Cultivating Responsibility

Within the Climate Uncertainty

A study on the Impact of Cyclone on the Small-scale Shrimp Farming in the Climate Change vulnerable South West Coastal Region of Bangladesh

S. Jahangir Hasan Masum

Ecosystems Grants Programme
EGP
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Promoting Peace & Progress

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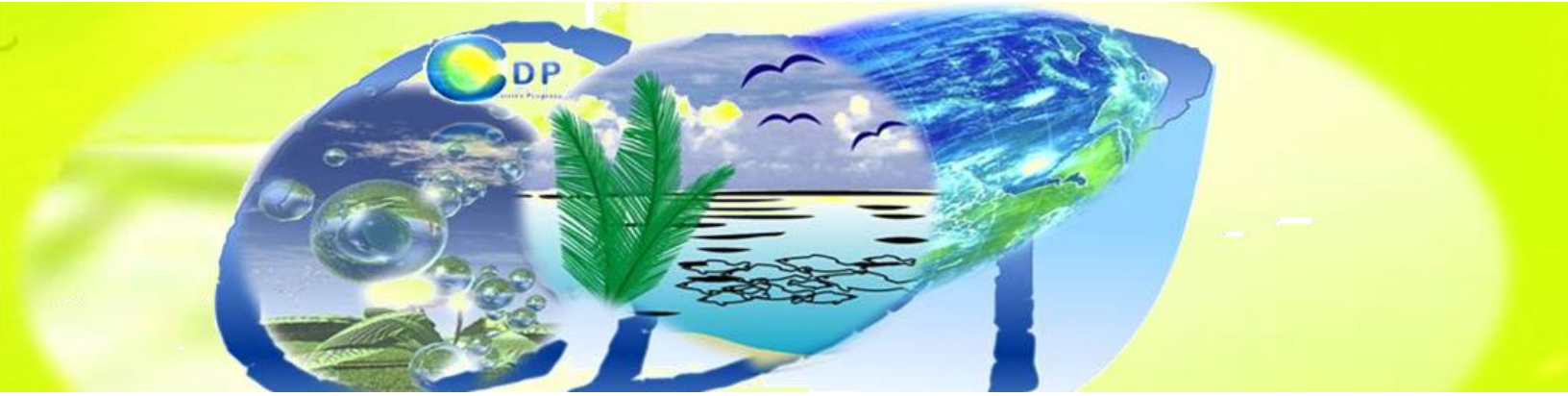

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EXECUTIVE SUMMARY

This report "Cultivating Responsibility within the Climate Uncertainty" is the compilation of the key learning's, baseline survey & monitoring data generated through the Safeguarding Coastal Ecosystem from Irresponsible Commercial Shrimp farming (SECO) project with assistance from the EGP (Ecosystem Grants Program) of IUCN NL (the Netherlands Committee of the IUCN). The overall goal of the SECO project was to reversing the degrading trend of the coastal ecosystem resources and coastal biodiversity due to commercial shrimp farming in the SW coastal region of Bangladesh. The project learning's strongly recommends that large or industrial scale shrimp farming practice must be avoided to protect ecosystem and biodiversity and shrimp farming areas should be separated from the agriculture areas to prevent intrusion of saline waters. SECO project recommended poly-culture is a way to work with the badly sited shrimp farms. SECO envisages that community-based Kewra forestation can provide new opportunity for the poor shrimp farmers to utilize fallow highly saline land or reutilize the abandoned land after the shrimp farming to generate income. SECO also recognized that capacity alone is not enough to take the challenges in a crisis moment, it also need willingness and commitment towards objectives. The most severe problem that SECO project had faced is the continuous blow of cyclones in the project areas.

In Bangladesh, indiscriminate shrimp and salt cultivation have completely destroyed Chokoria mangrove forest in Chittagong coastal region and same thing could happen to the coastal ecosystem for the same reason in the near future. On the other hand, If Bangladesh lose its markets for shrimp, then the livelihood of the 6 million people will be uncertain. Bangladesh is a breeding ground of different types of natural disaster and hazards such as floods, cyclones with storm surges, tornadoes, riverbank erosion, drought and earthquakes. Bangladesh can be designated as one of the most disaster prone countries in the world in terms of losses of lives and the intensity of disaster. The coastal region of the country where mean elevations are within 1 to 3 meter are identified as the most vulnerable part due to climate change. The baseline survey and shrimp farm monitoring has encompassed 403 shrimp farm owners from two (2) Upazilla of the SW coast of Bangladesh. Among the respondent, 399 are male and 4 are female.

This is a pioneer report to understand the impact of climate change on shrimp farming in the coastal region using Cyclone Ayla as climate change baseline marker. The Findings of the SECO learning's are as follows:

- The small scale shrimp farm owner is a middle aged, married Bengali man who did not managed to enter the secondary school has to take care of his 6 family members within the daily income of Taka 350 (US$ 0.83 per day per family member) and shrimp is not their primary occupation. Majority of them are involved in other income generating activities".
- The average annual income of the shrimp farmer's family is Taka 133,308 or Taka 11,109 per month (US$ 1900/year, US$ 5/day/family) including income from shrimp farming. Shrimp farming cover around 85% of the family income of the Shrimp farm owner.
- On average each shrimp farm has eight (8) workers. Majority of the shrimp farm owner (46.4%) reported to have 5-7 staffs working in their farm.
- The two-fifth of the total shrimp farms were established between the 5 years 2001 to 2005. During this the 5 years period, the annual growth of the shrimp farm establishment was 8.0%. Currently the shrimp farm establishment is growing with an annual rate of 3.4%.
- Despite government efforts, only around one-tenth (9.4%) shrimp farms have government registration. None of the women shrimp farm owner has government registration.
- Nearly one-sixth (15.4%) shrimp farm owner still directly involved in wild fry collection, despite the government ban on wild fry collection.

- The use of ground water in fresh water-based shrimp farms is almost 6 times higher than saline water-based shrimp farms. The river canal is the largest single source of water for both fresh water-based shrimp farms (36%) and saline water-based shrimp farms (78.4%). The use of river canal in saline water-based shrimp farms is 2.2 times higher than fresh water-based shrimp farms.
- Only two-fifth (39.7%) of the small-scale shrimp farmers has reported shrimp farming as their primary occupation. 92% of the interviewed shrimp farm owners reported that they integrate shrimp farming with rice, fish and vegetables in a modified rice field to ensure a year round supply of crops & vegetables for family intake along with cash income from shrimp farms. Small-scale farmers consider shrimp as a valuable cash crop (especially freshwater golda). Around 8% farmer does stand alone shrimp farming.

- **Impact of shrimp farming:** More than two-fifth (47.4%) shrimp farm owner reported that shrimp farming has no impact on local community. Reduction of fresh water fish species (30.8%) and land dispute (21.3%) are identified as the major impact on local community. Shrimp farming also have adverse impact on traditional social norms & culture (10.2%) and restricts local community access to public property (7.9%) like wetlands, Khas lands etc. Shrimp farming deprives child education (5.7%) and generates abuse and violence against women (4.0%). Two-fifth (40.2%) of the shrimp farmer admitted that community does not access enter and move in the Shrimp farm area. Shrimp firm owners reported that shrimp farming reduces productive agricultural land and related jobs (37.0%) and hinders cattle and poultry rearing (37.7%). Shrimp farming also Reduces fire wood supply (26.6%), Reduce homestead vegetable garden (19.9%) and Reduces production of local fish and fish fry (10.4%). More or less three quarter (75.2%) of shrimp farm owner acknowledged the expansion of salinity (50.6%) with increasing trend of salinity level (24.6%) is the key environmental impact of the shrimp farming. Wild fry collection destroying other local species of fish (26.6%), Loss of soil fertility (27.0%), Reduction & Degradation of biodiversity (18.1%) and Pollution (15.4%) are other major impacts. More than four-fifth (86.4%) shrimp farm owners acknowledged that shrimp farming turns any land into unproductive or uncultivable for 8 years.
- Shrimp farmer's follows integrated approach to maximize income through integrated farming approach. Modified traditional system based on extensive farming practice dominates the shrimp farming among small-scale farmers. The application of Modified Traditional System (84.6%) is around 5.5 times higher than Closed System (15.4%). Cyclone Ayla has no effect on Shrimp farmer's farming approach.
- Most of the farms (80%) are operated by their owners. The remaining 20% are tenant operators leasing in land from local as well as absentee owners of private shrimp land.

Climate change Impact: Cyclone AYLA, which smacked the southwest coasts of Bangladesh on May 25, 2009, virtually reduced family income for all the shrimp farm owners (95.8%). On average, Cyclone Ayla has reduced 71.33% income of the shrimp farm owner's household. Climate change may push nearly two-third (64.6%) shrimp farm owner under the poverty line (below the US$ 1.2). It is very likely that climate change (cyclone) could easily toppled two-fifth of the shrimp farm owners' household as extreme poor household within 3 to 12 months. Based on the impact of one cyclone in year, the study recognized that in ***the South west region of Bangladesh, shrimp farm owners are living on the edge of poverty and more or less two-third (65%) shrimp farms and their dependent families of are highly vulnerable to climate change. Climate change (a single cyclone like Ayla) may increase four (4) times higher magnitude of poverty than the current level among the shrimp farm dependent households.***

Chapter 1

Shrimp Farming within the Climate Uncertainty: Bangladesh Context

1 Introduction & Background

The study on the Impact of Cyclone on the Small-scale Shrimp Farming in the Climate Change vulnerable South West Coastal Region of Bangladesh was carried out as a part of the Safeguarding Coastal Ecosystem from Irresponsible Commercial Shrimp farming (SECO) project with assistance from the EGP (Ecosystem Grants Program) of IUCN NL (the Netherlands Committee of the IUCN). This is a pioneer study to understand the impact of climate change on shrimp farming. Cyclone is identified as a signature to the climate change.

This report "Cultivating Responsibility within the Climate Uncertainty" is the compilation of the key learning's, baseline survey & monitoring data generated through the SECO project. Since the previous SECO report on "Working Together for Responsible & Eco-friendly Shrimp Farming in Bangladesh" which explored Corporate Environmental Responsibility (CER) & Corporate Social Responsibility (CSR) in the context of Commercial Shrimp Sector in Bangladesh, this report has not discussed those issues in this report. The "Cultivating Responsibility within the Climate Uncertainty" report is mainly based on the primary data generated through the project process.

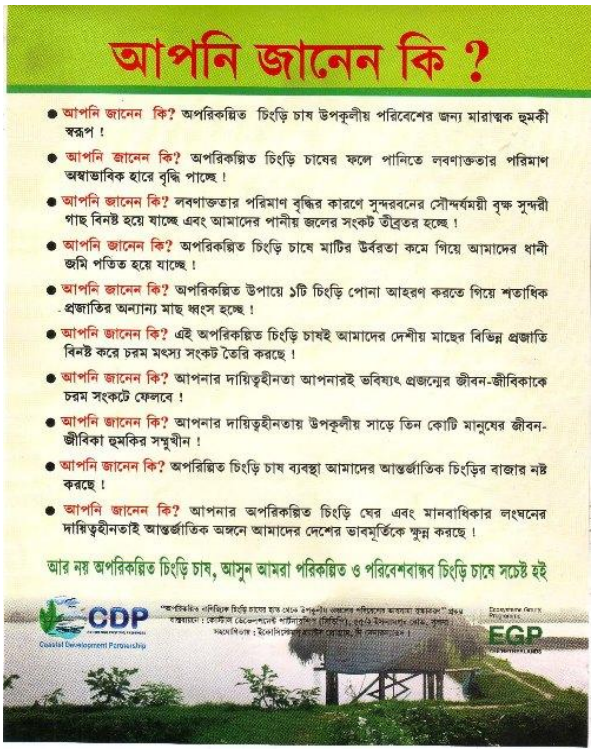
1.1 Safeguarding Coastal Ecosystem from Irresponsible Commercial Shrimp farming (SECO)

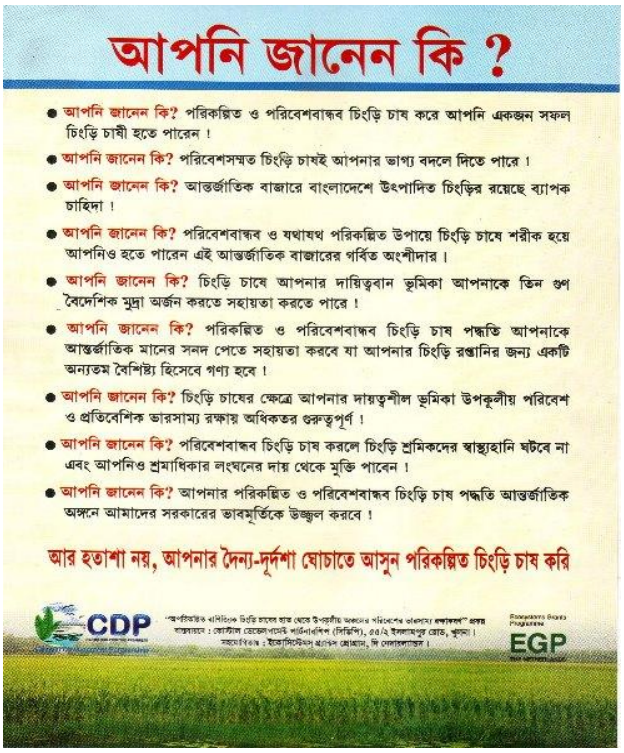
The safeguarding the coastal ecosystem is very important for Bangladesh as the loss of the coastal ecosystem might expose the entire southwestern region of the country to frequent cyclones and tidal surges. The livelihood of the SW coastal region in Bangladesh is largely dependent on coastal biodiversity and coastal ecosystem services and poor people directly harvest ecosystem goods. The expanding shrimp farming in the greater Khulna region has caused wide concerns for the rich bio-diversity of coastal area. In Bangladesh, indiscriminate shrimp and salt cultivation have completely destroyed Chokoria mangrove forest in Chittagong coastal region and same thing could happen to the coastal ecosystem for the same reason in the near future.

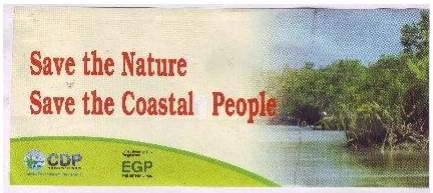
Considering the above context, an urgent intervention effort is required to redirect commercial shrimp farming towards conservation and wise management of the natural resource base of the coastal Mangrove Forest and the IUCN NL supported "Safeguarding the coastal Ecosystem from Irresponsible Commercial Shrimp farming (SECO)" is the outcome to address that required intervention. The purpose of the project was to reduce the pressure on the deteriorating coastal ecosystem resources (wetlands, coastal forests and biodiversity etc.) through strengthening the capacity of the commercial shrimp farms to protect coastal Mangrove Forest & Coastal wetlands. The overall goal of the project was to reversing the degrading trend of the coastal ecosystem resources and coastal biodiversity due to commercial shrimp farming in the SW coastal region of Bangladesh. The project worked with 300 commercial shrimp farms and associated stakeholders and the surrounding community of the shrimp farms from the two coastal districts which are closest to the coastal forest; Khulna and Satkhira in the SW coastal region of Bangladesh.

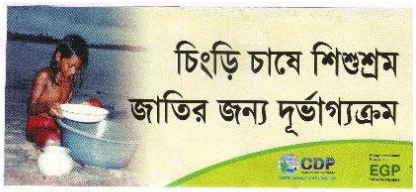
The project strongly recommends that large / industrial scale shrimp farming practice must be avoided to protect ecosystem and biodiversity. Moreover, CDP is conducting responsible shrimp farming as campaign in Bagerhat district

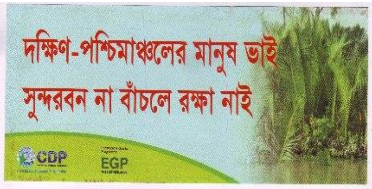
without having any financial support from others using the SECO tools and learning's. The campaign is promoting the idea that shrimp farming areas should be separated from the agriculture areas to prevent intrusion of saline waters.

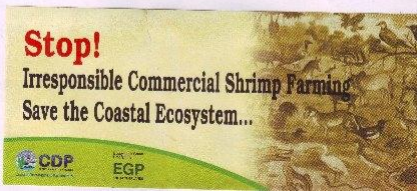


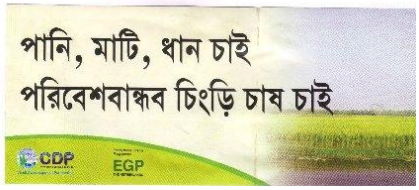












SECO project recommended poly-culture is a way to work with the badly sited shrimp farms. If farmers follow polyculture system together with prawn, white fish, crab and other species, then biodiversity is more protected in comparison with monoculture. Then farmer are also not 100% dependent on the export market, but can also produce for local market. Community shared with the SECO that small holder, locally owned farming systems are socially acceptable production, because many families are benefited from the shrimp farming. Large industry like production systems might create some jobs, but only very few families of the area are benefited from the profits generated by

the shrimp industry. CDP sees one potential aspect to continue the project with strong emphasis on social forestry. SECO envisages that community-based Kewra forestation can provide new opportunity for the poor shrimp farmers to utilize fallow highly saline land or reutilize the abandoned land after the shrimp farming to generate income. SECO also recognized that capacity alone is not enough to take the challenges in a crisis moment, it also need willingness and commitment towards objectives.

