazar region and the fry are transported by air or road to the southeast regions. In Cox's Bazar, in close proximity to the hatcheries, shrimp-supply businesses provide fish feed and other inputs for the hatcheries. These sale outlets import and sell all the necessary products to establish and run hatcheries, including shrimp feed.

Hatchery bred fry has the potential to displace wild fry in the value chain. The potential production capacity of bagda hatcheries stands at 6,000 million hatchlings per year compared to a demand of 3,000 million.³¹ Golda hatcheries produce about 10 percent of the total number of fries, around 2.7-3 million PL. The hatcheries are producing far less than their projected capacity, but the primary limitation appears to be the demand for hatchery fry.^{*} Opportunities exist to add value by enhancing and modernizing hatchery operations to supply more fry for farming and for seed certification to ensure the quality of the fry produced.

Unfortunately, coercive lending and contracting relationships also permeate the hatchery sector. Hatchery producers are often locked into sub-optimal contracting arrangements with commission agents and intermediaries. Furthermore, even if the hatchery owners borrow directly from banks, the additional non-bank charges and bribes they are required to pay to release funds, obtain cash, and change money raises the effective rate of interest to well above 12 percent.

FRY FARIA

Fry faria buy fry either from fry catchers or from hatcheries throughout the year. The peak season for buying fry is five months long from "Baishakh" (April) to "Bhadra"

^{*} Similarly, processing plants are also under-utilized, reflecting an insufficient supply of shrimp. Most processing plants are operating at between 20-30 percent of their capacity (see Processor and Processor/Exporter section).

(August).^{*} During this period, the faria conduct business every day, buying and selling twice a day. During the off season months of “Poush” (December) and “Magh” (January), they can face significant financial distress and frequently resort to loans from the fry aratdar which lock them into a contract to sell all fry to the lender. If they try to sell to other aratdars, they frequently face verbal or physical abuse.

TERMS AND CONDITIONS OF EXCHANGE FOR FRY FARIA

Some fry faria specialize in shrimp and others specialize in prawn. The degree of specialization depends both upon the availability of fry and the region. In Khulna, fry faria were also engaged in buying and selling both shrimp and prawn fry, while in Chittagong, the fry faria were almost exclusively trading in shrimp fry.

Fry faria borrow money from fry aratdars and are required to sell them the fry. Interestingly, since the loan amounts are larger than lending to fry catchers, contracting with written contracts is more prevalent.

No written contract is needed if the loan money is below 20,000 BDT. But for loans above 20,000 a written contract is needed that is stamped. As part of the loan requirements the farias are bound to sell their fries to these aratdars. If anybody breaches the contract he is fined and sometimes he is tortured physically (Fry aratdar, Cox’s Bazar, November 2005).

We estimate that net annual earnings for fry faria vary between \$450 and \$10,000, depending on the volume of fry sold.

Most of the fry faria report that they prefer to buy wild fry as these fry are perceived to be stronger and more resilient than fry from the hatcheries. This preference is reflected in prices where wild fry are valued at comparatively higher prices.

FRY ARATDAR

Fry aratdar also purchase fry that comes from hatcheries as well as natural sources. Many fry aratdar buy directly from fry faria, aggregating the volumes of fry. Fry are transported by the fry aratdar to the commission agents in other regions by air or road. Some fry aratdar are also farmers who own or manage ghers.

A fry aratdar has a broader market and may sell to different buyers in different regions. The focus group interviews revealed that aratdars sell approximately 60 percent of shrimp fries to the shrimp farmers of Satkhira and Khulna, and the remaining 40 percent are sold in different parts of Cox’s Bazar including Moheshkhali, Chakoria, and Mothertek.

Generally, fry is delivered in two types of containers that vary in size: the “Pateel,” or earthenware dish, and “Drum”. There are on average 10,000 to 12,000 fry per “Pateel” and 20,000 fry per “Drum”. According to Mr. Mujibur Rahman Howlader, a prominent fry aratdar at Foylahat in Bagerhat, an aratdar sells approximately 120 drums per day. While earnings vary, we estimate that fry aratdar have net earnings of between \$5,000 and \$12,000 per year.

^{*} For bagda, the peak buying season is between February and April in the south-west and February to May in the south-east region. The peak season for golda is May through August.

Usually, the aratdar do not feed the fry, meaning they sell them quickly, often within three days. A fry aratdar trades fry twice a day, primarily with a commission agent who sells the fry on to farmers. The market price varies, reflecting clients' demand and the overall market conditions. Golda consistently fetch higher prices at sale than bagda in both seasons. Hatchery fry typically earn lower prices (see Table 3).

Table 3. The Range of Prices for Fry Secured by Aratdar in Bagerhat, 2005

Fry Type	Seasonality	Source	Average Price in BDT/1000 fry
Golda	Off Season	Wild	950
Bagda	Off Season	Wild	400
Golda	Season	Wild	2000-2200 (MAX3400)
Bagda	Season	Wild	900
Golda	None	Hatchery	Usually not traded
Bagda	None	Hatchery	200-250

Notes: Data reflect averages for the year.

Source: Mr. Mujibur Rahman Howlader, a prominent fry aratdar at Foylahat in Bagerhat.

FRY COMMISSION AGENT

Shrimp fry is collected and transported to Khulna where most of the gher are located. Commission agents receive the fry and sell them to the farmers.^{*} The commission agents hold the fry for short periods of time. Large containers, usually plastic drums and aluminum pots, are used to carry and serve the fry. Shrimp fry are transported by air and road, and no food is provided during transportation, storage, and trading. The commission agents are generally medium- to large-scale entrepreneurs.

Commission rates vary between 10 and 60 BDT per 1000 fry with wild golda fry receiving the highest price (see Table 4).

Table 4. Commission Agent Rates in Khulna

Source	Shrimp type	Price (BDT/1000 fry)
Wild	golda	50-60
Wild	bagda	30-50
Hatchery	golda/bagda	10-15

Source: Mr. Mujibur Rahman Howlader

The commission agents filter the water in which the fry is kept to remove the shell residuals of the fry. Male workers sort the fry again in the depots before trading. Usually the sorters are hired at a rate of 10 BDT per 1000 fry count. The buyers who purchase fry from the commission agents pay for sorting at this point of sale.

Fry commission agents sell wild fry at higher prices than hatchery fry. Buyers willingly pay this premium since they believe that the wild fry have higher survival rates. They claim that they lose 10 to 12 thousand fry on average per one lakh (100,000) fry. The mortality rate depends on both the quality of net used in catching the fry and the type of management during transportation.

^{*} Some commission agents have their own ghers and produce shrimp themselves.

NURSERY

Nurseries are where the fry are adapted to the production environment. Technical expertise and infrastructure are required for the operation of a nursery.

In the nursery, the fry is kept under controlled conditions and is nourished through regular feeding at three-hour intervals. The fry gradually adapt to the temperature and pH level of the water where it will be grown. The fry arrive at the nursery at a temperature of between 22° and 23° centigrade. The water temperature is gradually increased to the temperature of the water available in the locality. The pH level can also be adjusted with lime to a level that matches the local environment. If necessary, the salinity of the water is also gradually changed to ensure proper adaptation for the fry. In addition, an uninterrupted supply of oxygen is provided at every stage of nursing. Because of the reliance on electricity, a generator is used to compensate for power outages. Typically there are only men working in the nursery. Fry stay in a nursery for about 3 days and are then sold at a higher price than fry that have not been acclimatized in this manner. Nurseries typically operate only during the shrimp production season. Workers at nurseries claim that their nourished fry have significantly higher survival rates and a few nurseries claim they offer a money-back guarantee if fry die.

Nursery culture is a new value addition option in the shrimp value chain that may help to improve survival rates of hatchery-produced fry. Introducing nurseries has the potential to increase the total availability of shrimp fry and provide employment opportunities—although some technical expertise and limited capital investment are required.

FARMING

Most bagda shrimp are farmed in Khulna, Bagerhat, and Satkhira; golda is produced in the south-western region in Bagerhat, Khulna, Satkhira, Jessore, Narail, Gopalganj, and Pirojpur* since they require fresh, not brackish, water for production. It is unclear how farmers decide what type of shrimp to produce. It is most likely that the types cultivated are influenced by the “dadon” system where shrimp faria and aratdar as lenders and buyers impose their preferences about shrimp varieties responding to price signals and market demand.

In a large gher (1000 bigha or 135 hectares), approximately 2,000 fry are seeded per acre (approximately 5,000 per hectare) and no further feed is usually provided. In a small gher, feed is provided as the stocking density is typically higher (5,000 to 10,000 fry per acre). On average, farmers spend 267 BDT or \$4.12 on food per acre of gher. Increasingly, farmers are cultivating smaller “pocket ghers” using less land, higher stocking densities, and adding feed.

Most of the farms are owner-occupied, with a little over 20 percent of farms run by tenant farmers. The majority of farms are also family owned and frequently all household members are engaged in production and sorting. Men, women, and children work on the farm, but the tasks are highly gendered. Women and children are disproportionately involved in weeding, cleaning and preparing ponds, and post-harvest

* Other important districts are Noakhali, Patuakhali, Lakshmipur, and Barguna.

processing. Men are hired for security, construction of dikes, and harvesting. Casual labor is hired in for specific tasks such as earth excavation, preparing, and cleaning the ponds. Of note is that security is increasingly a concern and many farmers pay guards to watch over the ponds to prevent theft. Labor costs make up between 5 and 30 percent of all costs incurred.

TERMS AND CONDITIONS OF PRODUCTION AND EXCHANGE FOR FARMERS

Our estimates of earnings indicate that bagda farmers reap net earnings of between \$76 and \$1,268 per hectare. Golda farmers reap net earnings of between \$800 and \$2,500 per hectare. Since golda farms are typically smaller, annual earnings from shrimp cultivation per household are broadly comparable.

Paralleling the case of fry catchers, and fry faria and aratdar, farmers may also be indebted and required to sell to specific intermediaries. This indebtedness may exacerbate problems with data collection, and contribute to the wide range of productivity and earnings rates reported in the sector. It is possible that indebted farmers try to conceal some of their production or claim higher loss rates in order to sell more freely in local markets.

In addition to concerns about the free sale of shrimp in local markets, farmers also face problems associated with access to land. The expropriation of land for shrimp farming and the lack of clear property rights legislation have led to coercive practices to gain land for shrimp farming. The customary approach to shrimp farming requires consensus or coordination. If at least 85 percent of the landowners agree to lease out their lands for shrimp farming, the owners of the remaining 15 percent are obliged to lease out their lands for the same purpose or allow the current lessee to inundate the entire area with saline water for farming³². This practice has led to documented expropriations, evictions, coercion, and human rights abuses as small farmers have been displaced and community activists threatened and killed.³³

SHRIMP FARIA

Shrimp faria conduct business throughout the year, but the peak season for their business lasts for five months. They offer conditional loans or “dadon” to the farmers and buy shrimp from them at a price that the faria determines. This price-fixing is ensured through the conditions imposed through the loan. Faria usually sell all the purchased shrimp to an aratdar the same day. Consequently, faria do not need to store or provide any food for the shrimp. If they need to store the shrimp, they use primitive refrigeration methods with blocks of ice or crushed ice.

The sale price is fixed based on the grades of shrimp produced and their number per unit of weight. Few accurate measuring devices are used to assess size and weight for grading. It is typically a highly subjective grading process, where the party who exerts greater power over the other reaps the benefits. The shrimp faria tries to pay the shrimp farmer as little as possible for the shrimp in order to maximize the profits the faria earns

* Additionally, permission should also be sought from the Bangladesh Water Development Board for the construction of a water management infrastructure and a license is required from the Upazila Shrimp Control Committee. However, neither of these bodies are representative and the interests of the landless or land-poor are seldom reflected in their decisions (Kabir, *personal interview*; Bhattacharya et al, “Environmental Impact”).

when selling to the aratdar. Moreover, shrimp farias and aratdars use relatively fewer grades than those prevailing in the export market—a tactic that tends to depress prices in the exchange.

Shrimp faria also make loans to the farmers and similar tied contracting arrangements prevail. The shrimp faria also supply equipment and materials to the shrimp farmers including: lime, fertilizer, fries, oil cake, wood for making sluice gates, and bamboo for fencing and partitions. The farmer borrows from the shrimp faria and sells directly to him. In turn, the shrimp faria borrows money from a commission agent and is thus obliged to sell to that commission agent.

I have taken advance money [payment] from a commission agent. I sell 100 percent of my shrimp to him (Shrimp faria, Cox's Bazar, November 2005).

SHRIMP ARATDAR

Shrimp aratdar buy shrimp from both faria and farmers. The faria or farmer packs the shrimp in ice in a tub, wicker basket, or plastic container to take to the aratdar. Shrimp are sold either through auction or buyer-seller negotiations in local markets.

Shrimp aratdars who trade from depots are increasingly facing new challenges. These depots now have to meet compliance standards set by the industry in accordance with mandates from the EU and US. Aratdars claim that their depots must be maintained according to HACCP recommendations. Yet, they have not received funding or training to meet these standards and will incur significant costs renovating and upgrading the depots.

Shrimp sellers and farmers who are not locked into contracts sell in spot markets or auctions. Spot markets, such as auctions, ensure that sellers get better prices in comparison to those they receive by selling directly to aratdars under contracts secured by loans. However, when mixed grade shrimp is sold in this process, the seller loses some of the potential price benefit for selling individual grades of shrimp that could be priced separately. When shrimp of mixed grade are pooled average prices prevail and the full producer surplus is not extracted.

Of note is that few women act as intermediaries, either faria or aratdar.* Socio-cultural norms limit women's mobility and as a result their engagement in local markets. Women and children may, however, provide casual hired labor and unremunerated household labor to faria and aratdar to perform sorting and grading. Furthermore, the financial requirements for faria and aratdar—particularly those who trade shrimp and extend credit to actors down the value chain—largely prohibit rural women from entry into this activity.

SHRIMP COMMISSION AGENT

Shrimp commission agents trade shrimp with exporters. They are typically medium to large sized entrepreneurs who have access to and provide financing. The commission agents buy shrimp from the aratdar and sell to the exporter. The commission agents maximize their returns by concealing the price at which they sell and depressing the

* This is also true for fry faria and aratdar.

price at which they buy. Sometimes they take bribes from the aratdar to sell their shrimp to a specific exporter. As a result, commission agents enjoy significant rents and side-payments.

SHRIMP RETAILER

Shrimp retailers are engaged in domestic sales for local consumption. As much as 10 percent of total production is sold domestically. Local hotels, restaurants, supermarkets, and consumers buy shrimp from retailers. The retail markets remain open throughout the year with the exception of holidays such as Eid and Puja, etc. Retailers buy and sell different types of prawn and shrimp such as Lobster shrimp, Tiger, Chaka, Chali, Horina, and Lailla. They also buy mother shrimp from the hatcheries and sell these at their stores throughout the year. Retailers buy from gher owners as well as aratdar. Sometimes they buy from sea fishermen where the most common marine variety is Chaka.

Retailers do not process shrimp but sell as purchased. They sell both head on and headless shrimp as well as fresh and frozen shrimp. Some retailers only sell shrimp and prawn while others sell a variety of fish as well.

All retail transactions are cash. Retailers usually do not make any sales by advancing credit. They sell shrimp on a cost-plus basis with the price ceiling set by the spot market unit price according to the size of the shrimp.

PROCESSOR AND PROCESSOR/EXPORTER

There are 130 shrimp processing plants in Bangladesh. Of these, 65 are currently in operation, and only 57 have been approved by the EU. Most of the plants operate at between 20-30 percent of their capacity partly reflecting the insufficient and discontinuous shrimp supply^{* 34}.

Most of the processors sell shrimp using their own brand name and also the brand name of importers and buyers. Many processors prefer to maintain multiple brand names as these brands enjoy different levels of popularity and image in different countries and/or markets. For example, Meenhar Sea Foods Limited sell processed shrimp using Jasmine and Marigold brands; they also remain ready to pack under any of their buyers' chosen brand names.

