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Indigenous Knowledge for Aquatic Resource Management in Coastal Bangladesh: A Study of Two Villages in Satkhira District

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Indigenous Knowledge for Aquatic Resource Management in Coastal Bangladesh: A Study of Two Villages in Satkhira District

A Dissertation Submitted to the Institute of Bangladesh Studies, University of Rajshahi, Bangladesh in Partial Fulfillment for the Degree of Doctor of Philosophy in Sociology

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Dedicated

to

My Family Members

Who Share the Adventures of My Life

DECLARATION

I do hereby declare that the dissertation entitled **Indigenous Knowledge for Aquatic Resource Management in Coastal Bangladesh: A Study of Two Villages in Satkhira District** submitted to the Institute of Bangladesh Studies, University of Rajshahi for the Degree of **Doctor of Philosophy** in Sociology is exclusively my original work. I further declare that this dissertation has not been submitted in full or part to any other university or institute for any degree or diploma whatsoever.

11.10.09

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CERTIFICATE

I am pleased to certify that the dissertation entitled **Indigenous Knowledge for Aquatic Resource Management in Coastal Bangladesh: A Study of Two Villages in Satkhira District** is the original research work carried out by Azizul Hoque Khan in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Sociology. To the best of my knowledge, this is the researcher's own achievement. In my opinion, Azizul Hoque Khan has certainly made distinct contribution to the field of Sociology through his original work. This dissertation or the part of it has not, as far I know, been submitted to any other university for any degree.

I also certify that the research work has been carried out under my direct supervision and the dissertation is found satisfactory for submission to the Institute of Bangladesh Studies, University of Rajshahi, Bangladesh for the Degree of Doctor of Philosophy in Sociology.

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ABSTRACT

This study **Indigenous Knowledge for Aquatic Resource Management in Coastal Bangladesh: A Study of Two Villages in Satkhira District** has been done in the south western coastal area of Bangladesh. This study has encompassed an extensive research conducted in two Satkhira villages- Munshiganj and Buri goalini. The study examines how the coastal people utilize IK with the changing environment induced by the shrimp and crab culture and focuses on indigenous knowledge and aspects of the impact on coastal society, economy and environment.

To attain the objectives of the study both primary and secondary data were collected and analyzed. Survey, FGD, Case study and Observation methods were applied for gathering primary data. These methods were applied for coming in direct contacts with the people and to come face to face with the realities of shrimp and crab aquaculture.

At the beginning, it describes the location and ecological setting of the study villages with a special attention to environment changing pattern of this coastal region. This description has been followed by the socio-demographic milieu of the study villages. At the micro level, the study attempts to find out the IK or traditional knowledge of shrimp and crab culture. People of the villages usually practice the aquaculture in the traditional way. In some cases, some of them also practice formal or scientific knowledge to culture shrimp and crab in the coastal area. So, there is collaboration between IK and ScK for coastal shrimp and crab management. There is a role of women for using IK in shrimp and crab aquaculture. But they are not conscious of the effect of their traditional knowledge of aquaculture on coastal environment and biodiversity. From this research, it has been seen that by aquaculture the salinization of soil and water has been increased. So, traditional agriculture nearly abolished and new crop pattern is introduced in the coastal area. In adapting to the changing environment the coastal people are surrounded with many problems. These problems are caused by their

socioeconomic scarcity. In confronting with such problems, they were impelled to sell out their properties and procure loan with interest from the rich neighbors and usurers.

Traditional shrimp and crab farming deteriorate the economic conditions of the small and marginal farmers. It largely reduced traditional agriculture in the south western coastal region of Bangladesh. The attractive shrimp and crab farming changed the land use pattern. This conversion sometimes induced environmental degradation and social unrest and may not deliver sustainable benefits to the poor farmers and small landholders. Traditional shrimp and crab aquaculture gradually changes the nature and environmental pattern of the area. Due to unplanned and unscientific knowledge of shrimp and crab aquaculture is liable for this kind of degradation of the socioeconomic environment of the area. This type of aquaculture is diminishing coastal resources which have resulted in conflicts among local people. It cut off traditional dry season activities such as grazing cattle and home gardening. It causes damage of traditional crop and livestock husbandry, household vegetation, loss of common property rights. The rich and large land holders shifted their land from traditional farming to shrimp and crab aquaculture easily. They are culturing the shrimp and crab in a planned way. They are using both IK and ScK for shrimp and crab aquaculture in the area. They can afford modern scientific instruments and methods for better harvesting and more profit. Moreover, they have available land, capital and social power. On the other hand, the poor and middle class farmers are bound to lease out their land to the large land holders.

Shrimp and crab aquaculture is a potential source of foreign currency which faces crisis due to severe attacks of white spot syndrome virus. Traditional techniques and knowledge create new problems for the shrimp and crab aquaculture in the area day by day. So, IK for aquatic resource management is not sustainable in the coastal area of Bangladesh. To maintain safety and quality standard set by the international buyers, it is needed to apply planned, scientific knowledge and IK simultaneously for shrimp and crab aquatic resource management in coastal Bangladesh.

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ABBREVIATIONS

AAI	Aquaculture Authority of India
ADB	Asian Development Bank
ADAB	Association of Donor Agency of Bangladesh
AER	Annual Export Report
ARM	Aquatic Resource Management
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BAAS	Bangladesh Association for the Advancement of Science
BARC	Bangladesh Agriculture Research Council
BARCIK	Bangladesh Resource Center for Indigenous Knowledge
BCAS	Bangladesh Centre for Advanced Studies
BES	Bangladesh Economic Survey
BFFEA	Bangladesh Frozen Food Exporters Association
BIDS	Bangladesh Institute of Development Studies
BPC	Bangladesh Population Census
BFRI	Bangladesh Fisheries Research Institute
BMD	Bangladesh Meteorological Department
BOBP	Bay of Bengal Program
BSER	Bangladesh: State of Environmental Report
CAEM	Coastal Aquaculture and Environmental Management
CARDMA	Coastal Area Resource Development and Management Association
CEP	Coastal Embankment Project
CEDAW	Convention on the Elimination of All forms of Discrimination Against Women
CPD	Centre for Policy Dialogue
DFID	Department of International Development

DoF	Directorate of Fisheries
EEZ	Exclusive Economic Zone
EIA	Environment Impact Assessment
EPASC	Environment Policy Aspects of Shrimp Cultivation
EPASC	Environment Policy Aspects of Shrimp Cultivation
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agricultural Organization
FFP	Fourth Fisheries Project
FFYP	Fifth Five Year Plan
FGD	Focus Group Discussion
FRI	Fish Research Institute
FSYBB	Fisheries Statistical Year Book of Bangladesh
GED	General Economic Division
GOB	Government of Bangladesh
GDP	Gross Domestic Product
IK	Indigenous Knowledge
IIRR	International Institute for Rural Reconstruction
IUCN	International Union for Conservation of Nature
MFL	Ministry of Fisheries and Livestock
MOA	Ministry of Agriculture
MOFL	Ministry of Fisheries and Livestock
NGO	Non Government Organization
NAEP	National Agricultural Extension Policy
OALD	Oxford Advanced Learner's Dictionary
PDO-ICZPM	Program Development Office for Integrated Coastal Zone Management Plan
PRSP	Poverty Reduction Strategic Plan
RCP	Right over Common Properties
ScK	Scientific Knowledge
SRDI	Soil Resource Development Institute

SYBB	Statistical Year Book of Bangladesh
SPBB	Statistical Pocket Book of Bangladesh
UAO	Upazila Agriculture Officer
UBINIG	Unnayan Nitinirdharoni Gobeshana
UFO	Upazila Fishery Officer
UNO	Upazila NIrbahi Officer
UNEP	United Nations Environmental Program
UPL	University Press Limited
UP	Union Parishad
WAC	World Aquaculture Conference
WDB	Water Development Board
WDR	World Development Report
WSS	White Spot Syndrome
WWF	World Wildlife Fund

GLOSSARY

Aman	The rice crop sown in monsoon and maturing after the monsoon
Aus	Rice crop planted before the monsoon season and maturing immediately before or in the wet season
Aswin	A month of Bengali Calendar year
Bagda	Bangla name of Tiger Shrimp (*Peneus monodon*)
Bawalis	The People who are involved in cutting wood in the Sunderbans
Crates and Coops	Baskets and cages of shrimp and crab
Depo	Sale center of shrimp and crab
Dike	Highland outside the shrimp *gher*
Faria	Middle man who purchases shrimp or crab from the retail seller
Gher	Farm or pond of shrimp or crab
Gol Pata	A mangrove plant which is found in the Sundarbans. This plant is used for making roof of a house in the coastal areas
Golda	Bangla name of Fresh water prawn (*Macrobrachium rosenbargli*)
Gonad	The ovary of female crab
Gai	A trench which is made for shrimp harvest
Gang	River
Hari	Landholders leased out their land to the shrimp producers in stead of money
Indigenous Knowledge	Native or local knowledge
Khasland	Government owned land property
Khal	Canal
Moualias	The people who are involved in honey collection in the Sundarbans
Munda and Mahato	Two Indigenous Ethnic group of Shyamnagar, Satkhira
Nodi	River
Scylla serrata	Scientific name of Mud Crab
Scientific Knowledge	Formal technical knowledge
Soil pH	Potential hydrogen- a measure of soil acidity and alkalinity
Thana	Police Station
Union	Local Government of rural area of Bangladesh

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CHAPTER ONE

INTRODUCTION

1.1 Prelude

Geographically, Bangladesh is bordered on the west and north by India, in the east by India and Myanmar and on the south by the Bay of Bengal. The interface or transition between land and the sea including the large inland lakes are commonly known as coastal areas. Coastal areas are diverse in function and form. They are dynamic in nature and difficult to define by strict spatial boundaries. Coastal districts of Bangladesh have been delineated into three contiguous regions, as south west constituting Satkhira, Khulna and Bagerhat, South central comprising of Patuakhali, Noakhali, Barguna and Barisal and south east consisting of Chittagong and Cox's Bazar (MPO 1987; Bashar 2004). As per the recent delineation, the coastal zone of Bangladesh consists of 19 districts comprising of 147 Upazilas covering 47,201 sq kms area and the exclusive economic zone (EEZ). Considering the exposedness to the coast or the estuary, a total of 48 Upazilas in 12 districts covering 23,935 sq kms area are exposed to the sea or lower estuaries, are defined as the exposed coast and the remaining 99 Upazilas of the coastal districts comprising of 23,266 sq kms area are termed as interior coast (PDO-ICZPM; Islam, 2004).

The coastal area of Bangladesh is rich in natural aquatic resources from the ecological point of view; it is an area of development potentials, it has abundant natural resources such as coastal resource, the Sundarbans, an intricate network of rivers and with rich fish habitats. Indigenous knowledge (IK) for centuries is handed down from one generation to the next. It is built upon, modified and refined in development which is one of the new approaches being pioneered. It is emerging within the context of increasingly popular participatory approaches. It works from below, at the

grassroots. It aims at making local voices heard more effectively. The majority of the population of coastal Bangladesh is either directly or indirectly associated with aquatic resource management.

Most of the area of Bangladesh is drained by many large and small rivers, which constitute one of the largest river systems in the world. The coastal zones, particularly in Cox's Bazar, Khulna and Satkhira region, being the interface of land and the Bay of Bengal, are ecologically sensitive and fragile. Most of the coastal areas of Bangladesh are an active or nascent delta with vigorous dynamism. Coastal area of Bangladesh includes lowlands and islands, inter tidal areas, salt marshes, wet lands, mangroves and beaches. Coastal aquatic resource has outstanding advantages in Bangladesh having a high population density in a small country. It opens a new frontier for income and livelihood while aquatic resource management is facing difficulties by water management, soil salinity, acidity and other socio-economic constraints. It is therefore expected that concerted efforts to develop coastal aquatic resource management may eventually lead to the overall integrated development of the neglected, impoverished coastal communities who are usually left out of other rural development schemes.

It is a field based study on the IK for shrimp and crab management in coastal Bangladesh. The study attempts to understand the IK of the coastal villagers employed for shrimp and crab management. The villagers have much knowledge that they use in shrimp and crab management in the area. Without formal education of shrimp and crab management, they cultivate shrimp and crab with own efficiency. More specifically, it depicts on the various strategies of shrimp and crab management that they formulate and undertake traditionally. The study examines the interplay

between IK and scientific knowledge, as, in many cases, they employ IK and scientific or international knowledge simultaneously.

1.2 Statement of the Problem

The total coastal area is 2800 sq. km that is 20 percent of total national areas and it is located in different coastal zone (Elahi 1998). About 30 percent of net cultivable areas of Bangladesh lie in the coastal zone. Out of 2.85 million hectares of coastal and offshore land, about 1.5 million hectors are affected by varying degrees of salinity. In the year 2003, the Government of Bangladesh declared 19 districts as coastal region and special economic zone (Haque 2006).

Many people in the western coastal zone, Satkhira, Bagerhat, Khulna and Barguna are engaged in shrimp and crab cultivation. This area is ecologically rich with shrimp and crab cultivation but these resources are not adequate for the subsistence of its vast population. On the other hand, the area has distinctive development opportunities with the high potentials of cultivation of shrimp and crab. The study covers the utility of IK for shrimp and crab management in coastal Bangladesh and tries to give recommendations to minimize the problems.

The Government of Bangladesh is found to be increasingly interested to IK in formulating and undertaking the recent strategies for environment and agriculture. Specifically, it pays more attentions to indigenous knowledge related to the natural aquatic resource management. The National Agricultural Extension Policy (NAEP1996) stated that farmers' indigenous knowledge is often environmentally sustainable. The NAEP also recognizes that farmers themselves are actively engaged in their own experimentation as part of their daily subsistence activities especially in

coastal area (MoA 1996). So it is clearly an opportune time for us to advance on IK in the context of its appropriateness and utilization for shrimp and crab management in coastal Bangladesh. It had been seen that many aspects in the development fields of rural Bangladesh depend on coastal people's IK because only scientific knowledge alone can not afford proper development of coastal Bangladesh. Also there were some problems of development strategies taken by Government and foreign countries and sustainability had been questioned. So at present, importance had been given on IK about shrimp and crab management.

The lack of studies on IK for shrimp and crab management in coastal area was one of the reasons for selecting the problem to be explored. In fact, it was found that many aspects of IK in coastal Bangladesh had still not yet been addressed by the social scientists. The present study, therefore, dealt with the coastal people's IK in utilizing shrimp and crab management in the sociological point of view.

1.3 Review of Literature

The researcher tried to find out some relevant studies. There were some general studies in about coastal area, IK and aquatic resource management, which were concerned with IK, natural resources and coastal aquatic resources. Here the researcher tried to incorporate the analytical ideas of IK and coastal aquatic resource management.

A significant number of studies on IK, coastal aquaculture and resource management of coastal area limited to their foci on coastal environment as flood, poverty, pollution, population displacement and sustainable development.

Karim (2000) discussed about climatic condition, subsistence activities, social, anthropological and economic setting, occupation, literacy of the munda and mahato communities in southwest coastal area of Bangladesh. He did not discuss IK for aquatic resource management. But there should be some discussion on IK for aquatic resource management.

Sillitoe *et al.* (2000) discussed about potentialities and importance of IK of Bangladesh. They were trying to assess current situation of IK of Bangladesh in their books. They explained that the local farmers have relied upon IK for centuries. Organizing production on the basis of local knowledge handed down from previous generations where it is built upon, modified and refined to suit current circumstances. Today farmers are exposed to modern scientific knowledge but they have not abandoned their IK and this remains true for other traditional occupational groups. So IK is transmitted to one generation to next generation. Also any development endeavor aiming to improve and enrich the lives of the poor and weak in a country like Bangladesh should be incorporated IK and involve local people's participation all stages of intervention. He has also discussed unexplored potentiality of IK for sustainable development. They did not discuss about IK for aquatic resource management. But in coastal area of Bangladesh, IK for aquatic resource management is very important to the coastal people to maintain their vulnerable daily life. They discussed the coastal area, aquatic resource management, Geology of aquatic management, national strategy on aquatic resource management, fisheries, forestry, land erosion and recommendation thoroughly. They have also discussed about the importance of resource management in coastal Bangladesh. But there was no discussion on IK for aquatic resource management.

Morton *et al.* (2005) discussed about aquatic resource management for sustainable development of poor people, impact of aquatic culture, the care experience in Bangladesh. They also emphasized on utilizing different aquatic resources for livelihoods in Asia. They gave emphasize on aquatic resource management in coastal area. There was no discussion on IK for aquatic resource management of coastal area of Bangladesh.

Islam (2005) focused on fish water and people, reflections on inland open water fisheries. The writer gave importance about aquatic resource management in Bangladesh. Also coastal aquatic resource is important for the development of Bangladesh. He had not discussed about coastal aquatic resource management in coastal Bangladesh.

Karim (2005) has discussed on coastal water resource, uses of water resource management of aquatic resource and inland coastal zone case study. But the writer had not discussed about IK for aquatic resource management of coastal Bangladesh. Indigenous knowledge is another potential factor for ARM in coastal area. So emphasize should also be given on IK for ARM of coastal Bangladesh.

ADB (2005) focused on aquatic resources and food security in Bangladesh in a publication. The Department of Fisheries of the government of Bangladesh and international center for living aquatic resource focused on their publication about fishes, living organisms in water. But there was no discussion on IK for aquatic resource management of coastal Bangladesh.