1.2 Background of the SECO project

The Study was carried out as a part of the Safeguarding Coastal Ecosystem from Irresponsible Commercial Shrimp farming (SECO) project with assistance from the EGP (Ecosystem Grants Program) of IUCN NL (the Netherlands Committee of the IUCN). The most severe problem the project has been facing is the continuous blow of cyclones (October 27, 2008 & May 25, 2009) in the project region. One of the major heartbreaking activities was the demonstration project on the restoration of the abandoned shrimp farm by the women. These women had tried twice but cyclone destroyed it twice. Women groups are determined to beat the cyclone and will do it again by themselves. CDP has already included these groups in the new 6-months research project on the restoration of the abandoned shrimp farm. CDP is trying to continue the SECO work for making socially and environmentally responsible shrimp aquaculture. In the next phase, CDP will focus on the following activities involving all of the badly sited existing farms:

- Organize the small-scale shrimp farmers and formation of group to go for certification process
- Provide Technical Assistance through Training to the shrimp farmer groups according to the new shrimp standard.
- Monitor the field activities shrimp farmer groups to find out challenges and constrains for the implementation of new standard.
- Help them for proper documentation to prove that the standards are followed properly.

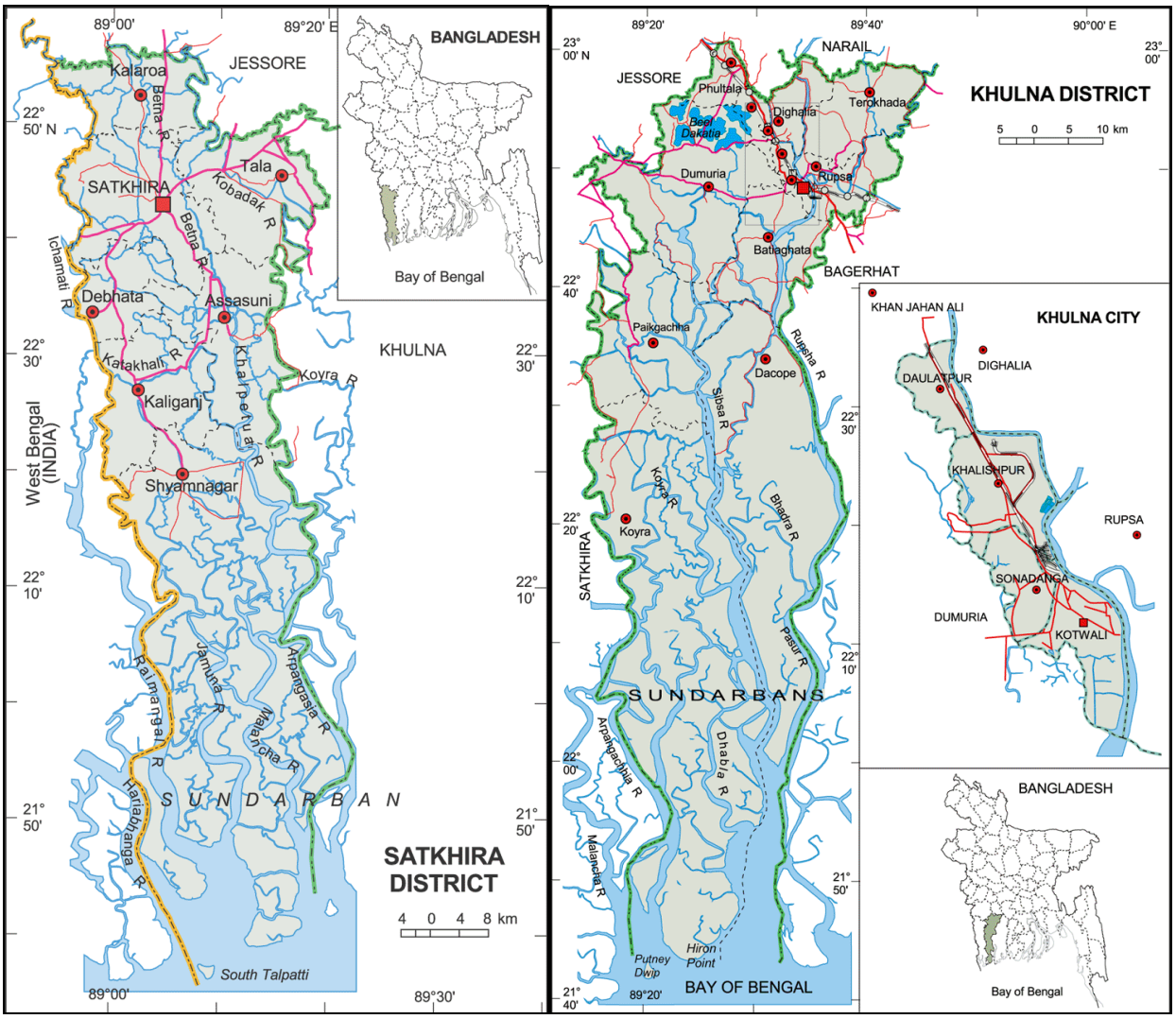
According to CDP's experience, it brings good result and achievement in a particulars issue & theme with particular donor partner. Since 2004 CDP has been working with the IUCN.NL on bio-diversity conservation issue of southwest coastal region of Bangladesh and still working on the same theme, although it is focusing few specific issues due to time changed, but the theme is not too much different. CDP have a plan to work with IUCN NL in future to introduce climate friendly alternative livelihood for the extreme poor through the plantation of saline resistant and land regenerative mangrove species on unproductive land or using the abandoned shrimp farm.

The study has been carried out in remote villages in the Southwest coast of Bangladesh. In general, methodological aspects of the present study are administered through the semi-structured interview with key informant interview. Besides, systematic observation in various parts of the study areas has been researched to obtain ethnographic information on shrimp farm activities and conditions. In this report, mostly descriptive analysis of both data has been made and the information is presented in appropriate tabular form with descriptive statistics (percentage, ratio, average etc.). The learning's of the SECO is structured into a "Rapid Impact Assessment Report". Since climate change was not core focus of the SECO, CDP contributed to include the climate change impact. Understanding climate change impact on shrimp farming using primary data to assess the shrimp farm vulnerability can assist the shrimp sector to be more responsible.

1.3 Methodology

The data collection has been done through the application of Rapid Assessment Methodology. This Rapid Assessment Methodology has included review of literature and records, interviews with key informants, observation and semi-structured questionnaire as the elements of data collection. Data collection through literature review generally helps to compile the secondary data. The key informants have been requested to provide information on shrimp farms and cyclone Ayla at selected localities to verify the reality with local

knowledge base. Observations were gathered for understanding the nature and extend of shrimp farm activities as well as to allow for the identification of the difference between what the respondents reported and what the actually situation. The observation has also visualized the infrastructure and environmental setting of the studied areas. Semi-structured Questions have been geared towards the respective target group at different shrimp establishments within the targeted villages. The Questionnaire were focused on specific issues and pre-tested. Although the interviews have been kept short, time for rapport building with the interviewee has been allowed.



In a simple quantitative survey, a portion of the target population is selected as a sample for research, and the results are used to make inferences on the characteristics of the population. However, the selected sample should be representative of the population so that valid inferences could be made. The population is usually considered as the totality of items or things under consideration. Sample is the portion of the population that is selected for analysis. Statistically, when the shape of the population distribution is not known, the size of the sample is a factor and needs to be at least 30 for any rapid assessment. It is statistically recommended to use samples of no smaller than 30 for each group in the experiment. Many common statistics are based on sample sizes of a minimum of 30.

The baseline survey has encompassed 403 shrimp farm owners from two (2) Upazilla of the SW coast of Bangladesh. Among the respondent, 399 are male and 4 are female.

Sample Distribution		Female Shrimp Farm Owner		Male Shrimp Farm Owner		Total Shrimp Farm Owner	
District	*Upazilla*	*N*	*%*	*N*	*%*	*N*	*%*
Khulna	Koyra	3	75.0	205	51.4	208	51.6
Satkhira	Tala	1	25.0	194	48.6	195	48.4
Total		4	100.0	399	100.0	403	100.0

Moreover, to understand the overall picture of the shrimp farm it is better to talk with the person who owns the farm. Nevertheless, it took long time to convince the farm owners to provide time for the survey because shrimp farm owners does not trust NGOs.

1.4 Conceptual Framework

1.4.1 Small-scale Shrimp Farmer (SF)/ Small-scale Shrimp Farm Owner (SFO)

The term "Shrimp Farmer" and/or "Shrimp Farm Owner" depicts same person in this report. The term owner is used to recognize the fact that responsibility comes with ownership and ownership with responsibility create space for accountability and traceability of the shrimp producer in any specific location. Shrimp Farmer (SF) is the person who directly works in the shrimp farm irrespective of ownership whereas, Shrimp Farm Owner (SFO) owns the farm, but may not work in the farm.

Small-scale Shrimp Farm can be identified using a set of parameters such as number of ponds, cultivation system and stock density. Small-scale Shrimp farmers usually have one or two ponds of at most 3 hectare with 1-2 shrimps per square meter. They use extensive cultivation systems with low levels of technology and tend to have lower stock-density. In Bangladesh Small-scale Shrimp farmers produce the majority of the shrimps exported to international markets. In general, Small-scale Shrimp farmers do not have the option to switch easily to other types of agro-commodities.

Extensive aquaculture is a production system characterized by a low degree of control (e.g. of environment, nutrition, predators, competitors, disease agents); requires low initial costs, low-level technology and low production efficiency (yield is less than 400 kg/ha/yr); highly dependent on local climate and water quality; use of natural water bodies (e.g. tidal inlets). On the other hand, intensive aquaculture is a system of culture characterized by a production of up to 200 tons/ha/yr; requires high initial costs, high-level technology and high production efficiency; and have tendency towards increased independence of local climate and water quality.

Usually the sea water that comes through tidal inlets also considered as brackish water in Bangladesh, which is not as salty as seawater. However, Brackish water is also refers to the water with salt added to it Ponds are inland body of standing water usually man-made in the context of shrimp aquaculture.

1.4.2 Value Chain approach with Third party certification

In Bangladesh context, shrimp farming is an international buyer-driven chain where retailers set the terms of reference for the price of a product and processors. Processor controls the production process through the middlemen. The middlemen have a powerful role in Bangladesh. Small-scale Shrimp farmers depend on middlemen due to a combination of lack of market knowledge, lack of access to credit and lack of organization.

It is quite known that the international shrimp certification schemes are growing rapidly and is likely to become a prominent decision-making tool for the shrimp aquaculture industry over the coming years and a significant percentage of the global production of farmed shrimp would be certified by at least one scheme within the next 5 years. However, the key challenge is how we can incorporate small-scale shrimp farmers in Bangladesh with the global market process, especially when they are virtually unfamiliar with international markets, standards and

certifications. Moreover, the shrimp supply chain in Bangladesh is highly fragmented and small-scale shrimp farmers are the weakest stakeholders in the value chain. The study explored the current status of the shrimp farming and small-scale shrimp farmers as well as the ways to involve them into the eco-friendly responsible shrimp farming.

In case of the shrimp aquaculture sector a high degree of monitoring and control is required to see whether the shrimps comply with international food safety standards to protect the consumers' health. Third party certification is widely believed to be most effective in preventing different interests from getting entangled as it has independent verification of compliance of the companies. Third party labeling schemes are initiated by an organization independent from the producers or the company that sells the labeled product. In some cases the standards organization accredits certification bodies to certify.

1.5 Commercial Shrimp Farming in Bangladesh

Commercial Shrimp farming in Bangladesh was started in the Satkhira district of the SW coastal region Bangladesh in 1960s. Culture of shrimp as a 100% export oriented activity based on commercial farming of shrimp is predominantly a development of 1980s. Commercial shrimp farming in Bangladesh got a crucial break with the implementation of the World Bank/UNDP investment programme of US$ 30 million in late 1980s and early 1990s. The frozen food export sector is the second largest export sector in Bangladesh's economy.

Concentrated in the southern coastal belts of Cox's bazaar (20% of the area), Bagerhat, Khulna and Satkhira (80% of the area) under shrimp culture in Bangladesh has witnessed a threefold increase in the last decade. Tidal wetlands are turning into water logged areas due to unplanned shrimp farming.

It now covers about 145 thousand hectares sprawled over 9000 farms, 18% of the total farms in the world. Most of the shrimp culture in such farms is done through extensive method, productivity averaging only 120 kg/ha/year. Although in 1980s, water logging have played role for promoting shrimp farming, now shrimp farms are promoting water logging. It has to be noted that Shrimp has been declared as industry 6 years ago, but not yet been completely activated. Besides, only Processing plant and Depot are under industry, the farm (Gheer) has not been considered under industry. Although it is mandatory to register the shrimp Gheer, among the 60,000 Gheers, only 1000 have been registered.

The shrimp farming encompasses around 1 per cent of total land area of Bangladesh (approximately 141000 hectares). Bangladesh ranks third among the world's largest inland fish producing countries after China and India. Shrimp production is the second largest export sector of Bangladesh after readymade garments. Among shrimp producing countries, Bangladesh ranks fourth with respect to area under shrimp farming and sixth in volume of production. Shrimp accounts for three-fourths of total export earnings from the frozen fish sector. Now, shrimp farms cover 170,000 hectares of land on the coastal belt and prawn farms cover 47000 hectares to meet export demands.

In terms of export earnings, the importance of shrimp in the economy of Bangladesh is increasing day by day. The overall export of shrimp has been increased as the production of shrimp was about 97,000 tons in 2001-2002 while it has been increased to 145000 tons in 2008-2009. However, during 2009 to 2010, the European Union has rejected 50% shipments of frozen shrimps produced in Bangladesh. If this continues Bangladesh may lose its markets for shrimp which will ultimately create livelihood insecurity for the 6 million people.

1.6 Climate Vulnerable Bangladesh at a Glance

Bangladesh is an agro-economy based developing country in South Asia. Bangladesh is located between $20^0 34'$ and $26^0 38'$ latitude and between $88^0 01'$ and $92^0 41'$ east longitude. It is bordered on the west, north and east by India, on the southeast by Myanmar, and on the south by the Bay of Bengal. Most of the country is low-lying land comprising mainly the delta of the Ganges and Brahmaputra rivers.

BANGLADESH: COUNTRY PROFILE	
Official Name	The People's Republic of Bangladesh
Capital City	Dhaka
Geographical Location	In South Asia between 20°.34¢ and 26°.38¢latitude and between 88^0.01¢& 92^0.41¢east longitude
Area	1,47,570 Sq.Km
Population	157.8 Million (in 2007) 185.6 Million (projected in 2020)
Density	881 Per Square Km. (Census-2001)
Population by Area	Rural-76.57% Urban-23.43%
Language	National Language: Bengali-98% English is also widely spoken and understood.
Religion based Population	Muslim (89.7%), Hindu (9.2%), Buddhist (0.7%), Christian (0.3%), Animist and tribal faiths (0.1%)
Administrative Units (BBS-2001)	Division -6, District-64, Upazila/Thana-520 Municipal Corporation: 4 Municipalities- 223,Union Parishad-4533, Village-87928
Time	GMT +6.00 Hours
Main Seasons	Winter (November-February) Summer (March-June) Monsoon (July-October)
Principal Rivers	Padma, Meghna, Jamuna, Brahmaputra, Tista and Karnophuli,
	Source: http://www.banbeis.gov.bd/bd_pro.htm

Administratively, it is divided into 6 Divisions[1], 64 Districts[2], 482 Upazillas[3] and 4,498 Unions[4]. The per capita income in Bangladesh is US$370. This ranks below average South Asian per capita income and per capita income for low income countries[5]. With a Gini Index of 0.332, income distribution is somewhat unequal, although less so than in many other countries[6]. More than one-third (36%) of the people in Bangladesh live in poverty; in rural areas, it is 40%. The coastal region of the country where mean elevations are within 1 to 3 meter are identified as the most vulnerable part due to climate change. Coastal area encompasses majority of the heavy industries, sea ports, and major tourist spots in Bangladesh. The coastal zone is home to over a quarter of the national population. Current estimates project the coastal population to reach 50 million by 2050. With the exception of the hilly Chittagong area and the northwestern part of the country, most of the country is less than 10 m above sea level. One-fifth of the country is flooded every year, and in extreme years, two-thirds of the country can be inundated. The huge sediment loads brought by three Himalayan rivers, coupled with a negligible flow gradient add to drainage congestion problems and exacerbate the extent of flooding.

All IPCC impact assessments carried out so far have identified Bangladesh as one of the most susceptible cases as regards the negative impacts of climate change. According to the IUCN report, the case of Bangladesh is unique in the climate change context as this country will eventually face the multidimensional appearance of climate change such as flood, cyclone, sea level rise, drainage congestions, salinity, drought etc[7]. Bangladesh currently has extreme vulnerability to cyclones, both on account of its somewhat unique location and topography, and because of the low capacity of its society and institutions to cope with such extreme events.