PROCESSING PLANT

The processing plant is an establishment with several facilities or processing rooms, two-floor shrimp warehousing, laboratory, bathrooms, a first-aid room, and administrative offices. The entrance to the plant typically contains a pool with chlorinated water for disinfecting and the whole plant is kept wet with disinfectants to ensure a hygienic environment. Individuals inside the plant are required to use plastic boots to reduce contamination. The two-floor warehouses are kept sealed and the whole plant is built with smooth floors and walls to facilitate cleaning. Generators are used to compensate for any loss of power supply.

* Concerns have also been raised that the rate of under-utilization also reflects the injection of highly fungible loans into the sector which precipitated a rapid expansion of capacity and in some cases the creation of shell processing factories that are not functioning (see Guimarães, *A Landscape of Contracts*).

Men and women work in the processing plants, but their work is highly segmented and differentiated. Typically women are engaged in cleaning and de-heading the shrimp, while the men work more closely with machinery, block freezing, and Individually Quick Frozen (IQF) processes. There are also reports of children working in the processing plants.³⁵

ACILS Bangladesh reports that a substantial amount of work is performed by children at shrimp processing, freezing, and packaging factories.* The work ranges from, de-heading and de-veining shrimp undertaken by smaller children who accompany their mothers, to young boys (9 and older) who clean the factories, load packed cartons of product onto the freezer trucks, and unload incoming trucks with the unprocessed products. Halim³⁶ observes they work long hours, do not attend school, and are paid significantly less for their work, between 10 and 15 BDT per day.

WAREHOUSING

Processors frequently adopt two-floor warehousing facilities in the factory. The first layer preserves semi or un-processed shrimp in 5-10 kg packs, to be processed at -5° centigrade in a chiller room. The second layer in cold storage keeps fully processed shrimp that will be shipped to buyers after verification. The second layer is kept at a temperature of between -12° to -20° centigrade.

Cooked shrimp that are boiled or semi-boiled and salted are increasingly in demand in the global market. To supply cooked shrimp, processors need to make a substantial capital investment and seek skilled staff to maintain the equipment and processes required. The processors frequently hire foreign experts and technicians at high cost to ensure the integrity and function of the spiral freezing and cooking plants. Currently in Bangladesh, it is estimated that between four and six processors have added a fully functioning cooking plant, other processors are now interested in installing the cooking plant machinery to meet the growing global demand for processed and cooked shrimp. Both the new prawn plants linked to the GNAEP project have a cooking facility.

PACKAGING

Processors and processors/exporters use locally manufactured cartons, plastic packets, and trays with customized labels. The packaging style varies according to requirements of the buyer and according to the price negotiated by the buyer. Shrimp earning higher prices usually command exclusive packaging; shrimp earning lower prices are frequently packed in single plastic packs or blocks and repackaged later by the importer or retailer. Usually buyers of block and unbranded products prefer simple packaging since disposal is expensive in developed countries. This preference for lower quality packaging for unbranded products, however, can conflict with compliance standards.

Ice is used in several stages of packaging and storing. Prices for ice vary but usually hover at around 70 BDT per 100 kg; at times of scarcity the price can rise to as much as 700 BDT. As a result, some processors began producing ice in their own factories to meet their needs; in some cases they sell any excess ice produced.

* Personal communication with Rob Wayss, Solidarity Center/ACILS Bangladesh, February 2006.

Box 3. Fish Preservers Limited: Diversifying Products and Ensuring Integrity

Fish Preservers Limited (FPL) processes and sells “GOLDEN FISH” and “FPL” brands according to HACCP rules, EU, and other regulations. FPL was established in 1978 and is an entirely export-oriented fish processing company. FPL also promotes itself as an organic shrimp processor and furnishes high quality shrimp and shrimp products. To diversify its product varieties and to expand its export market, FPL established a modern spiral (IQF) freezing and cooking plant, which required an investment of a little over three crore taka or \$462,000.

FPL employs a range of skilled and unskilled workers included Processing Technologists, Marine Scientists, Engineers and Quality control personnel. They comply with foreign regulations in all their export markets and have a U.S. FDA code number (BC-06) and EU approval number (CTG-38).

FPL is responsive to buyer demands and has a longstanding relationship with their buyers. The GMP and HACCP food-safety programs are well understood and fully adopted to guarantee product quality. Moreover, FPL has the required facilities, including a well-equipped and staffed microbiological laboratory, to meet customer requirements for product quality and prevailing market standards. FPL also has an efficient pest control system and filtered water reserve and ice production system on site.

FPL offers a wide range of shrimp and fish products including Black Tiger, Fresh Water Shrimp, White and Brown Horina Shrimp, and Lobster, etc., in IQF, Semi IQF, Cooked, Blanched, and Block Frozen form. Their product specifications include Head on shell on, Headless shell on, Easy peeled headless, Peeled de-veined tail on (PDTO, PTO), Peeled un-de-veined (PUD), Peeled de-veined (P&D), and Butterfly cut.

FPL has achieved an excellent national and international reputation and received the 7th International Award for Export in Barcelona in 1984. FPL also won the National Export Trophy of Bangladesh in 1991-1992.

Source: Personal interview with representatives of FPL.

TERMS AND CONDITIONS FOR WORKERS IN SHRIMP PROCESSING PLANTS

We estimate that there are approximately 30,000 non-management workers in shrimp processing factories. SAFE and the Solidarity Center have documented a number of concerns about working conditions in the sector including:

- Violations of the 8 hour workday
- Forced overtime
- Unpaid overtime
- Failure to provide adequate health-care
- Failure to provide child-care and maternal leave
- Failure to observe the right to organize and collectively bargain
- Inadequate hygiene and health and safety measures
- Insufficient bathrooms and toilet facilities

In addition to these violations, there are concerns about child labor being used in processing. We did not document the use of child labor and can only draw on data and evidence reported elsewhere. One of the few comprehensive studies of child labor in the shrimp sector was undertaken by Delap and Lugg in 1999.³⁷ These authors estimate that there were significant numbers of children, 5-14 years old, working in the shrimp sector primarily as fry-catchers, sorters, and farm labor. Some children, however,

accompanied their mothers to processing plants and were recruited to clean and de-head shrimp.

Children's employment is largely a feature of gender vulnerability in the chain. Their mothers, who are responsible for their care and supervision, bring the children to the workplace, and unscrupulous employers and contractors take advantage of their presence pressuring them to work alongside their parents. Some children, however, are contracted directly by processing plants or sub-contracted through brokers to perform specific tasks.

The types of violations increase with the use of casual labor. The use of casual and child labor in processing frequently occurs through contractors. Management may pay contractors as brokers who deliver workers to meet specific production targets. Casual workers are hired on the payroll of the contractors which is maintained separately and independently by the contractors themselves. Work may occur on the premises or elsewhere. If work is undertaken off the premises, the cleaned and prepared shrimp are delivered to the processing plant and weighed for payment. This type of practice appears to be associated with processing plants with lower capital investment and poorer facilities.

Unfortunately, labor laws and regulations are spotty, confusing, and inadequately enforced. Different acts, ordinances, and rules apply to different types of enterprises and workers. Some of the general categories to which rules and regulations apply are factories, shops and establishments, tea estates, and the public sector. For all of these categories of establishment, the labor laws cover basic worker rights in the following areas: minimum wages, payment of wages, leave and holidays, working hours, workplace safety, workplace facilities (washrooms, first aid, canteens for larger enterprises, and rooms for female workers' children in factories with over 50 female workers), workers compensation, maternity benefits, child labor, and industrial relations (including rights to organize and bargain collectively). Social security is offered to a number of workers through different types of welfare funds, provident funds, and/or participation funds that certain employers are required to establish and maintain.

The rights that workers have in the shrimp sector depend on the size of the company, the number of contracted employees, the location of the firm, and the local ordinances that apply. Much of the labor that is contracted on shrimp farms and in processing factories is informal or unregulated.* Few workers have contracts or receive statutory benefits. Many complain they lack ID cards. Furthermore, the minimum wages that apply in the shrimp sector are those set for agriculture, not those that apply to manufacturing. Yet, despite the existence of these minimum wages, they are frequently not observed.

In addition, concerns remain about injuries and health-impacts of working in the processing factories. Arthritis, urinary tract infections, varicose veins, repetitive strain, muscle strain, cuts, inflammation, fungal infections, and diarrhea are all ailments widely reported in the industry.³⁸ Some of these ailments are the direct result of working

* Many of these informal workers are considered permanent—they are contracted year round, but their hours and pay may vary.

conditions where workers stand for long periods of time and are exposed to significant temperature differences when compared with ambient temperatures. Others are the result of a failure to wear protective clothing, in particular gloves, in combination with exacting production targets. Employers may not provide sufficient protective gear or may subject workers to pressure to meet exacting production targets requiring that they work faster and increase productivity.

Box 4. Labor Rights in the Shrimp Processing Sector

“We know our rights, but we have no alternatives, we have no way to get another job. What we need is more organization.” Woman worker, shrimp processing factory, Khulna.

“Well, we don’t get what we should get. We don’t get a weekly holiday or day off. We don’t get annual leave, not even sick leave or maternity leave. We don’t even get paid overtime if we do it.” Woman worker, shrimp processing factory, Khulna.

“I work about 12 hours a day standing up without a lunch break. If I come later because of a problem at home, I have to stay later. Production goes on for 24 hours a day at peak time. It is very stressful.” Woman worker, shrimp processing factory, Khulna.

“I work in cold storage. I spend a lot of time in the freezer. What bothers me is the change in temperature. I get sick easily. It is hard work and the floor is slippery. If you fall you will get attention, but only in the moment. If you are bleeding they send you from the floor. But you never get any treatment after that.” Male worker shrimp processing factory, Khulna.

“We are all supposed to be permanent workers at our factory. But this isn’t true. None of us have an ID card.” Woman worker, shrimp processing factory, Khulna.

“Yes, the inspectors come, they have to come at least once a year. But they always inform the management first. The management then arranges everything: they change the shifts and only put people on who agree with them. They even prepare a separate salary sheet. The inspectors know the management, they are all friends.” Woman worker, shrimp processing factory, Khulna.

“One day an inspector came to our factory. I knew him, his family were friends of mine. He came over to talk to me. We didn’t talk about the work, just said hello. He asked about my family. But later, the management called me in. They were very worried. They wanted to know what I said. I felt uncomfortable. I feel like they are always watching me now.” Male worker shrimp processing factory, Khulna.

Source: Focus group with 2 men and 14 women workers in a shrimp processing factor in Khulna. The focus group was held outside the factory in the offices of the Solidarity Center affiliate in Khulna.

OTHER KEY FUNCTIONS AND SERVICES IN THE VALUE CHAIN

TRANSPORTATION

Transportation plays a critical role in the shrimp value chain. Although most of the segments are interlinked through transportation, there are some specific activities that require substantial transportation expenditures. The segments of the chain which incur the greatest transportation costs are fry aratdar, shrimp aratdar, processors, and exporters.

The following are the major routes which fry or shrimp are transported:

- Fry is transported by air or road from Cox’s Bazar and Chittagong to Khulna, Bagerhat, Satkhira, and Barisal.

- Shrimp are transported from pond/gher to aratdar. This often takes hours, during which time the shrimp lose weight and quality.
- The unprocessed or semi-processed shrimp is transported from shrimp aratdar to the commission agent by road using light vehicles.
- Shrimp is transported from commission agents to processors or processors/exporters by road using light vehicles.
- The processed shrimp is transported from processors or processors/exporters to foreign buyers. This involves the greatest transportation expenditure using airfreight.

The quality of transportation and management during transportation plays an important role throughout the value chain. For example, the transportation of fry from fry aratdar to fry commission agents can affect the physical state of the fry, and can influence the survival and growth rates of the shrimp. Survival rates decline and the integrity of the fry are oftentimes compromised by longer transportation and storage.

FEED AND FEED MILLS

Alauddin and Hamid³⁹ report that there was a significant shortage of artificial feed for shrimp in Bangladesh. In the early 1990s, an average of 6,000 mt of feed was produced nationally out of a total requirement of 100,000 mt. The majority of feed was imported from Thailand and Taiwan. Today, most farmers use locally made and produced feeds that may not contain all the nutrients required to promote growth.⁴⁰ Yet, while locally produced feeds may lack some nutrients, they do not contain additives or growth promoters. As such these feeds have the potential to be more sustainable.

The principal source of protein entering the value chain is from dried fin fish caught by inshore fishers and dried by family members—typically women and children. These fish are then sold to local feed mills in order to be ground. There are about 10 larger feed factories or processing plants and as many as 100 small scale facilities.

Snail meat, which is disproportionately used as prawn feed in ponds, is increasing in demand. Children and women are visible in gathering and processing the snails from May through July. Most of those engaged in this sector are from poor households in rural areas.⁴¹ Because of mobility restrictions and social sanctions, the women and children de-shell and clean the snails at home, then sell their harvest to traders who, in turn, sell them to farmers. Snails are frequently collected from the outlying beels. Abedin et al⁴² report that in the areas of Jessore, Khulna, and Bagerhat snails are almost exhausted.

The BFFEA emphasize that expansion of aquaculture and a shift to improved cultivation methods require more locally produced feeds of higher nutritional value.

FINANCING PROCESSING AND HATCHERIES

The majority of enterprises use formal credit markets and have obtained government-backed loans to build their establishments. The GoB has developed an Entrepreneurs Equity Fund (EEF) targeting agri-based and other commodity companies. A number of hatcheries and processors have obtained financing through this facility. Additionally, all

processors have access to a subsidy from the GoB at 10 percent of the F.O.B. value averaged over three years.

Unfortunately, most of the financing offers from the GoB are not well distributed. There is anecdotal evidence that they are being misused to fund shell investments and diverted for other activities.⁴³ This may contribute to the under-utilization of capacity reported in the shrimp processing sector.* Furthermore, almost all the financing available through the GoB targets the processors or processors/exporters; no funds or lines of credit are available to farmers or other lower level participants in the value chain.

Two processing factories, Meghna Shrimp and Bionic Seafood Exports Ltd., have raised investment funds selling shares in the Bangladeshi stock market, but their share position remains poor considering the price to earnings ratio implied by current market values in the Dhaka Stock Exchange (DSE). Similarly, Beach Hatchery Ltd. is also trading in the stock market. Unfortunately, the market value of shares of all three enterprises have declined, which does not appear to reflect their export position in the market (see Annex 1, Table 1).

STANDARDIZATION AND REGULATION

Phyto-sanitary regulations set by foreign import markets that require the standardization of production and processing methods using Hazard Analysis and Critical Control Point (HACCP) methods and Codex Alimentarius also lock buyers and sellers into repeated contractual relationships.[†] Although the costs of conforming to regulations have been largely transferred to the producers, buyers and importers have to commit to sourcing in advance. Failure to meet compliance results in fewer shrimp on supermarket shelves in Europe, Japan, and North America.

Shrimp importers rely extensively on random food-safety quality checks of products at point of entry or import. Most importers have highly computerized systems that accumulate information and monitor purchases from every supplier. Information about food-safety findings, phyto-sanitary properties, price, packing volume, water content, as well as quantity is sent back to the local intermediary in the developing country. Reputation is critical in maintaining contracts. If noncompliance is documented, the local intermediary or processing plant that is responsible to the importer runs the risk of losing future contracts. The importers either sell the product to supermarkets or import products for specific supermarket chains as they, in turn, have contracts and reputations that they must maintain. As a result, both importers and processing plants wish to engage in repeated contracts where both parties are known, quality is upheld, and buyer demands can be satisfied.

The expansion of standards and quality regulations also provide opportunities for upgrading. As a result, shrimp processors in Bangladesh have assumed greater costs

* There are also claims that because the sector is tax exempt, laundering is occurring with greater frequency, artificially inflating profits and distorting information about costs and returns in the sector.