Aftabuzzaman (1990) discussed in an article about the changes caused by the embankment of shrimp farming areas in Bangladesh. Those are; (a) changes of

environment, (b) hydro-morphological changes, (c) bio-system changes, (d) changes of the fertility of the soil, (e) changes of rural economy and social structure and (f) effects on natural health and nutrition.

Alam (1994) analyzed in a research paper about problems and prospects of shrimp culture in Bangladesh. He used some secondary data in favor of his arguments. As per the data, his arguments are not unrealistic but how far the data are correct, he did not check it by any field observation.

Alam (1995) in a study, pointed out that in order to make the shrimp culture most competitive and efficient, a number of measures had to be taken on priority basis and those are; (a) ensuring timely availability of adequate raw materials at competitive price, (b) adoption of improved methods and techniques of shrimp cultivation, (c) rehabilitation and reorganization of the sick units, (d) development of infra-structural facilities, (e) introduction of proper leasing policy and so on. This study was made on general basis of the shrimp sector. From this study we did not get categorically any idea about proper techniques of shrimp of Bangladesh.

Bhuiyan *et al.* (1995) in their study tried to review the export performance and examined the problems and prospects of shrimp culture in Bangladesh. In this respect, they pointed out that in Asia, the performance can only be compared with Pakistan and Sri- Lanka. They concluded that, the abundant water, land and fry resources also placed in Bangladesh, a unique position to produce cultured shrimp at production cost as low as compared to any countries in the world. In fact this study is mainly limited in export marketing of shrimp.

Chowdhury (1987) analyzed about the basic characteristics of shrimp farms, the cultivation process of shrimps, and the process of shrimp catching, the production functions of shrimp cultivation, production performance of shrimp, socio-economic characteristics of producers, socio-economic problems generated by shrimp cultivation and so on. He analyzed and compared the aforementioned factors among Chakoria, Maheshkhali and Satkhira Zones. In this study, he tried to find out the negative and positive effects of shrimp culture in Bangladesh and the end of the report he tried to suggest some necessary measures to overcome the negative effects. It is really a unique and pioneer work in this area of knowledge no doubt, but in the passage of time, shrimp culture has got a new dimension.

Atiur *et al.* (1993) in a study mentioned the socio-economic and environmental changes caused by the shrimp culture in the coastal areas, especially in Khulna region. In this paper they showed that various types of native fishes have been abolished due to determine, how agro ecosystem can be developed without any degradation of the environment. Two things have got preference here; (a) shrimp culture and natural environment and (b) shrimp culture and social environment. Their study was made completely in the Bagda cultivating area but it did not cover any Galda and Galda-Bagda mixed farm.

Mazid (2003) discussed on productivity of land, land vs. sector, major development objectives of fishery sector. IK is another potential factor for fish management in coastal area of Bangladesh. But there was no discussion on IK for aquatic resource management of coastal Bangladesh.

Alam and Philips (2004) discussed in Coastal shrimp aquaculture systems in south western Bangladesh about coastal shrimp farming practices and management among the different categories of farm ownership in south western Bangladesh. The current farming practices were characterized by extensive culture systems with low input use, leading to low productivity levels. The different farm management practices were noticed among the different categories of farm ownership. The average farm size varied among individual, group and outside lessee. The production systems include multi stock and multi harvest throughout the year. Inputs provided into the *gher* or pond with an average depth of 0.7 m water was mainly limited to improper ratio of lime, cow-dung and fertilizer. All the categories maintained an average stocking density of 1.7 fry. The outside lessee stocks less quantity and achieved higher survival rate then the other two categories. Due to disease pronness, each category achieved variable yields. Poor disease control mechanism prevailed in the area. Also they discussed about materials and methods of shrimp farming; geographic and climatic environment that is climate, hydrology, soil characteristics, water quality, farm location and *gher* management like sludge removal, *gher* drying, water intake, liming, fertilization, sources and stocking of fry, survivability of shrimp, water exchange, health and disease management, harvesting and marketing management etc.

Wahab *et al.*(2003) discussed about environmental and socioeconomic impacts of shrimp farming in Bangladesh about present status and strategies for future development of shrimp farming in Bangladesh. Bangladesh has unique and favorable environment for shrimp culture and traditional shrimp farming status, shrimp culture practices, farm environment, cultural species and production. The challenges and opportunities of coastal aquaculture are -prevention from industrial and agricultural

pollution; environmental impacts of shrimp of shrimp farming in the coastal area. Shrimp diseases and its consequences on the coastal shrimp framing, impact of deduction of mangrove forest due to shrimp farming on coastal environment, socioeconomic impacts of alternate shrimp crop farming, a code of conduct for shrimp farming or guide lines for best management practices.

Grenier (1998) in his book *Working with Indigenous Knowledge* discussed about characteristics of IK, erosion of IK systems, protecting intellectual property rights, developing a research framework, assessing validity and experimenting with IK.

Nuruzzaman (1993) discussed about coastal environment, its characteristics, the formation of estuaries, environmental background, coastal resources and exploitation, salinity in the south western region, soils of the coast, land use pattern, mangrove ecology, mangrove vegetation, bio-ecological zones, distribution of mangroves along the coast. He gave emphasis about impacts of coastal aquaculture on environment; conservation strategies for native flora and fauna; impacts of sea level rise in Bangladesh. He tried to identify the problems of coastal resource management and remedies of environmental pollution. Also he discussed the traditional and extensive methods of shrimp culture.

Warren *et al.*(1995) discussed about the importance of IK for the development of the rural area of any country and tied to identify the IK systems of different area of the world; different indigenous decision making systems like: ethno-botanical knowledge systems, experimentation and innovations.

By reviewing above related books, articles, publications the researcher realize that there was a knowledge gap about IK for aquatic resource management in coastal area of Bangladesh.

1.4 Definition of Key Concepts

The present research employs a number of concepts to operationalize the objectives in the methodological fashion of social science.

Indigenous Knowledge (IK): Indigenous knowledge is the information base for a society, which facilitates communication and decision-making. Indigenous information systems are dynamic and are continually influenced by internal creativity and experimentation as well as by contact with external systems. IK is the knowledge that people in a given community have developed overtime, and continue to develop. It is based on experience, often tested over centuries of use, adapted to local culture and environment, dynamic and changing (IIRR 1996).

IK is the local knowledge that is unique to a given culture or society. It is the basis, for local-level decision–making in aquaculture, ecological resource management and a host of other activities of the coastal people. IK is the base for a coastal society, which facilitates the subsistence or survival strategies of the coastal people. IK is the knowledge that people in a community have developed overtime, and continue to formulate and undertake in utilization of the natural resources. IK is based on experience, often tested over centuries of use, adapted to local culture and environment, dynamic and changing. IK may be related to common practice seen in communities that are indigenous to a specific area. It also refers to as traditional or

local or native knowledge. It means to the large body of knowledge and skills that has been developed outside the formal educational system.

IK is embedded in culture and is unique to a given location or society. It is an important part for subsistence activities of the people. It is the basis for decision making of communities in food security, human and animal health, education, aquatic and ecological resource management. It is an important part of the lives of the poor. It is the basis for decision making of communities in food security, human and animal health, education and natural resource management.

In this research, the researcher used IK for non-formal and local knowledge that is used to cultivate, preserve and marketing of shrimp and crab in the coastal area. The local knowledge that transmitted orally and un-institutionalized practices in the coastal villages for shrimp and crab management is called IK.

Coastal Area: Coastal areas are commonly defined as the interface or transition between land and sea, including large inland lakes. An entity of land and water is affected by the biological and physical processes of both sea and land.

Coast is a land (including water features) above the high water mark with significant visual, physical or environmental association with the sea or foreshore. A vast network of rivers, sea and it is leaden with sediments; including islands, and char land masses. The southeastern and southwestern parts of Bangladesh falling under the active influence of the tidal effect of the Bay of Bengal and it can be termed as coastal region. It is composed of the land and the sea including estuaries and island adjacent to the land water interface of south and southeast Bangladesh. Bangladesh coasts can be divided into three distinct regions. These are (a) the eastern region, (b) the central

region and (c) the western region. The eastern region covers Cox's Bazar and Noakhali, The central region covers Barisal, Bhola, Potuakhali and the western region covers Khulna, Satkhira, Bagerhat, Barguna (Pramanik 1983).

The present research limited its empirical focus only on the coastal area of two villages of Shyamnagar Upazila in Satkhira District.

Aquatic Resources: Aquatic means growing or living in or near water or connected with water and resource means a supply of something that a country, an organization or a person has and can use especially to increase their wealth (OALD). In Bangladesh, there are many aquatic resources like, fishes, shrimps, crabs, mangroves, algae. In the proposed research the researcher covered indigenous knowledge for the management of shrimps and crabs in the study area.

1.5 Objectives of the Study

The southwestern coastal area has distinctive development opportunities with high potential for exploitation of aquatic resources from the socioeconomic viewpoint. The present study tried to explore the nature and utilization of IK for aquatic resource management. In this context, the present study had aptly endeavored to identify the strategies of the coastal people that are formulated and undertaken for the utilization of shrimp and crab resources. This study finally tried to prescribe some ways and strategies for shrimp and crab management on the basis of its findings.

The following objectives had been molded considering the special features of the study area--

1. To explore the nature and characteristics of IK in shrimp and crab management ;

2. To analyze traditional methods and techniques that are formulated and undertaken for shrimp and crab management ;

3. To assess the effect of indigenous knowledge on the coastal society and environment;

4. To find out how coastal people incorporates with scientific knowledge and IK for shrimp and crab management;

5. To explore the problems and potentialities of IK in shrimp and crab management in the coastal area of Bangladesh; and

6. To know women's contribution in utilizing indigenous methods and techniques for shrimp and crab cultivation.

1.6 Hypotheses

According to the foci of the proposed research, the following hypotheses were being formulated for investigation.

1. IK for aquatic resource management contributes from the time immemorial to the subsistence of coastal people.

2. The conservation and development of resources are significantly shaped by the IK of coastal people.

3. IK has effects to some extent on coastal environment.

4. Coastal people incorporate scientific knowledge in their IK that they need to utilize shrimp and crab management properly.

1.7 Methodology of the Research

1.7.1 Study Area

The study areas of the research are Munshiganj and Burigoalini. These two villages are located in Shyamnagar Upazila of Satkhira District. The rationale for selecting the areas were– The two study villages are situated in the coastal region. IK based shrimp and crab management is to be observed in the area. The people who are dependent on IK based aquatic resource management are inhabited in the study area. The adequate numbers of shrimp and crab farms are found there. A considerable number of people are involved directly or indirectly in shrimp and crab resource management.

1.7.2 Sampling

Random techniques are used for sampling. The sample population was 215 in number who were involved in shrimp and crab management. The respondents of the study comprised of the farmers of different categories who culture and utilize shrimps and crabs. Also skilled labors, local personnel and officials had been interviewed in order to secure the accuracy of data.

1.7.3 Selection of Respondents

Respondents of this study have been selected from the farmers and inhabitants of the concern villages and they have categorized as follows:

Respondents of this study have been selected from the farms and concern areas and they have categorized as follows:

Name of Village	Shrimp HH	Respondents	Percent	Crab HH	Respondents	Percent	Others	Total Household
Munshiganj	50	45	90%	38	37	97%	164	252
Burigoalini	87	70	80%	65	63	97%	343	495
Total	137	115	84%	103	100	97%	507	747

* Total Households 215, HH= Household

1.7.4 Unit of Analysis

The household heads are interviewed directly and they represent the sampling units. These households are also the units of observation. The households are thus been considered as the unit of analysis.

1.7.5 Sources of Data

Both the primary and secondary sources of data were used to address the objectives of the present research. The sources of primary data were social survey, focus group discussion, case studies and observation and the like. The sources of secondary data were books, journals, theses, newspapers, publications, related office documents and records, different websites.

1.7.6 Nature of Data

In this research both the qualitative and quantitative data are used. It attempts to emphasize the qualitative explanation of IK for shrimp and crab management. Also, it associates quantification of collected data with the qualitative interpretation of research findings.

1.7.7 Methods of Data Collection

To conduct the study, the following methods are used: observation, social survey, focus group discussions (FGD) and case studies. The data are collected through extensive field-work for a period of 12 months spanned from November 2007 to October 2008. Some data are collected before and after of this period as per necessity of this study. Field observation is made for collection of primary data and information published and preserved in this respect in various offices and institutions, previous research reports, books, published and unpublished materials have been used as secondary sources of data.

1.7.8 Methods of Data Processing

The collected data and information from the study area are carefully reviewed, arranged, scrutinized, edited and stored. The sorted data are compiled sequentially and systematically. The data are explained and analyzed extensively in qualitative fashion. Additionally the data are presented in an orderly and systematic ways of some statistical techniques such as tabulation, mean deviation etc.

1.8 Possible Use of Research Findings

This research will help to develop database and make scope for future research on IK for shrimp and crab management in the coastal area of Bangladesh. Since there has no sociological study especially on indigenous knowledge for shrimp and crab management, the present study would serve as a baseline for further study and would bear importance in sociological research providing new facts in this area. The findings of this study may be useful for policy makers of national planning and development

and also for international development agencies in developing insights into their program contents of coastal Bangladesh. The findings of the research will also provide new area of IK utilized in shrimp and crab management in coastal Bangladesh for the learners and researchers, academicians and development.

1.9 Future Research Suggested

However, no research work is a complete one rather it opens new avenues for further research. Considering the coverage, limitations of this study and upcoming situation, following issues should be addressed in the future research to harness the full potential.

Importance on indigenous knowledge for natural resource management in Bangladesh should be highlighted. Study on the effect of up stream shrimp culture activity on the adjacent water bodies of Sundarbans may be undertaken. Sustainability of coastal shrimp culture as an environmental friendly industry can be studied. Integrated research to find out rice cum shrimp cultivation technology may be taken into consideration for study. Evolving highest salinity tolerant rice variety is urgent to ensure food security of the coastal people. Feasibility study on semi-intensive shrimp culture practices should be introduced.

Study on model development of environment friendly shrimp culture for socioeconomic development may de done. The role of women for shrimp and crab culture may be selected. Study on the shrimp and crab culture for poverty alleviation in the coastal area of Bangladesh may be done.

1.10 Justification of the Study

Research is an indispensable thing in every field to find out inherent problems and explore potentialities and prospects of the concerned sector and enhance knowledge for future research. Shrimp and crab have important role in developing the socioeconomic environment of the coastal Bangladesh. An estimate indicates that about five million people are engaged in shrimp and crab culture and related professions (DoF 1996).

The coastal areas of Bangladesh are ecologically rich and its aquatic resources are abundant though these resources may not be adequate for the subsistence and consumption of the coastal people. It is caused by the lack of information and improper methods of utilization of those resources. The coastal people utilize and accumulate shrimp and crab by their own traditional system. A lot of aquatic resources are sometimes misused by the coastal people. So, proper management and utilization of shrimp and crab management can play a vital role in sustainable development of the potential economic zone of Bangladesh. About 40.9 percent people now live below poverty line and at least 18.7 percent live below the extreme poverty line in Bangladesh (BES 2006). In coastal region there is an alarming condition. The world today has faced a critical situation in this context. The problems of coastal area are associated with increasing population, extensive use of aquatic resources, natural and man–made pollution. The subsistence of coastal people is based on aquatic and other ecological resources with low level of social resources.

So, the present study is an attempt to analyze the uses and benefit of IK to shrimp and crab management. From related literature review, it is found that there is necessity of

study on IK for coastal shrimp and crab management. The farmers of coastal area used to minimize the problems of shrimp and crab management by using their IK. But inadequate works have been done on the IK for shrimp and crab management from the sociological point of view. So, the proposed research tried to address the problem from the viewpoint of social science.

CHAPTER TWO

ECOLOGICAL SETTING AND DEMOGRAPHIC CHARACTERISTICS

2.0 Ecological Setting and Socioeconomic Profile

2.1 A Brief Description of Satkhira District

- 2.1.1 Munshigonj
- 2.1.2 Burigoalini
- 2.1.3 Topography of the Study Area
- 2.1.4 Agriculture and Food
- 2.1.5 Forest and forestation
- 2.1.6 Rainfall Trends
- 2.1.7 Sea Level Rise
- 2.1.8 Climate
- 2.1.9 Main Seasons of the Area
- 2.1.10 Hydrology
- 2.1.11 Soil Characteristics
- 2.1.12 Water Quality
- 2.1.13 Demographic and Social Characteristics of the Respondents
- 2.1.14 Educational Status
- 2.1.15 Sources of Drinking Water
- 2.1.16 Sanitation System

2.2 Economic Background

- 2.2.1 Occupation
- 2.2.2 Land Ownership
- 2.2.3 Necessity of Financial Support

2.0 Ecological Setting and Socioeconomic Profile

This chapter intended to explore the location and socioeconomic and environmental background of the study area. It includes the physiographic of the study village, the topography, soil type, hydrology, climate, temperature, flora and fauna, agriculture and socioeconomic profile etc.

Analysis of socioeconomic and environmental characteristics is very much important for such type of study which has been carried here, because shrimp and crab culture require some special socioeconomic and environmental characteristics. Shymnagar Upazila bears some of those special physical, environmental and socioeconomic characteristics.

2.1 A Brief Description of Satkhira District

There are six administrative divisions in Bangladesh and Satkhira District belongs to Khulna Division. It is situated in the southwest region of the country. It was upgraded to a district on the 3rd February 1994. It is bounded on the North by Jessore District, on the east by Khulna District, on the south by the Bay of Bengal and on the west by India. It lies between 21°36′ and 22°54′ north latitudes and between 88°54′ and 89°20′ east longitudes. Satkhira district is comprised with seven Upazilas and these are Satkhira sadar, Tala, Kalaroa, Ashasuni, Kaliganj, Debhata and Shyamnagar. Among these upazilas Shyamnagar Upazila is selected for this study.