1 It is a second tier of administrative unit at the divisional level just below the national level. The whole country is administratively divided into six divisions.
2 District is a third tier of administrative unit headed by Deputy Commissioner having co-ordination role among different departments of the Government. However, it is different from district council (Zilla Parishad), which is a first tier of Rural Local Government in Bangladesh.
3 Upazilla is a fourth tier of administrative unit and second tier of Rural Local Government in Bangladesh.
4 Union comprising on an average 8 to 10 villages having population of about approximately 30,000 serves as the lowest Local Government structure and administrative unit in Bangladesh.
5 World Bank, 2002. World Development Indicators
6 The Gini coefficient is a number between zero and one that measures the degree of inequality in the distribution of income in a given society. .
7 IUCN Bangladesh, 2003: Bangladesh National Dialogue on Water and Climate: Local Consultative Report.

Top 20 countries with the highest number of people affected by climate related events 1990-2008									
	Grand Total(Millions)	Drought	Earth Quake	Epidemic	Extreme temperature	Flood	Mass movement (Wet and Dry)	Strom	Other
China	2207.46	311.41	62.24	0.01	7.9	1481.63	0.02	344.22	0.03
India	904.45	351.18	5.56	0.35	0	512.15	0.22	31.95	0.04
Bangladesh	**147.95**	**0**	**0**	**2.21**	**0.19**	**114.76**	**0**	**30.77**	**0.03**
Philippines	70.2	2.85	1.97	0.01	0	7.55	0.29	56.16	1.36
Thailand	49.07	23.5	0.06	0	0	22.57	0.01	2.93	0.01
Kenya	44.61	35.7	0	6.87	0	2.04	0	0	0
Iran	40.84	37	1.37	0	0	2.3	0	0.17	0
Viet Nam	32.24	6.11	0	0.02	0	16.84	0	9.27	0
Ethiopia	31.04	29.09	0	0.05	0	1.89	0	0	0.01
Pakistan	29.41	2.2	1.25	0.02	0	23.98	0	1.97	0
United States	22.81	0	0.03	0.41	0	0.92	0	20.67	0.78
Malawi	19.86	18.25	0	0.05	0	1.56	0	0	0
South Korea	18.72	0	0	0	0	10.22	0	0.49	8
Cambodia	0	6.55	0	0.42	0	9.26	0	0	0.9
Sudan	6.55	11.36	0.01	0.08	0	2.49	0	0	2.6
Australia	11.36	7	0.01	0	4.6	0.07	0	3.94	0.05
South Africa	15.64	15.3	0	0.1	0	0.12	0	0.11	0
Mozambique	15.51	6.04	0	0.31	0	6.79	0	2.4	0
Zimbabwe	13.94	13.16	0	0.52	0	0.27	0	0	0
Brazil	13.88	12	0	0.85	0	0.85	0.01	0.15	0.01

Source: Kirsten Halsnaes and Nethe Veje Laursen (2009), "Climate Change Vulnerability: A New Threat to Poverty Alleviation in Developing Countries", In Simin Davoudi et al, *Planning for Climate Change: Strategies for Mitigation and Adaptation for Spatial Planners*, London: Earthscan

Climate change assessments of Bangladesh suggest steadily increasing temperatures, particularly for the winter season, but also during the monsoon season[8]. There is some uncertainty in projections on a clear direction of change in the case of long-term precipitation averages[9], though rainfall events are expected to become more intense, with increasing variability during the monsoon season. In addition, the IPCC Fourth Assessment Report (SPM)[10] suggests sea-level rise of several tens of centimeters by the end of the century, barring rapid glacial disintegration which could increase sea level much faster than anticipated with gradual change. This will change coastal morphology – leading to progressive inundation of low-lying lands – but will change river flow patterns and reduce river speeds, increasing sedimentation, raising river beds and worsening the threat of floods.

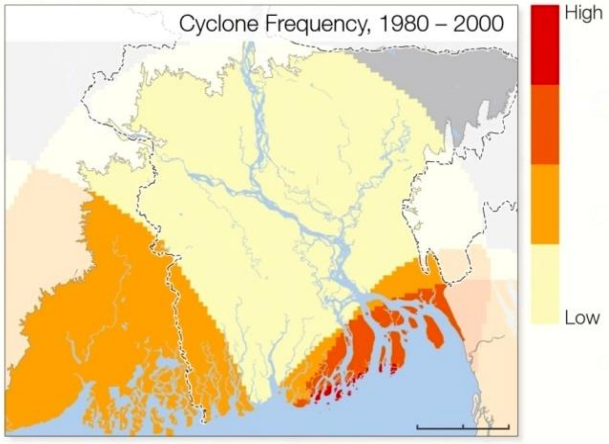
According to IPCC in their recently published Fourth Assessment, the following changes have been observed in climate trends, variability and extreme events

a) In Bangladesh, average temperature has registered an increasing trend of about 1°C in May and 0.5°C in November during the 14 year period from 1985 to 1998.
b) The annual mean rainfall exhibits increasing trends in Bangladesh.
c) Serious and recurring floods have taken place during 2002, 2003, and 2004. Cyclones originating from the Bay of Bengal have been noted to decrease since 1970 but the intensity has increased.
d) Frequency of monsoon depressions and cyclones formation in Bay of Bengal has increased.
e) Salt water from the Bay of Bengal is reported to have penetrated 100 km or more inland along tributary channels during the dry season.
f) The precipitation decline and droughts has resulted in the drying up of wetlands and severe degradation of ecosystems.

8 Ahmed, A.U. et. Al., (1999), 'Vulnerability of Forest Ecosystems of Bangladesh to Climate Change,' in S. Haque *et al*. (eds), 1999, Vulnerability and Adaptation to Climate Change for Bangladesh (Kluwer Academic Publishers), Dordrecht, The Netherlands.
9 Mitchell, T.D., Carter, T.R., Jones, P.D., Hulme,M., New, M., 2003: A comprehensive set of high-resolution grids of monthly climate for Europe and the globe: the observed record (1901-2000) and 16 scenarios (2001-2100). Journal of Climate: submitted.
10 IPCC 2007. "Climate Change 2007: The Physical Science Basis: Summary for Policymakers." IPCC: Geneva, Switzerland.

1.7 Cyclone as baseline markers of climate change

The geographic location and geo-morphological conditions of Bangladesh have made the country one of the most vulnerable ones to climate change, particularly to Sea Level Rise. Bangladesh is situated at the interface of two different environments, with the Bay of Bengal to the south and the Himalayas to the north. The environmental characteristics of the country are immensely controlled by the river system. Bangladesh has many rivers, canals, haors, baors, beels, and ponds, which are resources for culturing fish. Wetland-dependent fishers and farmers are most vulnerable to environmental change and disaster.



Climate change is a security concern because it has the potential to destabilize global socio-economic system, displace populations, and lead to the collapse of global development. Despite the omnipresent nature, climate security issues are still not high on the national security & policy agenda. Increased cyclone, storm surges, floods, riverbank erosion destroys and damage peoples properties including land, house, crop, cattle, and other livelihood assets and living essentials. Drought will generate scarcity of drinking water. Sea-level rise will contaminate fresh water resources with saline water.

The climate change directly and indirectly reduce securities for food, water, life, property, settlement, livelihood assets, livelihoods and others. Climate security is the integrated aspects of individual human security (e.g. livelihood security, food security, health security, water security and environmental security). Climate security may also be the capacity to survive against the climate change vulnerability or any adverse changes that may evolve due to climate change shocks. IPCC suggests that climate change vulnerability reflects the sum of the risks (hazards) to which a society or community is exposed, mitigated by its adaptive or coping capacity (its ability to respond effectively to risk) and compensated by the available alternative livelihood opportunities. In this form, the variability of vulnerability is seen to be driven locally mainly by socio-economic factors.

The effects of temperature and rainfall changes on basic human needs is already causing shortages in the supply of fresh water in many parts of the world, leading to increasing competition for this most important basic human resource need (Bates et al, 2008[11]). Increased competition for diminishing water and food resources will be catastrophic for the poorest that are most vulnerable, and could even entail enormous financial costs for countries that are already very poor. Temperature and rainfall variations drive new patterns of disease over time (WHO, 2008[12]). According to the World Meteorological Organization (WMO), global warming is linked to unprecedented rainfall and flooding in many parts of Africa in recent time, resulting in losses in human well-being of unprecedented magnitude (WMO, 2007[13]). Most of the climate models consider sea level rise, higher temperatures, evapotranspiration losses; enhanced monsoon precipitation and run-off, potentially reduced dry season precipitation, and increase in cyclone intensity are as baseline markers of climate change which causes various impacts from local to global scale based on the stress level of these markers. In case of Bangladesh, many of these climate change markers so stressed that they already demonstrates a serious barrier to the continual economic development of Bangladesh[14].

11 Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof eds. Climate Change and Water. IPCC Technical Paper VI (June 2008)
12 World Health Organisation (2008). Climate change and Health (Geneva: WHO, EB124/11, 20 November 2008).
13 World Meteorological Organisation (2007). Report on Extreme Weather and Climate Events (Geneva: WMO).
14 Shardul Agrawala, Tomoko Ota, Ahsan Uddin Ahmed, Joel Smith and Maarten van Aalst, 2003: Development and climate change in Bangladesh: focus on coastal flooding and the sundarbans, Organisation for Economic Co-operation and Development (OECD), COM/ENV/EPOC/DCD/DAC(2003) 3 /FINAL

The ten countries with the largest number of people living within ten meters of the average sea level are: China (143,888,000); India (63,188,000); Bangladesh (62,524,000); Vietnam (43,051,000); Indonesia (41,610,000); Japan (30,477,000); Egypt (25,655,000); United States (22,859,000); Thailand (16,468,000); and the Philippines (13,329,000). The ten countries with the largest share of their population living within ten meters of the average sea level are: Bahamas (88%); Suriname (76%); Netherlands (74%); Vietnam (55%); Guyana (55%); Bangladesh (46%); Djibouti (41%); Belize (40%); Egypt (38%); and the Gambia (38%)[15]. Between 1990 and 2000, the populations in the 0-10 meter zones of Bangladesh and China grew at more than twice the national population growth rate.

1.8 Understanding Cyclone (Climate Change Baseline Marker) Impact on the Shrimp Farming in the coastal Region

Bangladesh is a breeding ground of different types of natural disaster and hazards such as floods, cyclones with storm surges, tornadoes, riverbank erosion, drought and earthquakes. Bangladesh can be designated as one of the most disaster prone countries in the world in terms of losses of lives and the intensity of disaster. The geomorphic nature and the geologic structure of the country play significant role for nurturing these disaster and hazards. Due to the geographical location, Bangladesh is the natural playground of two giant geological systems, one is at the north; the Himalayan Range and the other one is at south; the Bay of Bengal. Besides that, some other influential geologic units exist within the close proximity of the Bangladesh such as the Swatch of No Ground, the Ninety Degree East Ridge and the Andaman-Nicobar Trench. During the last century, the country has experienced 5 earthquakes with magnitude more than 8 in Richter scale.

The IPCC Third Assessment illustrated the evidence of a 5-10% increase in peak intensity (wind-speed) of tropical cyclones that likely to enhanced storm surges and coastal flooding. IPCC also projects a 20-20% increase in intensity of associated precipitation that would contribute to (rain-water) flooding both in the coast and inland as the cyclone makes landfall[16, 17]. Although these estimates are not location specific but for tropical cyclones in general, hence could be considered appropriate for Bangladesh. In addition, IPCC also concluded that *frequencies of tropical cyclones may change but none that their locations will change*.

1.8.1 Cyclone Impact on development projects in Bangladesh

The most severe problem that SECO project had faced is the continuous blow of cyclones in the project areas. During the inception period (On October 27, 2008) a medium scale cyclone "Reshmi" flooded shrimp ghers in the project area which continued for 14 days. The shrimp farms were severely affected and we had waited to enlist shrimp farms again for involving with the project. On Monday, May 25, 2009, another super Cyclone Aila swamped the coast of southwest Bangladesh, killed 150 people and damaged houses, roads and crops. An eight to ten foot high tidal surge washed away 50% to 70% of the shrimp farms in three districts: Satkhira, Khulna and Bagerhat. The storm took place when the regions' first shrimp crop of the season was about to be harvested. Most of it was lost, and it will not be easy for farmers to restock because the supply of wild post larvae is not good at this time of the year. It would take years for a full recovery from the effects of the cyclone.

15 http://www.sciencedaily.com/releases/2007/03/070328093605.htm

16 IPCC, 2001a, "Climate Change 2001, Scientific Basis; Summary for the Policy Makers", Intergovernmental Panel on Climate Change (IPCC), WMO-UNEP, Geneva, Switzerland, pp. 20.

17 IPCC, 2001b, "Climate Change 2001: Impacts, Adaptation and Vulnerability, Summary for Policymakers",Working Group II, Inter-governmental Panel on Climate Change (IPCC), Geneva.

On 15 November 2007, Cyclone Sidr slammed into south-western Bangladesh, killing more than 3,500 people and displacing some two million in five coastal districts. The damages are bigger this time due to irresistible tidal surging than that of Cyclone Sidr. This was a very big blow for the project. It made all our monitoring data useless and we had to do baseline survey again after three months to identify shrimp farms for project stakeholders. This cyclone also damaged the two project field offices totally and we had to change the office location. Moreover, all our equipments & 3 computers, files, paper copies of the data & document of these offices are totally damaged. Demonstration project on the restoration of the abandoned shrimp farm had to reschedule as abandoned farms are also submerged yet under water. Monthly data collection for the Shrimp Farm Monitoring had severely been hampered due to the cyclone. The baseline data collected earlier were not able to assist monitoring farms as 70% of them were washed away.

1.8.2 Understanding climate change vulnerability and Shrimp Farming in the coastal zone

The coastal region of the country where mean elevations are within 1 to 3 meter are identified as the most vulnerable part due to climate change. Coastal area encompasses majority of the heavy industries, sea ports, and major tourist spots in Bangladesh. Climate change may undermine capacity of the government to support people to sustain livelihoods (Barnett, and Adger, 2005[18]). Climate change may undermine human security by reducing access to, and the quality of, natural resources that are important to sustain livelihoods.

Poverty and food insecurity may create more social conflict regarding resource ownership and use. The national economy of Bangladesh is consequently highly responsive to climate variability and change and potential social and economic implications of such changes would cause substantial inundation of the coastal low-lying areas of Bangladesh. Thus the entire coastal belt including Khulna, Barisal, and Patuakhali regions are most vulnerable to the projected sea level rise and changes in hydrological conditions brought about by climate change.

In national economic context, Shrimp covers more than 70% of the total export earnings from all the agro-based products, including tea, raw jute, vegetables, fruit, etc. This sector also supports large varieties of local level cottage industries (made out of the home) such as bamboo baskets, mats, traps, nets, rickshaw vans, tempos (tri-wheelers), boats, etc. Bangladesh is one among the world's top ten shrimp producers and had share of about 3 percent of world sales in 2006. In 2005, Bangladesh sales were limited to the United States (40 percent), the European Union (40 percent), and Japan (20 percent)[19].

The sustainability of a farming system is dependent on the location, the society and the market. The marginal and small farmers are often facing problem of marketing their product and are not getting fair price due to existence of trade syndicates. The expanding shrimp farming in the greater Khulna region has caused wide concerns for the rich bio-diversity of the Sundarbans. The current shrimp practices did not enhance social equity rather imposes soaring social costs (conflicts, fragmenting and dividing community) through disputes between local and outside landowners over land tenure and user rights, and conflicts between paddy farmers and shrimp cultivators (Hart & Nandy 1990[20]; Begum & Alam 2000[21]). Experts have recommended[22] that shrimp cultivation should be limited to the high salinity zones and part of medium salinity zones, where shrimp cultivation is economically more profitable. However, existing shrimp culture yet fail to address its negative impacts on ecosystem functions.

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[18] Barnett, J and Adger, N, 2005: Security and Climate Change: Towards an Improved Understanding, Paper presented at an International Workshop " Human Security and Climate Change" Holmen Fjord Hotel, Asker, near Oslo, 20–21 June 2005

19 Afzal Khan, "Bangladesh Shrimp Exports Poised to Soar with U.S. Assistance," U.S. Department of State, International Information Programs, Washington File, August 10, 2005.