† These regulations set limits and designate acceptable ranges for bacteriological quality, contaminants, residues, and additives. The Codex Alimentarius Commission has endorsed the HACCP methodology and incorporated it in the new Code of Practice for Fish and Fishery Products. Bangladesh has also incorporated the HACCP approach in its own regulatory framework (specifically in its Fish and Fish Products (Inspection and Quality Control) Rules 1997).

upgrading infrastructure and adding a wider range of prepared shrimp to their products, including consumer packed, ready-to-eat, cooked, peeled, de-veined, head-on, head-off, and split shell shrimp. Processors are also adding Individually Quick Frozen (IQF) shrimp to their array of products as supermarket demand for headless IQF black tiger shrimp on tray packs has risen substantially in Europe and North America. The preferred sizes are 13/15, 16/20, and 21/25. Even for block products, exporters and processors can add value by freezing the shrimp in pans (which are called pan-frozen products) that fetch 20–30 cents more per block than the carton-frozen products. Offering a broader range of higher value products increases leverage with buyers and importers, and increases the returns captured in country.

Interestingly, this same processing technology can be used for a variety of fish products and might be adapted for vegetables. Diversifying the products processed can enable processors to overcome product shortfalls and continue to produce for export year-round.

GENDER ISSUES WITHIN THE VALUE CHAIN

This report employs a gendered value chain analysis to highlight the different positions and contributions of men and women across the value chain. This analysis enables us to uncover the economic, organizational, and asymmetric relationships among actors located along different points of the industry.

In particular, a gender analysis of the chain affords another means to examine the power of actors to engage in the sector as well as the terms and conditions of their engagement. Power is socially determined and frequently gender-based.* Social norms, sanctions, and proscriptions frequently affect an individual's ability to enter labor markets, acquire productive assets, invest in their own or other's human capital, and lend and borrow money.

For example, women may face social proscriptions that restrict their mobility. Consequently their access to employment and markets is frequently limited. In the southeastern Cox's Bazar region of Bangladesh, few women are found in fry catching, largely because of social sanctions that prohibit them from entering bodies of water. Since the shrimp fry are caught in the surf, this activity is dominated by men and male children. These same social sanctions determine where women work and the type of work they undertake. As described below, single women working in shrimp processing factories typically work in a narrow range of activities in an environment that is largely sex-segregated. Where social norms and expectations result in highly sex-segregated activities and occupations, wages frequently differ for male and female activities. Heavily feminized activities usually command lower wages. This is certainly the case in shrimp production and processing where women earn consistently lower wages than men.⁴⁴

* Clearly, the economic and social dimensions of power are not mutually exclusive. Markets are socially determined and social manifestations of power frequently emerge from economic hierarchies.

SEGEMENTATION ALONG THE CHAIN

Segmentation analysis provides another means of exploring power and inequality along the value chain.⁴⁵ Men and women clearly have very gender-defined tasks, roles, and responsibilities along the shrimp value chain.

The labor market in Bangladesh is sex segregated. In almost all dimensions, men and women are not distributed evenly across all sectors and occupations in proportion to their participation in the total labor force. One way of measuring this segmentation is using the Duncan Index. The Duncan Index is calculated using the following formula:

$$D = 100 * \frac{1}{2} \sum_{i=1}^N |f_i - m_i|$$

Where $i = (1, 2, \dots, N)$ is the total number of sectors, industries, or occupations, and f_i and m_i are the sectoral employment ratios of men and women to their respective labor force. The Duncan Index of dissimilarity, ranging from 0 to 100, can be used to measure labor market segmentation by sex. An index of 0 indicates that sectors or occupations are not sex-segregated; women and men are distributed across these sectors and occupations in proportion to their participation in the total labor force. An index of 100 indicates that men and women are in entirely different sectors or occupations. The Duncan Index calculated for 10 sectors for the entire Bangladesh economy was 31 in 1990.^{*} By 2000, this index had fallen to 27, registering a decline of over 10 percent in sex-segmentation over the decade of the 1990s.

The degree of sex-segmentation in terms of person days per year is also calculated along the shrimp value chain using the number of segments within the chain. The analysis uses person days per year since hours and shifts vary in different activities across the value chain. Data was collected for the different tasks and activities undertaken in the different segments of the chain. The person days were summed for each of these activities and expressed as a percentage of the total person hours reported. For instance, at the farm level, labor includes time spent excavating and preparing ponds, weeding and cleaning, seeding, fertilizing and harvesting, post-harvest cleaning and preparation, as well as security. The Duncan Index for hours worked is 62 indicating that the shrimp value chain is highly sex-segmented.[†] It is clear that women and men cluster in different segments of the value chain and that their time is used unequally (See Table 5).

^{*} This calculates the index for all sectors using employment in sectors defined by two digit standard international classifications.

[†] The Duncan Indices for the shrimp value chain and the economy as a whole are not directly comparable because one is calculated for employment and the other is calculated in terms of person days. Additionally, the numbers of sectors considered differs.

Table 5. Segmentation by Sex Along the Value Chain

	Person Days Per Year			Female Intensity		
	Men	Women	Total	F/M	F%	Duncan Index
Fry Catcher	3721	2384	6105	0.6	39.0	
Fry Faria						
Fry Aratdar						
Shrimp Farmer	35028	786	35814	0.0	2.2	
Shrimp Faria						
Shrimp Aratdar	11650	183	11833	0.0	1.5	
Commission Agent	37	0	37	0.0	0.0	
Shrimp Nursery	600	0	600	0.0	0.0	
Shrimp Hatchery	6288	120	6408	0.0	1.9	
Transporter	127	0	127	0.0	0.0	
Retailer & Wholesaler	4	0	4	0.0	0.0	
Processor and Exporter	25790	42483	68273	1.6	62.2	
Shrimp Trawler	10	0	10	0.0	0.0	
Cargo Biman	50	0	50	0.0	0.0	
Input dealer						
Commission Agent (MS)	4	0	4	0.0	0.0	
Total	83,309	45,956	129,265	0.6	35.6	62.2

Notes: Data are estimates for survey area only.

Source: Authors' calculations using primary data.

Women's absence in parts of the chain is particularly noticeable. They are not active as intermediaries, nor are they visible in the management of processing plants. Socio-cultural norms limit women's mobility and their freedom to engage in certain types of economic and productive activities. Women who cannot travel without male accompaniment are unlikely to act as financial intermediaries to buy and sell shrimp or fry. Particularly interesting is their absence from farming, especially since farming is disproportionately undertaken by households as a family business. One explanation is that both women and men are likely to underreport female labor in farming because it is seen as an extension of women's household chores, not as an input to production. A time allocation analysis conducted at the level of the household would likely uncover more women and children in farming activities.

If the labor market is sex-segmented, men and women cluster disproportionately in certain activities and their time is unequally used. This can be a feature of norms and expectations that limit the choices men and women can make as workers. If, as a result of segmentation along the value chain, women workers are more insecure and dependent or are more likely to be contracted under informal arrangements for lower wages, then it is also likely that these norms and expectations constrain both the choices made by men and women workers as well as their productivity.

Where women are seen as secondary earners whose income supplements male earnings, they are more easily viewed as flexible and contingent labor. What is clear from this analysis is that women, and children, are disproportionately located in the more insecure nodes of the chain as seasonal or occasional labor in fry catching, farming, and processing. Where their employment is flexible and contingent, they are also more likely to earn lower wages and be more vulnerable to poverty.

Flexible and contingent workers are often recruited to keep labor costs low and meet buyer demands. Oftentimes women are seen as flexible workers, hired to meet immediate production or processing demands and then let go. They may also be required to work overtime to meet production schedules dictated by buyers or input availability.

At the other end of the global value chain, the commodification^{*} of products may depend on consumption trends that are linked to changing gender patterns of employment and higher female labor force participation.⁴⁶ As Barrientos⁴⁷ observes: “Marketing companies adopt gender-based strategies in their campaigns to sell high value goods.” This is the case with prepared foods such as salads, pre-washed, cut and packaged vegetables, as well as peeled and shelled shrimp and prawn. Even in the developed world, the responsibility for provisioning households still lies largely with women householders—many of whom are also working. A key element in marketing and sales strategies in higher income countries is to provide women households with foods that can be easily prepared with minimum expenditure of time and effort. Dolan and Humphrey⁴⁸ observe that such strategies can maximize product placement and increase sales. Dolan and Humphrey⁴⁹ document the case of horticulture producers in Kenya who tailor their output to meet the needs of dynamic markets and successfully earn higher incomes by producing washed, packaged, and chopped vegetables and salads that are ready-packed and labeled for individual stores on short demand. Orders can vary up to the day of dispatch and production is virtually continuous.

Certainly, INFOFISH and the BFFEA consider this a key strategy for increasing the value added captured by exporters and processors: “In all developed countries food habits are changing. The consumers are no longer willing to spend an excessive time preparing food.” The production and packaging of prepared, “heat and eat”, and semi-cooked fishery products are increasingly the focus of upgrading and expansion efforts in the sector. More prepared foods clearly capture more value added and command higher prices (see Table 6).

^{*} To commodify something means to transform a good or service that was formerly not sold into a product for sale. Here it conveys the notion that a food product is being sold; part of the transformation of that product replaces reproductive labor in the household.

Table 6. Range of Shrimp Products Exported

Product	Process	Value BDT/Kg
Head on shell with claws	IQF, Semi-IQF and Block frozen	420
Headless shell on	Head removed, neck meat trimmed, IQF raw consumer pack and raw tray packs	616
Headless shell on easy peel	Head removed, neck meat trimmed, IQF raw consumer pack and raw tray packs with garlic and herb bases, butter-fried, blanched and cooked in BF or IQF process	647
Peeled	Peeled, headless, raw and cooked, BF or IQF	650
Pull de-veined (PD), P&D tail on	Peeled, headless, de-veined, raw and cooked, BF or IQF	708
P&D butter-fried	Peeled, headless, de-veined, butter-fried, raw and cooked, BF or IQF	720
PD skewer, P&D Butter-fried tail on skewer	Peeled, pull de-veined, headless, IQF shutter pack raw	750
Cooked	Peeled, de-veined, headless and cooked	832

Notes: \$1=65 BDT; for comparability, the unit considered is 31-40 pieces per Kg.

Source: Author's calculations based on data from the INFOFISH.

WAGE DISPARITIES BY SEX ALONG THE CHAIN

Pay differentials for men and women are visible throughout the value chain. Table 7 reports average wages and earnings by task at different stages of shrimp production for men and women. This table underscores that women receive consistently lower wages at all points along the value chain. Women earn approximately 64 percent of male earnings as fry catchers and sorters. In farming activities, women earn approximately 82 percent of male labor earnings, while in processing their pay ranges from as little as 60 percent to 83 percent of male earnings. These findings are consistent with those from other sources. For example, SAFE documents the case of women workers who receive between 300 and 400 BDT per month less than their male counterparts for the same number of hours worked.⁵⁰

Table 7. Average Wages and Earnings by Task and Sex in Different Stages of Shrimp Production (BDT per day)

	Men	Women	Women's wages as a % of Men's
Fry catching			
Catching and sorting	89.2	56.7	64.0
Shrimp farming			
Pond repair	94.7	78.0	82.4
Seeding fingerlings	67.1		
Casual day labor	60.9	50.0	82.2
Maintenance	73.4	60.0	81.7
Security	77.2		
Harvesting labor	80.0		
Processing Labor	97.0		
Administration			
Shrimp Processing			
Building Repairs and Maintenance	79.0	65.0	82.3
De-heading	100.0	83.0	83.0
De-shelling			
De-veining			
Refrigeration	83.0	65.0	78.3
Cooking/breading	100.0	60.0	60.0
Packing	112.5	80.0	71.1
Administration	290.0	290.0	100.0

Notes: The length of a day or a shift is between 6 and 8 hours in farming.

Hours may vary in the shrimp processing sector and can be as much as 12 hours.

\$1=65 BDT

Source: Data from survey of wage rates and daily earnings at different points in the production process.

FLEXIBILITY OF LABOR BY SEX ALONG THE CHAIN

Inequality in women's participation is also evident in the security of their tenure and the work relationships they engage in along the value chain. Table 8 reveals that more male time is allocated to permanent work than female time, and that a greater proportion of male labor is concentrated throughout permanent employment when compared with female labor. For example, in most segments where women are employed or engaged as workers, a greater proportion of female time is concentrated in temporary or casual employment. In farming, although there are more men reported to be working, 73 percent of women's labor time is concentrated in temporary or casual employment as compared with 31 percent of men's time. Similarly in processing, where estimates reveal that women out-number men, 92 percent of the women's labor time used is considered temporary or casual.

Women concentrate in temporary, casual, and flexible labor primarily due to their subordinate social and economic status. Women are seen as secondary wage-earners

whose income supplements male earnings. Additionally, their dual role as mothers and caregivers limits their engagement in productive and remunerated activities, and is seen as a reason why their participation in paid employment must be secondary. The primacy of male earnings confers more protected status upon men and allows women's employment to be seen primarily as a buffer against risk, not part of an essential and co-equal strategy to generate household earnings. Where women's earnings are secondary, and in labor markets where tasks are highly gendered, women typically command lower wages. The increased use of flexible labor not only allows employers to reduce wages but can also reduce non-wage costs such as social insurance and other benefits. Finally, women are actively recruited as cheap, compliant labor that can be hired and fired more easily, and a host of gendered social norms reinforce their compliance.

Table 8. Permanent and Temporary Workers, Person Days per Year

Fry Catching	Men	Male %	Women	Female %
Seasonal	3,721 (100%)	61.0	2,384 (100%)	39.0
Hatcheries				
Permanent	3,912 (62%)	99.4	24 (20%)	0.6
Temporary/Casual	2,376 (38%)	96.1	96 (80%)	3.9
Nurseries				
Permanent	264 (44%)	100	--	--
Temporary/Casual	336 (56%)	100	--	--
Farming				
Permanent	24,207 (69%)	99.1	210 (27%)	0.9
Temporary/Casual	10,821 (31%)	94.9	576 (73%)	5.1
Intermediaries				
Permanent	11,650 (100%)	98.5	183 (100%)	1.5
Shrimp Processing				
Permanent	9,772 (36%)	72.8	3,468 (8%)	27.2
Temporary/Casual	16,518 (64%)	29.7	39,015 (92%)	70.3

Notes: Permanent in this case means continual employment, it does not imply that workers have contracts or receive mandatory benefits.

Source: Authors' calculations using primary data.

These figures may disguise the extent of flexibility in women's and men's employment in certain segments of the value chain. Flexibility is not only achieved through employing a greater number of temporary and contingent workers, but also by requiring permanent staff to work piece rate for varying numbers of hours and shifts. Flexible wage rates with variable piece rates associated with different activities also allow firms to reduce labor costs. Barrientos⁵¹ notes the following about horticultural value chains: "These types of flexible wage systems play an important role in raising the productivity of workers and

enhancing the economic rents that growers are able to extract from their more flexible workers.” This is also true for workers in shrimp processing plants:

We work 12 to 14 hours per day at peak season. Sometimes we had to work 72 hours continuously. But our salary is 1200 to 1600 BDT, at best. We do not get any overtime allowance for our extra hours of duty (Woman worker as a grader in a shrimp processing plant. SAFE, “Enduring Human Rights of Labourers”).

COSTS AND RETURNS IN THE VALUE CHAIN

This section analyzes the costs and returns to each representative actor in the value chain, from fry collectors to processors and exporters. The objective is to explore where the greatest returns are concentrated and to see how returns may be distributed more equally throughout the chain. This analysis underpins policy recommendations about how to increase productivity and returns for the different actors as well as whether some surplus may be potentially redistributed to compensate for any environmental and social costs.

Data was collected from each participant or actor within the chain to record costs of production or handling, as well as sale price at the exchange points as shrimp moves from the sea or hatchery, to farm production, to processing, and ultimate for sale to consumers.