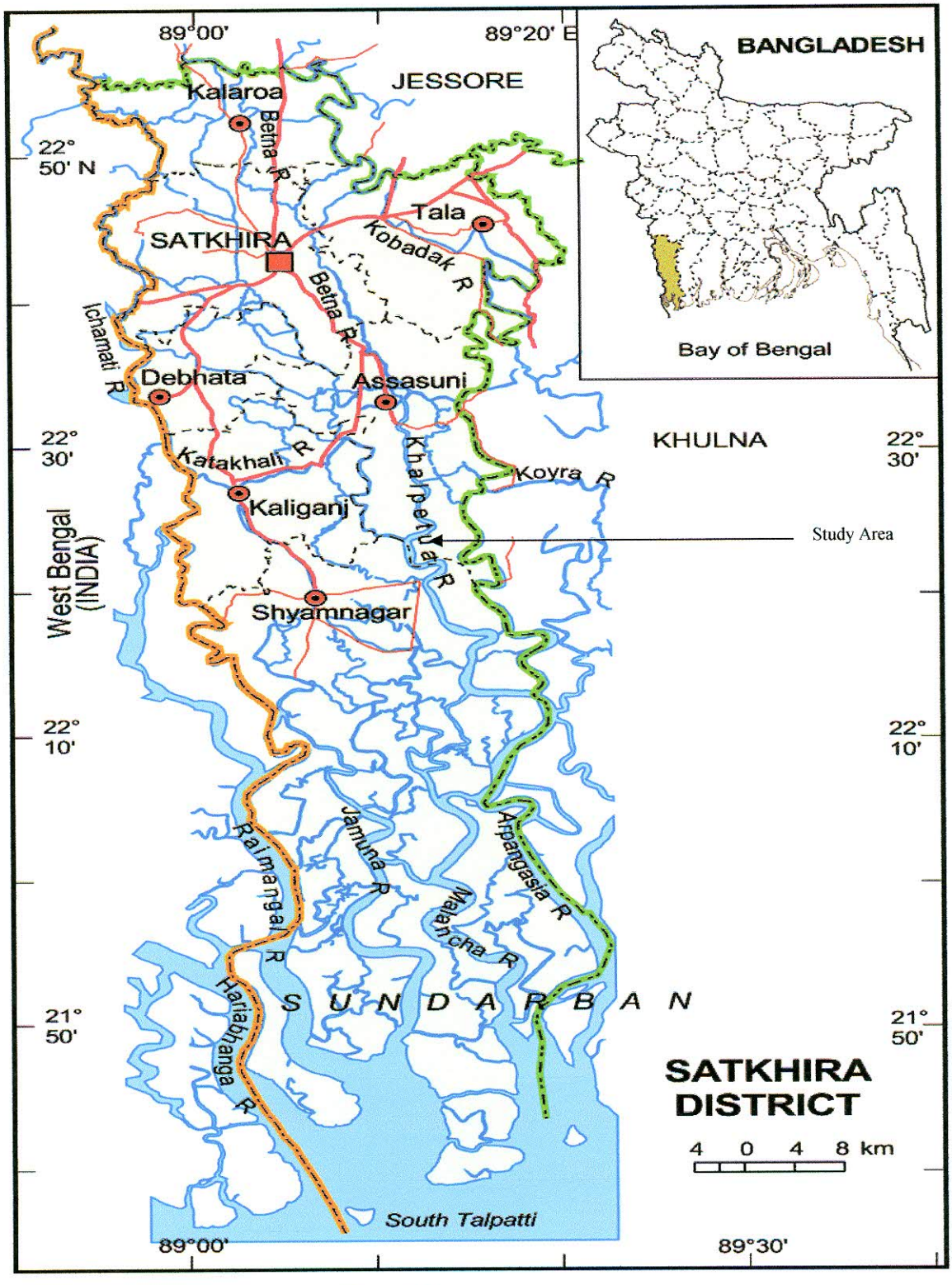
(i) Administrative history of Satkhira District:

Table 01: Satkhira District at a Glance

Sl. No.	Locality Name	Area in Ares	Households	Population Male Female Total	Literacy rate Male Female Total
1.	Satkhira District	9,53,421 acres	3,90745	9,55,198 9,09,506 18,64,704	51.84 38.91 45.52
2.	Rural Area	9,36,191 acres	3,55,134	8,64,791 8,28,299 16,93,090	50.41 37.39 44.02
3.	Urban Area	8,018 acres	24,804	62,853 50,537 1,19,390	66.98 56.64 62.08
4.	Other Urban Areas	9,212 acres	10,807	27,554 24,670 52,224	60.82 47.60 54.61

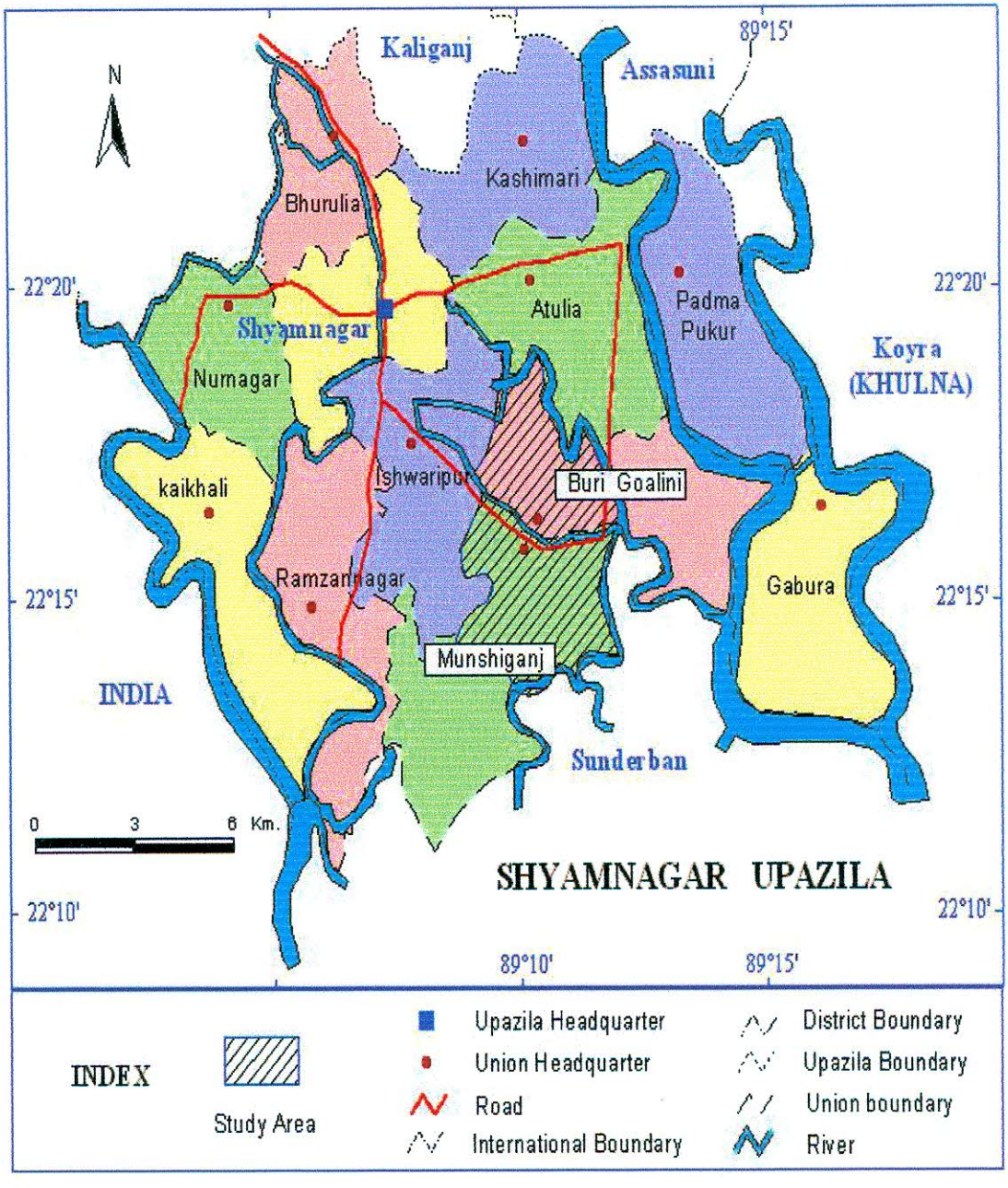
Source: BBS 2007

Map 01: Satkhira District



Source: BBS-1989
Mouza GEO Code, Shyamnagar Upazila.

Map No. 2
Munshiganj, Buri-Goalini Study Area



Source: BBS-1989
Mouza GEO Code, Shyamnagar Upazila.

Table 02: Shyamnagar Upazila

Administrative Unit	Police Station	1982
Administrative Units	Union	12
	Pourosova	01
	Village	216
	Mouza	126
Land Area	Total Area	455 sq km
	Area of Agricultural Land	89,686 acres
	Area of Forest	182,663 hectare
Population	Total	31,3781
	Male	16,0294
	Female	15,3487
	Literacy rate	39.69%
Aquatic Farms	Number of Shrimp Farms	4325
	Area Under Shrimp Farms	15,622 hectares
	Number of Crab Farms	1000
	Area Under Crab Farms	5,250 hectares

Source: UNO, Shyamnagar Upazila.

Shyamnagar Upazila

Shgamnagar Upazila is located at between 22°11′ to 22°17′ north latitudes and between 89°03′ to 89°19′ east longitudes. It comprises of twelve Unions, they are, Bhurulia, Kashinagar, Nurnagar, Ishwripur, Atulia, Kaikhali, Munshigonj, Padma Pukur, Burigoalini, Shyamnagar, Gabura. Among these Munshigonj and Burigoalini Unions are the study areas of this research. These two big villages are situated at the area adjacent to the coast line and southern side of Shyamnagar and northern part of the Sundarbans. Total land area of it is 455 sq kms.

Total population of the study Upazila is 3,13,781 and its total agricultural land is 3,60,519 hectares. It turned into thana (Pilice Station) in 1982. It comprises of 216 villages and 126 Mouzas. Total households of this Upazila are 32,614, and small rivers flow in the Upazila are 12. The occupation of the people is agriculture, shrimp and crab farming and others. Total land area of agriculture is 89,686 acres and non-agriculture is 23,262 acres. In Shyamnagar Upazila number of total shrimp *ghers* is 4325 and area under shrimp *ghers* is 15622 hectares and registered *gher* is 430 and unregistered gher is 3995.

In Shyamnagar Upazila, the rate of shrimp production per hectare is 250 to 300 kgs. There are 1000 crab *ghers* and 50 depots of crab and 1580 crab farmers in the upazila. Among the population male is 50.46 percent and female is 49.54 percent. Among the population Muslims are 74.10 percent, Hindus are 25.40 percent, Christians are 0.06 percent and Buddhists are 0.4 percent.

Study Villages

2.1.1 Munshigonj

Munshiganj is a big village situated in southern coastal area in Shyamnagar Upazila. It is bounded on the south and east by the biggest mangrove forest- the Sundarbans, on the west by Ishwaripur Union, on the north by Burigoalini Union. On the north side there is a river named Malancha. The population of the village is 1392 and total household is 252. More than 60 percent people live below poverty line. Among the population the Muslims are 55 percent, the Hindus are 40 percent and rest 5 percent are from other religions. There are some Munda, ethnic people in this village. There are one high school and two primary schools in this village. The literacy rate of this

village is 43.50 percent. Agricultural products like paddy and vegetables are cultivated in about 1600 acres of land. About 50 percent of lands are occupied by shrimp and crab *gher* and about 1900 acres of lands are occupied by shrimp and crab *ghers* (Sources: UNO, UFO, Shyamnagar; Chairman, Munshiganj Union).

2.1.2 Burigoalini

Burigoalini is another study village situated in Shyamnagar Upazila. It is abounded on the east by the Gabura union, on the west by Ishwaripur union, on the north by Atulia Union and on the south by the biggest mangrove forest- the Sundarbans. On the eastern side there is a river named Kholpetua. The population of this village is 1249 and 545 households live in this village. Among the population the Muslims are 58 percent, the Hindus are 38 percent and others are 4 percent. There are some *Munda* families in the village. There are one high school and three primary schools in the village. The literacy rate of this village is 47.90 percent. Shrimps and crabs are cultivated in about 60 percent of total land of the village. There are 972 shrimp *ghers* and land are occupied 1020 acres the number of crab *ghers* are 150 and 350 acres of land are occupied by these *ghers*. The shrimps and crab labors are near about 450.

Table 03: Information of the Study Villages

Name of village	Area Acres	Household	Population	Agriculture	Shrimp	Crab	Others	Literacy rate
Munshiganj	6165	252	1392	30%	20%	15%	35%	43.50
Burigoalini	3565	495	3033	32%	17%	13%	38%	48.40

Source: BBS 2006; UP Data

2.1.3 Topography of the Study Area

Geologically Bangladesh is a part of the Bengal basin, one of the largest geosynclinals in the world. The basin is bordered on the north by the steep tertiary Himalayas; on the northeast and east by the late tertiary shillong plateau, the Tripura hills of lesser elevation, the Naga-Lusai folded belt; and in the west by the moderately high ancient Chotonagpur plateau. The southern fringe of the basin is not distinct but geophysical evidence indicates it is open towards the Bengal for a considerable distance (Rahman 1989). South and southwest of the Ganges tidal flood plain, there is a broad belt of land, barely above sea level with a height of only 0.91 m. This very low land contains the Sunderbans forest and the reclaims estates. Relatively rapid changes in land forms due to erosion and sedimentation have occupied in the coastal areas. Physical evidence of changing conditions is apparently in eroding riverbanks; areas of new deposition and consequent changes in land forms are also present. Within the last 200 years, the estuary has grown through changes in shape, channel migration and southward growth of islands. The coastal areas with mangrove plantations are regularly inundated during high tide.

2.1.4 Agriculture and Food

Agriculture, shrimp and crab farming are the main occupation of the coastal villages. The soil and climate of this area is suitable for some vegetables and shrimp culture and hardening and fattening of crab.

2.1.5 Forest and Forestation

Forest is an area that prevents the adjoining areas from severe hazards like tornados, tsunamis, cyclones, droughts etc. Around half of the forests of the country are in the

coastal area. People receive various goods and services from the mangroves on regular basis, for their subsistence. Mangrove plantations are increasing in the area but they are losing growing stock. Coastal plantations are erected to protect people from cyclones and to make the land more suitable for human habitation. Coastal embankments are being planted and leased to poor settlers in exchange for routine maintenance of the victims of erosion. The grounds of the forests are flooded every time during the tide. The plants have preumatophores, with viviparous, germination and are evergreen in coastal area regulate the frequency and constituent feature of the species (Pramamik 1989).

2.1.6 Rainfall Trends

The average rainfall trend is downward. Due to changes in the weather and the climatic conditions, rampant deforestation, unconsciousness towards environment etc. the average rainfall in this area is less comparing than other areas of the country. It is observed that usual rainfall during last five years has decreased and unexpected rainfall has increased. As a result of declining rainfall, cultivation is facing uncertainty. Generally, rainfall starts in Aswin (Mid September to Mid October) and during this time seven to ten days there is heavy shower of rain every year. This accompanies stormy winds. It causes fatal sufferings to the farmers (BMD 2006).

2.1.7 Sea Level Rise

Sea level rise is another variable that determines the vulnerability of coastal area of Bangladesh. The coastal lands are receiving additional sediments due to tidal influence and land subsiding due to tectonic activities. The compactness of sediment

can play a role in defining net change in sea level rise in the coastal area. It also happens for the increasing tendency of global warming and melting of ice.

2.1.8 Climate

The coastal area has a subtropical monsoon climate with a moderate rainfall that has significant effect on the fluctuating level of salinity and hydrology. It has effect on shrimp and crab cultivation.

2.1.9 Main Seasons of the Area

There are three main seasons namely: Pre-monsoon (From March to May), Monsoon (June to September), post monsoon (October to February). The pre-monsoon is characterized by southerly winds, high temperatures, evaporation rate and by occasional thunderstorms and south westerly winds. The monsoon brings heavy rainfall, high humidity and cloud. The post monsoon is hot and humid with occasional thunderstorms, cyclones, and storms surges. The dry winter season is characterized by cool, dry and sunny weather. The average maximum temperature is 25°C in January and 34°C in May. The major natural hazards in the area are cyclones, tidal waves, saline intrusions, drainage congestion and drought.

2.1.10 Hydrology

The study villages are intersected by many small rivers and canals. These are called *nodi, gang* and *khal* respectively. The two main rivers are Kalindi and Kholpetua, flowing south to the Bay of Bengal through many distributaries in the Sunderbans. These rivers and canals are all having tidal reaches in their lower stretches and these

affect their hydrology by damming back water each high tide. The water from shrimp and crab farms is drained into the rivers and canals through different sluice gates.

2.1.11 Soil Characteristics

The predominant soil texture is silty loam and silty clay loam with slightly acid to alkaline condition and sand pH varies from 7.5 to 8.2, clay dominates over silt (36%) and sand (2%). This is less variation in acidity in agricultural land; areas than there is in shrimp and crab areas. In agricultural areas the overall soil fertility is low and salinity is the major hazard to be overcome. Due to environmental factors, the coastal soils are slightly or moderately saline on the surface and highly saline in subsurface layers. The saline soils are found in the coastal area of Shyamnagar Upazila in Satkhira district.