20 Hart D. and Nandy S., 1990. Equity Aspects of Shrimp Cultivation in Khulna Region. Dhaka: government of the Netherlands

21 Begum A. and Alam S.M.N., 2000. Bangladesh: Case Study-1; Social Aspects of Coastal Shrimp Aqua-culture in Bangladesh. Caritas- Bangladesh (Sponsored by World Bank, NACA and FAO), Dhaka, Bangladesh

22 Ghafur A, Kamal, M. Dhaly MR, Khatun S., 1999. Socio-Economic and Environmental Impact of Shrimp Culture in South-western Bangladesh: An Integrated Approach, Nijera Kori and IDPAA at Proshika, Dhaka, Bangladesh

1.9 Policy Context of the Shrimp Aquaculture

Bangladesh is on the verge of a major policy shift in shrimp aquaculture. Government of Bangladesh is going to introduce the National Shrimp Policy for the first time. This policy includes quality control issues from farms to processing plants to ensure disciplined and environment-friendly growth of the export sector worth nearly $350 million. National Parliament is going to approve the 'Fish Feed Act 2010' and the 'Hatchery Act 2010' very soon. The Hatchery Act is expected to require the registration and licensing of hatcheries and set standards for equipment and management practices. In January 2010, Bangladesh Parliament passed a bill prohibiting the use of antibiotics, growth hormones, steroid and harmful pesticides in animal and fish feeds. Shrimp is one of the country's major export items. The new bill, if turned into law, will guarantee safer standards for fish and animal feeds that will ultimately contribute to people's health.

Region	Country	Production in 1,000 tons per year, rounded																						
		1985	86	87	88	89	1990	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07
Asia	*China*	40	83	153	199	186	185	220	207	88	64	78	89	96	130	152	192	267	337	687	814	892	1'080	1'265
	Thailand	10	12	19	50	90	115	161	185	223	264	259	238	225	250	274	309	279	264	330	360	401	501	501
	Vietnam	8	13	19	27	28	32	36	37	39	45	55	46	45	52	55	90	150	181	232	276	327	349	377
	Indonesia	25	29	42	62	82	84	116	120	117	107	121	125	127	97	121	118	129	137	168	218	266	326	315
	India	13	14	15	20	28	35	40	47	62	83	70	70	67	83	79	97	103	115	113	118	131	132	108
	Bangladesh	**11**	**15**	**15**	**17**	**18**	**19**	**20**	**21**	**28**	**29**	**32**	**42**	**48**	**56**	**58**	**59**	**55**	**56**	**56**	**58**	**63**	**65**	**64**
	Philippines	29	30	35	44	47	48	47	77	86	91	89	77	41	38	39	41	42	37	37	37	39	40	42
	Myanmar	0	0	0	0	0	0	0	0	0	0	1	2	2	2	5	5	6	7	19	30	49	49	48
	Taiwan	17	45	80	34	22	15	22	16	10	8	11	13	6	5	5	6	8	10	13	13	13	11	11
Americas	Brazil	<1	<1	<1	<1	1	2	2	2	2	2	2	3	4	7	16	25	40	60	90	76	63	65	65
	Ecuador	30	44	69	74	70	76	105	113	83	89	106	108	133	144	120	50	45	63	77	90	119	150	150
	Mexico	<1	<1	<1	<1	3	4	5	8	12	13	16	13	17	24	29	33	48	46	46	62	90	112	114
	U.S.	<1	<1	1	1	<1	<1	2	2	3	2	1	1	1	2	2	2	3	4	5	5	4	3	2
Middle East	Saudi Arabia	0	0	0	0	<1	<1	<1	<1	<1	<1	<1	<1	1	2	2	2	4	5	9	9	11	12	15
	Iran	0	0	0	0	0	0	0	<1	<1	<1	<1	<1	<1	1	2	4	8	6	7	9	4	6	3
Oceania	Australia	0	<1	<1	<1	<1	<1	<1	<1	1	2	2	2	1	1	2	3	3	4	3	4	3	4	3

Aquaculture shrimp production by the major producer nations. http://en.wikipedia.org/wiki/Shrimp_farm

Currently the regulatory environment for shrimp production is weak due to limitations in legal definitions, unclear and conflicting jurisdiction, poor regulation of fry collection, unclear and conflicting policies on the management and regulation of mangrove fishing in reserved forests, land conversion to shrimp estates that do not have appropriate saline water access, and granting of fishing licenses for collection of rent. This has led to mangrove destruction, social conflicts, environmental pollution, and a loss of biodiversity. The government banned the collection of wild fry in 2000, but this ban has mostly gone unenforced because hatcheries are only able to meet 50% of the demand for bagda post-larvae and only 10% of the demand for golda. In any case, only 13% of the hatchery operators in Bangladesh use farm reared brood (mother shrimp) stock, and the rest come from wild brood which must be caught. This process too is quite destructive since only about around a tenth of percent of the total catch of fishing trawlers are adult brood stock (Azad, Jensen and Lin 2009[23]).

Human rights violation issues of this 2nd largest export earning sector are not addressed in the national policy frameworks and in local level very few organizations seems to be interested to address rights issues. Besides, lack

23 Azad, A. Kalam, Kathe R. Jensen, and C. Kwei Lin. "Coastal Aquaculture Development in Bangladesh: Unsustainable and Sustainable Experiences." Environmental Management 44 (2009): 800-809.

of clearly defined policy guidelines, provides scope to the outsiders to get permission from the local government for shrimp cultivation in wetlands. Although the collection of wild post-larvae has been banned for the last four years, the practice continues on a smaller scale. On the other hand, shrimp aquaculture enjoys financial incentives from the government in the form of subsidies, nominal lease fees and tax deduction. Moreover, after the productive life, the site of the commercial shrimp farm is unfit for further productive use. One good indication is that recently a research body has been set up in Bagerhat for carrying out research, so that Bangladesh could produce quality shrimp.

Overall shrimp production has increased steadily over the last 20 years, but still much lower than that of the neighboring countries such as Thailand and India. The typical plant has the capacity to process 270,000 tons per year but the utilization rates are in between 15% to 30%. This overcapacity is the result of an over-generous government incentives package that offers a waiver of import duty on machinery, a nine year tax holiday, cheap loans, and export price supports. During early 1970's inland open water capture fisheries contributed about 90% of total fish production whereas, in 2007-08 it has reached up to only 41%, showing a marked decline in fish production due to environmental degradation and species depletion. Incidence of shrimp disease has caused some damage to the shrimp industry. But no appreciable preventive or curative intervention measures appear to have been taken to address the issue. Research efforts need to be enhanced for immediate prevention of such outbreak.

Recent trend in fish production in Bangladesh
Source: Bangladesh Economic Review, 2009

Commodity	Growth (during 2001-2008)
Inland fish	8.2
Culture fish	4.2
Marine fish	2.4
Total fish	5.3

The World Bank estimates that 30% of all inland fish species which provide 66% of the country's protein are in danger of extinction (World Bank 2006[24]). Similar effects have been reported for other inputs; snails used for shrimp feed have nearly disappeared from the region (Ahmed, Demaine and Muir 2008[25]).

24 World Bank. Bangladesh: Country Environmental Analysis. Bangladesh Development Series: Paper 12, Dhaka: The World Bank, 2006.
25 Ahmed, Nesar, Harvey Demaine, and James F. Muir. "Fresh Water Prawn Farming in Bangladesh: History, Present Status and Future Prospects." Aquaculture Research, 2008: 1-14.

Chapter 2

Sketch of the Small-Scale Shrimp Farming in Bangladesh

2 Introduction

Most of the shrimp farms (ghers), deports and processing factories are situated in the three districts (khulna, Bagerhat and Shatkhira) of southwest coastal region of Bangladesh. This region is identified as the 'Shrimp Region' of Bangladesh. In this region there are 26,155 Bagda (Penaeus monmodon) and 67,644 Golda (Macrobachium rosenbergii) farms consisting of 156945 hector of land (Commercial shrimp farming in Bangladesh, Ashraf-ul-Alam Tutu, 2004). This region represents 80% of total area under shrimp farming in Bangladesh and the rest is in Cox's Bazar and other areas of the country. Besides, CDP has vast experiences to work in various uapzilas and villages in this region. The proportion of the small and big scale holders is 75%:25%.The numbers of small holders in Khulna, Sathkhira, Bagerhat, Narail and Jessore are 47,084, 25,730, 43,061, 4,885 and 15,008 respectively.

Shrimp farms are vulnerable to natural disasters, price fluctuations in the global market, and market demand. Although the frozen foods export is the second largest export sector of the country, continued product quality is still a major challenge in the shrimp sector. Viral outbreaks in the shrimp farms often hamper the production target. Moreover, natural hazards each year many shrimp enclosures are wiped out. Viral contamination in shrimp farms has also brought about tremendous losses not only to the shrimp, but also to the biodiversity in areas under cultivation by semi-intensive methods.

2.1 Profile of the Small-Scale Shrimp Farm Owner

The study portrayed the small scale shrimp farm owner as such, "*A middle aged, married Bengali man who did not managed to enter the secondary school has to take care of his 6 family members within the daily income of Taka 350 (US$ 0.83 per day per family member) and shrimp is not their primary occupation. Majority of them are involved in other income generating activities".*

Age of the Shrimp Farm owner: Majority (58%) of the small-scale shrimp farm owners are middle aged (31 years to 50 years old). More than one-third (34.7%) of the small-scale shrimp farm owners are in between 31 years to 40 years age category. The youngest shrimp farm owner is 20 years old and the oldest is 78 years old. The mean age of the male shrimp farmer is 42 years and for women shrimp farmer the mean age is 37 years.

Religion & Ethnicity of the Shrimp Farm owner: Around three-fourth (75.3%) shrimp farmers identified them as Muslim and nearly one-fourth (23.6%) is Hindu. Virtually all the shrimp farmers are Bangali (99%).

Marital Status of the Shrimp Farm owner: More than four-fifth (89.6%) shrimp farmer are married. However, among the women shrimp farmers, 50% is widow and abandoned by husband.

Family size of the Shrimp Farm owner: The average family size (members) of the Shrimp Farm owner is 6. Nearly half of the Shrimp Farm owner (49.6%) reported that their family size is 5-7 members.

Educational Background of the Shrimp Farm owner: More than half (89.6%) of the shrimp farmers has not managed to enter the secondary school level and can be considered as functional literate. A small portion (6.7%) of the farm owners has graduate degree. A signification portion (7.7%) of the farmers reported them as uneducated.

Profile of the shrimp farm owner	Female		Male		Total	
	N	%	N	%	N	%
Age of the Shrimp Farm owner						
<= 30 Years	1	25.0	75	18.8	76	18.9
31 - 40 Years	1	25.0	139	34.8	140	34.7
41 - 50 Years	2	50.0	92	23.1	94	23.3
51 - 60 Years			62	15.5	62	15.4
60 + Years			31	7.8	31	7.7
Total	**4**	**100**	**399**	**100**	**403**	**100**
Mean Age (year) of the Shrimp Farm owner		**37**		**42**		**42**
Minimum Age (year) of the Shrimp Farm owner		**28**		**20**		**20**
Maximum Age (year) of the Shrimp Farm owner		**44**		**78**		**78**
Religion of the Shrimp Farm owner						
Islam	4	100	302	75.7	306	75.9
Hindu			95	23.8	95	23.6
Traditional religion			2	.5	2	.5
Total	**4**	**100**	**399**	**100**	**403**	**100**
Ethnicity of the Shrimp Farm owner						
Bangali	3	75.0	396	99.2	399	99.0
Non-Bengali	1	25.0	2	.5	3	.7
Indigenous			1	.3	1	.2
Total	**4**	**100**	**399**	**100**	**403**	**100**
Marital Status of the Shrimp Farm owner						
Unmarried			38	9.5	38	9.4
Married	2	50.0	359	90.0	361	89.6
Widow	1	25.0			1	.2
Widower	1	25.0			1	.2
Abandoned			2	.5	2	.5
Total	**4**	**100**	**399**	**100**	**403**	**100**
Family size of the Shrimp Farm owner						
2 - 4 Members	3	75.0	127	31.8	130	32.3
5 - 7 Members	1	25.0	199	49.9	200	49.6
8 - 10 Members			53	13.3	53	13.2
10 + Members			20	5.0	20	5.0
Total	**4**	**100**	**399**	**100**	**403**	**100**
Average family size (members) of the Shrimp Farm owner		**4**		**6**		**6**
Educational Background of the Shrimp Farm owner						
Primary	1	25.0	112	28.1	113	28.0
Lower secondary	3	75.0	121	30.3	124	30.8
Secondary			81	20.3	81	20.1
Higher secondary			27	6.8	27	6.7
Degree			18	4.5	18	4.5
Masters			9	2.3	9	2.2
Uneducated			31	7.8	31	7.7
Total	**4**	**100**	**399**	**100**	**403**	**100**

Occupation of the Shrimp Farm Owner: Only two-fifth (39.7%) of the small-scale shrimp farmers has reported shrimp farming as their primary occupation. One-fifth (19.9%) of the surveyed shrimp farmers reported Agriculture as the primary occupation and another one-fifth (20.1%) reported Business as the primary occupation.

Occupation of the Shrimp Farm Owner	Primary Occupation		Secondary Occupation	
	N	%	N	%
Food maker \Food processor	29	7.2	22	16.6
Business	81	20.1	27	20.3
Shrimp Farming	160	39.7	11	8.3
Agriculture	80	19.9	35	26.3
Catching fish	12	3.0	11	8.3
Others (Ayurvedic treatment, Dress making, Furniture making, Poultry rearing, Radio-TV repairing, Electric works, Driving, Handicrafts, Teacher, Doctor etc)	41	10.1	27	20.3
Total	**403**	**100**	**133**	**100**

2.2 Household Income of the Small-Scale Shrimp Farm Owner

The average annual income of the shrimp farmer's family is Taka 133,308 (US$ 1900/year, US$ 5/day/family) including income from shrimp farming. Nearly two-third (63.9%) shrimp farmers reported that their annual family income is in between Taka 10,000 to Taka 100,000. Only a small portion (6%) has annual family income over Taka 300,000.

Economic status of the shrimp farm owner	Female		Male		Total	
	N	%	N	%	N	%
Yearly family income of the Shrimp farm owner						
TK. 10,000 - 30,000			49	12.3	49	12.2
TK. 30,001 - 60,000	1	25.0	100	25.1	101	25.1
TK. 60,001 - 1,00,000	1	25.0	106	26.6	107	26.6
TK. 1,00,001 - 1,50,000	1	25.0	64	16.0	65	16.1
TK. 1,50,001 - 3,00,000	1	25.0	56	14.0	57	14.1
TK. 3,00,000 +			24	6.0	24	6.0
Total	**4**	**100**	**399**	**100**	**403**	**100**
Average family income (Taka/year) of the farm owner		**112000**		**133521**		**133308**
Minimum family income (Taka/year) of the farm owner		50000		10000		10000
Maximum family income (Taka/year) of the farm owner		200000		3000000		3000000

Average family income (Taka/year) of the farm owner is Taka 133,308 or Taka 11,109 per month.

2.3 Status of the Small-Scale Shrimp Farm Worker

The workforce of the small-scale Shrimp Farms is predominantly the male. More than four-fifth (82.1%) shrimp farm owner reported that male workers are more in their farm than female. The rest 17.9% shrimp farm owner have more female workers than male in their farm.

Distribution of the Shrimp Farm Workers according to Sex	Female		Male		Total	
	N	%	N	%	N	%
Female	2	50.0	70	17.5	72	17.9
Male	2	50.0	329	82.5	331	82.1
Total	4	100	399	100	403	100

Majority (71.3%) of the female shrimp farm workers falls into the 21-35 years age category. Three-quarter (74.9%) of the male shrimp farm workers are in between 26 years to 40 years age category. The youngest shrimp farm worker is 18 years old and the oldest is 50 years old. The mean age of the male shrimp farm worker is 34 years and for women shrimp workers the mean age is 28 years.

Profile of Shrimp Farm Workers	Female		Male		Total	
	N	%	N	%	N	%
Age of the female Shrimp Farm Workers						
18 - 20 Years	1	25.0	23	5.8	24	6.0
21 - 25 Years			122	30.6	122	30.3
26 - 30 Years	1	25.0	100	25.1	101	25.1
31 - 35 Years	1	25.0	63	15.8	64	15.9
36 - 40 Years			14	3.5	14	3.5
Don't know/can't say	1	25.0	77	19.3	78	19.4
Total	4	100	399	100	403	100
Average age (years) of the female Shrimp Farm Workers		27		28		28
Minimum age (years) of the female Shrimp Farm Workers		18		18		18
Maximum age (years) of the female Shrimp Farm Workers		35		40		40
Age of the male Shrimp Farm Workers						
18 - 20 Years	1	25.0	8	2.0	9	2.2
21 - 25 Years			33	8.3	33	8.2
26 - 30 Years			91	22.8	91	22.6
31 - 35 Years	1	25.0	126	31.6	127	31.5
36 - 40 Years			84	21.1	84	20.8
40 + Years	2	50.0	39	9.8	41	10.2
Don't know/can't say			18	4.5	18	4.5
Total	4	100	399	100	403	100
Average age (years) for male staffs working in the Shrimp Farm		36		34		34
Minimum age (years) of the male Shrimp Farm Workers		20		18		18
Maximum age (years) of the male Shrimp Farm Workers		45		50		50

2.3.1 The Working Condition & Wages in the Shrimp Farming sector

On average each shrimp farm has eight (8) workers. Majority of the shrimp farm owner (46.4%) reported to have 5-7 staffs working in their farm.