These data were used to obtain an estimated average of: use of equipment including buckets, pails, and containers; quantity of shrimp fries collected; costs of transportation; use of inputs such as feed, lime, and fertilizer; costs of processing; and, all labor throughout the chain. The data was then transformed into per kilogram values by dividing the costs by the quantity of shrimp handled. Figure 3 provides a graphic presentation of the distribution of the costs and exchange values or prices at each point along the chain. Costs and prices are separated for bagda and golda. Although golda get a significantly higher price per kilogram, the volumes produced are lower and differences in the returns to factors of production, i.e. labor and capital, are not as pronounced.

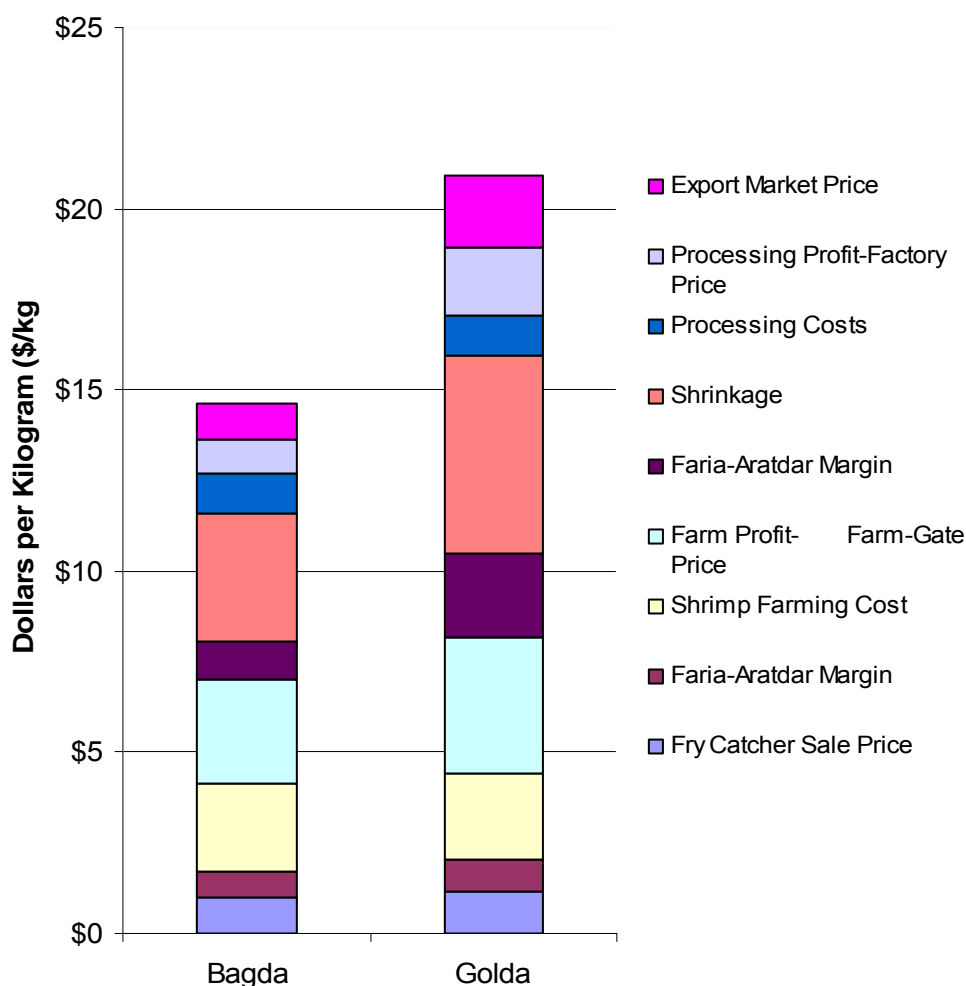
Since the data was not derived from a statistically representative survey or from controlled experiments, they should be seen as indicative of costs and returns in the sector. We cannot calculate confidence intervals and levels of significance for these data, but they do illuminate the potential for redistribution of returns throughout the value chain.

THE DISTRIBUTION OF COSTS AND RETURNS

Figure 3 below reflects the costs incurred along the value chain as the shrimp pass from fry catcher to intermediary to shrimp farmer to more intermediaries, and finally to the processor-exporter. All costs are included but only a reduced set of value chain participants are shown in the histogram for the sake of simplicity. Hatchery costs are included in the cost of fries to the farmers, as are nursery costs if separate from those incurred by the farmer. Transportation costs are born by the intermediaries, as well as the costs for buckets and drums to transport the fries or shrimp. Similarly, any wastage

that is incurred is a cost to intermediaries. Packaging of the frozen shrimp for export is included in the processor costs.

Figure 3. Distribution of Costs and Returns Along the Value Chain (\$/Kg)



The first bar in the histogram shows the price for the amount of fries required to produce a kilogram of shrimp, averaged over all sources either from fry catchers or hatcheries. This is \$1.02 for bagda and \$1.14 for golda. This measurement is not by weight of fries but by value of fries that are fed into the ponds. The second bar from the bottom represents the margin earned by the farias, aratdars, and commission agents. In other words, the difference between the price paid to the fry catchers or hatcheries, and the price paid by the shrimp farmers. Since the farias, aratdars, and commission agents purchase from the fry catchers, hatcheries, and one another, and they trade in different volumes across different regions, it is impossible to distinguish clear price differentials accruing to each of these groups separately. Moreover, these agents usually operate on a commission basis and charge 5-15 BDT per kilogram of fry or shrimp handled. Using the normal unit of fry measurement of 1,000 fry, this commission can be between 60 and 80 BDT. To simplify the analysis, we report the value of the difference between the

fry provider (catcher or hatchery) and the farmer. This margin is valued at \$0.67 per kilogram of shrimp produced for bagda, and \$0.88 per kilogram for golda.

The third bar from the bottom presents the costs of shrimp farming, including any and all inputs, labor, rent, and equipment. Since golda have higher yields per hectare, their costs per kilogram are less. Production costs per kilogram for bagda are \$2.48/kg and \$2.39/kg for golda. Although this difference is not pronounced, it does reveal the comparatively higher productivity and returns to prawn farming.

The fourth bar shows profits earned by the farmer and reflects the farm-gate price, the price at which the farmer sells to the intermediary, whether it is farias, aratdars, or commission agents. Few farmers sell directly to processors. Most processors engage commission agents to do their purchases. Earnings for the bagda farmers are approximately \$2.82/kg of output and \$3.75/kg of output for the golda farmers. Although this is a significant difference, it must be recognized that the bagda farmer's ponds are much larger, averaging 4.5 hectares, whereas the golda farmer's ponds are smaller. To further complicate the analysis, reflecting on the nature of the bagda growing cycle, the farmers engage in multiple activities during the year, such as harvesting fish and growing rice and vegetable crops simultaneously or sequentially in the same ponds or around them. Hence, when farm incomes are calculated instead of returns per kilogram for shrimp and prawn, the differences are much less pronounced.

From the farm, the shrimp are handled again by the farias, aratdars, and commission agents, and their total margin is shown in the fifth bar. It is impossible to distinguish margins between each of these marketing agents. What is shown is the difference between the farm and the processor; this margin is \$1.09 for bagda and \$2.31 for golda. The intermediaries receive a fixed commission per kilogram ranging from 5 to 15 BDT per kilogram. Their earnings depend on the volumes processed and costs incurred.

These prices and values do not reflect what happens when a fry catcher, farmer, or any intermediary receives credit from someone higher up in the value chain and uses this for personal consumption or operational inputs. When this occurs, the margins shift, because 10 BDT or more is subtracted from the price paid per kilogram by the lender to the loan recipient, and this difference serves as interest on the loans. It is not possible to estimate the rate of interest charged since it depends upon how much is loaned per kilogram handled.

It is clear that there is significant loss from spoilage along the chain of intermediaries which trade and transport shrimp and prawn prior to their purchase for processing. It is possible that as much as 16-20 percent of the total weight of shrimp is lost prior to processing.* It is clear, however, that spoilage reduces the margins for intermediaries and is borne largely as a cost to faria, aratdar, and transportation agents.

The next bar represents shrinkage. This reflects differences in the volume between what the processor purchases and what they pack out. This captures the loss of weight from processing and the removal of heads, tails, claws, etc. Since this is weight that was valued in the exchange up through processing, it is a parameter that allows us to

* An additional 10 percent of shrimp enter the domestic market for consumption.

convert the weight produced and sold before processing to the finished and processed product weight for export. About 30 percent of total weight is lost in this process, translating into \$3.50 per kilogram for bagda and \$5.50 per kilogram for golda.

Processing costs, the third bar from the top, are the same for bagda and golda shrimp in our analysis, since they are processed in the same plants and are effectively the same product. These costs include labor, energy, rent, machinery, and packaging. Costs are estimated at approximately \$1.11 per kilogram.

The second bar from the top reports earnings or profits per kilogram that accrue to the processors. This is \$0.92 for bagda and \$1.86 for golda. This difference clearly reflects the higher value of the golda prawns. An additional margin of \$1.00 for bagda and \$2.00 for golda reflects the wholesale price at the end of the value chain in the export markets.

COSTS AND RETURNS PER ACTIVITY

The data reveals that costs and returns vary significantly between and among the different participants along the chain, with farmers earning the greatest margin per kilogram (a little under \$3 per kg for bagda and almost \$4 per kg for golda). Processing plants earn surprisingly little per kilogram (less than \$1 per kg for bagda and almost \$2 for golda).

The returns from farm production and the margins for faria and aratdar appear to be comparatively high, and those for fry catchers significantly lower. These margins do not translate directly into earnings since the scale and intensity of activities vary. For example, fry catchers collect fry numbering somewhere between 20,000 and 50,000 per kilogram. Their returns, in terms of earnings, must be measured in income per day from collection. In peak season, they may collect about 67,000 fry in a month. As many as 4 people may be involved in catching and sorting this volume of fry. Moreover, the values presented in the histogram reflect the value of fries required to produce one kilogram of mature shrimp.

In traditional shrimp production, input use is minimal although the number of fry inserted into the ponds is relatively high. There is a clear trade-off between growth and stocking densities, particularly if farmers are not feeding and fertilizing the shrimp. Some small farmers clearly recognize that lower stocking levels can produce higher rates of growth with lower costs. That is, reducing stocking densities can raise productivity. This realization has led to the incremental adoption of modified traditional practices.

Feeding and fertilization is minimal in traditional shrimp production. What this leads to is the widespread practice of an exceedingly low cost per kilogram production system, and one which is very competitive. As a result, many people make money throughout the value chain, earning significantly above the local wage rate of 80 BDT per day.

In our sample, shrimp farmers appear to be earning approximately \$704 per hectare for bagda farmers, and \$2,500 per hectare for golda farmers. These values exceed local returns to rice or other grain crops. Only a limited range of vegetables could earn these levels of return, and this would only be possible if an efficient vegetable marketing system was in place. It is important to note that these returns include shrimp as well as other products that may be produced in the ponds, such as fish, salt, and in some cases

rice crops and/or dry season vegetables. Yet practicing polyculture and sequential cropping can increase total incomes, keeping the ponds productive throughout the year.

The margins earned by *faria*, *aratdar*, and commission agents might seem high, but it is important to remember that these returns are distributed among many intermediaries. While one programmatic goal may be to reduce the number of intermediaries, it is clear that they play a crucial role in the shrimp value chain ensuring that inputs reach farms and processors. Where communication is poor, information sparse, and transportation inadequate, these intermediaries perform a vital role getting fry and shrimp from disperse locations to the next production or processing point. These marketing agents typically operate through lending. They obtain funds from a marketing agent higher up the value chain, or from some other financial source, and lend money to those below them in the chain. As a result of lending, the buyer pays less for the product by roughly 10 BDT per kilogram.* Furthermore, the buyer/lender tries not to collect the total outstanding debt in order to keep the loan recipient continuously indebted to the buyer and to ensure that the loan recipient is tied exclusively to that particular buyer. This relationship breeds the potential for exploitation. The borrowers tend to become indentured workers for the buyers, and when borrowers do not pay or violate the conditions of the loans, compliance is extracted by force. As noted earlier, this system of lending is widespread throughout the shrimp value chain.

Our data reveal that the intermediaries (*faria*, *aratdar*, and commission agents) who market the fry or shrimp all earn incomes significantly above the standard wage rate of 80 BDT per day (\$1.23). Most of these agents receive between 5 and 15 BDT per kilogram of shrimp handled. On a per kilogram basis, this return is not excessive. The need to collect fries and shrimp from disbursed areas to bring them to the farms or the processors requires an elaborate system of collection and assembly.

Shrimp processing adds significant value to the shrimp by sorting, de-veining, de-heading, de-shelling, cleaning, packaging, and freezing for export markets. Freezing can be in traditional blocks or in IQF, which is increasingly in demand yet has low returns per kilogram. As a result the volumes processed must be high in order to generate significant revenues in this sector. Many processors complain that their activities are limited by the availability of raw shrimp. These low margins appear to be subsidized by fungible credit and tax exemptions for capital imports in the sector.

The shrimp processors appear to be operating at less than full capacity (some indications are they routinely operate at 20-30 percent capacity utilization). Furthermore, only 65 out of roughly 130 factories are in operation. Some plants are waiting for approval to initiate activities; others are in disrepair and out of business. Nonetheless, it is clear that there is excess capacity in the chain for the volume of shrimp currently being processed and exported. As a result, margins and incomes earned by processors are not large. It is important to note that processors have had subsidized or preferential access to credit for capital investments and machinery imports, which may have precipitated over-investment and led to the creation of excess capacity. Additionally,

* It is difficult to calculate the interest on these loans because total loans are given per season and the interest is collected in the form of a reduced price for the shrimp or fry sold.

previous studies and anecdotal evidence indicate that funds were obtained for establishing processing capacity; some of these funds were diverted to other activities. There is no direct evidence of this in our data, but secondary sources appear to confirm that some credit has been diverted away from shrimp processing.⁵² However, in order to open up new facilities or put old facilities back into production, an increase in total shrimp output will be required.

Our data did not allow us to compare returns to specific factors, such as labor and capital, across the different players in the chain. However, we were able to analyze these returns for the processing firms to determine their relative returns to capital and sales. These figures represent the net income earned over investment and net income earned over sales. Our results showed that these firms roughly earned 20 percent on capital and 2-3 percent on sales.

The analysis of costs and returns reveal that substantial margins are generated in the value chain. These margins are distributed across multiple actors. Many of the participants in the shrimp production and marketing chain earn substantial incomes from their activities. For some, these earnings are well in excess of local minimum or standard wage rates. The shrimp sector is clearly vibrant, earns money, affords comparatively high returns, and employs or absorbs many people (upwards of 1.2 million people). These returns could be better distributed to promote greater equality and more pro-poor growth. Furthermore, there are sufficient margins to consider raising revenue from the sector to address both social and environmental concerns.

EMPLOYMENT ALONG THE CHAIN

This section provides an estimate of the total numbers of people engaged in the shrimp sector. This does not estimate full time equivalent employment, based on 8 hours a day for 240 days a year, but rather provides an approximation of the numbers of people earning incomes from shrimp production and sale. In this case, the number of people employed or engaged in the sector is given by the number of people that work for a daily or monthly wage, or earn the equivalent of a daily wage from producing a product that is sold at a profit.

Using production figures and parameters from earlier estimates, we calculate that there are approximately 425,935 fry catchers. In 1990, the FAO calculated that there were 160,000 fry catchers. Production has increased almost fivefold since 1990. However, there has been a shift to more hatchery fry. We estimate that in 1990 approximately 10 fry catchers were required to generate one metric ton of live shrimp. In 2005, approximately 50 percent of all fry are sourced in the wild.

To develop an estimate of total employment in the chain we explore the ratio of intermediaries—farias, aratdars, and commission agents—to fry catchers. Applying averages of the number of clients each intermediary has, we estimate that there are estimated 26,800 farias, 4,000 aratdars, and 800 commission agents.

We estimate the total employment in feed production, including inshore fishers, gatherers, processors, and feed mills are about 50,000.