2.1.12 Water Quality

There is a noticeable lack of variation in the water quality over the study area, with a high degree of uniformity of salinity, water temperature, transparency, ammonia and dissolved oxygen content. The low level of oxygen at the shallow depth of the water is deteriorating water quality. Water quality is the lowest in the agricultural land and lightest in the shrimp and crab farming areas. In the study area there are medium salinity in the water for this reason, farmers cultivate galda, bagda and mixed in the area.

2.1.13 Demographic and Social Characteristics

The sociodemographic characteristic marks of the study population significantly shape the shrimp and crab management of the study villages and reciprocally their indigenous management pattern also affect their socioeconomic status. Especially, age

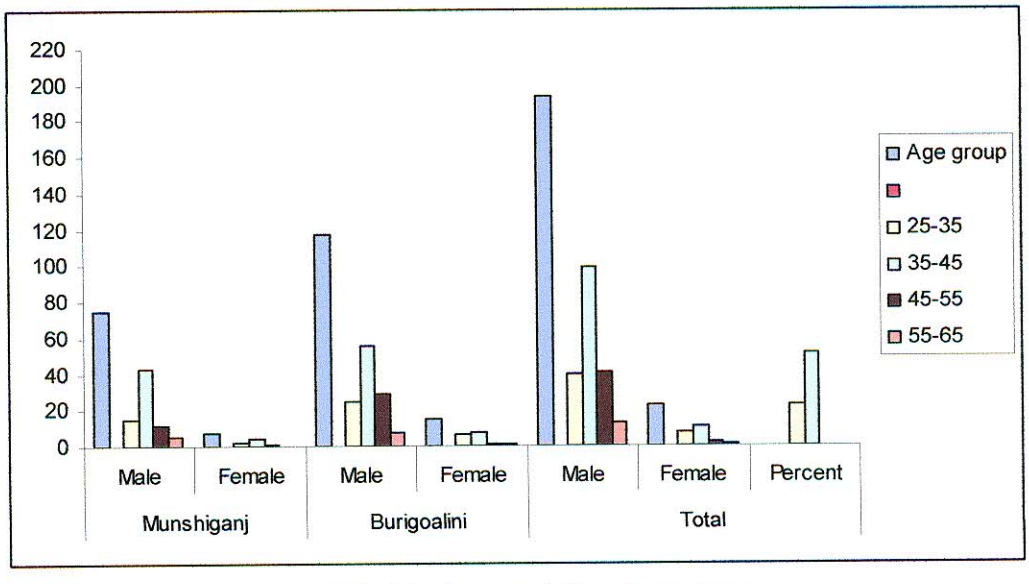
and sex of the respondents are important to know the background information of shrimp and crab farm owners and farmers. The additional socioecocnomic characteristics of the study population are their religion, education, family size and types house ownership, sources of drinking water, sewerage and sanitation, urban rural ratio of population etc.

Table 04: Age and Sex Structure

N=215

	Munshiganj		Burigoalini		Total		
	Male	Female	Male	Female	Male	Female	Percent
Age group	75	07	118	15	193	22	Male 89.8 Female10.2
25-35	15	02	25	06	40	08	22.33
35-45	43	04	56	07	99	11	51.16
45-55	12	01	29	01	41	02	0.20
55-65	05	00	08	01	13	01	0.07

(N.B. Lower limit of each class is included)



Graph 01: Age and Sex Structure

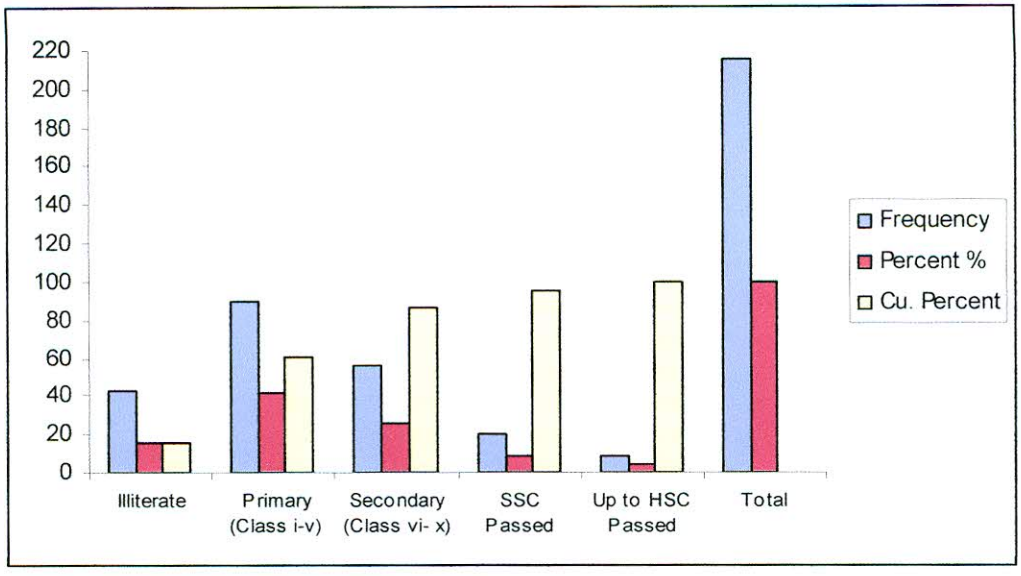
The data of the respondents indicates that 25-35 age group is 22.33 percent of the total respondents, 35-45 age group is 51.16 percent, 45-55 age group is 0.20 percent, 55-65 age group is 0.07 percent. It is found that majority of the respondents come from the age group 35-45 and 45-55. Because shrimp and crab farmers are middle aged people and they are more or less active and chief of the house hold. Also the age group of 35-45 and 45-55 are the most active population of the villages. Both the villages contain a population of 55-65 which is only 0.07 percent. In respect of the proportion of children, adult and aged population, the position of both the villages is more or less same.

The average age of the respondents of the study area is 41.13. Among 215 respondents 193 are male and 22 are female. The percentage of male farmers is 89.8 and female is 10.2 percent. Because the majority farmers of shrimp and crabs are male and few are female. But there are many female labors in the works of cultivation of shrimps and crabs. The aged population in both the villages shows the highest sex ratio. The fertility group of population includes only the female population between 14 to 49 years. This group consisted of 20 percent of the total population. This fertility group contributes to the promotion of population growth of both the villages.

2.1.14 Educational Status

Table 05: Educational Status of the respondents

	Level of Education	Frequency	Percent %	Cu. Percent
	Illiterate	43	16.2	16.2
Literate	**Primary (Class i-v)**	90	41.9	60.5
	Secondary (Class vi- x)	56	26.0	86.5
	SSC Passed	20	9.3	95.8
	Up to HSC Passed	9	4.2	100.00
	Total	215	100.00	



Graph 02: Educational Status of the respondents

The status of literacy for Munshuganj and Burigoalini occupies a slightly negative position than the national status of literacy. The national literacy rate is 53.3 percent in 2006. Munshiganj has 43.50 literacy rate and Burigoalini has 48.40 percent literacy rate (BBS 2007). It has been seen that, after the war of independence of Bangladesh two items came into export market and these are ready-made garments and shrimp and crab. But in the passage of time, rural illiterate or least educated people were involved in shrimp and crab sector.

The level and percentage of education of the people involved in the shrimp and crab sector is low. By looking at the level of education of shrimp and crab farmers, we find that, most of their educational status is within class five to ten. Almost 77.2 percent belong to this category. The literate population up to H.S.C. level is about 4.2 percent. The percentage of higher education is very negligible. As a matter of fact, illiteracy remains a scourge in both the study villages. It is above 16 percent in both of the villages.

Table 06: Religious Status of the Respondents

Religion	Number	Percent
Muslim	110	51.62
Hindu	98	45.58
Christian	04	1.8
Buddhist	03	1.3
	215	100.00

Data Source: Field Data

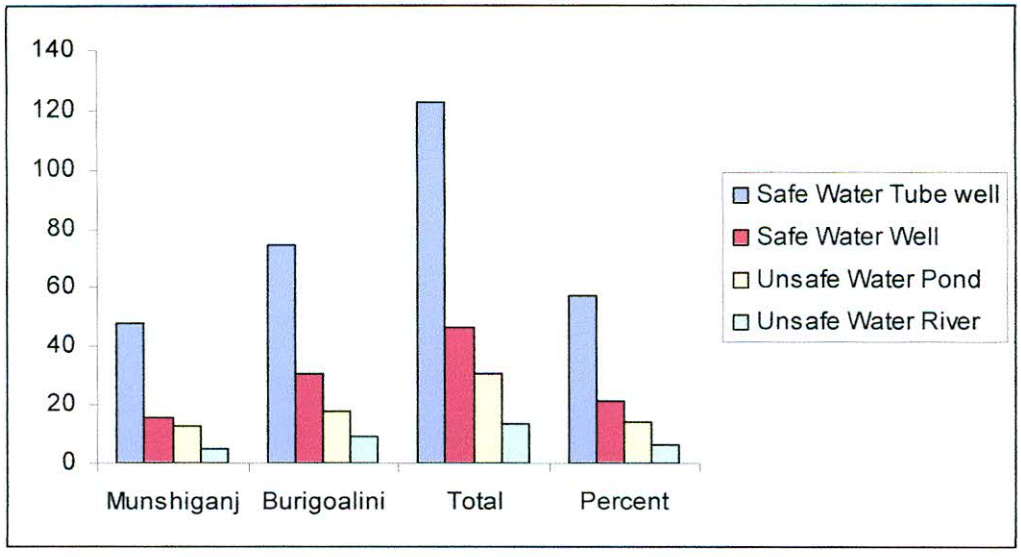
Most of the people of Munshigonj and Burigoalini are Muslims and Hindus. Among the respondents Muslims are 51.62 percent and Hindus are 45.58 percent: But the percentage of Christian and Buddhists are 1.8 and 1.3. So, they are very few in number in the locality. Once mainly the lower caste Hindus of the belt were involved in shrimp and crab culture, but at present a major part of the Hindus and Muslims of coastal villages are involved in these profession.

2.1.15 Sources of Drinking Water

People of the study area do not use the similar source of drinking water. The following table (Table 07) shows the pattern of the source of their drinking water.

Table 07: Source of Drinking Water

Type	Source	Munshiganj	Burigoalini	Total	Percent
Safe Water	Tube well	48	75	123	57.21
	Well	16	31	47	21.86
Unsafe Water	Pond	13	18	31	14.42
	River	05	09	14	6.51
		82	133	215	



Graph 03: Source of Drinking Water

It has been found that only 57.21 percent respondent of the area drink tube-well water and it is only the safe drinking water, 21.86 percent respondents use well water, 14.42 percent use pond water and 6.51 percent use river as the source of drinking water which is unhealthy and totally unhygienic. But this situation is improving because of the improvement of socioeconomic condition and awareness building among the respondents of the study villages.

Table 08: Marital Status of the Respondents

Type	Munshiganj		Burigoalini			
	Male	Female	Male	Female	Total	Percent
Married	60	03	98	08	169	78.6
Unmarried	10	00	16	03	29	13.5
Widow, Widower	05	02	02	02	11	5.1
Divorced Others	00	02	02	02	06	2.8
Total	75	07	118	15	215	

It is found that majority of the male and female respondents are married, it is about 78.6 percent, and 13.5 percent are unmarried and only 5.1 percent are widow, widower and 2.8 percent respondents are divorced or others. Female become widow and is divorced by the male farmers and labors. Also, male has to go to catch fry and crab in the Sundarbans and tigers kill their husband. For this reason, widow and widower rate is increasing day by day in the study area. Male workers come from different outside area in the harvesting season and leave the area after season. Some of them married in the area and divorced the female when they leave the area.

Table 09: Years of Living in the Area

Years	Number	Percent
01- 25	5	2.0
25-35	76	35.35
35-45	98	45.58
45-55	30	13.95
55-65	06	2.7
	215	100.00

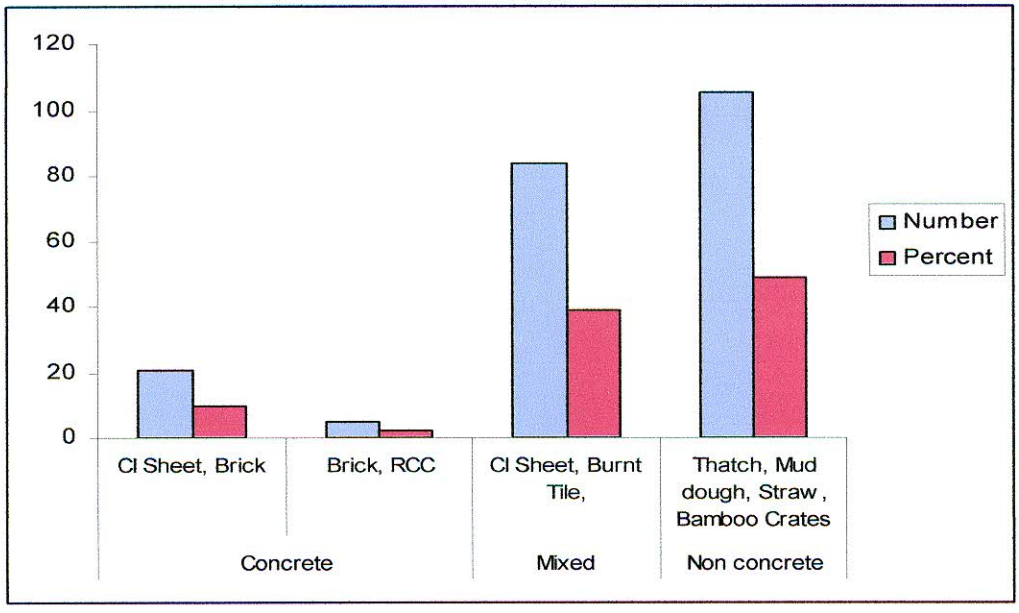
The data demonstrates that majority of the respondents belong to 25-35 years of living group that is 35.35 percent and 35-45 years of living group, that is 45.58 percent. Only 13.95 percent have been living here for 45-55 years and 2.7 percent have been living here for 55-65 years. So, it is meant that majority of the people of the two villages came from different neighbor villages or upazilas or district to live in the area for their survival. They are migrated from Jessore, Noakhali, Barisal and many other districts of Bangladesh.

Table 10: Housing Pattern

a. Structure of Residential House

Pattern	Roof materials	Number	Percent
Concrete	CI Sheet, Brick	21	9.8
	Brick, RCC	05	2.3
Mixed	CI Sheet, Burnt Tile,	84	39.1
Non concrete	Thatch, Mud dough, Straw, Bamboo Crates	105	48.8

N=215



Graph 04: Housing Pattern

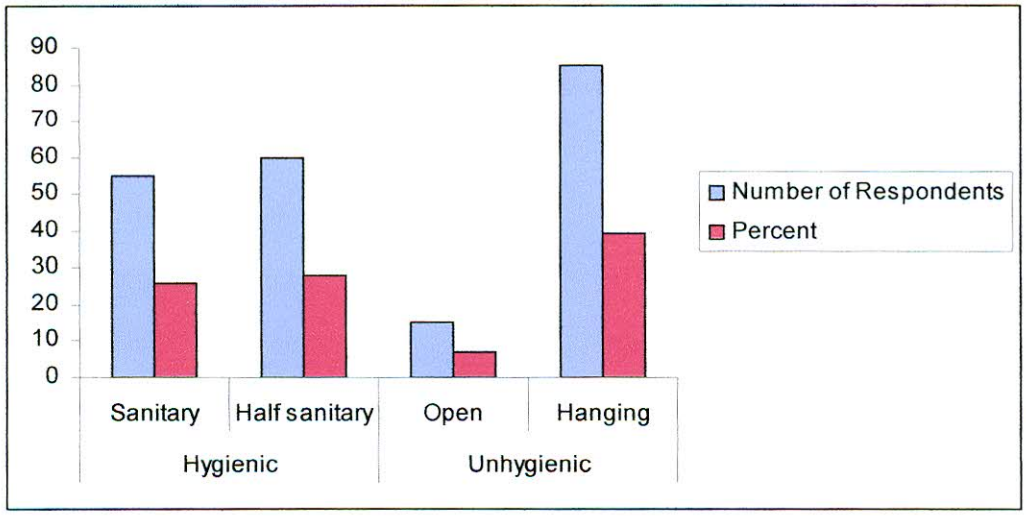
It has been found in this study that people of study villages have very little brick built houses, it is only 2.3 percent. They built their residential house by brick, but majority of them have house which is made of mixed materials like CI Sheet, mud dough, Bamboo crates and Straw that is 48.8 percent and 39.1 percent have the house which are made of CI Sheet and wood. So, it is seen from the table that the socioeconomic condition of the respondents is not satisfactory. They always have to face cyclone,

Tidal wave and many other natural calamities. So, they can't afford good house for their living but they only have survival strategy for existence in the area.

2.1.16 Sanitation System

Table 11: Sanitation System of the Respondents

Sanitation Type	Type of bathroom	Number of Respondents	Percent
Hygienic	Sanitary	55	25.6
	Half sanitary	60	27.9
Unhygienic	Open	15	6.9
	Hanging	85	39.5



Graph 05: Sanitation System of the Respondents

It has been found that among the respondents only 53.5 percent use hygienic sanitation system and that is improving day by day in the study area. By culturing shrimp and crab they improve their economic condition. Other 46.5 percent use unhygienic latrines. They are not conscious about the sanitation system and health. Among them 39.5 percent respondents use hanging latrine and only 6.9 percent respondents use open latrines. It is because; they can not afford the cost of sanitary

latrines. It is not only the matter of the improvement of socioeconomic condition but also the matter of social consciousness and responsibility.