Status of Shrimp Farm workers	Total	
	N	%
2 - 4 Staffs	105	26.1
5 - 7 Staffs	187	46.4
8 - 12 Staffs	69	17.1
13 - 20 Staffs	27	6.7
20 + Staffs	15	3.7
Total	**403**	**100**
Average number of workers/Shrimp Farm		**8**

Working condition of Shrimp Farm workers (Total respondents 403)	
Average working hours for full time staff	Hour/Day
Female full time staff	8
Male full time staff	15
All full time staff	16
Average working hours for part time staff	
Female part time staff	6
Male part time staff	6
All part time staff	7
Average working hours for workers	
Female workers/Labors	6
Male workers/Labors	7
All workers/Labors	8
	Taka/Day
Average wages/salaries for female full time staff	184
Average wages/salaries for male full time staff	291
Average wages/salaries for all full time staff	298
Average wages/salaries for female part time staff	192
Average wages/salaries for male part time staff	185
Average wages/salaries for all part time staff	220
Average wages/salaries for female worker	193
Average wages/salaries for male worker	159
Average wages/salaries for all worker	197

2.3.2 Health Status of the Shrimp Farm Workers

Two-third (59.1%) shrimp farm owner acknowledged the possibility of sickness of Shrimp farm workers due to shrimp farm environment. Fever, Cough and cold is reported as the frequent health problems. More than half (54.1%) of the shrimp farm owner reported the possibility of accidents of Shrimp farm workers due to shrimp farm environment. Physical injury is most frequent accident occurs in the shrimp farm. Village doctor is the primary source of treatment for diseases of Shrimp farm's staff.

possibility of sickness of Shrimp farm workers due to shrimp farm environment	Female		Male		Total	
	N	%	N	%	N	%
Yes	2	50.0	236	59.1	238	59.1
No	2	50.0	163	40.9	165	40.9
Total	**4**	**100**	**399**	**100**	**403**	**100**
Type of diseases						
Fever	1	50.0	206	87.3	207	87.0
Cough	1	50.0	178	75.4	179	75.2
Cold			142	60.2	142	59.7
Headache	1	50.0	23	9.7	24	10.1
Diarrhea	2	100	35	14.8	37	15.5
Jaundice	1	50.0	10	4.2	11	4.6
Eye defect			9	3.8	9	3.8
Throat problem			6	2.5	6	2.5
Pain (Body/Tooth/Stomach)			16	6.7	16	6.7
Gastric			11	4.7	11	4.6
Asthma			9	3.8	9	3.8
Total	**2**	**100**	**236**	**100**	**238**	**100**

Staffs and workers health status at shrimp farm	Female		Male		Total	
	N	%	N	%	N	%
Possibility of accident of staff's due to the environment of Shrimp farm						
Yes	2	50.0	216	54.1	218	54.1
No	2	50.0	183	45.9	185	45.9
Total	**4**	**100**	**399**	**100**	**403**	**100**
Type of accidents						
Physical injury /Sprain	1	50.0	127	58.8	128	58.7
Get hurt	1	50.0	136	63.0	137	62.8
Burn			8	3.7	8	3.7
Cut	1	50.0	55	25.5	56	25.7
Fracture			6	2.8	6	2.8
Electric shock			1	.5	1	.5
Injure by instruments used in shrimp farm			19	8.8	19	8.7
Biting by snakes/beech	1	50.0	27	12.5	28	12.8
Total	**2**	**100**	**216**	**100**	**218**	**100**
Primary source of treatment for diseases of Shrimp farm's staff						
Government hospital			55	13.8	55	13.6
Free/charitable hospital			11	2.8	11	2.7
Private clinic / hospital	1	25.0	43	10.8	44	10.9
NGO health service			1	.3	1	.2
Dispensary sales man	1	25.0	27	6.8	28	6.9
Village doctor	2	50.0	250	62.7	252	62.5
Homeopathic doctor			11	2.8	11	2.7
Total	**4**	**100**	**399**	**100**	**403**	**100**

2.4 Establishment of the Shrimp Farm

Since 1971, there is the existence of the shrimp farms in the Khulna and Satkhira districts. However, the growing trend of the shrimp farming was started in the early 90's. The two-fifth of the total shrimp farms were established between the 5 years 2001 to 2005. During this the 5 years period, the annual growth of the shrimp farm establishment was 8.0%. Currently the shrimp farm establishment is growing with an annual rate of 3.4%.

Establishment Year of the Shrimp farm	Female		Male		Total		Annual Growth (%)
	N	%	N	%	N	%	
1971 - 1990 Years			21	5.3	21	5.2	0.26
1991 - 2000 Years			110	27.6	110	27.3	2.73
2001 - 2005 Years	2	50.0	159	39.8	161	40.0	8.0
2006 - 2009 Years	2	50.0	53	13.3	55	13.6	3.4
Don't Know/Can't say			56	14.0	56	13.9	0
Total	4	100.0	399	100.0	403	100.0	

2.5 Registration and Certification of the Shrimp Farm

Registration Status of the Shrimp Farms: Despite government efforts, the study identified that nearly one-tenth (9.4%) shrimp farms have government registration. None of the women shrimp farm owner has government registration. Among the registered farms, three-fifth (60.5%) were registered in between 2006 to 2009.

Status of registration and certification of the shrimp farm	Female		Male		Total	
	N	%	N	%	N	%
Registration status of the shrimp farm in any government authority						
Yes			38	9.5	38	9.4
No	4	100	361	90.5	365	90.6
Total	**4**	**100**	**399**	**100**	**403**	**100**
Year of registration under any government authority						
1992 - 2000 Years			3	7.9	3	7.9
2001 - 2005 Years			12	31.6	12	31.6
2006 - 2009 Years			23	60.5	23	60.5
Total			**38**	**100**	**38**	**100**
Status of regular inspection by government						
Yes	1	25.0	12	3.0	13	3.2
No	3	75.0	387	97.0	390	96.8
Total	**4**	**100**	**399**	**100**	**403**	**100**

2.6 Outlook of the Shrimp Farming Economy

Slightly over one-third (34.5%) of the shrimp farmer's yearly income by Shrimp exporting/selling is limited between Taka 50000 to 100000. One-fifth (20.8%) earns Taka 10,000 to 30,000. The average yearly income by selling shrimp is Taka 110,771.

Total yearly income by Shrimp exporting/selling	Female		Male		Total	
	N	%	N	%	N	%
TK. <= 10,000			20	5.0	20	5.0
TK. 10,001 - 30,000	1	25.0	83	20.8	84	20.8
TK. 30,001 - 50,000	1	25.0	67	16.8	68	16.9
TK. 50,001 - 1,00,000	1	25.0	138	34.6	139	34.5
TK. 1,00,001 - 2,00,000			60	15.0	60	14.9
TK. 2,00,000 +	1	25.0	31	7.8	32	7.9
Total	**4**	**100**	**399**	**100**	**403**	**100**

The average annual income from the shrimp sale was Taka 117,027 in the last year. However, the average income from the shrimp sale was Taka 56,843 in the present year. It is interesting that only a few (8.4%) farms sell their shrimp directly to the factory. Two-third (66.7%) farms sells to depot.

Economic status of shrimp farm	Female		Male		Total	
	N	%	N	%	N	%
Average yearly income (Taka) by Shrimp exporting/selling		**112000**		**110759**		**110771**
Average income (Taka) by Shrimp sale in the last year		**97500**		**117223**		**117027**
Average income (Taka) by Shrimp sale in the present year		**24750**		**57438**		**56843**
Expected average income (Taka) from Shrimp sale in the next year				**126305**		**126305**
General Shrimp Selling Point						
Depot	2	50.0	267	66.9	269	66.7
Factory			34	8.5	34	8.4
Local Middle man	3	75.0	170	42.6	173	42.9
Total	**4**	**100**	**399**	**100**	**403**	**100**

2.7 Sketch of the Shrimp Farming Practices

The shrimp production irrespective of Bagda (shrimp) and golda (prawn) follows some distinct phases which includes fry collection, farming; processing and export. Bagda grows in brackish water and hatcheries require saline water all through the hatching process and accordingly farms are located along the coast. Golda hatcheries require saline water in their initial stages but shrimp grow out in fresh water. Bagda takes 3 months (Jan/Feb to March/April) to be ready to harvest. Yields vary from place to place.

Shrimp Farming Period (Months)	Density of the shrimp stockpile (Number of Shrimps/Bigha)			Average Survival rate of the shrimp fry (%)	Average Survival rate of the marketable shrimp (%)	Annual average production (kg/Bigha)
	Average	Median	Mode			
January to June	9348	4000	6000	58	41	51
July to December	6388	3000	1000	58	42	45
1 Bigha = 0.134 hectare or 0.33 acre						

2.7.1 Preferred Shrimp Farming Practice

Preferred Shrimp Farming Practice	Female		Male		Total	
	N	%	N	%	N	%
Bagda shrimp (Saline Water Shrimp) is more profitable	3	75.0	325	81.5	328	81.4
Golda shrimp (Fresh Water Shrimp) is more profitable	1	25.0	74	18.5	75	18.6
Total	**4**	**100**	**399**	**100**	**403**	**100**
Quantity per Bigha (0.134 hectare or 0.33 acre) of Bagda shrimp cultivation last year						
< 1,000			77	20.3	77	20.1
1,000 - 5,000	1	25.0	95	25.1	96	25.1
5,001 - 10,000	2	50.0	91	24.0	93	24.3
10,001 - 30,000			72	19.0	72	18.8
30,001 - 50,000			17	4.5	17	4.4
50,000 +	1	25.0	27	7.1	28	7.3
Total	**4**	**100**	**379**	**100**	**383**	**100**
Average quantity of Bagda shrimp per Bigha) in the last year		**19750**		**13673**		**13736**

The bigha is a unit of measurement of area of a land, commonly used in Nepal, Bangladesh and in a few states of India like Bihar, West Bengal, Assam, Gujarat etc. In Bangladesh, the bigha was standardized under British colonial rule at 1600 square yards (0.1338 hectare or 0.3306 acre); this is often interpreted as being 1/3 acre.

Quantity (per Bigha) of Golda cultivation last year	Female		Male		Total	
	N	%	N	%	N	%
< 1,000			91	41.2	91	40.8
1,000 - 5,000	1	50.0	97	43.9	98	43.9
5,001 - 10,000			10	4.5	10	4.5
10,001 - 30,000	1	50.0	17	7.7	18	8.1
30,001 - 50,000			6	2.7	6	2.7
Total	**2**	**100**	**221**	**100**	**223**	**100**
Average quantity of Golda shrimp per Bigha in the last year		**11000**		**4390**		**4449**

2.7.2 Shrimp Fry Collection

	Female		Male		Total	
	N	%	N	%	N	%
Source of shrimp fry						
Wild fry collection from the River by themselves			62	15.5	62	15.4
From the Depot	1	25.0	60	15.0	61	15.1
From the Hatchery	2	50.0	296	74.2	298	73.9
From the local Aratdar /Middlemen Fry seller	4	100	165	41.3	169	41.9
Total	**4**	**100**	**399**	**100**	**403**	**100**

Although majority of the farm owners (73.9%) reported to collect shrimp fry from the hatchery, nearly one-sixth (15.4%) shrimp farm owner still directly involved in wild fry collection, despite the government ban on wild fry collection. The peak time for shrimp fry collection February to April.

Timings (Month) of shrimp fry collection						
January	1	25.0	150	37.6	151	37.5
February	2	50.0	240	60.2	242	60.0
March	4	100	238	59.6	242	60.0
April	2	50.0	169	42.4	171	42.4
May	2	50.0	135	33.8	137	34.0
June	2	50.0	153	38.3	155	38.5
July	2	50.0	70	17.5	72	17.9
August			47	11.8	47	11.7
September	1	25.0	24	6.0	25	6.2
October			30	7.5	30	7.4
November			1	.3	1	.2
December			2	.5	2	.5
Total	**4**	**100**	**399**	**100**	**403**	**100**

2.8 Feed Management for Shrimp Farming

Grain-based Food & commercial fish feed is the principal source of feed for shrimp farms. Around one-sixth (16.2%) shrimp farm owner use Chemical Fertilizer (Phosphate, TSP, Urea) to feed the shrimp for better growth.

Food management for shrimp farming	Female		Male		Total	
(in case of multiple responses, the total may exceed 100)	N	%	N	%	N	%
Types of foods provided for growing shrimp						
Wheat/flour/corn	2	50.0	143	35.9	145	36.0
Rice/ chira	1	25.0	135	33.9	136	33.7
Noodles/pasta			17	4.3	17	4.2
Grain-based Food	**3**	**75.00**	**295**	**74.1**	**298**	**73.9**
Snail	2	50.0	145	36.3	147	36.5
Fish feed	**2**	**50.0**	**269**	**67.4**	**271**	**67.2**
Cow dung	1	25.0	32	8.0	33	8.2
Chemical Fertilizer (Phosphate, TSP, Urea)	**2**	**50.00**	**63**	**15.9**	**65**	**16.2**
Don't know/can't say			9	2.3	9	2.2
Total	**4**	**100**	**399**	**100**	**403**	**100**
Source of foods for shrimp cultivation						
Fish feed store			104	26.1	104	25.8

Local market	4	100	324	81.2	328	81.4
Don't know/can't say			11	2.8	11	2.7
Total	**4**	**100**	**399**	**100**	**403**	**100**
Mode of food processing for shrimp cultivation						
Feeding full processed food	2	50.0	242	60.7	244	60.5
Feeding by processing fish meal in the Shrimp Gher	2	50.0	204	51.1	206	51.1
Total	**4**	**100**	**399**	**100**	**403**	**100**
Source of foods for shrimp cultivation						
Fish feed store			104	26.1	104	25.8
Local market	4	100	324	81.2	328	81.4
Don't know/can't say			11	2.8	11	2.7
Total	**4**	**100**	**399**	**100**	**403**	**100**
Mode of food processing for shrimp cultivation						
Collect complete processed food	2	50.0	242	60.7	244	60.5
Collect Ingredient and then process in the Shrimp Farm	2	50.0	204	51.1	206	51.1
Total	**4**	**100**	**399**	**100**	**403**	**100**
Type of Ingredients collect for shrimp food processing						
Snail/crunch shell			109	27.3	109	27.0
local sun dried fish /Powder of dry fish	1	25.0	48	12.0	49	12.2
Wheat/Corn/ Rice/Pulse	**1**	**25**	**239**	**59.8**	**240**	**59.6**
Cow dung	2	50.0	232	58.1	234	58.1
Chemical Fertilizer (mainly Urea)	3	75.0	254	63.7	257	63.8
Grain Husks (Paddy husk, Khail/Oilly husk)	3	75.00	300	75.2	303	75.2
Soyabean			3	.8	3	.7
Salt	1	25.0	4	1.0	5	1.2
Molasses			6	1.5	6	1.5
Total	**4**	**100**	**399**	**100**	**403**	**100**

More than three-quarter (81.4%) shrimp farms collect shrimp feed from the local market.

2.9 Care & Disease Management Practice within the Shrimp Farms

Status of Shrimp cultivation at Shrimp Farm	**Female**		**Male**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
Types of care needed for Shrimp at the time of growth						
Regular feeding	1	25.0	215	55.4	216	55.1
Testing of Diseases regularly	1	25.0	158	39.6	159	39.5
Using pesticides and molasses as necessary	3	75.0	155	38.8	158	39.2
Regular cleaning of water source	2	50.0	142	35.6	144	35.7
Total	**4**	**100**	**399**	**100**	**403**	**100**

During diseases attack in the farm, the farmers take care of their farms as per their own methods. Besides the unapproved medicines of markets they also used their own manufactured medicines. Sometimes they go to Upazilla Fisheries Officer for suggestions and treatments of shrimp, but no treatment is being applied in the cases of dangerous diseases like 'virus'.

diseases outbreak at Shrimp Farm	Female		Male		Total	
	N	%	N	%	N	%
Pattern of diseases broadly attacks the Shrimp						
Bear searching	1	25.0	144	36.1	145	36.0
Storing water on neck	1	25.0	59	14.8	60	14.9
Tail rotating water	3	75.0	161	40.4	164	40.7
Gill rot			100	25.1	100	24.8
Problem of Bear antenna	1	25.0	24	6.0	25	6.2
Develop a blister on body, red color & weak	2	50.0	136	34.1	138	34.2
Virus dieses	3	75.0	320	80.2	323	80.1
Bacteria dieses			16	4.0	16	4.0
The skin Fish make of dry			146	36.6	146	36.2
Total	**4**	**100**	**399**	**100**	**403**	**100**
reasons for diseases outbreak in the Shrimp farm						
Dieses pry	1	25.0	156	39.1	157	39.0
Amiss ion of gas of soil/due to soil	3	75.0	212	53.1	215	53.3
Miss management of Shrimp Farm	2	50.0	53	13.3	55	13.6
Heavy rain fall/draught	3	75.0	180	45.1	183	45.4
Lake of proper care	1	25.0	26	6.5	27	6.7
Lack of experience in diagnosis	1	25.0	85	21.3	86	21.3
Rotan plank tons			54	13.5	54	13.4
Careless	1	25.0	26	6.5	27	6.7
Lake of fresh water			96	24.1	96	23.8
Don't get nutrition food in time			41	10.3	41	10.2
Boiled water in exes hit			102	25.6	102	25.3
Total	**4**	**100**	**399**	**100**	**403**	**100**

insects control at Shrimp Farm	Female		Male		Total	
	N	%	N	%	N	%
Types of insecticide used to control insects						
Bleaching powder	1	25.0	139	34.8	140	34.7
Lime stone	4	100	357	89.5	361	89.6
Potash	4	100	228	57.1	232	57.6
Feetkiri	1	25.0	143	35.8	144	35.7
Geolite			14	3.5	14	3.5
No kind of pesticide used			14	3.5	14	3.5
Thiodin			51	12.8	51	12.7
Recoat			3	.8	3	.7
Phosphate			3	.8	3	.7
Cutup			4	1.0	4	1.0
Tartaric			3	.8	3	.7
Total	**4**	**100**	**399**	**100**	**403**	**100**

2.10 Source of Water for Shrimp Farming

Saline water-based shrimp farming: More than three-fourth (78.4%) saline water-based shrimp farms use River canals as the source of water. More than one-tenth (14.6%) saline water-based shrimp farms use wetlands channels. A notable farms (7%) use ground water from both shallow and deep aquifer. However, the use of deep aquifer ground water is 1.8 times higher than shallow aquifer. It was found that a few (3%) follows the practice of artificial transformation of sweet water in to saline water.