There are approximately 39,000* bagda shrimp farms and 110,000 golda farms, each employing an average of 3 workers per farm in addition to the owner, yielding approximately 600,000 workers in shrimp farming. Applying rough estimates for the numbers of clients serviced by different intermediaries, we arrive at approximately 10,500 shrimp farias, 3,200 shrimp aratdars, and 360 commission agents.

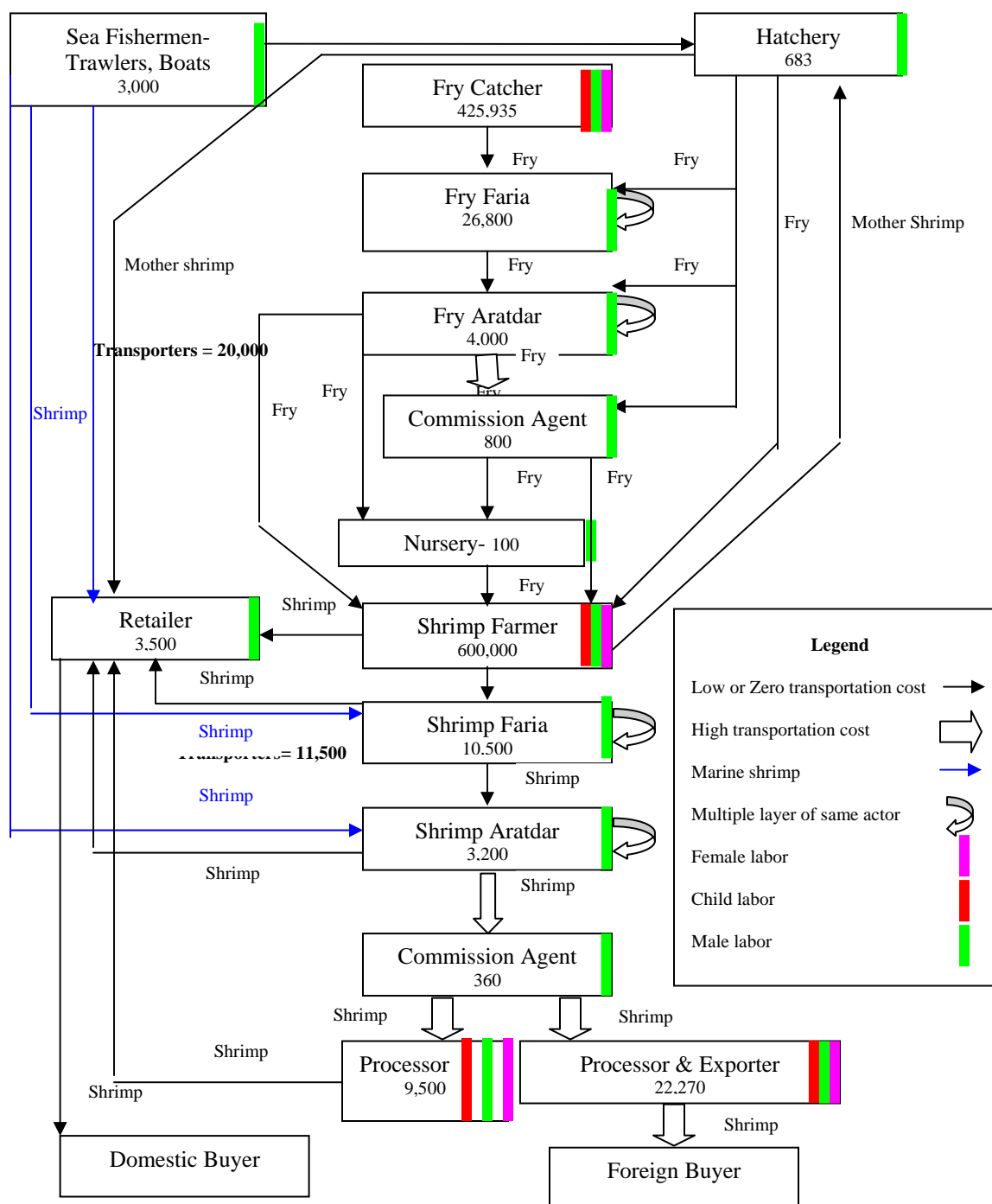
Secondary data have estimated the labor force of the processing companies to be 31,770 engaged in 130 processing plants, a number which may be high in light of our data, but that is widely used as a figure for employment in processing. The hatcheries employ roughly 680 people, and the trucking industry around 31,000. Retail outlets for shrimp employ 3,500, and the boats and trawlers employ approximately 3,000.

The total number employed in this sector, for relatively short periods or as full time equivalents, according to our estimates, reaches 1.2 million. Actual employment may be even higher if we consider the number of part time, temporary, and casual workers who we may not have identified. Although it is not true for all workers, a substantial number are earning wages above the local standard of 80 BDT (\$1.23) per day.

This is a large agribusiness sector and one which should be analyzed carefully. Our initial findings underscore that carefully designed interventions could improve income and earnings for workers and producers lower down the value chain. Improving modified traditional practices could increase output and earnings. Incomes could also increase even further if there were an organized approach to horticulture farming in the dry ponds after golda harvest. Doubling shrimp output, were that to be desirable, could potentially add another 800,000 workers. Introducing systematic horticulture employment in the winter dry season could add a further 2 jobs per hectare.

* The official data report different numbers of bagda farms. The Shrimp Foundation estimate that there may be as many as 55,000.

Figure 4. Actor Based “Marketing” Flow Chart “Employment”



CREDIT AND FINANCING

Virtually all of the intermediaries provide loans to their supplier clients. This type of informal credit system is very elaborate. Intermediaries obtain these funds from their buyers or from banking sources and money lenders. These funds are used to provide credit to fry catchers, shrimp producers, or other intermediaries to increase their supply of fries or shrimp. These loans are transferable and are not always used to purchase

inputs. They are frequently used to cover living expenses for the loan recipients in the lean season. The extent to which fry catchers or shrimp farmers take on these loans depends upon their ability to meet their immediate subsistence needs. It is not clear how much the intermediaries charge for these cash-in-hand loans, but interest is likely to be extremely high given that many clients remain indebted for long periods of time. Unfortunately, the system is maintained by the fact that production in one season rarely is sufficient to enable borrowers to repay their debts in full. Consequently, a form of indenture prevails, season after season, which serves to bind or coerce the loan recipients into remaining with the original intermediary, and subject to the discounted prices set by that intermediary.

Some loan recipients may try to underestimate their production in order to sell some of their product freely in spot markets. Borrowers are prevented from doing this by coercive practices that include violence and intimidation.

Informal credit is available throughout the system because the sector generates a highly valuable product. With such high prices, there is ample room for intermediaries to provide substantial amounts of financing to their suppliers. The suppliers are only too willing to accept these loans as advance payments which enable them to obtain inputs and cover subsistence living expenses in the lean season. As a result, the cycle repeats itself.

Lending outside the formal banking system will almost certainly lead to some form of exploitation and comparatively high costs. Yet without this liquidity, the procurement system could dry up, and shrimp fry would not be so readily available. Hence, a system which generates 1.2 million in employment, and over \$360 million in sales, with a potential multiplier effect of a further 3 million non-agricultural jobs*, is one which should be safeguarded and improved, rather than disrupted or destroyed. Rarely is a system found in agriculture or agribusiness where the influence of informal credit provision encompasses thousands of poor collectors and small farm producers.

COMPLEMENTARY ECONOMIC ACTIVITIES

FRUIT AND HORTICULTURE

Poly-culture of shrimp and other crops can increase food security, diversify the income portfolio and raise incomes for the rural poor. Bangladeshi farmers have pursued mixed aquaculture (typically capture aquaculture), rice paddy, and horticulture for several centuries. In June and July they would plant rice and harvest fish cultivated in the same paddy. In November and December they would harvest rice, followed by oil-seeds, pulses, and vegetables. Integrating these types of cropping patterns with shrimp cultivation has significant potential to improve rural livelihoods and meet local food security requirements.

* This applies Mellor's standard coefficient of 2.5 non-farm jobs per worker in agriculture (Mellor, "Relation Between Growth").

RICE

Mixed aman rice and shrimp is also a viable strategy to ensure food security and diversify income-earning for small farmers in some parts of the delta. This may work better with golda production or in areas where rains are sufficient to flush the shrimp ponds and reduce salinity. The FAO⁵³ has documented some of the positive synergies between rice and shrimp:

- After rice harvesting, debris and the remains of the paddy plant stem become food for the microorganisms through the process of bacterial decomposition. In turn these microorganisms feed the shrimp.
- During shrimp culture, the molted shells of shrimps and the heightened metabolite load enriches the soil through and contributes to organic fertilization of the soil for paddy culture.
- Sediments deposited during water exchange for shrimp culture also enrich the soil for paddy culture.

This system works best where farmers are land owners or tenants for the entire year. The FAO observes that where tenants for different crops are different, a competition for land can occur that reduces earnings for the paddy farmer. If the tenant shrimp farmer can influence the land owner to increase the time allotted to shrimp cultivation, this then will affect the paddy cultivation since the water in the pond is not drained in time to plant and harvest optimally.

FISH AQUACULTURE

A recent study of polyculture in Thailand underscores that fish and shrimp aquaculture has the potential to raise and diversify income sources.⁵⁴ Three versions of tilapia-shrimp* polyculture—simultaneous, sequential, and crop rotation systems—are practiced by Thai shrimp farmers. Tilapia is a shrimp species that is particularly well-suited to freshwater farming because it is easy to reproduce, tolerates varying water qualities, and is receptive to both natural and artificial foods. The only constraint for tilapia farming is the temperature: at temperatures less than 16°–17°C tilapia does not feed, and at temperatures lower than 10°–12°C it dies.

Yi and Fitzsimmons⁵⁵ find that among the farmers who adopt a simultaneous tilapia-shrimp polyculture system in Thailand, 76.9 percent released tilapia directly into shrimp ponds and 23.1 percent stocked tilapia in cages suspended in the shrimp ponds. The survey revealed that shrimp production and economic returns from the two simultaneous polyculture systems and the sequential polyculture systems were higher than those in the shrimp monoculture systems practiced before. Furthermore, shrimp production and economic returns from these polyculture systems were higher than those in the crop rotation polyculture system and in the currently practiced monoculture system. Additionally, there was evidence that the tilapia-shrimp polyculture could improve water quality in shrimp ponds, reduce disease, and decrease chemical use.

* Tilapia-shrimp polyculture can take place in a wide range of salinity levels from 0 to 30 percent. Tilapias used in polyculture in Thailand include red tilapia (*Oreochromis spp.*), Nile tilapia (*O. niloticus*), and Mossambique tilapia (*O. mossambicus*).

Some species actually perform better in the presence of other fish and crustaceans; freshwater prawn is one such variety.⁵⁶ When certain fish species that do not predate prawns, such as tilapia, are stocked with *M. rosenbergii*, their feces serve as a substrate for bacterial growth which provides additional nourishment for the prawn.⁵⁷ Another species that has the potential to grow well with golda is mono-sex GIFT, a strain of Nile Tilapia.

Fish cultivated in small ponds are typically consumed or sold in the domestic market. A mixed shrimp-fish aquaculture system has the advantage that fish can also be processed for consumption during the lean season. Fish processing by salting and drying is usually undertaken by women. PROSHIKA has worked with women's groups to provide technical assistance and loans to promote fish processing. The average loan provided is 100,000 BDT and it is repayable in one year. PROSHIKA has demonstrated that this activity can yield an average income per member of between 1,200 and 1,500 BDT per month.⁵⁸

ENVIRONMENTAL AND SOCIAL CONCERNS ALONG THE VALUE CHAIN

Shrimp farming has been the subject of heated debate and scrutiny as a result of the negative environmental and social impacts that have been documented around the world. As Bhattacharya et al⁵⁹ observe: "One of the reasons why this particular type of farming has come under close scrutiny on a global scale is that whilst open (capture) fisheries are generally deemed to be self-producing and self-sustaining, closed (culture) fisheries need direct use of inputs and human care, involve property rights and, whilst being renewable, generate a wide range of externalities* that makes sustainable development a critically important issue."

A number of significant external costs have been documented in Bangladesh that are associated with significant changes in land-use patterns and access rights which affect traditional agriculture activities and practices.⁶⁰ Since shrimp cultivation occurs in a closed or semi-closed system, there is potential for waterlogging and increased salinity levels to alter drainage patterns and the quality of the soil.⁶¹ Declining soil quality and the obstruction of natural drainage has been blamed for the spread of standing water-borne disease and a marked decline in the diversity of agriculture. Furthermore, the use of fine seine nets to sieve for shrimp larvae for cultivation has been associated with the decline of other fish species that were naturally occurring in the river deltas of Khulna and Chittagong. Finally, the loss of vegetative cover has also been attributed to increased salinization and salt water intrusion.

Where the density of shrimp farms has risen sharply, concerns about water-borne disease have also been documented.⁶² Standing water increases the likelihood of malaria and other mosquito-borne diseases. During cultivation when the ponds are being used, aquaculture can reduce the amount of mosquito larvae since they are eaten

* An externality describes a situation where the benefits or costs of an economic activity affect a third party. Pollution is clearly a negative externality.

by shrimp and fish. But when the ponds are not stocked, they may become a breeding ground for mosquitoes. While the net impact of shrimp farming on health is difficult to establish, some researchers have estimated that extensive farming may increase the risk of water-borne disease by as much as 50 percent.⁶³

Manju⁶⁴ documents the impact of shrimp farming in the village of Chalbunia. According to his analysis, the percentage of the population cultivating rice decreased from 33 to 13 percent as the proportion of farmers cultivating shrimp rose from 20 to 32 percent. Manju also documented the net impact on incomes as a result of external costs attributed to shrimp farming. Significant declines in income were documented that were attributed to declining rice productivity, the loss of poultry and livestock, the loss of homestead vegetation, and changes in social forestry brought about by changes in soil fertility and access rights. From these changes, Manju estimated that income levels for local peasant households were only 62 percent of their incomes prior to the shift to shrimp farming.

Similarly, social and human rights concerns have also been documented where land has been annexed for shrimp farming and where communities and activists organizing against shrimp production have been targeted for repression. There are also concerns about the terms and conditions of employment in processing factories, depots, and on boats. This section briefly summarizes these concerns and highlights the environmental and social costs that have not been addressed elsewhere.

SALT-WATER INTRUSION

This section pertains to the cultivation of bagda only. Salt-water intrusion is not a problem in the exclusive cultivation of golda or in golda-polyculture systems that use freshwater.

There have been few rigorous studies of the environmental impacts of salt water intrusion. Nijera Kori contracted the Soil Science Department of Dhaka University in 1996 to carry out a systematic analysis of the impact of salt water intrusion and waterlogging. The findings pointed to significant and unmitigated environmental costs. The report identifies the following costs:

- Increasing salinity and soil degradation;
- Deforestation and the destruction on homestead vegetation;
- Loss of coastal vegetation; and,
- Waterlogging leading to irreversible changes in wetland ecology and the loss of micro flora and fauna.

Other researchers and NGOs report similar findings. The Coastal Partnership for Development maintains that rice production has declined in many shrimp producing areas, leaving these communities dependent on rice imports from other parts of Bangladesh, imperiling food security, and undermining nutrition.⁶⁵ Additionally, the Environmental Justice Foundation report that in some shrimp producing areas farmers do not follow drainage management protocols and discharge pond water appropriately which contributes to seepage and salt water intrusion and reduces crop yields by up to one third.⁶⁶

Salt water intrusion affects both economic and household activities but can place a disproportionate burden on women who are largely responsible for provisioning fuel wood and water. As salinity increases in wells, fresh water is scarcer. The Environmental Justice Foundation documents the case of women and girls who have to walk further and carry water for greater distances to ensure that their household has sufficient access to drinking water.⁶⁷ The EJF attributes this to increased salinity as a result of shrimp farming.