Table 12: Health Care Services

Type of Treatment	Munshiganj	Burigoalini	Total	Percent
Homeopathic	30	44	74	29.8
Ayurbedic	32	58	90	41.9
Allopathic	16	36	52	24.2
Exorcise	04	05	9	4.2
	82	133	215	100.00

It is seen that majority respondents of the study villages have been taking more allopathic medical treatment and services in comparison to their previous period. Allopathic medical treatment is comparatively costly in the study area. Generally, a person becomes financially solvent than before, he tries to avail allopathic medical treatment. 24.2 percent respondents take medical services from allopathic doctors and pharmacists. 29.8 percent respondents are taking treatment from homeopathic and ayurbedic doctors and *Kabiraj*, and 41.9 percent respectively. Moreover, 4.2 percent people take treatment from *Kabiraj* and *Hekim* and others. Although, some of them have financial capacity to go allopathic doctors and clinic, they do not go there. It is because of their illiteracy and ignorance of health. They are not aware of the hygienic condition of health and proper treatment. Specially, the female patients do not want to go to the costly treatment. Because of their financial insolvency and ignorance they go to the *hekim* and *kabiraj*. Also, they are affected by some diseases which are related to shrimp and crab culture. Because they are using IK for the working period but they do not use any protection of their health.

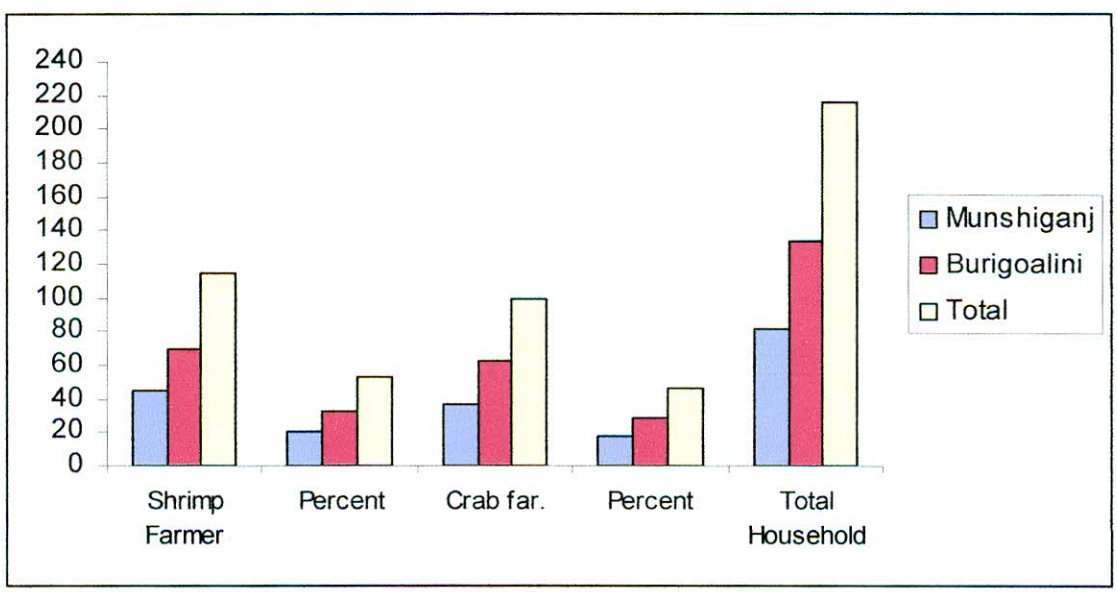
2.2 Economic Background

2.2.1 Occupation

Occupation is a vital identity of man. Occupation refers to a person's social and economic status in his society. Being a coastal area, the occupational structure of the respondents is.

Table 13: Occupation of the Respondents

Name of Village	Shrimp Farmer	Percent	Crab far.	Percent	Total Household
Munshiganj	45	20.93	37	17.21	82
Burigoalini	70	32.56	63	29.30	133
Total	115	53.49	100	46.51	215



Graph 06: Occupation of the Respondents

It has been found that 20.93 percent of Munshiganj village and 32.56 percent of Burigoalini village of the respondent are shrimp farmers. 17.21 percent of Munshiganj

village and 29.30 percent of Burigoalini village of the respondents are crab farmers. This scenario is changing day by day. Because shrimp and crab farming is growing very rapidly in the study area. So, agriculturists are changing their occupation and these two aquatic resources will occupy the major part of the land of the area.

2.2.2 Land Ownership

The pattern of land ownership in Bangladesh is based on a system of very unevenly distribution. This distribution system along with the increasing scarcity of land and increasing growth of population causes a change in the ownership pattern of land. Land ownership is a significant indicator or variable that certifies one's socio-economic status in a rural society. Table 14 furnishes the study results, which show the pattern of land ownership of the study villagers.

Table 14: Land Ownership

Land Ownership Status	Owned land (in acres)	Munshiganj	Burigoalini	Total	Percent
Landless farmers	00	02	03	05	2.3
Marginal farmers	1-5	05	09	14	6.5
Poor farmers	5-10	34	52	86	40.0
Average farmers	10-15	30	49	79	36.74
Rich farmers	15 above	11	20	31	14.42

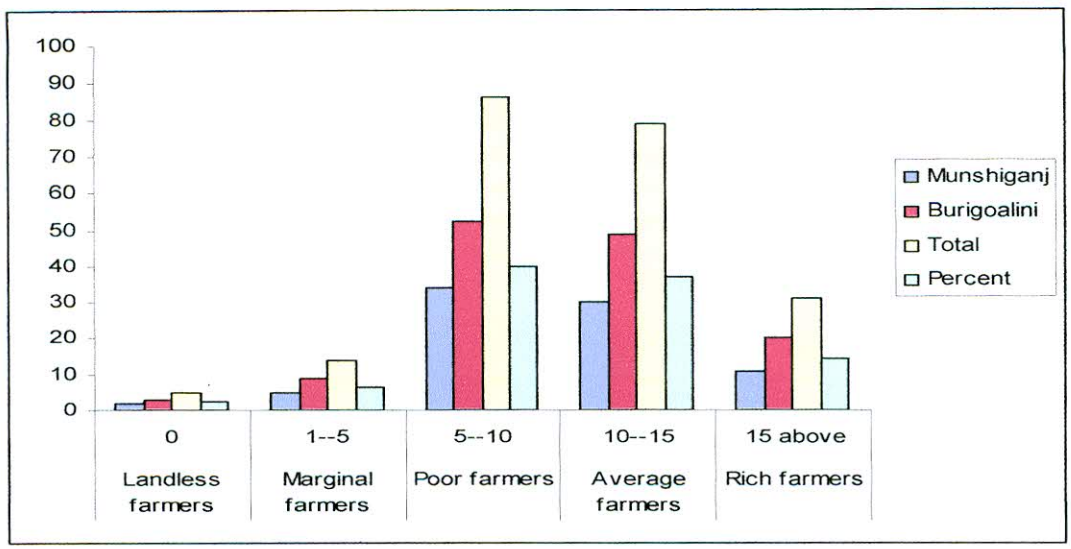
Notes: Rich farmers : Those who posses land above 15 acres.

Average farmers : Those who own land of 10 to 15 acres.

Poor farmers : Those who have land of 05 to 10 acres

Marginal farmers : Those who own below 05 acres of land

Landless farmers : Those who have no land of their own.



Graph 07: Land Ownership

About 71.43 percent households are shrimp and crab farmers, directly involved in non agricultural work and only 28.57 percent is involved in agricultural work. It is seen that 2.3 percent respondents have no land and they are landless. They borrow land from others who are not directly involved in shrimp and crab farming. 6.5 percent respondents have below 05 acres of land and they are marginal farmers. They also can not farm only their own land and have to borrow land from others. 40.00 percent respondents have 05 to 10 acres of land and they are poor farmers, 36.74 percent respondents have 10 to 15 acres of land and they are average farmers, 14.42 percent respondents have above 15 acres of land and they are rich farmers. The rich farmers take more land from others as *hari* to cultivate shrimp or crabs. At present, the maximum agricultural land transferred to non-agricultural land because of the salinity of the shrimp and crab *gher*. The marginal and poor farmers are facing difficulties to culture shrimp and crab. They do not have financial capabilities to adopt more land and scientific methods and techniques to culture the shrimp and crab. The production rate of big *gher* is much more than that of small *gher*. So, the poor and marginal farmers get less profit than the rich farmers.

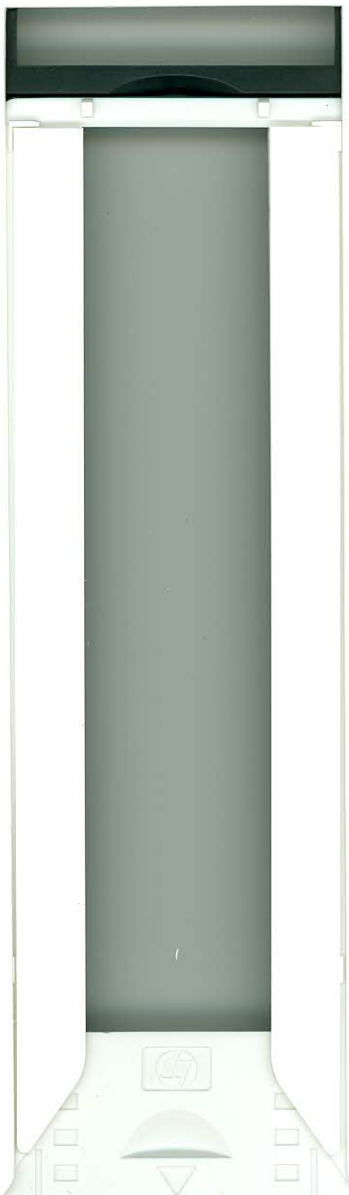
Table 15: Level of Income

Income Yearly (in Dollars)	Munshiganj	Burigoalini	Total	Percent
100-200	**20**	**33**	53	**24.7**
200-300	**52**	**88**	140	**40.9**
300-400	**07**	**07**	14	**6.5**
400 above	**03**	**05**	08	**3.7**
			215	

The data indicates that majority of the respondents have the income of 100 to 200 US Dollar and 200 to 300 US Dollar. It is seen that 65.6 percent respondents have the income 100 to 300 US Dollar and 24.7 percent respondents have the income of 100 to 200 US Dollar and 40.9 percent respondents have 200 to 300 US Dollar yearly incomes. But very negligible villagers have the income of above 400 US Dollar that is only 6.5 percent. Only 3.7 percent respondents have the income of above 400 US Dollar. The average income of the respondents of the study villages is above 150 US Dollar only. Apparently, it is assumed that the socioeconomic condition of the people of the area is improving very rapidly but the real scenario is different from that. The fact is found in the field that the rich farmers come from outside the study area. They come from Satkhira and Shyamnagar Upazila. They can easily afford any kind of techniques and support. So, socioeconomic condition of the rich farmers is improving better than that of poor, marginal and landless farmers of the area.

2.2.3 Necessity of Financial Support

Majority of the respondents need loan from different sources and different amount. That is 76.74 percent respondents need financial support and only 23.26 percent need not.



Also majority of them get financial support from that is 62.42 percent got financial support loan from village and business cooperative societies, and 19.39 percent get financial support from Non Government Organizations and 18.18 percent get financial support from *Krishi* (Agricultural) Bank and different schedule banks.

Table 16: Necessity of Financial Support

	MG	BG	Total	Percent
Yes	75	90	165	76.74
No	20	30	50	23.26

Table 17: Sources of loan

Name of Source	Number of Respondents	Percent %
Co-operative Society	103	62.42
N.G.O	32	19.39
Bank	30	18.18
	165	100.0

Table 18: Amount of Financial Support

Amount of Financial Support (in US Dollar)	Number of Respondents	Percent %
150-250	106	64.2
250-350	47	28.5
350-450	11	6.7
450-550	01	0.6
	165	100.00

The average financial support they received from different sources is 17,300 taka or 247 US Dollars. The rich farmers get financial support easily because they have very

good relation with the bank stuff. They posses political and social power and they can easily repay the cash. As they get more profit. On the other hand, the average and poor farmers can get some financial support from different rich usurer as *dadon* and from other cooperative societies on high interest. So, they aren't capable to repay the financial support timely. Their farms are very smaller in size and production rate of those farms are very low. For this reason, the poor and marginal farmers become poorer day by day. Other landless and very poor farmers can not get financial support. So, they can not run their farms timely. So, they are in very miserable condition. From this discussion, it is clear that the rich farmer can use both IK and ScK simultaneously. The production rate is high and it is more profitable. But the poor and marginal farmers use only their IK and local mechanisms to culture the shrimp and crab. The production rate is less and less profitable. They can not afford the costly scientific technology and methods.

Table 19: Refund of Loan

Type of Refund	Number of Respondents	Percent %
Monthly	80	48.48
Weekly	60	36.36
Yearly	25	15.15
	165	100.00

Also, majority of the respondents of the study area get 150 to 200 US Dollar, which is about 64.2 percent and 28.5 percent, get 200 to 450 US Dollars. And only 7.3 percent respondents get above 450 Dollars as financial support (Table 18). Farmers repay their loan in three ways. That is about 36.36 percent respondents repay installment of financial support in every weekly, 48.48 percent respondents repay installment

monthly and only 15.15 percent of the respondents repay the installment yearly. Some (20%) of the respondents claims that if they are unable to repay the loan the usurer and banks do not show any sympathy to them and sometimes the organizations are compelled to occupy their land.

In this chapter, the researcher tries to analyze the ecological, sociodemographic data of the respondents. It has been seen that the people of study area are socially and financially more solvent then before but there arose some problems like scarcity of drinking water, insufficient financial support, food insecurity etc. It is also clear that if the government and schedule banks give financial support easily specially to the poor and marginal shrimp and crab farmers, they can be capable of using the modern technology and sustainable shrimp and crab culture in the locality. It is very much important for the development of the coastal villages of Bangladesh.

CHAPTER THREE

IK PRACTICES IN SHRIMP AND CRAB CULTURE

3.1 History of Shrimp Farming

3.2 Ownership Pattern

3.3 System of Production

3.4 Activities of Shrimp Farming

3.5 Health and Disease Management

3.6 Harvesting, Marketing and Management

3.7 Marketing

3.8 Crab Culture in the World Context

3.9 Activities of Crab Culture

IK Practices in Shrimp and Crab Culture

The present chapter is intended to explore the utilization of Indigenous Knowledge practices of shrimp and crab farming in the study villages. It included the indigenous or native practices and activities that are useful for shrimp and crab farming. Different indigenous practices adopted for shrimp and crab farming like fry collection, stocking of fry, harvesting, disease management and marketing system. With a view, to the researcher try to evaluate the data concerning indigenous knowledge for shrimp and crab management of the study villages.

The study area includes the largest mangrove forest of the world, largest delta, potential area for shrimp and crab farming: the high productivity and availability of large number of cultivable species of shrimps and crabs in the region offer an important opportunity for shrimp and crab management and development. So, shrimps and crabs are the two important aquatic resources in the coastal area of Bangladesh.

3.1 History of Shrimp Farming

During the early 1950s, to grow more rice, government undertook an ambitious but faulty Coastal Embankment Project (CEP) without paying due consideration to the hydro morphological and environmental conditions and conservation of the valuable natural fish resources. By the mid 1960s, before completion of that project, some rivers were quickly silted up resulting in artificial water logging in the monsoon and started affecting some riverine areas adversely. By the early 1970s, the situation further aggravated to expose a vast area of the southwest coastal region to water congestion and paddy cultivation had to be abandoned. By the late 1970s almost all

the canals, medium sized rivers and some big rivers had cross dams and the entire costal areas were embanked and divided into several polders having small and big drainage sluice gates with further aggravation of the situation (Aftabuzzaman 1990).

By the mid 1970s, out of desperation, some local people forcibly cut open the embankment and started the traditional *bheri* culture practice again incidentally at the same time, shrimp had very costly product in the world market. On the contrary, people were not getting any agricultural products from their land due to water logging. These two factors together catalyzed the acceleration of shrimp culture as commercial practice (Karim 1996). Then it all started in Satkhira District and then spreaded over to other coastal areas of Bangladesh (Aftabuzzaman 1998; Islam *et al* 1997).

Initially Water Development Board (WDB) was seriously against the practice. But as the WDB could not solve the water congestion problem more importance, the government favored this practice and recognized shrimp farming as industry under second five year (MoP 1981) and adopted necessary measures for increased shrimp production bringing more area under shrimp rather than protection of coastal environment. The national strategic plan PRSP (Poverty Reduction Strategic Plan) has addressed the shrimp issue and suggested to adopt remedial measures (GED 2005).

Shrimps are cultivated in all nine Upazilas of Satkhira district. Mainly bagda (*Paeneus monodon*) are cultivated in the Shyamnagar Upazila due to the requirement and presence of higher salinity; and galda (*Macrobrachium rosenbergii*) in the areas as it requires lower water salinity Bagda and Golda mixed culture also exists.

Shrimp became the white golden bar of Bangladesh. It earned 5.2 percent of the export earning product and it earned Taka 26,983.5 million by exporting 49,317 metric ton frozen shrimp in 2005-2006 (DoF 2005-06).