Source of water for saline water shrimp farming	Female		Male		Total	
	N	%	N	%	N	%
From sea			12	3.0	12	3.0
Deep Aquifer Ground Water (Deep tube well)			18	4.5	18	4.5
Shallow Aquifer Ground Water (Shallow tube well)			10	2.5	10	2.5
River- Canal	3	75.0	313	78.4	316	78.4
Canal-Beel (wetlands channels)	1	25.0	58	14.5	59	14.6
Artificial transformation of sweet water in to saline water			12	3.0	12	3.0
Total	**4**	**100**	**399**	**100**	**403**	**100**

Fresh water-based shrimp farming: Two-fifth (40.5%) fresh water-based shrimp farms use ground water from both shallow and deep aquifer. More than one-third farms (36%) use river canals as the source of water. It was found that a few (3%) follows the practice of artificial transformation of fresh water in to saline water. More than one-tenth fresh water-based shrimp farms use wetlands channels (12.9%) and rain water (11.9%). The fresh water-based shrimp farms (40.5%) use more ground water than saline water-based shrimp farms (7%).

Source of water for sweet water shrimp farming	Female		Male		Total	
	N	%	N	%	N	%
Deep Aquifer Ground Water (Deep tube well)	2	50.0	76	19.0	78	19.4
Shallow Aquifer Ground Water (Shallow tube well)			85	21.3	85	21.1
Pond water	2	50.0	27	6.8	29	7.2
River- Canal			145	36.3	145	36.0
Canal-Beel (wetlands channels)	1	25.0	51	12.8	52	12.9
Rain water			48	12.0	48	11.9
Total	**4**	**100**	**399**	**100**	**403**	**100**

The use of ground water in fresh water-based shrimp farms is almost 6 times higher than saline water-based shrimp farms. The river canal is the largest single source of water for both fresh water-based shrimp farms (36%) and saline water-based shrimp farms (78.4%). The use of river canal in saline water-based shrimp farms is 2.2 times higher than fresh water-based shrimp farms.

2.11 Status of Water & Drainage Management System of the Shrimp Farm

Water discharge management system of the Shrimp farm	Female		Male		Total	
	N	%	N	%	N	%
Irrigation by the machine	1	25.0	137	34.3	138	34.2
Digging cannel	3	75.0	62	15.5	65	16.1
Linking river with pipe	1	25.0	207	51.9	208	51.6
Drain out throw sluice gate			26	6.5	26	6.5
Total	**4**	**100**	**399**	**100**	**403**	**100**
Destination of the discharged water of the Shrimp farm						
In the side hole			2	.5	2	.5
Nearby farming land			37	9.3	37	9.2
River cannel	3	75.0	263	65.9	266	66.0
Ditch			7	1.8	7	1.7
In cannel bills	1	25.0	104	26.1	105	26.1
Total	**4**	**100**	**399**	**100**	**403**	**100**

Status of possible negative impacts from the discharged water of the Shrimp farm	Female		Male		Total	
	N	%	N	%	N	%
Yes	1	25.0	48	12.0	49	12.2
No	3	75.0	351	88.0	354	87.8
Total	**4**	**100**	**399**	**100**	**403**	**100**

Type of possible negative impacts by the discharged water						
Creates ditch	1	100	37	77.1	38	77.6
Prevalence of diseases			2	4.2	2	4.1
Damage natural equilibrium			14	29.2	14	28.6
Soil Erosion (washing out of soils)			33	68.8	33	67.3
Total	**1**	**100**	**48**	**100**	**49**	**100**

Chapter 3

Impact of the Small-Scale Shrimp Farming in Bangladesh

3 Shrimp Farming Impact

The magnitude of social impact of the Shrimp Farming depends on the ownership, community acceptance, and land use pattern of the shrimp farm. The study identified primary occupation of the Shrimp Farm Owner is also a factor. Salinity enhanced by shrimp culture has been changing the harvesting process, crop production, plant diversity and severe scarcity of food in the coastal regions of Bangladesh. Salinity has already encroached 21% of the cultivated land in the South-west coastal area within last three decades. Around 56% of the rivers in this area are contaminated by salinity.

One of the key findings of the study is the identification of the changes in ownership pattern. Currently, majority of the farms (80%) are operated by their owners. The remaining 20% are tenant operators leasing in land from local as well as absentee owners of private shrimp land. However, such changes in ownership giving shrimp farm a community or local identity rather than outsider identity. Nevertheless, this local face has not enhanced value addition power within the shrimp value chain. The outsider groups who once controlled shrimp farms in the villages gradually shifted into different sub-sectors of the shrimp industry with more money and power still dominates the value chain.

Only two-fifth (39.7%) of the small-scale shrimp farmers has reported shrimp farming as their primary occupation. 92% of the interviewed shrimp farm owners reported that they integrate shrimp farming with rice, fish and vegetables in a modified rice field to ensure a year round supply of crops & vegetables for family intake along with cash income from shrimp farms. Small-scale farmers consider shrimp as a valuable cash crop (especially freshwater golda). Around 8% farmer does stand alone shrimp farming.

3.1 Social Impact of the Shrimp farming

The Small-Scale Shrimp Farm Owners has to take good care of their shrimp pond because they cannot afford to change shrimp ponds frequently and also want to keep their limited land for future generations. Moreover, as small scale farmers usually live in close relationship with their neighbours, share community resources, they also have to follow social norms.

Acknowledgement of negative social Impact by the Shrimp farming		Female		Male		Total	
		N	%	N	%	N	%
	Yes	3	75.0	121	30.3	124	30.8
	No	1	25.0	278	69.7	279	69.2
	Total	**4**	**100**	**399**	**100**	**403**	**100**

Nearly one-third (30.8%) shrimp farm owners acknowledged that shrimp farming has negative impact on local community.

3.1.1 Shrimp Farming on Local Livelihood

The study recognized that shrimp farming multi-dimensional impacts on the local livelihood in terms of agriculture production, livestock rearing, income & employment, food & nutrition. It is worth to mention that this recognition comes from the shrimp farm owners. However, two-fifth (39.5%) farm owner reported that shrimp farming has no impact on local livelihood. Shrimp firm owners reported that shrimp farming reduces productive agricultural land and related jobs (37.0%) and hinders cattle and poultry rearing (37.7%). Shrimp farming also Reduces fire wood supply (26.6%), Reduce homestead vegetable garden (19.9%) and Reduces production of local fish and fish fry (10.4%).

Shrimp Farming Impact on Local Livelihood	Female		Male		Total	
	N	%	N	%	N	%
Reduces agricultural land and related jobs	1	25.0	148	37.1	149	37.0
Reduces production of local fish and fish fry			42	10.5	42	10.4
Reduces fire wood supply	1	25.0	106	26.6	107	26.6
Reduce homestead vegetable garden			80	20.1	80	19.9
Hinders cattle and poultry rearing	1	25.0	151	37.8	152	37.7
No impact on livelihood	3	75.0	156	39.1	159	39.5
Total	**4**	**100**	**399**	**100**	**403**	**100**

3.1.2 Shrimp Farming Impact on Agriculture

Shrimp culture has adversely affected the potential crop-mix, cropping intensity, crop calendar and the overall cropping pattern in the areas. Polders and shrimp culture has cut off traditional dry season activities such as grazing cattle and goats, home gardening etc. Shrimp farming need saline water round the year and gradual expansion of shrimp farming (annually 7% of the total landmass) expanded saline area simultaneously.

Shrimp Farming Impact on Agriculture	Female		Male		Total	
	N	%	N	%	N	%
Reducing Rice (aman) cultivation	3	75.0	260	65.2	263	65.3
Reducing grazing land and straw			56	14.0	56	13.9
Decreasing vegetable cultivations	2	50.0	127	31.8	129	32.0
No impact on agriculture	1	25.0	140	35.1	141	35.0
Extra benefit			16	4.0	16	4.0
Total	**4**	**100**	**399**	**100**	**403**	**100**

Agriculture has been reduced, resulting in reduction of employment options for the poor and land-less. Reduction in agriculture has resulted in lack of food security, especially for poor people of the region.

3.1.3 Shrimp farming impact on the local community

More than two-fifth (47.4%) shrimp farm owner reported that shrimp farming has no impact on local community. Reduction of fresh water fish species (30.8%) and land dispute (21.3%) are identified as the major impact on local community. Shrimp farming also have adverse impact on traditional social norms & culture (10.2%) and restricts local community access to public property (7.9%) like wetlands, Khas lands etc. Shrimp farming deprives child education (5.7%) and generates abuse and violence against women (4.0%). Two-fifth (40.2%) of the shrimp farmer admitted that community does not access enter and move in the Shrimp farm area.

Salinity has adversely affected homestead vegetable gardening, poultry farming and cattle-rearing, thus denying the poor people their sources of home-grown nutrition and subsidiary incomes. The lack of vegetables, fruits,

eggs and milk has resulted in massive malnourishment, especially of women and children, in the region. Drinking water is mainly affected by the increasing salinity in the coastal region.

The fresh water shallow aquifers are contaminated by saline water. Housing affected due to function of salinity. Mud houses are mostly vulnerable to saline water and tidal surge.

Nature of shrimp farming impact on the local community	Female		Male		Total	
	N	%	N	%	N	%
Land dispute	1	25.0	85	21.3	86	21.3
Abuse and violence against women			16	4.0	16	4.0
Limiting access to public property			32	8.0	32	7.9
Adverse impact on traditional social norms & culture			41	10.3	41	10.2
Deprivation of education of the children			23	5.8	23	5.7
Reduction of fresh water fish species	2	50.0	122	30.6	124	30.8
No impact on local community	3	75.0	188	47.1	191	47.4
Total	**4**	**100**	**399**	**100**	**403**	**100**
Community access to enter and move in the Shrimp farm area						
Yes	2	50.0	239	59.9	241	59.8
No	2	50.0	160	40.1	162	40.2
Total	**4**	**100**	**399**	**100**	**403**	**100**

The local community does not have any control of the public resources because the industrialized shrimp farming has more money & influence to get government support for using these resources for their profit. Every year many people are injured or killed due to fight and many cases are filed against each other due to conflict of shrimp farm's ownership among the cultivators groups in the society.

3.2 Environmental Impacts of the Shrimp Farming

More or less three quarter (75.2%) of shrimp farm owner acknowledged the expansion of salinity (50.6%) with increasing trend of salinity level (24.6%) is the key environmental impact of the shrimp farming. Wild fry collection destroying other local species of fish (26.6%), Loss of soil fertility (27.0%), Reduction & Degradation of biodiversity (18.1%) and Pollution (15.4%) are other major impacts.

Environmental Impact due to shrimp farming	Female		Male		Total	
	N	%	N	%	N	%
Types of Shrimp farming impact on Environment						
Wild fry collection destroying other local species of fish	1	25.0	106	26.6	107	26.6
Pollution due to the shrimp production & processing	1	25.0	61	15.3	62	15.4
barrier of water flows from rivers and cannel	1	25.0	28	7.0	29	7.2
Increment of salinity level	1	25.0	203	50.9	204	50.6
Expansion of saline area			99	24.8	99	24.6
Reduction & Degradation of coastal forestry	1	25.0	31	7.8	32	7.9
Reduction & Degradation of biodiversity			73	18.3	73	18.1
Extinction of various marine species			8	2.0	8	2.0
Loss of soil fertility	2	50.0	107	26.8	109	27.0
Risky and uncertain livelihood of the shrimp worker			8	2.0	8	2.0
No Impact on Environment			103	25.8	103	25.6
Total	**4**	**100**	**399**	**100**	**403**	**100**

One-fourth (25.6%) shrimp farm owner reported that there is no environmental impact from shrimp farming.

Declining of others species during the collecting shrimp fry: The small- scale shrimp farmers cannot collect

healthy and diseases free shrimp fry in all time. Shrimp farmers have expressed that Fry collected from the natural sources (i.e. Sea, river) has a great demands to the farmers although these are costly than hatcheries fries. Farmers perceive that Hatcheries fry has no guaranty but the natural fry has more legibility and the rate of missing is very low. It is important to note that, only causes of unavailability of the farmers are using the hatcheries fry only when natural fry is unavailable to them. The fries or PL have to fly from Cox's Bazar to Jessore and then distributed through a chain of middlemen to hundreds of farms. Destructive methods of shrimp fry collection have damaged aquatic bio-diversity and resulted in reduction of the fish population, adversely affecting the livelihoods of fishers.

Perceive that today's technology of Shrimp cultivation is environment friendly						
Yes	4	100	251	62.9	255	63.3
No			148	37.1	148	36.7
Total	**4**	**100**	**399**	**100**	**403**	**100**

Reason for the perception that current Shrimp cultivation is not environment friendly						
Not receiving training			119	80.4	119	80.4
Degradation of bio diversity			54	36.5	54	36.5
Create ecological imbalance			17	11.5	17	11.5
Reduce warmness			37	25.0	37	25.0
Total			**148**	**100**	**148**	**100**

The current shrimp farming practice is severely impacting on environment. The saline water is affecting the forests and biodiversity. As a result, the local verities of fishes are on the way of declining, as well as the local species of snakes, frogs and the earth-worms. Any kinds of pesticide should not be used whether it is shrimp, rice and any other cultivation because it will create problem on Sundarban environment and biodiversity. The saline water which is being used in the shrimp farming destroys the grasses of the adjacent lands of shrimp farming area. Consequently it is creating a massive shortage of food for live stock resources in the locality.

One of the interesting finding was that shrimp farm owners did not mentioned mangrove destruction as impact. Later the study during focus group discussion raised the issue. The shrimp farm owners reported that they do shrimp farming in the agricultural polders which was built during 70s and they have not cleared mangroves, most of the mangroves were cut well before their birth.

3.3 Shrimp Farming Impact on Land Resources

Shrimp Farming has changed the coastal landscape in the past and such change is ongoing. When the shrimp culture fields are abandoned they cannot easily be converted to croplands, as these fields are highly saline for any agriculture produce. After several years washings with rainwater the soils ultimately become normal again by natural ways and be again suitable for agricultural use.

More than four-fifth (86.4%) shrimp farm owners acknowledged that shrimp farming turns any land into unproductive or uncultivable for 8 years. More than two-fifth (45.5%) shrimp farm owners reported that it is possible to reuse the shrimp farm abandoned land within 1-3 years. More than one-third (36.4%) shrimp farm owners denied such short reuse time lag, rather they think that more than 10 years is required to reuse the shrimp farm abandoned land. This is a serious concern for a country like Bangladesh where so many populations depend on very tiny amount of land. When saline water stay for a long period in a particular land then it affect on the other adjacent lands and it is considered as a caused of expanding of more saline porn area which is ultimately influencing to reduce the average rate of agro based production. Besides, it also hampered on the growth of coco-nut trees, betel-nut trees and other trees, even it is also influencing to reduce the feeds for cows, buffalos, goats, sheep and other livestock resources. Due to expanding shrimp farms the cultivable land of the local areas are

decreasing day by day. Moreover, after the productive life, the site of the commercial shrimp farm is not suitable for any further productive use.