EUTROPHICATION

Natural eutrophication is the process by which lakes, semi-closed, and closed water bodies age and become more nutrient-laden. This process normally takes place over thousands of years. Humans, through their various activities, have accelerated this process in thousands of lakes and water bodies around the globe. Anthropogenic eutrophication is water pollution caused by runoff from the application of excessive plant nutrients to crops, sewage, and other organic pollutants. Semi-intensive shrimp aquaculture can contribute to eutrophication with the discharge or seepage of nutrients and feeds added to the ponds.

LOSS OF LIVESTOCK

The expansion of the shrimp sector may contribute to the loss of livestock and access to grazing lands. The construction of ponds, dikes, and the annexation of land prevent villagers from accessing communal grazing lands. Additionally, community members may be discouraged from keeping patio ducks since ducks eat the shrimp larvae and feed. Livestock produce milk, meat, and dung for fuel. As a result, the landless or land poor lose additional income and a critical source of domestic fuel.*

DEFORESTATION

While much of the loss of mangrove forest in Bangladesh occurred over the previous 50 years, some areas have been deforested as a result of shrimp aquaculture. Among those forests that have been identified as experiencing significant deforestation as a result of shrimp aquaculture is the Chokoria mangrove forest in the Cox's Bazar region. Approximately 8,750 hectares of mangroves have been lost to salt water intrusion, dike and pond construction, and human intervention.⁶⁸ In addition, with the gradual deposition of silt encouraged by water management practices under shrimp cultivation, the land elevation has increased so that land is flooded only during the monsoon. As a result, the drainage system gradually changes which increases the retention of fresh water and alters the saline balance required for sustaining the mangrove forest.⁶⁹

Mangroves are highly valuable ecosystems that perform multiple functions which secure direct and indirect benefits for the coastal inhabitants. Mangroves are also essential for aquaculture and open sea fisheries in providing critical breeding, spawning, and nursery grounds for shrimp and commercial fish species. Their loss implies foregone sustainably

* The loss of domestic fuel has been linked to greater incidences of diarrhea and higher parasite burdens as fuel is prioritized for cooking and not for boiling water (EJF, "Smash and Grab").

harvested fuel wood and timber, the loss of key fisheries, barrier and filtration services, as well as habitat and potential pharmaceutical benefits.*

CONCLUSIONS

Shrimp is an important export for Bangladesh and its cultivation and processing provides livelihoods for the poor, small farmers, intermediaries, and exporters. However, the profits generated from shrimp exports are not broadly shared throughout the chain—there are marked differences in the benefits middlemen and farmers accrue in contrast to the surplus acquired by fry catchers. Furthermore, gender disparities permeate the chain leading to occupational segmentation, wage inequality, and increased job insecurity for women.

It is clear that the most vulnerable actors in the chain occupy the least secure employment, depend on open access resources, and have limited opportunities to upgrade their production or change the terms and conditions of their labor and product exchange. Women are not visible in many activities, in particular as *faria*, *aratdar*, or as management in processing. Instead, they are concentrated in the more flexible and insecure nodes of the value chain as fry catchers, farm laborers, gher workers, and shrimp processing plant workers. Insecurity in the chain is synonymous with lower incomes and greater vulnerability to poverty.

In order to increase the opportunities and benefits from trade, there is an urgent need to raise productivity and improve production methods in the shrimp sector. Additionally, efforts need to be made to reduce indebtedness lower down the value chain and free-up producers to sell in local markets without being tied to lenders. There are an excessive number of intermediaries in the sector. These intermediaries perform an important function injecting informal credit into a system that faces substantial credit constraints at lower levels of the chain as well as aggregating inputs and products over disperse geographical areas. Yet the density of intermediaries also illustrates substantial inefficiencies in the sector. Indebtedness binds fry-catchers and farmers into sub-optimal contracts with intermediaries reducing their returns and depressing incomes. Additionally, significant loss or spoilage occurs as the fry or shrimp pass through multiple intermediaries before reaching the farm or processing plant. Finally, social and environmental costs hamper growth in the sector. These costs can be addressed through improved aquacultural practices, better legislation, and enforcement. National policies concerned with the sector need to be revisited and a broader consultative process among stakeholders need to be developed.

Below, are some program and policy recommendations that may raise productivity, address social and environmental concerns, and ensure growth benefits are distributed more equally throughout the value chain. There are four overarching strategies to improve outcomes in the sector:

1. To increase incomes and assets for those lower down the value chain;

* The Environmental Justice Foundation reports that fishermen in Chokoria believe yields have declined by over 80 percent since shrimp farming has expanded in the region. They attribute this loss to the loss of mangroves and the construction of dikes and polders (EJF, “Smash and Grab”).

2. To improve the terms of trade and exchange;
3. To create a favorable policy and legal environment; and,
4. To increase stakeholder dialogue and voice within the chain.

RECOMMENDATIONS

The following recommendations are a distillation of those emerging from the analysis of the value chain which were refined in consultation with our technical advisory team. A summary of these recommendations appear in a policy matrix format within the executive summary. Some recommendations focus on a family approach to improving the lives of men and women within a household and increasing the income for the entire household, while others include gender specific interventions to increase opportunities for women in key segments of the chain.

INCREASE INCOMES AND ASSETS FOR THOSE LOWER DOWN THE VALUE CHAIN

SHIFT TO MODIFIED TRADITIONAL PRACTICES

- Support modified traditional practices. Increase production and returns by supporting small farmer's adoption of modified traditional practices. Increasing production by introducing modified traditional practices could prove particularly helpful for small farmers, and both men and women within the household should be trained in these approaches. Trainings should factor in women's household responsibilities when and where trainings take place, and both men and women should be trained as extension agents in order to provide these trainings in the future. The principal approach to this type of intensification is to increase the feeding rate significantly, reduce the population of fries, and introduce other forms of nutrients, such as fertilizer, to improve the growth of algae and other sources of food in the ponds. The Shrimp Seal of Quality project has a number of recommendations for such practices and should be drawn upon to increase the transfer of these technologies to small farmers. Yields from this system could approach 600 kg/ha, with corresponding incomes almost tripling those earned under traditional practices.

Bagda is unfortunately prone to a number of viruses including the White Spot Syndrome Virus (WSSV) that affected Bangladeshi production in 1995. WSSV was first documented in Asia in 1992-1993.⁷⁰ Rapid and complete pond mortality can occur in infected animals, particularly in semi-intensive and intensive systems. Although golda is not prone to WSSV, they can act as a carrier. To reduce the risks of contamination, farmers require virus-free larvae and need to adhere to strict hygiene requirements to prevent cross-contamination from other infected shrimp and crustaceans. In Thailand, management protocols endorse cleaning ponds with short-lived insecticides that kill other crustaceans that may also carry the virus.⁷¹ Since WSSV does not survive outside of a host for more than 3-4 days, treating the ponds in this way for a minimum of 5 days can reduce the risk of contamination. This practice could easily be integrated into the modified traditional approaches.

Others approach to keep ponds and stock free from viruses is to endorse the seed certification program (see Environmental Regulations and Guidelines section), provide support for adequate hygiene, and aid in water management techniques.

INCREASE GOLDA PRODUCTION

- Support the increased cultivation of golda. Bagda and golda are both valuable crops. Golda, however, garners higher prices in the market, faces fewer risks from viral contamination, and is associated with lower environmental impacts. Because golda farms are generally smaller than bagda farms (averaging 0.28 hectares compared to 4 hectares), golda cultivation supports a greater proportion of poor and marginal farmers.⁷² Furthermore, women are more visibly engaged in golda production as farmers, feed production workers, and in nurseries. Care should be taken to ensure that women are not displaced from these activities if additional resources are channeled towards golda production. Additionally, investments should be made in nursery and feed production, where women are engaged, particularly in the golda sub-sector.

Efforts to increase the share of golda produced by small farmers, following examples such as the Noakhali Aquaculture Extension project supported by DANIDA and the CARE/ICLARM projects, could prove successful. USAID could provide resources to distill the lessons learned from these projects and promote their replication in other regions of Bangladesh to build on their proposed project of expanding prawn culture in Pabna and Mymensingh.

Although golda and bagda are grown in different regions, there are opportunities to expand the production of golda further inland. Additionally, some bagda farmers are adopting sequential badga and golda cultivation during the rainy season as the levels of salinity drop in their ponds.

Table 9. Production, Costs and Returns for Bagda and Golda

Type of Shrimp	Bagda	Golda
Production/Hectare	133 kg	496 kg
Costs/Hectare	\$552	\$1,533
Income/Hectare	\$793	\$3,947
Cost/Kg	\$4.16	\$3.74
Sale Price/Kg	\$5.99	\$8.16
Net Return/Ha ^a	\$242	\$2,225
Additional Income/Ha ^b	\$463	\$225
Total Net Income/Ha	\$704	\$2,450

Notes: ^a The bagda yield is exceedingly low. Any increase in productivity, up to 250kg/acre, would increase bagda earnings to \$920. This is the minimum productivity recorded by the ATDP project for traditional practices. Polyculture of other fish species would also significantly increase per hectare earnings.

^b Additional income is generated by harvesting other fish from ponds growing aman, aus, and boro rice, as well as harvesting salt and raising vegetables in the dry season along the banks of the ponds.

COMPLEMENTARY PRODUCTION

- Support projects to develop complementary production. A variety of complementary production and polyculture types could be implemented that would increase returns, reduce risk, and ensure greater food security for small producers. This can either be done in the shrimp ponds themselves or

undertaken sequentially so that the cultivation of different species is part of the water management and treatment process. Not only does such an approach increase yields and diversify risk, but it also has the potential to absorb more labor, potentially the labor that may be displaced from fry catching.

Following are the opportunities with which polyculture could be mixed cropping systems:

- Carp
- Tilapia
- Milkfish
- Mullet
- Clams
- Scallops
- Mussel
- Oysters
- Mud crab

An additional feature of polyculture systems is that they require labor for sorting at harvest time. A labor abundant country such as Bangladesh should have no difficulty contracting additional workers at harvest time. USAID should consider supporting projects that integrate polyculture into their activities and focus on small farmers.

Other types of mixed cropping systems could include aman rice, horticulture, and timber.

FEED PRODUCTION*

- Invest in domestic production of shrimp feed. In addition to the diversification of homestead and small-farmer production, there are opportunities to substitute domestically produced feed for imported feed. Currently, the majority of shrimp feed used is imported. Shrimp feeds require higher protein content than fish feeds. These feedstuffs are both expensive and occasionally problematic. There is a danger of viral contamination from the imported feed since the feed is frequently made from animal and vegetable proteins. This is also the case for domestic feed if it uses these ingredients without care. Furthermore, feed can be a source of nitrofurans introduced to control fungal contamination. Care needs to be taken as expanding the feed sector also increases the quality of the feed available.

A number of sources for protein, carbohydrates, fats, vitamins, and minerals which are derived from raw materials currently available in Bangladesh can be considered for shrimp feed:

- Legumes: soybean meal, soybean flakes, green pea meal, etc.
- Miscellaneous fodder plants: sweet potato leaves, cassava leaves, water hyacinth.

* We are grateful to the BFFEA and Alhaj Ali Hassan Chowdury Secretary General of the Shrimp Hatchery Association of Bangladesh for detailed information on this section of the report. We also draw on findings from Suprayitno and Widagdo (2003).

- Roots and tubers: sweet potato, cassava, sago, molasses.
- Cereals and cereal by-products: rice bran, broken rice, corn meal, wheat flour, sorghum.
- Oil cakes: copra meals, copra oil, palm oil, corn oil, ground peanut cake, etc.
- Feeds of animal origin: blood meal, meat and bone meal, bone meal, shrimp meal, fish meal, earthworm meal, hydrolized feather, limestone powder, squid meal, clam powder, fish liver meal, white fish meal, etc.
- Other feedstuffs: Vitamin sources in synthetic form are available commercially and premixed, or are sold individually or in combination of two or more. Vitamins that are usually added to the ration are vitamins A, D, E, K and B12, choline, niacin, riboflavin, pyridoxin, vitamin, calcium, panthothenate, biotin, folacin, ascorbic, and inositol. Mineral sources: calcium, phosphorus, sodium, chlorine, potassium, iron zinc, cobalt magnesium, and iodine.

Sourcing nationally will increase the backward linkages in the sector and secure employment benefits. Additionally, some of these inputs could be produced locally by small producers, cooperatives, and women-owned businesses. USAID could provide resources to expand the local production of feeds with a higher nutritional content that target small producers and women-owned businesses.

EXTENSION SERVICES

- Provide extension services. Extension services along the value chain are critical, both to promote and enhance upgrading and to shift producers to complementary economic activities. Extension services and technical assistance can be provided through a variety of mechanisms: the Department of Fisheries; NGOs working in particular regions; the Bangladesh Shrimp and Fish Foundation; farmer associations; and, shrimp processing plants. In the latter case, the extension could be deployed to ensure the integrity and continual supply of shrimp and prawn to processing plants.

Certainly, the Department of Fisheries believes that the failure to provide targeted and appropriate extension services has accelerated the spread of disease and increased the risks borne by small farmers and traders:

One result of the lack of support is the prevalence of diseases, reducing survival, lowering yields and reducing profits (DoF, "Management Options," 3).

The lack of handling, transporting and pond stocking techniques of traders and pre-nursery operators and the shrimp farmers themselves also contributes to poor survival rates of fry (estimated at 60-70 percent) (DoF, "Management Options," 3).

Extension services must provide information that is easily understood and applied. Popular education techniques, pamphlets, cartoons, audio-visual materials, dramatizations as well as workshops and on-site visits can be targeted to a wide audience of both men and women. Many of these materials already exist but need to be more widely disseminated and used.

NURSERIES

- Introduce nursery production. Simple nursery production methods can be introduced through the construction of a shallow nursery pond within the confines of each grow-out pond. With a two phase production cycle, farmers stock juvenile shrimp from hatcheries in nursery ponds and, several weeks later, transfer the juveniles to grow-out ponds. Shifting to a two phase production process increases survival rates and allows for more continuous production. The Department of Fisheries could provide training through NGOs to provide the technical expertise required to expand nursery production on farms and to acclimate fry sold to farmers by aratdar. Women are currently involved in nursery production (particularly in golda) and, as production expands, could be targeted for trainings in order to attain employment at a nursery.

FARMER ASSOCIATIONS

- Organize associations. Greater returns could also be secured for small farmers through organizing and pooling their resources for shrimp culture instead of leasing their land to large farmers. This would require efforts to support farmer associations:* create collective storage, post-harvest processing, and refrigeration facilities; encourage shared transportation; and, provide extension services to collectives and associations of small farmers.

IMPROVE THE TERMS OF TRADE AND EXCHANGE

MARKETING SYSTEMS

- Foster and expand spot markets and auctions. Spot markets and auctions offer farmers and intermediaries higher prices. Injecting credit into the sector lower down the value chain and expanding spot markets could release many small farmers and intermediaries from usurious contracts. Expanding depots and encouraging auctions as well as providing resources to ensure that depots meet compliance requirements and standards could increase the returns lower down the value chain and ensure that these returns are better distributed.

USAID could work with the Department of Fisheries to identify regions lacking depots and provide targeted credit and assistance to increase the use of auctions and spot markets.

CREDIT AND FINANCIAL SERVICES

- Break the cycle of indebtedness. Clearly, a cycle of indebtedness and sub-optimal contracting prevails along the value chain. Fry collectors, inshore fishers, farmers, faria, and aratdar are indebted and indebt others; they are locked into contracts that perpetuate this cycle of debt. Providing flexible credit to enable small producers and intermediaries to invest, upgrade, and adopt better management practices would alleviate debt burdens and free agents to seek better contracting arrangements. Repayment schedules and horizons should be flexible and reflect the likely yield stream of the activities in question. Credit

* Farmer collectives should include both male and female households and workers.

should be graduated and lending should be extended to groups if individuals do not have sufficient capital or assets for collateral.*

Historically, credit has been available in the sector but has been targeted at the higher end of the value chain. The Department of Fisheries has identified a pressing need to provide credit to activities lower down the value chain. Specifically, DoF recommends offering credit facilities to improve the development of extension services for farmers, post harvest practices, and water management regimes in the polders.⁷³ The DoF recognizes that targeting funds to the production sector will require a more decentralized and responsive system. They recommend that financial resources be divested at the Union Parishad level, or a local government division, and priority given to improving extensive production systems and post harvest practices.