The above discussion it has been seen that shrimp culture is good enough to earn foreign currency but it is not out of debate. It has various social, economic and environmental impacts. The experts have mentioned many arguments increasing salinity, destruction of mangrove resources and other vegetation, reduction of employment, growing landless, increasing social conflict, violence and other undesirable consequences, biodiversity reduction, declining land productivity, increasing deforestation. All these many have serious implication for sustainability not only of shrimp farming itself, but also of the rural community in the coastal areas of Bangladesh. Considering it potential threat to environment, Department of Environment (DoE) has included the shrimp production and processing in Amber-B group which needs to submit Initial Environmental Examination (IEE) report, general information, feasibility study process flow diagram and design of waste treatment to the DoE for getting chance (MoF 2004; DoE 1997).

The commercial shrimp farming system in our country has not achieved it's at the present level within a fortnight. In fact, it is a gradual development during a span of time. The contribution of coastal aquatic resources to both the rural and national economies is a major source of export earnings and of employment in the coastal areas. Shrimp is the second highest foreign income earning resources of Bangladesh. Bangladesh has a large area of coastal tidal land this area covers over 0.143 million hectares of for shrimp aquaculture. In 2001-2002, the country produced 65,579.42 metric ton shrimp of all kinds and exported 30,209 metric ton frozen shrimp and

earned 1,447.8 crore taka (DoF 2003). If we want to know the background of shrimp culture in Bangladesh, we have to consider its situation from the world perspective.

Age of the earth has been divided into several groups from the biological point of view. The first group is the age of Canbrium' and its duration was 5.5 million years. This age was followed by the age of Silurian' and the age of Devodean' and the duration of the two ages were 3.5 million years. Shrimp is originated in the age of Devodean' in the world. There are 450 varieties of shrimp in the world and only 67 varieties have been identified in Bangladesh till today. The past history of shrimp culture alerts the fact that from hundred or more years earlier the paddy field owners produced shrimps by traditional methods in the paddy field. Fuginago and Hundiago of Japan and S. W. Ling of Malaysia played the vital role for extension of shrimp culture in the world. They become successful to produce shrimp fries in the hatchery. As a result, hatchery and shrimp culture extended in the Mid-Asia, the south of the USA and the island of Hawaii. Nowadays 20 to 25 percent of total world shrimp production is produced in the shrimp farms of the different parts of the world (Paul 1996).

Shrimp culture in Bangladesh was initiated in 1970's. Now it has emerged as one of the important economic activities that contribute significantly to the national export earnings of Bangladesh. But its rapid and unplanned expansion created a lot of social and environmental tension at the local level including the question of its sustainability, benefit-cost distribution and equity (BSER 2000).

Shrimp farming is an age old or indigenous or traditional practice in coastal Bangladesh. Farmers use their own lands and that were formerly rice fields. Farming

refers to the natural rearing process in its simplest form. Farmers have grown out ponds or *gher*s for shrimp cultivation on the lands of rice cultivation.

Coastal shrimp aquaculture in Bangladesh is mainly confined to two regions, namely: Khulna and Chittagong. At present 80 percent of the shrimp farms are located at the southwest region, Khulna while the rest are located in the southeast region Cox's Bazar and other coastal areas. It is evident that the level of water salinity is not identical in these two coastal regions of Bangladesh. This difference causes inevitable difference in the shrimp culture and its production period of the two regions. It is notable that the shrimp culture practices also vary due to salinity variances from one area to another of the southwest region. Alternate shrimp-paddy is followed in some areas of the Khulna region.

Following this pattern, one crop of transplanted Aman is grown between September and November during monsoon season when the water of the river becomes fresh and sweet. From February to August, a crop of shrimp is cultured, when the water of the surrounding rivers becomes saline. In the areas under Satkhira District, Shrimp farming is almost year round due to the presence of moderate to high salinity in the water (Alam 2002).

3.2 The Ownership Pattern of Shrimp *Gher*

The ownership pattern of shrimp *gher* is complex and varies from area to area in Bangladesh. The major categories of shrimp *gher* ownership are:

(a) **Individual Ownership**: In this category, the land is owned and operated by one person. The land owner invests cash according to his capability and enjoys total returns from the farm.

(b) Farmers Group: In this category, the land is owned by a number of persons who all play an active role in operating the farm. They contribute land and money and do the farming jointly. They share the returns from the farm proportionate to their contribution of land, cash and physical labor.

(c) Outside Lessee: In this category, the land is leased out by owners to a person or persons living outside the area. The outsiders provide capital and usually set up shrimp and crab *ghers* taking most of the land from small and medium land owners. They usually ally themselves with neighboring medium sized land owners by taking their land and giving them a share in the *gher* operations and income. This is due to gain influence over the land and control over the local people. Generally, majority of cases, it is believed that the culture and practiced by the different farm owners are almost similar.

3.3 System of Shrimp Cultivation in Coastal Area

Farmers use their own lands that were formerly rice fields. Farming refers to the natural rearing process in its simplest form. The main species used in coastal aquaculture is the black tiger shrimp (Penaeus monodon) (Alam 2004).

Farming period starts from February to the end of November using multiple stocking and multiple harvesting methods. In shrimp monoculture a series of activities are needed for successful growth of shrimp. All the respondent farmers performed almost the same type of management activities, for land preparation and grow out. However, the farm size, the application rate of fertilizer, stocking density of PL, and water exchange rates varied from farmer to farmer. The farming practices under individual, group, and outside category are discussed in the following sections. Shrimp is

cultivated in Bangladesh under extensive or traditional system, improved or extensive system, semi-intensive system and intensive system (Mazid 2003).

1. Extensive or Traditional System

This is an age-old traditional practice for shrimp cultivation in some enclosures which is locally known as *gher*. The flow of water into the enclosed areas is usually controlled by small wooden sluice box. From February to April sluice gates are opened to allow the entry of saline water carrying juveniles of various varieties of coastal fin fish and post larvae of shrimps which breed in the sea and the estuarine water get into the enclosures are allowed to grow until they attain harvestable size. This practice of natural stocking of the *gher*s is being progressively replaced by artificial stocking with the PLs of desired species of shrimps. This type of shrimp culture is called extensive shrimp culture. The *gher*s used in this type of farming systems are generally irregular in shapes and size up to 10 hectares. Usually each *gher* has a peripheral ditch 10 to 20 meters wide and 30 to 60 meters deep. The middle portion of the *gher* may be slightly elevated to about 40 centimeters above the bottom, while the *gher* bottom should be entirely flat. The typical shrimp culture is extensive or traditional culture system is considered the simplest culture system. Fry stock normally comes from the wild and supply is season dependent. Shrimp fry in these *gher*s either gained entrance during water exchange or are intentionally stocked by the farmer with fry collected from the wild source. Extensive farming employs very low stocking densities, usually in the range of about 3000 to 5000 fry per hectare. In this system supplementary food is not given and water management is done only by tidal exchange (Nuruzzaman 1993).

During the decade of 1980s, improvement and innovations in the extensive shrimp culture method have appreciably increased production. Among these improved techniques are application of time prior to stocking to condition the soil, use of pesticides to eradicate pests and predators, application of organic and inorganic fertilizers to enhance natural food condition, increased pond water depth, and increased stocking density either pumping water daily or direct stocking is done. The innovations and manipulations generate higher and more consistent yields. The extensive culture approach, despite many drawbacks, it is still the most profitable enterprise for subsistence farmers with very low capital.

2. Improved or Extensive System

In this system, the improvement over the traditional approach is in the introduction of a systematic pond configuration. The ponds are generally built in rectangular manner with size about 1 to 3 hectares and water depth of 0.8 to 1.5 meters. Each pond should have separated by inlet and outlet gates to facilitate water exchange, advanced pond preparation and harvesting methods are necessary. A diagonal ditch, 5 to 7 meters wide and 30 to 40 centimeters depth extending from inlet to outlet is to be constructed to facilitate drainage of water and collection of shrimp during harvest may be an ideal case also in sunny day. This method involves higher stocking rates, use of supplementary feed and the implementation of a regular water management. The typical rate of stocking PL for semi-intensive culture operation varies from 20,000 to 50,000 fry per hectare. Supplementary feed either formulated or fresh is given daily in addition to the existing natural food produced in waters though the application of fertilizers. This operation also requires the use of water pump to facilitate water exchange. While this approach would substantially increase yield per cropping, this

use of supplemental feeds entails additional cost which generally accounts for the biggest share in operational expenditure. In this method, a few to 50 hectares *gher*s are normally tied fed, but smaller *gher*s at higher elevation are sometimes fed with pump. Lime and fertilizers are used and feeding is also done but not systematically with 50 percent of the water which is exchanged during each spring tide cycle or 5 to 7 centimeters water is exchanged every alternate day (Nuruzzaman 1993).

3. Semi-intensive System

It was first initiated in Cox's Bazar in 1988. In this system 10 to 35 fries per square meter are stocked in smaller *gher*s ranging from 0.4 to 5 hectares. Shrimps thrive mostly on pellet feed but they also subsist on natural foods.

4. Intensive System

This culture operation is more sophisticated requiring very high financial and technical support and inputs. The rearing facilities are either earthen ponds or concrete ponds. The distinct features of this culture operation is better when it depends on hatchery-bred fry, high stocking density, use of formulated feeds, application of aeration to increase dissolved oxygen level in pond water and intensive water management is essential.

Sizes of pond or tank vary from 500 to 5000 square meters as found in Japan, Taiwan, Philippines and Thailand. Dikes may be of pure earthen materials; earth coated with plastic sheets or sometimes may be of concrete. Most designs include separate inlet and outlet gates or small water inlets for flow through purposes. Drain out system is in the form of a centrally located drain pipe; a drain gate; may be of monk or sluice type

or combination of both, may be contrasted. Farmers are still waiting to introduce semi intensive or intensive shrimp culture systems but they have to practice them under limited area. In order to introduce this system, they may just initiate the program in a limited area say 10,000 hectares. The farmers should be organized and trained by the government and help them to initiate the intensive shrimp culture system with all relevant inputs to make it success; so that other farmers of different areas may follow the system later on. In this system, water is created and at least 30 percent water is exchanged daily. Shrimp is grown on artificial feed. Farming period starts from February to the end of November using multiple stocking and multiple harvesting methods. In shrimp culture a series of activities are needed for successful growth of shrimp (Nuruzzaman 1993).

3.4 Activities of Shrimp Farming

3.4.1 Fry Collection

About 0.42 million people are involved in shrimp post larvae collection along the estuaries and coastline of the Bay of Bengal in Bangladesh (Nuruzzaman 1993). Shrimp fry collection from the wild sources is ecologically destructive. But shrimp farming of Bangladesh mainly depends on wild fry. It has been estimated that more than two billion shrimp fries are collected annually from wild sources. More than 90 percent of the total Pl is derived from wild sources Shrimp seed collection has given employment opportunities for thousands of coastal landless unemployed people. Among the fry collection gears, the set bag net (locally called *Behundi*), the drag net (locally called *Baksha Jal*) are important. The collectors used a series of set bag nets to harvest shrimp fry along the shore line. The nets were set with the help of long nylon rope, floats and weight. They use bamboo or wooden frame and long nylon

rope for the operation. Locally, available nylon mosquito nets were used as netting materials. The abundance of fry depends on the lunar cycle and wave action. It was observed that fry collectors harvested a good number of fry during the spring tide (full moon) after which the number decreased. Again the number of fry increased during the new moon and gradually decreased. It is observed that four to five powerful middlemen were involved in the fry collection. These middlemen often formed some sort of association locally called syndicate. Fry collectors sell all the fry to the *faria* or syndicate. The *hawkers* collect the fry from the collectors. And collectors collect shrimp fries from rivers and canals of the Sundarbans and the sea. Fisherman and fry collector hunt fries by using nets and then keep them in the pot. The fishers sell the fry to the shrimp farmer. At present the farmers sometimes use the fries grown in hatchery.

3.4.2 *Gher* Preparation

For *gher* preparation, the farmers almost perform same type of management activities. However, the *gher* size, pond drying, preparing the dikes, the application rate of lime and fertilizer, stocking density and water exchange rates varied from one farm to another.

3.4.3 *Gher* Location and Characteristics

In coastal aquatic resource management the location of *gher* is an important factor because the selection of a suitable site always plays a major role in shrimp farming. The selection is made on the basis of information on topography, ecosystem, meteorological and socio-economic conditions of the people in relation to farm design, species compatibility and overall economic viability of the envisaged

activities. Almost all *ghers* are located in the inter-tidal range. Farm design was highly dependent on the characteristics of the site selected. But there was no so-called design followed by the different type of farmers. Maximum farmers followed the open systems, with no treatment ponds. Bottom topography of the surveyed farms was irregular. All the farms were within the range of 145 meters from the main river of the area. They use open system *ghers*. The average water depth in *gher* is 0.61 meter. Generally 11 to 13 centimeters. of water height is reduced at every 14 to 15 days interval. 20 to 30 percent of pond water volume is exchanged during tidal regimes and farm effluents discharged directly to the common flushing cum drainage canal. The shape of the *ghers* is mostly rectangular or irregular with large surface area. The variation of the farm size in the different categories was distinctly noticed in the study area. The actual farm size was highly variable. The average size of the shrimp *gher* in the area is 8.81 hectare which was lower than the findings (10 hectares in Shyamnagar Upazilla (Hoq *et al.* 1997). Farms under individual category were generally smaller in size (2.28 hectares) followed by group farm category (4.59 hectares). The largest size of the farm under this category was 19.56 hectares. The range of the farm size was 10.80 hectares to 36.44 hectares. In a study Caritas 1997 reported that 88 percent of shrimp *ghers* in the areas were less than 10 hectares. The Bangladesh Centre for Advanced Studies (BCAS 2001) census in the southwest costal area found that about 93 percent of shrimp farms were below 10 hectares in size. According to the Department of Fisheries, total number of shrimp *ghers* in Bangladesh is 15,218 with an estimated *gher* size 9.5 hectares during 1999 to 2000 in the four coastal districts covering nearly 99 percent shrimp *ghers*. The findings from the study reveal that farm

sizes are becoming smaller day by day and most of the farms were operated by the individual or group enterprise.

3.4.4 Required Water Quality of the Farm

Water quality includes all the inherent physico-chemical and microbiological characteristics of water. In any selected site, pH of water preferably ranges from 7.5 to 8.5. Fluctuations in dissolved oxygen level should be predetermined and the oxygen level should not be lower than 4 ppm. The water should be turbid but not too turbid. Water with heavy silt load causes clogging of filter nets, sluice gates and increase sedimentation at the pond bottom. The water should be ideally rich in microorganisms (both plants and animals).

3.4.5 Salinity of the Water

Salinity variation is considered as determinant factor in shrimp production in the coastal farms. Optimum level varies from species to species, the tiger shrimp (*Penaeus monodon*) grows faster at 15 to 25 ppt. whereas white shrimp (*Penaeus monodon*) tolerate higher salinity ranges (24 to 40 ppt).

3.4.6 *Gher* Management

Gher management and preparation is an important activity at the start of each culture period of shrimp. Almost all the farmers of the locality practiced pond preparation. Pond dikes are constructed manually up to a height of about 0.4 to 1.2 meter (average 0.7 meter) and the width of the dike vary from 0.2 to 0.7 meter. The dikes are built by excavating the top soil adjacent to the dikes. Thus shallow canals along the periphery of the dikes are created to retain water and act as shrimp refuse.

3.4.7 Tidal Fluctuations

The tidal characteristics of the selected site should be known. Knowledge of this parameter is of extreme importance in determining pond bottom elevation of dike, slope ratio and drainage system. Areas best suited for shrimp farming should have moderate tidal fluctuations which may range between 2 to 3 meters. In areas where the tidal range is greater than 4 meters this place may prove uneconomical to develop or operate as large and high pond dikes will be required. In areas where tidal range is less than one meter, water management will be expensive requiring the use of pumps. A salient point to consider in relation to tidal range is the knowledge of the occurrence of highest and lowest water levels. Then farmers may build perimeter dike of desired size and height to prevent flooding and even tidal bore of lower magnitudes. The direction and strength of water current should be known for making provisions for dike construction to reduce erosion.

3.4.8 Soils of the Grow Out Ponds

The types and texture of the soil of the chosen site should be analyzed before setting on a site for shrimp farming. Soil samples must be taken at random location, preferably up to a depth of 0.5 to 1 m and subjected to physical and chemical tests to measure the acidity, amount of organic load, level of fertility and composition. The soil should have enough clay content to ensure holding water in the ponds. Good quality dikes are usually built from sandy clay or sandy loam materials which harden and compacted easily, clay loam or silty clay loam at pond bottom promotes growth of natural food organisms.

3.4.9 Topography of the Farm

It is very essential to know a detailed topography of the selected site for pond design and farm layout. Coastal sites where the slopes run gently towards the sea are easier for pond development requiring less financial inputs since excavation cost is minimal. Filling and draining of water likewise is easily facilitated by gravity.

3.4.10 Pond Design of the Shrimp Farm

Present day farming practices still heavily rely on the experience of individual farmers, financial capability and the environmental conditions prevailing in the area. The improved structural design should largely depend on the behavior of the local shrimps. The perfect design can add the wall surface vegetation growth; it can promote high stocking densities and minimizes the land area.

An ideal shrimp farm is a complex establishment consisting of: (i) various sizes of ponds for nursery and grow out; (ii) water control structures including embankments, supply and drainage canals and sluice gates; and (iii) support facilities such as roads, drinking water facilities; (iv) marketing facilities; (v) well connected communication systems are of pre requisite of the success of aquaculture.