Shrimp farming impact on land resources	Female		Male		Total	
	N	%	N	%	N	%
Shrimp farming turns any land into unproductive/uncultivable						
Yes			55	13.8	55	13.6
No	4	100	344	86.2	348	86.4
Total	**4**	**100**	**399**	**100**	**403**	**100**
Time needed to regain the shrimp farm abandoned land into agriculture production						
1 - 3 Years			25	45.5	25	45.5
4 - 9 Years			10	18.2	10	18.2
10 - 15 Years			10	18.2	10	18.2
15 + Years			10	18.2	10	18.2
Total			**55**	**100**	**55**	**100**
Average time (Year) needed to reuse the shrimp farm abandoned land into agriculture production		**0**		**8**		**8**
Availability of any alternative income options without Shrimp farming						
Yes	1	25.0	263	65.9	264	65.5
No	3	75.0	136	34.1	139	34.5
Total	**4**	**100**	**399**	**100**	**403**	**100**
Types of alternative income generation options						
Cultivate Paddy	1	100	186	70.7	187	70.8
Cultivate vegetables			33	12.5	33	12.5
Cultivate white fish	1	100	133	50.6	134	50.8
Total	**1**	**100**	**263**	**100**	**264**	**100**

It is quite interesting to note that shrimp farm owners perceives that shrimp farming is reducing abandon land through converting fallow or highly saline waterlogged land into productive shrimp farm. Shrimp farm owners explained that in early days, people were depended on rice cultivation. If the nature do not respond positively then the rice cultivation used to hamper, even the maximum lands were fallen into abandon land in a year, but now people can cultivate shrimp without keeping any abandon land. They made a strong point that shrimp farming was introduced to them as alternative livelihood options for using the abandoned water-logged land by different embankment projects. They also pointed out that HARY (rental fee of shrimp farm) is an example of how shrimp farms has added value to the previous valueless highly saline unused land.

Chapter 4

Climate Change Impact on the Small-Scale Shrimp Farming

4 Climate Change Impact on the Shrimp Farming

The degree to which people are vulnerable to climate change depends on the extent to which they are dependent on natural resources and ecosystem services, and the extent to which the resources and services they rely on are sensitive to climate change. Collective vulnerability of a nation, region or community can be determined by 'institutional and market structures, such as the prevalence of informal and formal social security and insurance, and by infrastructure and income (Adger, 1999'[26]).

Climate is a major driver that enhances the aquaculture sector growth and sustainability. The small scale shrimp farmers are among the highest vulnerable to climate change. The occurrence of cyclone & storm surges are expected to results high damage of shrimp farm and cost high for recovering the destroyed. The variability of temperature, evaporation, precipitation rainfall and degradation of the water source quality for shrimp production activities may create production loss and increase income vulnerability among farmers. The climate change risk may increase disease outbreaks and production cost in managing the farm efficiently[27]. The farmers, consumers or dependent people to aquaculture are vulnerable to the direct and indirect impacts of predicted climatic changes and climate warning is important to help them prepare in any possible uncertainty. Poor and marginalized men and women have a limited ability to cope with these challenges.[28] Despite its undoubted success and significant contribution to the economies of developing countries, coastal aquaculture has suffered from conflict over land and water resources; pollution disease; and fluctuating prices.

4.1 Mapping the climate change Impact of shrimp farming: Cyclone as the indicator of climate change

The cyclone Ayla striked on the south-west coast of Bangladesh on May 27, 2009 and caused extensive damage to crops, fisheries, coastal embankments and other infrastructure in coastal districts.

4.1.1 Cyclone Ayla/ climate change impact on shrimp cultivation

The main cultivated species is Peneus monodon (tiger shrimp) locally known as bagda chingri and Macrobrachium rosenbargii (Big freshwater prawn known as golda) commonly.

Type of Shrimp cultivated	Before Aila (January' 2009) (%)			After Aila (September' 2009) (%)		
	Female	Male	Total	Female	Male	Total
N=	4	399	403	4	399	403
Bagda shrimp (Saline water)	50.0	46.9	46.9	50.0	47.9	47.9
Golda shrimp (Fresh water)		5.3	5.2		9.8	9.7
Both Bagda and Golda shrimp	50.0	47.9	47.9	50.0	42.4	42.4

26Adger,N. (1999). Social Vulnerability to Climate Change Extremes in Coastal Vietnam. World development 27.
27 Sulit, V. T., Aldon, M. E. T., Tendencia, I. T., Ortiz, A. M. J., Alayon, S. B. and Ledesma, A. S. (2005) Regional Technical Consultation on the Aquaculture of P. Vannamei and Other Exotic Shrimps in Southeast Asia. Manila, Philippines, 1-2 March 2005.
28 R. Masika, "Editorial – Gender and climate change", *Gender and development*, Vol. 10, No. 2, July 2002.

Total	**100**	**100**	**100**	**100**	**100**	**100**

One of the interesting findings is that Shrimp farmer's follows integrated approach to maximize income through integrated farming approach. Modified traditional system based on extensive farming practice dominates the shrimp farming among small-scale farmers. The application of Modified Traditional System (84.6%) is around 5.5 times higher than Closed System (15.4%).

Ratio of Shrimp farming when Bagda & Golda both are cultivated (% of bagda and % of golda) N=403	**Bagda (Saline Water Shrimp)**		**Golda (Fresh Water Shrimp)**	
	Before Cyclone (January' 2009)	After Cyclone (September' 2009)	Before Cyclone (January' 2009)	After Cyclone (September' 2009)
< 20%			21.0	7.6
20% - 50%	13.4	17.3	57.5	59.5
51% - 70%	17.0	18.7	10.3	11.9
71% - 90%	15.4	11.0	1.4	2.4
91% - 100%	54.2	53.0	9.8	18.6
Total	**100**	**100**	**100.0**	**100.0**

Modified traditional system integrates shrimp farming with rice, fish and vegetables in a modified rice field. Such modification is popular because it provides a year round supply of crops & vegetables for family intake along with cash income from shrimp farms. Small-scale farmers consider shrimp as a valuable cash crop (especially freshwater golda). Only around 8% farmer does only shrimp farming. **Cyclone Ayla has no effect on Shrimp farmer's farming approach.**

Pattern of Shrimp Farming Practice	**Before Aila (January' 2009)**		**After Aila (September' 2009)**	
	N	**%**	**N**	**%**
Only Shrimp Farming	32	7.9	30	7.4
Integrated Shrimp Farming & Salt Cultivation	1	.2	2	.5
Integrated Shrimp Farming & Paddy Cultivate	67	16.6	68	16.9
Integrated Shrimp Farming & Fish Culture	303	75.2	303	75.2
Total	**403**	**100.0**	**403**	**100.0**
Number of Gher (Pond) that a Shrimp Farmer owns				
1 Gher	191	47.4	193	47.9
2 Gher	186	46.2	185	45.9
3 - 4 Gher	18	4.5	20	5.0
4 + Gher	8	2.0	5	1.2
Total	**403**	**100.0**	**403**	**100.0**

Most of the farms (80%) are operated by their owners. The remaining 20% are tenant operators leasing in land from local as well as absentee owners of private shrimp land. Farm management practices in Bangladesh are of two types: extensive and improved extensive culture system. There are presently no semi-intensive farms in operation.

Type of Technology used by the Shrimp farms	**Female**		**Male**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
Technology of Closed System	1	25.0	61	15.3	62	15.4
Technology of Modified Traditional System	3	75.0	338	84.7	341	84.6
Total	**4**	**100.0**	**399**	**100.0**	**403**	**100.0**

4.2 Climate Change Impact on the Shrimp Farm Infrastructure

Disaster Impact on the Shrimp farm Infrastructure	Before Aila (January' 2009) (%)			After Aila (September' 2009) (%)		
	Female	Male	Total	Female	Male	Total
N=	4	399	403	4	399	403
Average land (Bigha) for the Shrimp farm	**11**	**19**	**19**	**11**	**19**	**19**
Average office rooms in the Shrimp	**1**	**2**	**2**	**1**	**2**	**2**
Physical condition of office rooms in the Shrimp						
Brick-Built		1.3	1.2		1.5	1.5
Half Brick-Built		1.0	1.0		1.0	1.0
Clay & straw	50.0	48.1	48.1	50.0	47.9	47.9
Bamboo & Straw Built (Macha/tong house)	50.0	49.6	49.6	50.0	49.6	49.6
Total	**100**	**100**	**100**	**100**	**100**	**100**

Cyclone Impact on the Shrimp farm Infrastructure	Before Aila (January' 2009) (%)			After Aila (September' 2009) (%)		
	Female	Male	Total	Female	Male	Total
N=	4	399	403	4	399	403
Average number of plots in the Shrimp farm	**2**	**1**	**1**	**2**	**1**	**1**
Average Size (Sq. meter) of the individual plots in the Shrimp farm	**5490**	**110407**	**109148**	**6732**	**92696**	**91843**
Average number of Shrimp farm owned by the farm owner	**2**	**2**	**2**	**2**	**2**	**2**
Area of total shrimp farm land (for more than 1 farm) of Shrimp farm owner						
<10 Bigha	75.0	35.4	36.2	75.0	30.1	31.0
10 - 15 Bigha		22.8	22.4		22.3	21.9
16 - 25 Bigha		17.5	17.1		16.5	16.2
26 - 50 Bigha	25.0	14.1	14.3	25.0	13.1	13.3
50 + Bigha		10.2	10.0		8.3	8.1
Lost farm due to Aila					9.7	9.5
Total	**100**	**100**	**100**	**100**	**100**	**100**
Average size (Bigha) of farm land (for more than 1 farm) of Shrimp farm owner	**12**	**29**	**29**	**12**	**31**	**31**

1 Bigha = 0.134 hectare or 0.33 acre

Bamboo & Straw Built (Macha/tong house)

Shrimp Farming Period	*Average Density of the shrimp stockpile (Number of Shrimps/Bigha)*	*Average Survival rate of the shrimp fry (%)*	*Average Survival rate of the marketable shrimp (%)*	*Annual average production (kg/Bigha)*
Before Cyclone	9348	58	41	51
After Cyclone	6388	58	42	45
1 Bigha = 0.134 hectare or 0.33 acre				

4.3 Climate Change (Cyclone Ayla) Impact on Shrimp Farm Owner's Family

Cyclone AYLA, which smacked the southwest coasts of Bangladesh on May 25, 2009, virtually reduced family income for all the shrimp farm owners (95.8%).

Disaster Impact on Shrimp Farm Owner's Annual family income	**Average Income (Taka/year)**		
	Female	**Male**	**Total**
Average family income (Taka/year) of the farm owner (without any disaster)	112000	133521	133308
Average family income of shrimp farm owner's before Cyclone Aila (January' 2009)	82000	113437	113111
Average family income of shrimp farm owner's after Cyclone Aila (September' 2009)	27000	32500	32430
Reduction of family Income of shrimp farm owner's	**55000**	**80937**	**80681**
Average family income (Taka/year) of the farm owner (from all sources)	112000	133521	133308
Average family income of shrimp farm owner's (from shrimp farming only)	82000	113437	113111
Average family income of shrimp farm owner's (from non-shrimp sources)	30000	20084	20197

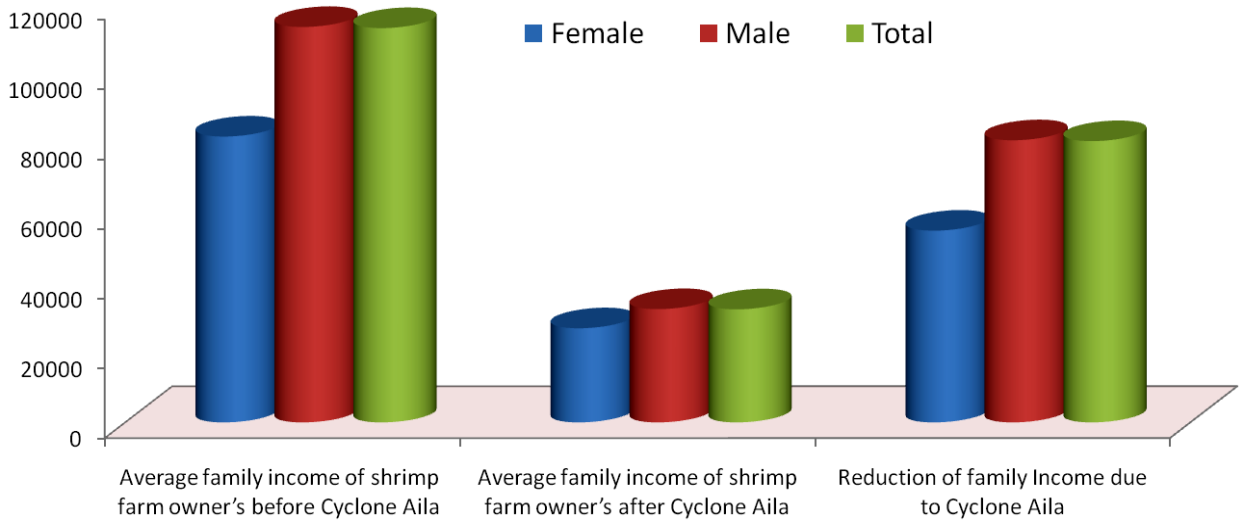
Nearly one-tenth (9.5%) shrimp farm owners have lost their total farm area due to the cyclone Ayla. The Average family income of the shrimp farm owner is Taka 11,109 or US$ 150 per month and shrimp farm provides Taka 9,426 or US$ 135 per month in that income. This means that **shrimp farming cover around 85% of the family income of the Shrimp farm owner**.

Before the cyclone Ayla, shrimp farm owner's family income was Taka 9,426 or US$ 135 per month (US$ 5/day/family) and after cyclone it was Taka 2703 or US$ 39 per month. The shrimp farm owner's household have lost Taka 6723 due to cyclone Ayla. The income reduction is slightly higher in Male (71.35%) owners than Female Owners (67.1%). The main reason for less income reduction is as such, the Female Owners household has 67% more income from non-shrimp farming sources than Male owners.

Disaster Impact on the shrimp farmer's household/family	Female		Male		Total	
	N	%	N	%	N	%
Have any change on family income of Shrimp farm owner due to Aila						
Yes	4	100	382	95.7	386	95.8
No			17	4.3	17	4.2
Total	**4**	**100**	**399**	**100**	**403**	**100**

It may seem that shrimp farm owner family monthly income Taka 9,426 (US$ 135 per month) is well above the poverty line and enough to sustain their family. However, the per capita income reveals the poverty risks and income vulnerability of shrimp farm owner's household due to cyclone. **On average, Cyclone Ayla has reduced 71.33% income of the shrimp farm owner's household**.

Average family size (members) of the Shrimp Farm owner is 6. Therefore, per capita income of the shrimp farm owner's household before cyclone was Taka 52.4 or US$ 0.83 per day per family member, which after the cyclone drops into Taka 15 or US$ 0.21 per day per family member.

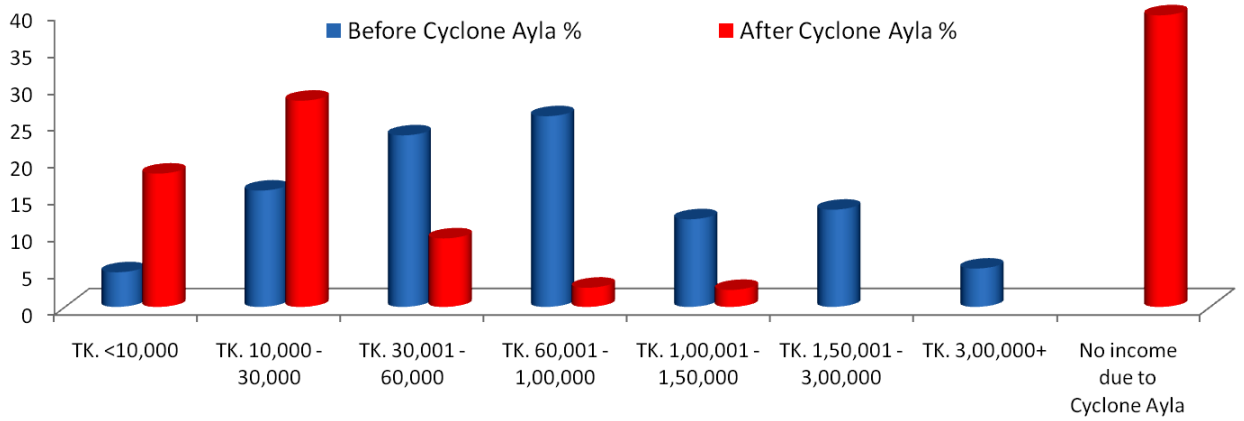


Before the cyclone, 21% of the shrimp farm owned households maximum monthly income was Taka 2500, and after the cyclone it was 85.6%. Before the cyclone, shrimp farm owner has at least had minimum monthly income of Taka 833. However, two-fifth (39.6%) of the shrimp farm owners had no family income due to the Cyclone Ayla. This envisages that **climate change (a single cyclone like Ayla) may increase four (4) times higher magnitude of poverty than the current level**. **Climate change may push nearly two-third (64.6%) shrimp farm owner under the poverty line (below the US$ 1.2).** It is very likely that **climate change (cyclone) could easily toppled two-fifth of the shrimp farm owners' household as extreme poor household within 3 to 12 months.**

Economic Dependency of the People on the Shrimp Farming: The exact number of workers in the Bangladesh shrimp industry is difficult to estimate. With a high percentage of undocumented workers, as well as unregistered farms and processing plants, many work beyond the reach of official statistics. According to one U.S. Government source, at least 142,000 families, or more than 600,000 people, depend directly on the shrimp farming for their livelihood[29]. Bangladesh Shrimp and Fish Foundation estimated the number at 600,000 direct workers, who support some 3.5 million dependents. On average, 8 (8) shrimp farm workers are dependent of the shrimp farm for their livelihood, if family members are added then the directly dependent of the shrimp farm for livelihood will be 14. If 6 family members are not counted, then at least 2 non-family workers are working on the shrimp farm. This infers that on average 10 (6 to14 persons) persons depend directly in one (1) shrimp farm. The livelihood of the 28000 shrimp farm dependent families and 240,000 shrimp farm workers will be uncertain due to climate change.