- Provide options for credit. USAID could work with the Government of Bangladesh and development organizations to provide credit through specialized micro-finance agencies. The credit should be offered with technical assistance and tied to specific investments. In the case of fry and shrimp farming and aratdar, they can upgrade their fry and shrimp management by adding drums and containers and, where appropriate, cooling, water treatment, and feeding. Similarly, in the case of shrimp farmers, credit could be provided for specific investments in pond excavation and treatment, water management, feeding, and hygiene. Credit could also be provided to diversify out of shrimp production and increase the portfolio of arable crops and horticulture. Credit could be provided for individually and collectively owned enterprises to produce shrimp and fish feed to substitute for imported feed. Since feed production is likely to be a female intensive activity, these credits could be marketed towards women, women-owned enterprises, or women's collectives.

APPROPRIATE TECHNOLOGY TRACEABILITY MEASURES

- Introduce technology. Introducing low cost and appropriate technology traceability measures could increase the price at which fry and shrimp are sold. Labeled and dated buckets and drums for transportation, feed sacks that are labeled and dated, and barcode labels for transported fry and shrimp could be easily implemented to maximize traceability and increase compliance.[†] The goal would be to work towards traceability in the entire chain from feed mills and fry, through processing. The provision of credit and extension should also require recipients to implement such measures.

LINK FARMERS WITH PROCESSING PLANTS

- Link the chain. There is an urgent need to develop linkages between shrimp farmers and processing plants. This would reduce the number of intermediaries and ensure greater product integrity, maximizing quality and traceability. There is

* The GNAEP project has implemented similar programs with fishers and fish driers in Hatiya, where they have refinanced the loans and connected the fishers directly with a local miller in Noakhali. Preliminary evidence would indicate that incomes have risen and debt burdens have been reduced.

[†] For similar approaches refer to the Noakhali GOLD project supported by DANIDA which has implemented low cost and appropriate technology traceability measures with tremendous success.

potential for the factory to provide capital to farmers and the farmer to supply shrimp to the processing plants.

DIVERSIFY PRODUCTS SOLD FOR EXPORT

- Diversify. For processors, adding new products and diversifying the range of products available provides another opportunity for value addition. Exporting “heat and eat” and semi-cooked products may provide a new retail niche for Bangladeshi shrimp exporters.

CREATE A FAVORABLE POLICY AND LEGAL ENVIRONMENT

A range of options may be available to the shrimp sector to improve environmental outcomes and to address social and human rights concerns. These will require a more favorable policy and legal environment.*

ENVIRONMENTAL REGULATIONS AND GUIDELINES

The sector should be encouraged to develop a series of environmental guidelines and protocols that are consonant with existing environmental laws and regulations. These guidelines should be developed consensually and consultatively under the auspices of an independent or semi-autonomous body (see Institutionalizing Change section). Clear definitions need to be developed for extensive and semi-intensive production, and zoning regulations should be designed and implemented that are appropriate for each region.† These guidelines and protocols will define extensive and semi-intensive methods of cultivation that are based on stocking densities, input usage, nutrient recycling, and discharge.

- Fry catching should be gradually phased out and incentives developed to absorb displaced fry catchers in other economic activities. The Department of Fisheries has developed a series of guidelines with stakeholders that provide recommendations for phasing out this activity.⁷⁴ As an interim measure, fry catchers could be issued permits and licenses that allow the seasonal capture of fry. The Department of Fisheries recommends an open season from April to September in addition to providing training for catchers and traders to improve catching methods that reduce by-catch, better handling, storage, and transport methods. Although women participate in fry catching in some regions of Bangladesh, they remain a minority. Nonetheless, specific outreach and training should be provided for women to assist them in developing new livelihood options. The Department of Fisheries also advocate further regulating the

* It is important to note here that a number of prominent grassroots organizations and activists, most notably groups such as Nijera Kori, maintain that any attempt to ameliorate the environmental and social costs will be insufficient and will only allow current perpetrators to continue to evade poorly enforced rules and regulations. For these groups, the environmental and social costs far outweigh the potential gains (Nijera Kori, “Impact of Shrimp Cultivation:; Adnan, “Coastal Aquaculture and Environment”). Other groups, such as the Centre for Policy Dialogue and the Coastal Development Partnership, believe that the environmental and social costs are significant, but that there may be measures that can be implemented to reduce these costs and improve the lives and livelihoods of those who are working in the sector (Bhattacharya et al, “Environmental Impact”; Tutu, *personal interview*).

† Zoning should be undertaken at the Thana and Upazila level and be overseen and approved by the appropriate authorities, including the Department of Fisheries, Bangladesh Water Development Board, Ministry of Land, Ministry of Forests and Environment, Thana Nirbahi Officer, and the Upazila Nirbahi Officer.

broodstock fishery to protect stocks in addition to releasing hatchery fry into coastal areas to replenish stocks.*

Efforts should also be made to enable fry-catchers to switch into other economic activities. These could include feed production, operation of shrimp fry nursery, shrimp fry trading, artisanal production of fishing traps and gears, operation of fish feed mills, shrimp de-heading for processing, crab fattening, hogla and mat making, bee-keeping, coir industry, tree plantation, horticulture, tailoring and knitting, etc. Training for women fry catchers could focus on production of traps and gears, operation of feed mills, shrimp de-heading, mat making, bee-keeping, or knitting. Credit and training could be provided to facilitate diversification into other activities.

- Promote seed certification. Seed certification for hatchery fry is required to ensure the continued production and supply of quality hatchery bred shrimp seeds. Seed certification requires the screening of shrimp brooders and seed lots for viruses and deformities using quick and reliable diagnostic techniques. Seed certification should generate a demand for certified seed that will facilitate a shift away from over fished wild-caught fry. A careful evaluation of existing programs that have attempted to introduce seed certification, such as the FAO “Empowerment of Coastal Fishing Communities for Livelihood Security” in Cox’s Bazar and the DANIDA Greater Noakhali Aquaculture Extension project, should yield concrete recommendations on how to implement and expand such a program.
- Encourage the use of biofilters. Shrimp producers adding feed and fertilizers to their ponds should be encouraged to introduce settlement ponds, canals, and biological filters (biofilters) that treat the effluent. These ponds capture nutrient-rich sediments so that they are not released into local waters. Suspended solids can take a week to settle out. Similar experiments in Colombia have found that an area equal to 10-25 percent of the surface area of the ponds is required for adequate settlement and treatment.[†]
- Review and revise existing laws and regulations. There is a need to review all pertinent laws and regulations to develop a unifying framework and a comprehensive law, such as a Sustainable Shrimp Culture Act, which could encompass all aspects of sustainable shrimp aquaculture, land management, and conservation. These laws and regulations include the Fish Act (1950), Shrimp Mohal Management Policy (1992), the Shrimp Cultivation Tax Act (1992), and the National Fish Policy. Additional documents such as the Bangladesh Environment Conservation Act (1995), the National Environment Management Action Plan (NEMAP), and the National Conservation Strategy also lay out guidelines that are relevant for sustainable shrimp culture.

* These recommendations were developed in a workshop and were endorsed by hatchery producers.

[†] See for example work by WWF

http://www.panda.org/about_wwf/what_we_do/policy/agriculture_environment/commodities/shrimp/better_management_practices/nutrient_loading/index.cfm

The Department of Fisheries has made significant inroads in identifying policy and legislative reform that could harmonize existing laws and regulations as well as address some of the environmental and social concerns.⁷⁵ Additional donor funds and resources directed towards enacting these recommendations and policies would prove particularly useful.

LABOR RIGHTS AND BENEFITS

- Develop a welfare fund for workers in the sector. Clearly, in the interim, as the sector grows and transforms, many workers will remain informal, working without contracts, IDs, and mandated benefits. Informal and sub-contracted workers do not have access to those benefits extended to formal workers, including health care and pensions. One way the Government of Bangladesh could formalize the provision of these benefits to informal workers in the sector could be through a Welfare Fund, taxing not the employers but the revenues generated in the sector.* The welfare fund could operate hospital and dispensaries, award scholarships, and provide school supplies and uniforms to the children of shrimp sector workers. Such a system could be particularly useful to ensure that the children of informal workers in the shrimp sector, including fry catchers, have the opportunity to go and remain in school.

As the market becomes more sensitive to the terms and conditions under which shrimp are produced—particularly in Europe—the possibility of taxing the shrimp sector revenues to ensure workers receive coverage for health care and pensions is likely to be well received.

- Encourage ethical trading initiatives. Another avenue for distinguishing Bangladeshi shrimp, increasing market share, and ensuring improved terms and conditions of employment could be through supporting ethical and fair trading initiatives. For example, the Ethical Trading Initiative (ETI) is an alliance of companies, NGOs, and trade union organizations based in the United Kingdom. The ETI exists to promote and improve the implementation of corporate codes of practice which cover working conditions in specific supply chains. The ETI works with local stakeholders in developing countries to develop codes of conduct, monitoring and verification procedures, and certification for traded products. Their goal is to ensure that the working conditions of workers producing for the UK market meet or exceed international labor standards.[†]

An alternative group that is keen to establish ethical trading initiatives is the Fair Trade Foundation (FTF) in the UK, representing the Fair Trade Labelling Organization (FLO).[‡] The FTF is currently exploring the possibility of certifying the DANIDA Noakhali Gold prawn producers. FTF is working with the DANIDA producers to see whether they can develop appropriate standards and codes for the sector.

* India has a similar system for *bidi* workers who produce hand-rolled cigarettes (Jhabvala and Tate, “Out of the Shadows”). The *Bidi Workers Welfare Act* (1976) stipulates that revenues generated by the sector be taxed to create a welfare fund administered by the Government.

[†] See for example, <http://www.ethicaltrade.org/>.

[‡] See <http://www.fairtrade.net/>.

Similarly, the Shrimp Seal of Quality Program (SSOQ) is attempting to address a wide range of social, environmental, and labor right concerns through the certification of standards. The standards developed through the SSOQ program describe the requirements that must be met by shrimp operators (hatcheries, farmers, depots or transporters, processors, etc.) in Bangladesh in order to receive SSOQ certification.* SSOQ is a voluntary process certification and certifies that the operator has met the minimum requirements in the areas of food safety and quality assurance, traceability, environmental sustainability, labor practices, and social responsibility.

Finally, a number of private sector initiatives are also emerging in the aquaculture sector. The Aquaculture Certification Council (ACC), based in the US state of Missouri, builds on the voluntary standards set by the Global Aquaculture Alliance Responsible Aquaculture Program. The ACC's mission is to "help educate the aquaculture public regarding the benefits of applying best management practices and the advancing scientific technology that directs them. By implementing such standards, program participants can better meet the demands of the growing global market for safe, wholesome seafood produced in an environmentally and socially responsible manner." The ACC has developed a "Certification of Aquaculture Production Processes for Seafood Buyers" that combines site inspections and effluent sampling with sanitary controls, therapeutic controls, and traceability measures. This certification is currently targeted toward seafood buyers and shrimp producers and processors.⁷⁶ ACC has introduced the possibility of "Four Star Certification" of production systems, involving certification of hatcheries, feed producers, grow-out systems, and processing plants. But this is in an incipient phase.

USAID could consider providing funds and technical assistance to enable farmers to meet these types of standards and quality assurance measures by expanding programs, such as the SSOQ, to meet the needs of small and tenant farmers. Such an initiative could be implemented in tandem with low cost appropriate technology traceability measures.

LAND TITLING AND ACCESS RIGHTS

- Support projects that guarantee and uphold property rights. A more secure system of tenure is essential for improvements within the existing system. Property rights include individual and collective title to land. Existing court cases disputing dispossession have yet to be adequately resolved⁷⁷ and concerns about land insecurity for tenant farmers remain unaddressed in many communities. Nijera Kori estimates that 70 percent of all cases currently in local and national courts pertain to land-related disputes.⁷⁸ Progress must be made on land rights to reduce individual and collective risk and to ensure the rights of communities. In the absence of this progress, certification under ethical trading vehicles will not be earned.

* The SSOQ standards can be downloaded at: <http://www.enaca.org/modules/mydownloads/viewcat.php?cid=101>

- Protect khas land rights. Among the key concerns raised by NGOs working on environmental and human rights are those that relate to khas land. Khas land should not be used for shrimp cultivation unless the cultivation is extensive and it can be proven that: 1) those households cultivating shrimp ponds are landless or land-poor, and 2) they have elected to cultivate shrimp freely and without being subject to duress. Prosecution of rights to khas land is an imperative that should not be ignored. The Government of Bangladesh should take pains to ensure that collective rights to khas land are protected.

Additionally, where the same land is cultivated in sequence by several tenants, efforts to promote greater livelihood security can be significantly undermined. Initiatives that focus on diversifying the portfolio of crops cultivated—including shrimp and fish aquaculture, and shrimp and rice—may need to be accompanied by support for more secure tenure and defined access rights.

- Secure tenure regimes and titles. USAID could support broader initiatives to investigate appropriate individual and collective tenure regimes and secure land title for the landless and land poor. Women's land rights are largely secured through their relationship to a male family member.* Changes in that relationship, such as those brought about by marriage, divorce, death, and widowhood, can undermine a woman's rights to land. Care should be taken to ensure that land title is extended legally to both spouses, and that women's inheritance rights are observed and protected. Initiatives to increase titling to the rural poor should make clear provisions for women, most particularly divorced and widowed women.
- Support optimal land management. USAID could also support participatory analyses of optimal land management practices in areas where shrimp cultivation is being practiced. Where access rights to common property and grazing land have been undermined additional costs are imposed upon households. If these changes result in fewer head of livestock, an essential source of animal protein and fuel wood may be lost. Similarly, if shrimp farming reduces the portfolio of crops grown locally, the nutritional implications can be far reaching and should be fully evaluated. The costs of the reduced availability of staples and animal proteins may not be distributed equally; calories may be prioritized for income earners, typically men, and women and girls may bear the brunt of any nutritional deficit. Additionally, if dung is not available for fuel, women may have to spend greater time gathering fuel wood to meet domestic cooking needs. The increase in time burdens may have significant impact on the caring responsibilities, welfare, and wellbeing of women and children in the household.

In support of SO13 “A better educated, healthier and more productive population” and SO14 “Improved food security and disaster mitigation, preparedness and relief,” USAID could consider providing resources to evaluate the full costs of shrimp

* Patrilineal inheritance systems, dowry, early marriage, and female seclusion contribute to women's subordinate status (Kabeer, “We don't do credit”). See also McGill (2006).

farming in terms of changes in local measures of food security and nutritional indicators as well as time burdens and intra-household impacts.

DATA COLLECTION

- Invest in better data collection. Secondary data on shrimp production and marketing are extremely difficult to obtain and may be contradictory. Efforts to invest in sex-disaggregated data collection and verification could greatly improve policy and inform targeted and responsive interventions. The Department of Fisheries has diligently tried to collect and monitor data from the sector, but could benefit from additional resources and technical assistance to ensure that the data gathered is consistent and verifiable.
- Foster inter-institutional data exchange. Greater efforts could be made to foster the inter-institutional exchange of data on the sector among a number of agencies, including the Bangladesh Bank, the Bangladesh Bureau of Statistics, the Ministry of Food, the Ministry of Land, and the Ministry of Environment and Forests. Triangulating information and cross-verifying estimates of costs and returns in the sector will also improve policymaking. Furthermore, inter-agency collaboration could provide additional means of combating unlawful laundering, diversion, and misuse of credit in the sector. USAID could provide support for an inter-agency task force on data collection that would address improvements in generating and verifying data on the sector.