3.4.11 Pond Preparation

In any earthen pond culture system, the bottom soil plays a major role in pond yield. High organic matter content in natural soil often promises higher productivity and results a higher production of shrimps. Natural food organisms are one of the most important food sources in shrimp ponds. It is rich in protein, vitamins, minerals and other essential growth elements that simple supplementary feed can not complete

(Uddin 2003). Shrimp yield in pond can also be affected by the presence of predators, deteriorating water quality un-proper pond management. Hence, pond preparation is the most important step towards higher production. The pond preparation of shrimp culture operation may therefore, be grouped into three categories:

(i) Those shrimps that depend entirely on naturally produced organisms in the ponds for their growth;

(ii) Those that depend on both natural food and the application of fertilization the pond water, and sometimes supplementary feeds are also given to enhance the growth rate;

(iii) Those not entirely depend on artificial feeds and done by intensive management practices, the aeration, draining out water, make water quality up to the standard level etc. Irrespective culture operation practiced, it is always advisable to prepare the ponds in sustaining high natural productivity the culture in a stipulated period and have higher growth rate during the shorter span of time.

3.4.12 Sludge Removal

The sediment waste from the farm is removed manually and dumped on the top or outside the dike. Generally there was no huge sludge produced from this farming system. Decayed grass, debris and algae to some extent were removed at this stage.

3.4.13 Farm Drying

The drying of bed of shrimp farm is the most practical, easy and effective method of eliminating undesirable species, organisms and minerals in grow out ponds prior to

the culture operation. Drying always oxidizes harmful chemicals especially; sulfides and facilitates mineralization of organic matter. The pond is dried until the soil cracks or when the soil becomes firm enough to hold one's weight sinking more than 5 cm. one can walk on the surface.

Drying of *gher*'s bottom is an important work. For the successful growth and survival of the organisms and shrimp fries, the farmers have to dry the bottom of their *ghers*. Generally the water of the old shrimp *gher* is washed away by the end of November and the bottom of their gher is left to sundry for a month. The large farms applied ploughing using a tractor after drying while the smaller farms took water after drying and ploughed by tractor. During the process of drying the ponds, other important tasks must be completed. Theses include repairing of dikes, sluice gates, reconditioning of pond bottom trench, leveling of all areas of culture up to the desired management level, installation of screens and substrates and repair guard shed and other infrastructure. Substrates installation such as twigs or coconut fronds at the pond bottom is very important in the pond few weeks of culture because the juveniles have the habit of clinging on vertical surfaces. Aside from that, substrate also serves other purposes:

(i) Providing additional surface area for some benthic food organisms;

(ii) Providing shelter against direct sunlight; and

(iii) Reducing mortality of shrimp juveniles from predators.

3.4.14 Tilling the *Gher*

Tilling or ploughing of *gher* bed improves the soil quality by exposing subsoil to the atmosphere thereby speeding up the oxidation process and the release of nutrients are

enhanced and are known as an desirable substances that are already locked up in the soil, which is released through ploughing the soil and make them available for primary productivity. After drying the *gher* bed the farmers till the bed of *gher* perfectly. The large farmers plough the bottom of the *gher* using a tractor after drying it properly.

3.4.15 Control of Undesirable Organisms

Undesirable species which are pests, competitors and predators consist of fin fishes, molasses, reptiles, birds and mammals should be taken proper care by the shrimp farmers. Some species burrow into the dikes, destroy the dikes and causes leakages which may allow the entrance of more undesirable animals. Others may be the wood borers and barnacles which also cause a considerable damage to cultured stocks.

3.4.16 Water Intake

After drying and tilling the farm was filled with tidal water up to six inches. The smaller farmer usually took ploughing at this stage. Water is raised at interval of putting each input. There was a tendency among the individual and group farmers to spray thiodan, a kind of liquid insecticide at the first intake of water to kill unwanted organisms from the farm. The applied dose is 70 to 100 gm per hectare.

3.4.17 Liming the *Gher*

Following drying and filling the farm with tidal water, the agricultural limestone was applied after two days of insecticide application. They broadcast lime in the *gher*. They use lime to neutralize organic acid. The limestone is put in a drum with water for the whole night sprayed all over the *gher* the following day. Lime is applied at the

rate of 82.82 kg per hectare depending on the acid level of the soil. The individual category used lower rate of lime (67.37 kg per hectare) compared to other categories. The farmers use lime in the shrimp *ghers* for the following actions:

(a) Killing most microorganisms especially parasites due to its caustic actions;

(b) Raising pH of acidic water;

(c) Increasing the alkaline reserve in water and soil which changes in pH;

(d) Neutralizing sulfides and acids;

(e) Promoting biological productivity;

(f) Enhancing nitrification due to the requirement of calcium;

(g) Improving fine textured bottom soil in the presence of organic matter.

3.4.18 Fertilization in the *Gher*

Before shrimp fry stocking, the last activity for *gher* preparation is to fertilize the *gher*. One usual way of increasing carrying capacity of a shrimp pond is to improve its natural fertility through the addition of organic and inorganic fertilizers. Both inorganic and organic fertilizers could be used in shrimp ponds to enhance its primary productivity.

1. Organic fertilizers: The common fertilizers are animal manures, rice bran, compost, cow-dung and chicken litters and ducks droppings, sewage and biogas slurries. Application of organic fertilizers can serve as soil conditioner. The rate of application for shrimp ponds ranges from 500 to 2000 kg/ha. but dosage varies upon the situation.

2. Inorganic fertilizers: It includes synthetic fertilizers that generally contain concentrated amount of at least one of the potassium, nitrogen and phosphorus. The rate of application ranges from 25 to 100 kg per hectare.

After 3 to 5 days of liming the pond was applied with semi dried cow-dung. The outside farmer used the highest quantity of cow-dung (1.058.72 kg per hectare) than those of individual (830.42 kg per hectare) and group (792.99 kg per hectare) categories. Inputs like urea Triple Super Phosphate (TSP), Di Ammonium Phosphate (DAP), Muster cake and others like zinc and potash were used by the different categories for improving pond productivity.

3.4.19 Seed Supply

There were two sources of fry i.e. wild and the hatchery bred fry. Majority of the farmers under each category first preferred wild fry because they are stronger in nature, readily available and adjusted to the local water parameters. When there was shortage of wild fry and the price hiked up, shrimp farmers were compelled to buy hatchery bred fry regardless if prices.

Natural abundant supply of naturally collected post-larvae of Penaeid shrimp in many tropical and subtropical Asian countries has supported a large number of shrimp farms in the region. At present majority of the shrimp farms still depend on wild fry for culture. PLs are collected through trapping from natural fry grounds.

Fry quality has a major impact on production and the profitability of a shrimp farm. Therefore, farmers have to select good quality fry at the age of PL 15 to 25 to ensure profitable harvest. Stocking larger post larvae can improve survivability due to more

developed resistance to disease, stronger benthic feeding behavior and improved predator resistance.

3.4.20 Trapping the Fry

Natural stocks of shrimp larvae are carried into brackish water ponds by raising tide when the pond gates are opened. When the tide starts to recede, the gates are closed and the shrimp seeds are thus trapped. The fry are allowed to grow for about two months before being harvested.

3.4.21 Collection of Wild Fry

Fry catchers and collectors employ many methods for collecting shrimp fry. Shrimp fry are usually collected together with milkfish fry. However, due to increasing demand and high cost of shrimp fry in Bangladesh, a number of efficient gears have been developed. The shrimp farmers and their neighbors adopt indigenous devices for fry collection in the study area.

(a) Twig- Small bunches of twigs are suspended close to or placed on the bottom of shallow lagoons, estuaries and protected coasts. The shrimp fry are collected during low tide by placing a scoop net under each bunch of twigs as it is and collected white picked up.

(b) Fry lure- Lure lines are made of salt water grass. These are usually set along the banks of beaches and rivers. Each line is 20 meters long and supported on both ends.

(c) Scoop nets- In areas where there is abundance of aquatic weeds, a scoop net can be used to collect shrimp fry which usually cling to weeds, could easily be collected at ease.

(d) Push or scissor nets- The nets are with or without cord end. These are used along the beach, lagoons and bays near shore and in estuaries which can be operated by hand or boat.

(e) Fry traps- This stationary gear consists of a wing and a collecting chamber is kept afloat by bamboo raft and the wing is fixed with bamboo poles against the incoming water.

3.4.22 Stocking Density of Fry

Shrimp farms under different categories of *gher* ownerships are found to stock with varied number of fry. Majority of the farmers under all category stocked shrimp PL directly to grow out *gher*s, while a few of them nursed fry in nursery *gher* before transferring to grow out *gher*s. The study reveals that the smaller farm stocked more than those of large sized farms. The individual shrimp farmer prefers to stock about 20,000 fry per hectare, the outside farmer that holds the largest amount of area stocked only about 13,500 fry per hectare. Overall the average stocking density in the study area was 16,500 fry per hectare, which was within the range of findings (15,000 to 40,000 fry per hectare) by Hoq *et al.* (1997).

3.4.23 Stocking method

Farmers under different categories often tested samples of hatchery bred fry. Majority of the farmers counted PL at the farm gate using white melamine spoon and a bowl. A

sample of hatchery bred fry was put into a bowl and acclimatized to pond water for 20 minutes. In some cases the fries were put into a net *hapa* and their survival rate was checked for 24 hours and then released into the pond.

3.4.24 Frequency of Stocking

In the study area, almost all farmers practice shrimp fry stocking more than five times in their ponds and harvested for several times (more than 16 times) in their farming calendar. This is because of availability of year round saline in the nearby rivers and canals. Farmers completed stocking between February to April and harvested between April to November.

3.4.25 Survivability of Shrimp

The varied survival rate of shrimp post larvae by different categories is observed in the present study that depicted 70 percent of post stock PL. The large farms under outside category had the highest survivability of the PL (45%), while the individual and the group farmers received 24 percent and 26 percent of PL survivability respectively. The findings also support the findings of Karim and Stellwagen (1998) marked that coastal shrimp aquaculture represented an estimated 20 percent survival of the stocked post larvae, revealing a post stocking wastage of PL. The higher mortalities are found during the early stage 50 to 70 fries per kilogram of shrimp culture.

During the rainy season, the high loading of silt creates an unfavorable pond environment of shrimp. Such practices could lead to post-stocking mass mortality of post larvae leading to immediate limitation of potential yield and increased

susceptibility to diseases leading in the environment. Thus timing of stocking played a key role in shrimp culture with respect to increase productivity and sustained good health of shrimp. The trend of avoiding stocking and extending culture cycle during unfavorable months of the year is quite evident in the study area in all categories of farmers.

3.4.26 Feeding

One of the most important operational functions in shrimp culture is the provision of adequate food supply to ensure that the cultured shrimps attained the desired harvesting size within the targeted time frame. Feeds are among the largest operational cost of shrimp farming. Every effort should be made to ensure efficient utilization of feeds for growth. It is, therefore, necessary to have adequate knowledge on the feeding habits and behavior of the cultured organisms, their nutritional requirements and efficiency in dietary protein conversion for growth. Traditional shrimp farming in Bangladesh employs extensive culture operation in which the growth of shrimps fully depends on natural food organisms. Traditionally, the farmers use supplemental food and aware of using different feed to their *gher*. Usually, they uses four diets in the shrimp *ghers* that are formulated using rice bran, fish meal, mustered cake, wheat flour and oyster shell.

3.4.27 Water Exchange

The shrimp farmers exchange farm's water through the sluice gate made of wood and concrete. The smaller farms use wooden gate while the large farm usually use both wooden and concrete gate. Both gates are controlled by a wooden shutter. Majority of the farms use the same gate for drainage and flushing purposes. Very few have

separate drainage and flushing gates. A few of the farms use pump machine for water intake inside the farms due to higher land elevation. The water volume of the farm is routinely exchanged every 4 to 6 days at every lunar cycle. In case of, unwanted occurrence farmer exchange water any time.

3.5 Health and Disease Management

Farmers of all categories check shrimp growth randomly throughout the production cycle. Each time, 15 to 20 shrimp are checked using cast net and hand. The body color, size variation, external gut and the shell are checked by all categories of farmers. Farmers use a combination of several measures in this regard. Majority of the farmers of individual and group categories check frequently while outside farmers check every weekend. Shrimp disease is a regular occurrence in the study area. The affected farmers harvest early when shrimp disease occurs in his or neighbor's farmer. Farmers have a tendency to use chemicals, like Thiodan during the occurrence of diseases. Water quality improvement measures are not practiced besides exchange of water during tidal variation. When the extent of disease is severe, farmers reduce all the water and let the bottom of farm to dry up under the sun. The remaining shrimp took refuge the canal along the periphery of farm. After drying its bed the farm is filled again with brackish water and stocking also takes place. Some farmers have transformed a portion of the farm into paddy culture during monsoon period to avert the risk. For whatever type of disease, the farmers use to associate it to viral disease. In 2006, majority of the shrimp farms experienced with red body color and food deficiency. A few farmers experienced white spot diseases. The shrimp disease occurs at the age of 15 to 20 gm. from May onward. Other diseases causing high mortality are tail rotten. Sometimes body color of the shrimps changes into red due to virus

infections. Among the poor farmers, the management practices – shallow *gher* depth, bad water quality, no feed, presence of thick submerged weeds and vegetation are sharply marked. There is also high temperature (45.5°C in May) and rainfall (411 millimeters in June) prevailing at that time.

This view is often supported by the Department of Fisheries. In 2001, there was evidence of shrimp diseases and this was reported by many Government Organizations and consultants. The reports depicted that the observed trends in disease outbreaks indicating production losses and shrimp diseases were managed poorly. The deterioration of the *gher* environment played a key role in putting shrimp in a stressful condition.

It was evident from the FAO (1997), those bacterial diseases and stress symptoms due to poor pond environment appeared to be a significant contributory factor to the recurrent mortality. As per results of the mentioned survey, high incident of pale and red discoloration of the body and tail rot with swollen edge indicated deteriorated bottom and environment.

3.6 Harvesting, Marketing and Management

Harvesting the last activity of the shrimp culture is carried out after 90 to 120 days of extensive shrimp farming. Harvesting usually takes place during full and new moon of a lunar cycle. A cycle consists of 5 to 7 days.

During that lunar period the farmers use to drain out farm water of the canal. Then fresh tidal water from the canal is introduced into the farm. The shrimp becomes

excited and starts moving towards the entry point of the tidal water as shrimp, by their habits like to swim against the rush of current.

The following methods are practiced in harvesting farmed shrimp in the study area.

3.6.1 *Gai* Method

Usually, a very small portion of the farm which is converted into a rectangular shaped harvesting area. This area is prepared at the adjacent of the canal by all categories of farmers. The individual and farmer groups built the area using soil made dikes all around. One wooden gate is placed in the inner dike of the area to control the flow of water from both sides. The outside lessees built all the dikes and bottom using concrete materials to ease the harvesting process.

A bamboo fence is used by individual farmer which is usually placed at a short distance from the canal to prevent escaping of shrimp. The well of farmers, either individual or group category are now using plastic pipe to make this fence for durability and longevity. The total harvesting area is locally called *gai.* Shrimp enter into the catchment's area through a narrow passage in the fence, and those can not go back to the rearing area of the farm. While in-flow of the water has become stationary, catching of shrimp is then started by cast net. The outside lessee sometimes drags the cast net, as the bottom is smooth due to concrete materials. Lastly, the water in the catchment's area is totally drained out and the last piece of shrimp is caught manually. This system is repeated one to another during lunar cycle.

3.6.2 Trap Method

Trapping is another way of harvesting shrimp. Some bamboo traps of various sizes are placed at 8 to 10 feet intervals from the periphery to inside the farm. Fine meshed net is attached to each of the set up trap. These are set up into the deeper area of the farm. During flow of tide, the shrimp usually moves towards the edge of the dike and happens to enter into the traps. The traps are then checked at certain breaks and shrimps are taken out and placed inside again. This system continues until the end of each lunar period. The large shrimp farms especially the outside lessee usually set up the traps frequently where shrimp during tidal wave are unable to move to the *gai.*

3.6.3 Net Method

Cast net is used for harvesting shrimp when fewer amounts of shrimp are caught in the *gai* or in the trap. The farm owner engages the help of cast net owners. The netters stand close to each other and cast the net together. Thus, they move forward casting nets all over the farm and shrimps are then harvested. Particularly, large farm owners or outside lessee employ this technique at the end of season.

3.7 Marketing

The harvested shrimps are kept in different kinds of bamboo crates and coops. The shrimp are then washed with water and placed in a heap to be ready for sale at the farm gate. The buyers come to the farm gate to haggle and settle the selling price. Sometimes selling through auction takes place due to the presence of a number of buyers. The winning bidder occasionally shares the lot with other fellow buyers who come to bid and thus keep social harmony in the locality. The head-on shrimp are then

taken into the local depot for icing and are forwarded to the processing plant within the shortest possible time for beheading and onward dressing.

3.8 Crab Culture in the World Context

Portunid crabs are known to have great potential in aquaculture. Among different species, Scylla serrata (Scientific name of mud crab) is the most commonly cultured due to its preference for estuarine habitats, less aggressive behavior and higher value (Cowan 1984). So, mud crab is successfully cultivated in many Southeast Asian countries and Australia and fetches a high price in the local and international market.

In Taiwan Scylla serrata has been reared in both polyculture (together with shrimp, milkfish and rice) and monoculture ponds (Chen 1976). In Philippines, the species has been cultured in ponds (Catanaoan 1972; Samonto and Agbayani 1992; Trino *et al* 1999).