Cyclone Impact on the shrimp farmer's household/family

Per month Income (taka)		Before Cyclone Ayla		After Cyclone Ayla		Maximum Per Capita Income Per Day per shrimp farmer's household	
		N	%	N	%		
Minimum	**Maximum**					**Taka**	**US$**
No income due to Cyclone Ayla				153	39.6		0
833	2500	79	21	178	46	83.3	1.2-2.39
	<2500	**79**	**21**	**331**	**85.6**		
2501	5000	90	23.3	36	9.3	166.7	2.4-3.99
5001	8333	100	25.9	10	2.6	277.8	4.0-5.99
8334	12500	46	11.9	9	2.3	416.7	6.0-11.89
12501	25000	51	13.2			833.3	11.9
25000 +		20	5.2			>834	>12
	Total	**386**	**100**	**386**	**100**		



Based on the impact of one cyclone in year, the study recognized that in ***the South west region of Bangladesh, shrimp farm owners are living on the edge of poverty and more or less two-third (65%) shrimp farms and their dependent families of are highly vulnerable to climate change.***

29 Khan, "Bangladesh Shrimp Exports Poised to Soar with U.S. Assistance." 60 U.S. Agency for International Development (USAID), Office of Women in Development, Greater Access to Trade Expansion (GATE) Project, "A Pro-Poor Analysis of the Shrimp Sector in Bangladesh," Development & Training Services (DTS), (Washington DC: USAID, February 2006), p. 17

4.4 Climate Change (Cyclone Ayla) Impact on the Shrimp Farming Economy

Cyclone Ayla Impact on total cost for Shrimp production		Before Cyclone Ayla (%)			After Cyclone Ayla (%)		
		Female	Male	Total	Female	Male	Total
	N=	4	399	403	4	399	403
TK. 1,000 - 5,000			23.3	**23.1**		16.8	**16.6**
TK. 5,001 - 10,000		75.0	47.1	**47.4**	50.0	29.6	**29.8**
TK. 10,001 - 20,000			17.5	**17.4**		9.0	**8.9**
TK. 20,001 - 50,000		25.0	7.3	**7.4**	25.0	3.8	**4.0**
TK. 50,000 +			4.8			1.5	**1.5**
Totally damaged due to Ayla and unable to start again					***25.0***	***39.3***	***39.2***
Total		**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Average shrimp production Kilogram /Bigha		Before Cyclone Ayla (%)			After Cyclone Ayla (%)		
		Female	Male	Total	Female	Male	Total
	N=	4	399	403	4	399	403
<= 20 Kilograms			7.3	**7.2**	25.0	12.8	**12.9**
21 - 30 Kilograms		25.0	17.3	**17.4**	25.0	4.8	**5.0**
31 - 50 Kilograms		50.0	39.8	**40.0**		9.3	**9.2**
51 - 100 Kilograms		25.0	28.1	**28.0**		2.3	**2.2**
101 - 200 Kilograms			3.0	**3.0**		1.8	**1.7**
200 + Kilograms			4.5	**4.5**		1.5	**1.5**
Damaged due to Cyclone Aaila					50.0	67.7	**67.5**
Total		**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

More than two-thirds (67.5%) shrimp farms have lost all production due to cyclone Ayla.

Data Collection Period (Months)	Expenditure for Shrimps/Bigha (Taka)			Average shrimp production Kilogram/Bigha	Average market price of the shrimp (Taka Per Kilogram)	Income from Shrimps/Bigha (Taka)		
	Average	*Median*	*Mode*			*Average*	*Median*	*Mode*
Before Cyclone	16663	8000	10000	83	375	26944	16000	12000
After Cyclone	12031	8000	10000	53	400	37216	12000	12000

1 Bigha = .134 hectare or 0.33 acre

Bagerhat Shrimp Cultivators' Association (BSCA) has demanded that the government declare Bagerhat district a disaster zone for shrimp farms as eight to 10 feet high tidal surges of cyclone Aila washed away 55 percent of shrimp farms & around 18,800 shrimp Gher in the district with an estimated loss of over Tk 150 crore. Besides, over 8000 fish farms worth over Tk 70 crore were also washed away. It is worth to mention that Bagerhat has 60,000 shrimp gher which produce 40 percent of the export-oriented shrimps in Bangladesh.

Improving the productivity of brackish water shrimp: Since many of the farms produce several crops of shrimp each year, productivity per ha is very low compared to the several thousand kgs per ha per year obtained in major shrimp farming countries such as Thailand, China and Vietnam. Improved productivity can be achieved through improved technology. The industry should also move to the use of disease free seed from brood stock produced in a land based captive breeding program and halt the capture of mother shrimp so that wild stock may be protected. This would also be a key step to effective disease management in shrimp farming.

Chapter 5

Challenges & Prospects of the Small-Scale Shrimp Farming

5 Shrimp Farming Challenges & Prospects

Bangladesh is one among the world's top ten shrimp producers and had share of about 3 percent of world sales in 2006. In national economic context, Shrimp covers more than 70% of the total export earnings from all the agro-based products, including tea, raw jute, vegetables, fruit, etc. This sector also supports large varieties of local level cottage industries (made out of the home) such as bamboo baskets, mats, traps, nets, rickshaw vans, tempos (tri-wheelers), boats, etc.

5.1 Challenges of Shrimp Farming

Shrimp farming in Bangladesh enjoys financial incentives from the government in the form of subsidies, nominal lease fees and tax deduction. Although government is providing cash incentive on shrimp exports, the small-scale shrimp farmers are out of that scheme. Most of the shrimp farm owners do not pay off any tax to the government. Shrimp farm registration activities are very slow due to the lack of government initiatives. Shrimp Farmer Owners opined that the each sector of shrimp under the registration process and under a fixed taxation to reduce the unplanned shrimp farming and enhance traceability of quality shrimp products.

Due to lack of control and dependency along the value chain, smallholders face more constraints than big-scale farmers to connect with global dynamic markets. Farmers depend on hatcheries to obtain shrimp fries and depend on middlemen to sell their produce. In Bangladesh context, middlemen are local people who control the local shrimp farming by giving loans with high interest rates to farmers and set the terms and conditions of production (type, size, weight and price of the shrimps).

The capital required for shrimp farming is beyond the most of the local community. The Shrimp Farmers from the local community also expressed similar concerns that due to the lack of capital, external traders who have more capital are controlling the business in locality. According to the Shrimp Farmers, to get the bank loan for the capital investment is very difficult them. Even banks take long time to process. On the other hand to get the NGO loan is very easy, but it is not profitable for the shrimp cultivators due to the weekly pay off scheme of NGOs.

The long chain of interdependence observed in the shrimp cultivation and processing in Bangladesh is likely to create a chain reaction when any shock affects the sector. The every fragmented part of the supply chain is narrowly focused on their particular interest. Bangladesh has increasing small-holder participation, but guidelines for water sharing, seasonal cropping in paddy areas and worker rights are urgently needed.

5.1.1 Economic Injustice within the shrimp value chain

When talk about shrimp, we forget to mention the small-marginalized farmer who is the real producer. When we talk about shrimp industry, we talk about export income; we do not talk about the economic injustice to the poor people who are working in various components of the shrimp industry and uncertainty of their life.

The study recognized that the small-scale shrimp farm owners are the victim of Economic Injustice and it is a continuous victimization process. The fair share is very far for small-scale shrimp farm owners, though are producing more or less all the shrimps in Bangladesh. Small-scale shrimp farm owners are not receiving the "fair share" of the benefits and resources available in the shrimp value chain which ultimately makes them as the weakest stakeholders. The Fair price is still far away from the small-scale shrimp farm owners. The prices of shrimps are dictated by the processors and paid irregularly to the farmers. The real the benefit of the higher price of shrimps in the market mainly goes to the middlemen's pocket rather than by the farmers.

The most reported challenge in shrimp farming sector is the lack of access to financial support. More than two-thirds (71.7%) shrimp farm owners reported lack of banking support/lake of access to adequate capital is hindering their farms potential. Moreover, these farmers are totally under the control of companies or their agents. The small-farmers have no voice on price fixation and payment delivery. More or less one-third shrimp farmers reported that Irregular payment of sold shrimp (31.3%) and the fixation of price according to the desire of the companies and their agents (30.5%)

Obstacles for the Shrimp farming	Female		Male		Total	
	N	%	N	%	N	%
Lack of banking support/lake of adequate capital	4	100	285	71.5	289	71.7
Irregular payment of sold shrimp	1	25.0	125	31.3	126	31.3
Companies fix the Price as per their desire	2	50.0	121	30.3	123	30.5
Unavailability of adequate water	1	25.0	90	22.6	91	22.6
Scarcity of dieses free fry in time	1	25.0	81	20.3	82	20.3
Lack of training	2	50.0	189	47.4	191	47.4
Technology related problems	1	25.0	114	28.6	115	28.5
Land grabbing during political unrest			17	4.3	17	4.2
Total	**4**	**100**	**399**	**100**	**403**	**100**

5.2 Perceived benefits from Shrimp Farming

Challenges of Shrimp Farming	Female		Male		Total	
	N	%	N	%	N	%
Shrimp farmers opinion regarding the benefits of Shrimp farming						
Employment generation / unemployment reduction	4	100	272	68.2	276	68.5
Cash Profit within short period	2	50.0	202	50.6	204	50.6
Provide nutrition			74	18.5	74	18.4
Use of abandoned waterlogged area	1	25.0	89	22.3	90	22.3
Financial development	4	100	296	74.2	300	74.4
Earning foreign currency	2	50.0	133	33.3	135	33.5
Total	**4**	**100**	**399**	**100**	**403**	**100**

5.3 Access to External Supports for the Shrimp Farms

The access to external supports refers to the linkage of the shrimp farm with other Shrimp Farm or any Government, NGO, Semi-Government and Private Organizations to receive help or assistance in time of their needs. Only one-fifth (20.1%) shrimp farm owners admitted that they have received support from the external sources, which is mainly the financial support (92.6%) from the NGOs (65.4%).

Status of support received by the shrimp farm	Female		Male		Total	
	N	%	N	%	N	%
Received support from external sources						
Yes	1	25.0	80	20.1	81	20.1
No	3	75.0	319	79.9	322	79.9
Total	**4**	**100**	**399**	**100**	**403**	**100**
Broader category of support received						
Financial Support	1	100	74	92.5	75	92.6
Technical assistance			1	1.3	1	1.2
Capacity development			8	10.0	8	9.9
Total	**1**	**100**	**80**	**100**	**81**	**100**
Source of support received						
Government			9	11.3	9	11.1
NGO	1	100	52	65.0	53	65.4
Private organization	1	100	6	7.5	7	8.6
Individual			9	11.3	9	11.1
Autonomous organization			4	5.0	4	4.9
Bank			10	12.5	10	12.3
Total	**1**	**100**	**80**	**100**	**81**	**100**
Specific types of support received						
Financial Support			*66*	*82.6*	*66*	*81.5*
Credit			51	63.8	51	63.0
Capital			15	18.8	15	18.5
Capacity development						
Training			6	7.5	6	7.4
Technical assistance	*2*	*200*	*31*	*38.8*	*33*	*40.6*
Soil Quality Test	1	100	12	15.0	13	16.0
Water Quality Test			13	16.3	13	16.0
Technical Advice	1	100	6	7.5	7	8.6
Total	**1**	**100**	**80**	**100**	**81**	**100**
Purpose of receiving support by Shrimp farm						
Credit for Shrimp Farm operation			29	36.3	29	35.8
Investment for Shrimp Farm development			14	17.5	14	17.3
Purchase/Collect shrimp Fry			32	40.0	32	39.5
Technical Advice for Yield increment	1	100	16	20.0	17	21.0
Soil & Water Quality Tests for shrimp farming	1	100	19	23.8	20	24.7
Training & awareness for planned & better shrimp farming	1	100	3	3.8	4	4.9
Total	**1**	**100**	**80**	**100**	**81**	**100**

5.4 Challenges for Shrimp Certification in Bangladesh

The shrimp sector in Bangladesh has yet been facing difficulty in maintaining hygiene perspective during the handling of raw shrimp as well as follows modern sanitary practices, safety standards and quality requirements due to absence of high quality water and ice, irregular electricity supply, poor infrastructure, transportation facility, lack of resource for environment friendly equipments and trained staff etc.

Shrimp Certification is a process of systematic assessment to verify that shrimp product meets certain minimum standards or criteria for both quality and good practice. A potential strategy to add value to Bangladesh shrimp products is through certification to internationally recognized standards for both quality and good practice. Most certification schemes require traceability from fry to fork. However, smallholders usually do not know where their fries come from nor the destination of their produce. They have no system to trace the product. Further along the chain, shrimps from different ponds are often mixed by intermediaries who buy shrimps from different farmers and sell them all together to processing plants.

All the small-scale shrimp farmers agreed as one of the key drawbacks for responsible shrimp farming is their lack of technical knowledge. According to the shrimp farmers, the technical knowledge is any kind of knowledge which has importance to ensure professional relationship buildup with all shrimp stakeholders for maintaining quality management in all activities doing by the farmers Due to lack of professional skills, the shrimp farm owners do not know how to choose fry, how to follow rules & regulations, standards for responsible farming, how to recruit labors etc. Without their skills development, the small-scale shrimp farmers will always be staying in a backward position.

Problems linked with shrimp Farm/shrimp farmers which creates obstacles for Shrimp Certification

- Shrimp farmers Use of Urea/Injection for shrimp growth
- Shrimp farmers Use of antibiotic to speed up shrimp growth into 3 months instead of 6 months
- Shrimp farmers use harmful chemical to reduce the death of shrimp and increase the size of shrimp

Shrimp Certification process in Bangladesh requires two laboratory tests. One is microbiological test and another is chemical test. Around 35 shrimp export processing industries & plants in Khulna can easily do the microbiological tests. But there is only one machine available in Dhaka for chemical test for the whole shrimp industry in Bangladesh. Therefore, it takes 30 to 40 days to get the test report. Bangladesh Frozen Food Exporters Association (BFFEA) demanded at least 3 machines for Dhaka, Khulna and Chittagong.

One of the main problems of certifying small-holders is the cost-efficiencies in certifying large numbers of small farms. One possible solution is ‘group certification’, where a homogenous group of producers pool resources and apply for a single certificate. Members of a group do not hold individual certificates, but so long as they comply with all the requirements of group membership, they are covered by the overall group certificate.

The lack of investment is a great problem for the small- scale shrimp farmers, even if they want to move for responsible farming. If the farmer can invest capital in time with flexible process, they can reduce many sustainable practices that currently happening. It has to be noted that none of the financial incentives from the government directly reaches to the real farmers.

Virtually all of the small-scale shrimp farmers do not know how to export shrimp after the processing activities or to who may be contacted to get the information about the current market and price as well. But the large-scale shrimp farmer are gaining huge amount of profit through their direct linkage with the foreign buyers. Setting

information center to provide professional information to the farmers, buyers, and other related stakeholders in the shrimp farming could be very useful for the small- scale shrimp farmers.

Multi-stakeholder platforms from community to the national level are required to monitor implementation of standards, codes and value chain innovations, for mutual support and the sharing of good practices. Capacity building on technical management will provide confidence to the small holders and reduced the fragmentation of the shrimp value chain.

5.5 Ways to ensure the Sustainability of the Responsible Group-based Shrimp Farming

a) Adequate Government support is critical for sustaining Responsible Shrimp Farming
b) Institutional support must be available to protect shrimp farms from different diseases:
c) Development of the Small-Scale Shrimp Farmer owned shrimp Social Enterprise to create access
d) The utilization of quality document management systems to ensure traceability
e) Need-based, Intensive technical training education & skills development on market, certification & value chain is a necessity
f) Provision of flexible investment for small-scale farmers
g) Setting information center to provide professional information to the stakeholders:
h) Capacity building of the Small-scale Shrimp farm to adapt with the international standards
i) Identify and demarcate “safe shrimp zones” and real-time monitoring of those zones
j) Development of Training Institute for continuous skills improvement of the Shrimp Value Chain Stakeholders
k) Develop Multi-stakeholder platforms from community to the national level to strengthen the competitiveness of smallholder farmers
l) Strengthen the Regulatory Environment for Shrimp Production to Reduce Environmental Degradation and Loss of Biodiversity

Coastal Development Partnership (CDP)

Central Coordination Office: MUSAFIR Villa, House No # 53/1&53/2, Flat # B-3, West Agargaon, Sher-E-Bangla Nagar, Dhaka-1207, Bangladesh

Registered & Foundation Office: 55/2 Islampur Road, Khulna-9100, Bangladesh