INCREASE STAKEHOLDER DIALOGUE AND VOICE WITHIN THE CHAIN

INSTITUTIONALIZING CHANGE

- Create an independent oversight body. It is clear that to effect these recommendations support will need to be given to current ministries—including Labor, Health, Agriculture, and Fisheries and Livestock. Additionally, we recommend that the Government of Bangladesh consider creating an independent body that is vested with powers to inspect farms, processing plants, export facilities, and to ensure that compliance is upheld. This independent oversight body should be quadpartite, composed of representatives from the private sector, government, labor movements, and civil society. The civil society representatives should be chosen to reflect environmental and social concerns, and to ensure that the concerns and interests of the landless and land-poor are included in any directives issued by the independent oversight body.

This body should be responsible for developing guidelines and protocols to govern shrimp aquaculture that include: definitions of intensive and extensive farming; zoning and land-use regulations; wetlands conservation and mitigation obligations; upholding common property and access rights in shrimp aquaculture regions; biodiversity protection including protocols for brood stock and fry harvesting; and, measures to monitor and ensure compliance. Where possible, these guidelines should be introduced as regulations and ordinances following the appropriate legal and judicial procedures.

CONTINUOUS MONITORING

- Undertake continuous monitoring. It is clear that an independent body composed of the principal sectors engaged in and affected by shrimp farming should pursue continual monitoring and oversight. Deliberate and persistent evasion of regulations or the failure to adhere to existing laws and ordinances should be sanctioned—either by curtailing access rights to open access resources, such as marine and coastal fisheries, or by reducing access to credit, technical assistance, or tax benefits.

ANNEX 1: NATIONAL AND INTERNATIONAL MARKET INDICATORS

Table 1. Market value of share prices in BDT

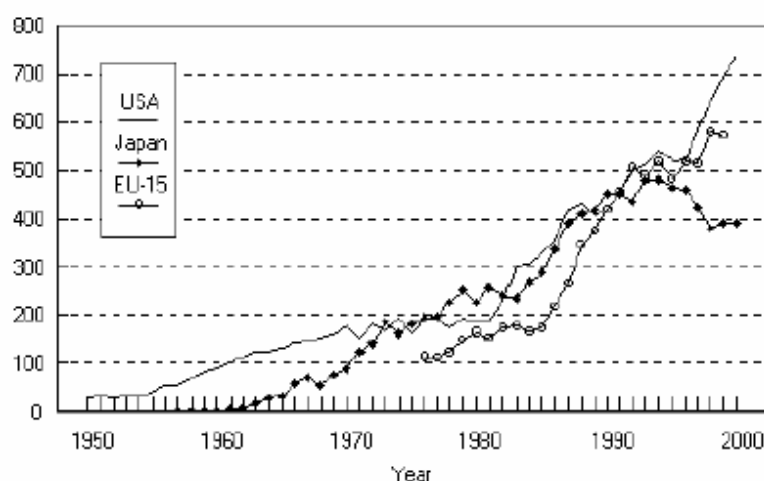
Name	Face value of share	Current market share price
Meghna Shrimp	100.00	16.75
Bionic Seafood Exports Ltd.	10.00	2.20
Beach Hatchery Ltd.	10.00	3.70

Source: The Daily “Prothom-alo” on November 01, 2005

INTERNATIONAL MARKETS AND PRICING

The total volume of shrimp traded continues to rise in the three principal markets: Europe, the United States, and Japan (see Figure 1). The greatest volume of shrimp from Bangladesh is exported to EU countries, with the United States being the second major consumer (see Table 5). The resumption of foreign buyers’ interest in Bangladeshi shrimp creates an opportunity for further expansion in this sector. Growth in the US market appears to have the greatest potential for absorbing Bangladeshi shrimp. Between 1990 and 2004, imports of Bangladeshi shrimp almost tripled, rising from 14,733 thousand pounds to 38,314 thousand pounds product weight (6,685 thousand to 17,384 thousand kg). According to the National Fisheries Institute, Americans spend around \$50 billion each year on seafood. The bulk of this spending, approximately 68 percent, is spent on fresh or frozen seafood—with shrimp being the primary commodity.*

Figure 1. Volume Imports of Shrimp to Principal Markets (Thousand of Metric Tons, Round Weight)



Notes: It appears that household income and consumption expenditures, and in particular consumption of shrimp, may have been significantly affected by slower growth in Japan’s economy in the 1990s.

Source: NOAA, “Southeast Shrimp Fisheries”.

* See <http://www.foodmarketexchange.com/>

Table 2. Exports of Bangladeshi Shrimp (Percentage)

Country	Percentage of Earning in terms of Value	
		Sub-Totals
USA	34.78	34.78
Japan	11.26	11.26
EU Countries		48.74
Belgium	16.22	
U. K.	11.26	
Netherlands	8.59	
Germany	6.86	
Denmark	2.07	
France	1.15	
Norway	0.92	
Switzerland	0.76	
Italy	0.91	
South East Asia		2.21
Thailand	0.12	
Singapore	0.29	
Malaysia	0.08	
Taiwan	0.05	
Hong Kong	1.67	
Australia	0.03	0.03
Middle East	0.05	0.05
Saudi Arabia	0.03	
UAE	0.02	
Other Countries including India	2.93	2.93
Total	100	100

Source: Bangladesh Export Promotion Bureau, 2004

Shrimp exported from Bangladesh is inspected in Singapore to ascertain whether it meets importer standards before it is sent to the buyer. SGS, Switzerland* and LLOYDS, UK are the international agencies that perform the pre-shipment inspection before shipment to the buyer. Additionally, some in-country inspections in Bangladesh are also performed by appointed quality inspectors for processors and exporters, buyer-designated quality assurer, and EU delegated Government bodies.

Despite rising world demand, the prices by weight for shrimp have been declining in recent years as supply has increased. The trend in shrimp prices was consistently upwards between 1970 and 1990. Thereafter, world prices of shrimp in the major markets largely stagnated and, since the late 1990s, have begun to decline in some markets. As of December 2005, shrimp in Bangladesh were fetching a price of between \$15.07 and \$6.16 per kilogram depending on the numbers of shrimp per weight. Unfortunately, the real value of prices secured by exporters and processors has declined since the late 1990s (see Figure 2).

* See <http://www.ch.sgs.com/>

Figure 2. Real Value of Bangladesh Black Tiger Shrimp, Headless Tail On, New York Frozen Wholesale Shrimp Prices (1990 \$/pound)

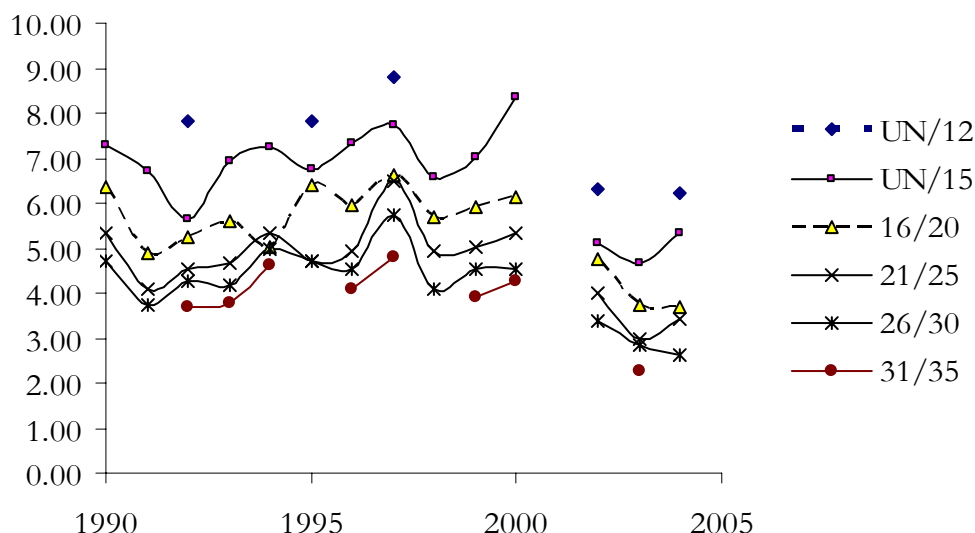


Table 3. Preference of Shrimp Importers

Importing Country	Shrimp Type	Grades (shrimps per pound)
Japan, Vietnam, and India	Black Tiger	8/12, 13/15, 16/20, 21/25, 26/30, 31/35, 31/40, 41/50, 51/60, and 61/70
US and Europe	Freshwater Golda	U/5, 6/8, 8/12, 13/15, 16/20, 21/25, 26/30, 31/35, 31/40, 41/50, and 51/60
US and Europe	Chaka (Sea water White, Sea water Brown, and Sea water Catfish)	61/70, 71/80, 71/90, 81/100, 91/120, 100/200, 200/300, 300/500, Broken
Spain	Horina (Seawater Gray)	61/70, 71/80, 71/90, 81/100, 91/120, 100/200, 200/300, 300/500, Broken

Source: Personal interview with Mr. Khairul Anam, owner of Unique Ice and Foods Limited.

Table 4. Shrimp and Prawn Catches in Bangladesh in Metric Ton

Year July to June	Shrimp and Prawn				
	Marine Capture Fishes		Inland Aquaculture	Inland Water Capture	Grand Total
	Industrial Trawler	Artisanal Catch			
1993-94	3,475	18,040	28,302	50,721	100,542
1994-95	2,416	17,947	28,813	64,190	113,366
1995-96	3,588	22,765	38,327	51,975	116,655
1996-97	3,537	21,281	44,954	48,962	118,734
1997-98	2,444	22,346	54,394	46,172	125,356
1998-99	3,317	23,810	58,317	54,143	144,202
1999-00	2,915	28,480	59,414	48,400	139,209
2000-01	3,172	27,865	59,156	50,157	140,350
1001-02	3,168	28,808	58,241	62,303	152,520
2002-03	3,765	27,977	64,870	62,702	159,314

Source: International Conference on Aquaculture Production and Marketing of Shrimp-Finfish and Bangladesh Seafood-Expo, November 2004.

ANNEX 2: ADDITIONAL MEETINGS WITH KEY INFORMANTS

Individuals	Organization	Location
Kudrat-E-Kabir Major Manzoor Ahmed	ATDP	Khulna
Sunil George Gomes	Banchte Sheka (Learn How to Survive)	Jessore
Maqsudur Rahman	BFFEA	Dhaka
Dr. Debapriya Bhattacharya Fahmida A. Khatun	Centre for Policy Dialogue	Dhaka
Ahraf UI Alam Tutu Abul Hossain Rana Sarder Serajul Islam	Coastal Development Partnership	Khulna
Akmal Hossain	Hortex Foundation	Dhaka
Dr. Syed Ferhar Anwar	Institute of Business Administration University of Dhaka	Dhaka
Focus Group (10 male shrimp pond farmers)	Kurush Kur Kulia Para Shrimp Cooperative	Cox's Bazar
Jamil Ahmed	Meenhar Fisheries Ltd. (Seafood Processing Plant)	Cox's Bazar
Zahid Hossain, Director General Ilahi Dad Khan, Administrative Director	Ministry of Food	Dhaka
Khushi Kabir	Nijera Kori	Dhaka
Asaduzzaman	Social Activities for Environment	Khulna
Alhaj Ali Hassan Chowdury, General Secretary	Shrimp Hatchery Association of Bangladesh	Cox's Bazar
Sahorab Hossain Jakia Parveen	Solidarity Center	Khulna
Nasiruddin Ahmed, Director General Matsya Bhaban	Department of Fisheries	Dhaka
Maqsudur Rahman, President Touhidur Rahman, General Secretary	BFFEA	Dhaka
Harvey Demaine	DANIDA	Dhaka

NOTES

1. World Bank, 1985 cited in Bhattacharya et al, "Environmental Impact"
2. CGIAR, "Net Worth"
3. Asaduzzaman and Toufique, "Rice and Fish"
4. INFOFISH, "Status of Quality Assurance System"
5. Alauddin and Hamid, "Shrimp Culture in Bangladesh"
6. INFOFISH, "Status of Quality Assurance System"
7. INFOFISH, "Status of Quality Assurance System"
8. BSFF, "Quality/Volumne of Yearwise Shrimp Export"
9. Cato and Subasinge, "Food Safety"
10. *ibid*
11. Angell, "Promotion of Small-scale Shrimp and Prawn"
12. INFOFISH, "Status of Quality Assurance System"
13. ATDP II, "Traditional Shrimp Farmer Survey"
14. World Bank, "Future of Fisheries"
15. Alauddin and Hamid, "Shrimp Culture in Bangladesh"
16. DoF, "Department of Fisheries," 4
17. INFOFISH, "Status of Quality Assurance System"
18. Khatun, "Fish Trade Liberalization"
19. DoF, "Management Options"
20. Abedin et al, "Freshwater Prawn"
21. Abedin et al, "Freshwater Prawn"; Demaine, *personal interview*
22. Demaine, *personal interview*
23. Abedin et al, "Freshwater Prawn"
24. ICZMP, "System Analysis of Shrimp Production"
25. FAO, "Bay of Bengal Small-Scale Fisherfolk Communities"
26. Frankenberger, "Livelihood Analysis of Shrimp Fry Collectors"
27. ICZMP, "System Analysis of Shrimp Production"
28. ICZMP, "System Analysis of Shrimp Production"
29. Halim et al, "Women and Children Study"
30. FAO, "Bay of Bengal Small-Scale Fisherfolk Communities"
31. ICZMP, "System Analysis of Shrimp Production"
32. Bhattacharya et al, "Environmental Impact"; Tutu, *personal interview*
33. Ahmad, "Commercial Shrimp Cultivation"; Tutu, *personal interview*
34. Cato and Subasinge, "Food Safety"; World Bank, "Bangladesh Growth and Export Competitiveness"
35. Halim, "Women and Children Study"; Halim, "Marginalization or Empowerment?"
36. Halim, "Women and Children Study"; Halim, "Marginalization or Empowerment?"
37. Delap and Lugg, "Not small fry"
38. Halim, "Marginalization or Empowerment?"
39. Alauddin and Hamid, "Shrimp Culture in Bangladesh"
40. *ibid*
41. Abedin et al, "Freshwater Prawn"
42. *ibid*
43. Guimarães, *A Landscape of Contracts*
44. Tutu, *personal interview*; SAFE, "Jiboner Kotha Newsletter, Case Study"
45. Barrientos, "Gender, Flexibility and Global Value Chains"; Joeke, "Bridging Gender Analysis into the Value Chain"; Ramamurthy, "Cotton Commodity Chain"
46. Barrientos, "Gender, Flexibility and Global Value Chains"
47. Barrientos, "Gender, Flexibility and Global Value Chains," 83
48. Dolan and Humphrey, "Changing Governance Patterns"
49. *ibid*
50. SAFE, "Jiboner Kotha Newsletter, Case Study"
51. Barrientos, "Gender, Flexibility and Global Value Chains," 88
52. Guimarães, *A Landscape of Contracts*
53. FAO, "Report on Tidal Area Study"
54. Yi and Fitzsimmons, "Survey of Tilapia-Shrimp Polycultures"
55. *ibid*
56. Lutz, "Polyculture"
57. *ibid*

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58. Rahman, "Women's Participation in Aquaculture"
 59. Bhattacharya et al, "Environmental Impact," 50
 60. Adnan, "Shrimp Culture Projects"; Ahmad, "Commercial Shrimp Cultivation"
 61. Guimarães, *A Landscape of Contracts*
 62. Kabir, *personal interview*
 63. Bhattacharya et al, "Environmental Impact"
 64. Manju, "Political Economy of Shrimp Culture"
 65. Tutu, *personal interview*
 66. EJF, "Smash and Grab"
 67. EJF, "Smash and Grab"
 68. Bhattacharya et al, "Environmental Impact"
 69. FAO, "Report on Tidal Area Study"
 70. Jory, "Shrimp Whitespot Virus"
 71. *ibid*
 72. DoF, "Management Options"
 73. DoF, "Shrimp Aquaculture in Bangladesh"
 74. DoF, "Management Options"
 75. DoF, "Shrimp Aquaculture in Bangladesh"
 76. ACC, "Certification of Aquaculture"
 77. Kabir, *personal interview*
 78. Kabir, *personal interview*

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