In East Malaysia, pen culture is a common practice where the mud crabs are allowed to grow in their natural habitats in enclosures in mangroves (Chang 1997).

In Indonesia, various silvo-fishery models that combine integrated mangrove tree culture with brackish water aquaculture have emerged. The silvo fishery ponds may combine mud crab mud crab and shrimp production. Experimental culture of Scylla serrata in plastic cages, placed in large fish ponds has also been undertaken in Tuticorin, India registering significant growth increments (Bensam 1986). Breeding and maturation of mud crab was also undertaken in Karwar, India, where females attained sexual maturity at 80 mm carapace length (Prasad and Neelkantan 1989).

In Bangladesh, mud crab is the most important crab species for food and trade. It is extensively cultured in ponds together with shrimps (Giasuddin and Alam 1991) and in mangrove tidal flats (Kador 1991).

3.8.1 Crab Culture in the Coastal Area

Crab farming means to culture small and juvenile crab in a saline watered *gher* for 2 to 4 weeks to become the full size of exporting in the foreign countries. The saline zone of the coastal area of Bangladesh is suitable for crab farming. So, crab farming is now a growing aquaculture practice in coastal regions of Bangladesh. Local fishers including women are active in crab farming.

Crab can soon be attained the level of another important aquatic resource in Bangladesh. It has been tried in India, the Philippines, Sri Lanka, Taiwan, Thailand and Malaysia. In Bangladesh, the techniques for the culture of crab are yet to be developed through crab is being harvested from shrimp *gher* where the larvae enter the *gher* along with the tidal water, but the farmers do not take any special care of them. In 1987, a group of fishermen tried to culture juvenile mud crabs (2 to 4 centimeters) to marketable size in the Matamuhury estuary at Chokoria, Cox's Bazar. But due to previous experience, technical know how and financial constraints they could not continue the experiment (Ahmed 1992). Considering the crab as a potential aquatic resource, the Government of Bangladesh introduced crab fishery in the Sundarban area during 1987-88. Usually the coastal villagers cultured crab in their own traditional system. A field survey was conducted on suitability of crab cultivation with financial help of DFID (Department for International Development of UK) in the

coastal area of Bangladesh in 2003. One of recommendations of the survey is that the coastal area and saline water of that area is suitable for crab cultivation (Jafar 2003).

There are different species crabs in the sea and rivers of Bangladesh. Among them mud crab, is one of the important crab that is cultivated in the coastal area of Bangladesh. Its financial benefit is significant. The mud crabs are found in the rivers and canals of the Sundarbans. They are naturally grown up crab. Like shrimp, nowadays the exporting of crab is very important and profitable. Mud crabs have various uses, such as human dietary items to fulfill nutritional deficiency of poor coastal people and as export commodity fetching good amount foreign currency (Jafar 2005). The hardening and fattening of mud crab is very popular now in the coastal area. Every year Bangladesh earns near about 350 crore taka by exporting crab. From Bangladesh, crabs are exported in Hong Kong, Malaysia, China, Taiwan, Singapore, USA and different European countries.

3.8.2 Hardening and Fattening of Crab

The culture of mud crab species is of two kinds: fattening and growing out. In fattening post molt water crab of market size is held for short periods of time and fed until their meat content is increased. Grow-out operations stock small seed crab, usually in ponds or *ghers* and provide feed and water exchange until they reach market size.

Mud crab fattening in bamboo cages has created a new avenue for the coastal people making livelihood approach easier for them. The country has bright prospect for the mud crab culture (Jafar 2005). Fattening of crab started in 1993 in Bangladesh because of the rising demand in international buyers. Small crab (180 gram), juvenile

and female crabs are cultured in the *ghers*. It takes 2 to 4 weeks to be hard and fatty. This process is called hardening and fattening of crab. This time farmers give food to the crab. Crab culture is important for the people of coastal area. Coastal environment is useful for crab cultivation. Its increasing trends of export in the foreign countries. It is more profitable and invest is low. There is minimum risk in crab fattening. It takes only 10 to 15 days to fatten the small crab. There is very low rate of diseases of crab. Also crab is tolerable at any environment for more time.

3.9 Activities of Crab Culture

3.9.1 Crab Pond

The crab farmers select the place where saline water is available and mangrove will be cultivable as crab farming pond. For crab fattening alluvial and silted alluvial soil is needed. The area of crab pond is 20 to 50 decimal and depth is 3 to 5 feet. It is good for selection for a pond place where the tidal water comes easily. It needs separate gate for changing water. Crabs are held for fattening in a variety of floating cages and pens. Most operations are small scale and crab may even be kept in individual containers made of plastic or split bamboo and suspended from a raft. Pens can be erected in tidal areas and may even be found under the culturists' homes.

3.9.2 Quality of Soil

Tidal soil both saline and non-saline land especially loam and alluvial mud is very useful for crab farming.

3.9.3 Area of the Pond

Fattening ponds range from 500 to 800 square meters and depth is 3 to 5 feet.

3.9.4 Preparation of the Pond

Ponds may be used for fattening. Such ponds are usually quite small, and are dug by trenching, leaving a mound of earth in the center of the pond which can be used by the crab for burrowing and shelter. At first the farmers make dikes outside the pond. They give a fence over the dikes. They use to give a mat that is made of bamboo inside the dikes. Then they use lime to clear the soil and water. They make some sheltering place whether the weak crab can hide and can change their shell. They give some water, cow-dung and natural manure into the pond.

3.9.5 Juvenile Crab Selection

Seed stock for crab fattening is usually obtained from local markets and dealers where mud crab have a relatively low value. Female crabs are particularly sought after. The farmers select healthy and good small crab from wild source to culture in the pond. The weight of the small crab is 25 to 50 gram. They usually culture 60 to 70 juvenile crabs per decimal.

3.9.6 Pond Preparation

At first the farmers dry the dike of the ponds in the sun. They make fence outside of the pond to protect the crab whether crab go to outside. They give the fence 1.5 feet under the ground. They give lime in the pond to purify the soil and water. After seven days of liming, they give cow-dung in the pond.

3.9.7 Stocking of the Juvenile Crab

Crabs are found in the rivers and canals of coastal area, Sundarbans area and shrimp ponds. The fishers catch the juvenile crab by net and sell to the crab farmers. The

farmers try to make the crab hard and fatty and they stock in the pond forty crabs per decimal. A stocking density is of 10, 000 crab lings per hectare.

3.9.8 Feeding in the Crab Farm

The farmers give different food in the crab pond thrice a day that is in the morning, at mid day, at night. Small tila fish, silver cup fish, meat of snails and oysters, meat of shark, wheat, abdomen of cattle, head of shrimp heads, eel fish etc. are given as foods in the crab farms.

3.9.9 Water Management in the Crab Pond

Farmers use different septic item in the crab ponds which can be rotten within a very short time. So, water quality should be maintained regularly. For this reason, farmers change water within 4 to 5 days. After ten days of stocking the crab they observe *gonad* (the ovary of the female crab) is matured. The farmers are very careful about water change of the crab ponds. Because it is very important to make the crab healthy and quick fattening

3.9.10 Harvesting and Marketing of the Crab

Generally in 14 to 16 days, the small and immatured crabs are matured and they become hard and fatty. Then the farmers catch the crabs and bind the crabs with taps with very carefully. Otherwise, there might be a risk of breaking the crab's legs. Then the farmers stock the crabs to bring in *depot* (sale center) and grading the crabs to sell.

3.9.11 Grading of Female Crabs

Female crabs are graded in the following way: F1 grade is 180 gm and above, F2 grade is 150 to 179 gm and above, F3 grade is 100 to 149 gm and above and F1 grade female crabs are exported to foreign countries.

3.9.12 Grading of Male crabs

Grading of male crabs is as follows: Double XL grade is 500 gram and above, XL grade is 300 to 499 gram and above, L grade is 200 to 299 gram and SL grade is 150 to 199 gram (BFRI 2004).

In this chapter, the researcher tried to introduce some important activities of shrimp and crab cultivation has been discussed very carefully. These activities represent their indigenous knowledge for shrimp and crab cultivation. The researcher visited the area to collect primary data about the IK of the coastal farmers that is used in shrimp and crab culture.

CHAPTER FOUR

SOCIO-ECONOMIC IMPACT OF SHRIMP AND CRAB CULTURE

4.1 Social Impact

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- 4.3.7 Job Abolished or Reduced
- 4.3.8 New Jobs Created

4.1 Social Impacts

In Bangladesh aquatic resources specially, shrimp and crab culture has expanded very rapidly and it is done to its greatest potentialities in the country's economic sector. It is a blessing for our socioeconomic development. It has impacts on our society. In the beginning of shrimp culture, the socioeconomic impact was negligible but nowadays, the rapid expansion of shrimp and crab brought significant attention from different corners of the country. In this chapter, socioeconomic impact of shrimp and crab hardening and fattening, have also investigated and the researcher tries to trace out the positive and negative aspects of the issue.

4.1.1 Academic Attachment

It is alleged that shrimp farming has negative impacts on the children's education. During field investigation, the respondents expressed diverse views. They viewed that the enrolment in the primary and N.G.O schools has been increased. The study reveals that the primary level educated members of shrimp farmers have been increased in the study area:

The above discussion depicts that the *gher* owners' family members are more educated than laborers. It is due to their financial solvency. This may be considered as the positive impact of the shrimp and crab farming. On the other hard, the children's education of the study area had negative impact; because the people of the area along with their children are involved in shrimp fry collection. Association of Aquaculture of India (AAI 2001) reported that provision of good education has been increased due to expansion of shrimp culture. Battacharya *et al.* (1999) reported that children miss

their classes during shrimp fry collection season. Uddin (2003) reported nearly similar situation of the *gher* owner's family children in Bagerhat district.

4.1.2 Changes in Residential Structure

The housing structure of any area mainly depends on the financial capability of house owners and availability of housing materials. The present study finds that by the increased resource, the shrimp *gher* owners try to improve their housing structure. So, the present housing structure owned by them is different from that of before the introduction of shrimp culture. Before its introduction, 30 percent respodents had straw shed house but now very few (8%) house had straw shed.

Similarly, 30 percent house owner used *golepata* shed-house in pre-shrimp era but now few farmers use *golepata* as roof material of their house. Also CI sheet shed (9.8%), RCC roof building (5%) and wooden house (10%) have been increased in the study villages. The shrimp farmer's residential structure is much more improved than those described by BBS (1992, 2004). The type of change may be considered as the positive impact of shrimp culture.

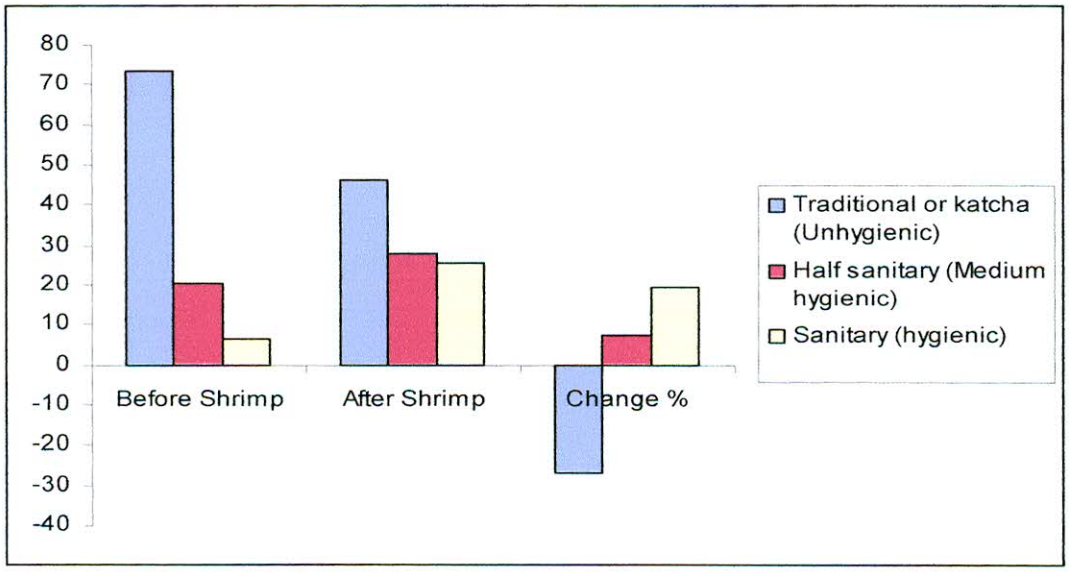
4.1.3 Changes in Sanitation

Sanitation is an important matter of living standard. Shrimp farmers economic conditions have been increased due to financial benefit. From this study, it has been seen that, as compared to pre-shrimp situation, *katcha* or traditional toilet have significantly reduced by 27 to 30 percent in the study area.

Table 20: Changes in Respondents' Sanitation Pattern

Sanitation pattern	Before Shrimp	After Shrimp	Change %
Traditional or *katcha* (Unhygienic)	73.4	46.4	-27.0
Half sanitary (Medium hygienic)	20.4	27.9	+7.5
Sanitary (hygienic)	6.2	25.7	+19.5

Source: Field Data



Graph 08: Changes in Respondents' Sanitation Pattern

It is seen that there is positive impact of shrimp and crab on the sanitation status of the respondents of the study area. Before shrimp and crab culture there was 73.4 percent respondents use unhygienic or traditional *katcha* latrines but after shrimp and crab culture it is only 46.4 percent. Before shrimp and crab culture there was 20.4 percent respondents use medium hygienic or half sanitary latrines but after shrimp and crab culture it is only 27.9 percent. Also, it is more important that before shrimp and crab culture only 6.2 percent respondents used full sanitary latrines but after shrimp and crab culture there is 25.6 percent respondents who use full sanitary latrines (Table

20). This is the symbol of socioeconomic improvement and some sort of awareness building of the shrimp and crab farmers .

4.1.4 Portable Water Availability

In the study area, scarcity of drinking water is a common problem, which has now triggered by the introduction of shrimp culture.

This is due to installation of number of shallow tube-wells and deep tube- wells in the area. Farmers' use of tube well's water for drinking and also for shrimp culture. 50 percent respondents expressed the drinking water has been decreased due to shrimp culture. Because of prolonged water logging, the saline water contaminates the pond water, which local people use for washing and cooking. So, portable water availability is decreased.

4.1.5 Portable Water Source

Before shrimp culture, about 90 percent respondents drank pond water but after shrimp culture only 10 to 14.42 percent respondent use pond water for their drinking purpose. Only 7 percent used river as the source of drinking water. In summer people have to collect water from the pond even by small bowl, the local dwellers reported. Though the saline water contaminates the ponds, nevertheless, they are impelled to use that water.

4.1.6 Portable Water Collection Distance

Scarcity of drinking water is a common problem in the study area. This is due to the distant location of the portable water source. It is because of the contamination of

ponds and hand tube-well by saline water sparked off by shrimp culture. In the study area 36 percent respondents had drinking water source within 0.5 km from their residence, 40 percent had water source within 1to1.5 km and others had within 2 km. The female are fetching drinking water from the pond of the study villages.

4.1.7 Food and Nutrition Intake

By the advent of shrimp culture, food and nutrition has been affected seriously. Intake of rice, meat, fish, egg and milk has been changed remarkably. It is because of less food intake. Fish and cattle are reducing by saline intrusion in the study villages. Open water fish and cattle have been reduced due to shrimp and crab culture. Ban on ducks to graze in the shrimp ponds and difficulty to rear chicken in the house is evident due to water logging and increased diseases incidence. People can not rear of poultry in study villages because of saline intrusion. So, people the study villages have to intake less meat, egg or milk and suffer from malnutrition.

Ahmed (1996) reported that the health of most the people in shrimping areas have suffered from malnutrition; particularly their diet lacks protein from fresh water fish dairy products, meat and poultry.

4.1.8 Consumption Pattern and Change towards Modern Life

Shrimp and crab culture has brought change in the consumption pattern and life style of the modern life. It is only because of increase of income. They saved money and try to improve their living style. Islam (2003) observed that shrimp farming and related activities helped the concerned people directly or indirectly to increase their

household income which led them to more savings and investment resulting in better livelihood.

4.1.9 Law and Order Situation

Shrimp farming area of coastal belt is not out of terrorism. By reading daily newspapers one can see news in this connection. Terrorism like occupation of *ghers*, occupations of other's land for shrimp and crab farming, eviction from the *gher* or land, killing of protestor or opponent and so on are the commonly reported social problems in the study area. It was supported very small percentage of respondents. Only 20 percent conscious and literate respondents told during the field observation that terrorism is a major problem in the locality. At the same time, Upazila Nirbahi (Executive) Officer or Officer in Charge of the Shyamnagar Police station does not admit that terrorism is a major problem of shrimp farming area.

Table 21: Filed Cases in Police Station

Description of Cases	Years			
	1998	2001	2003	2006
Total number of cases	584	583	431	420
Total number of cases related to shrimp culture	00	15	10	12
Total number murder of cases	0	0	0	0
Murder cases related to shrimp culture	00	01	02	04

Source: Officer in Charge, Shyamnagar Police Station Satkhira

However, only from this information, it can not say that terrorism has been decreased of the area than earlier time. In fact whatever is happening there, all are not going to the stage of filing a case at the police station. It may be due to mutual minimization or illegal pressure on the victim. Majority of the respondents mentioned that earlier

terrorism was a major problem but in course of time it has been minimized. According to them this is due to the following causes:

i) Shrimp culture attained more discipline than earlier period.

ii) Nowadays terrorists can be shareholders of farms.

iii) Pressure created by the political leaders may have discouraged of it.

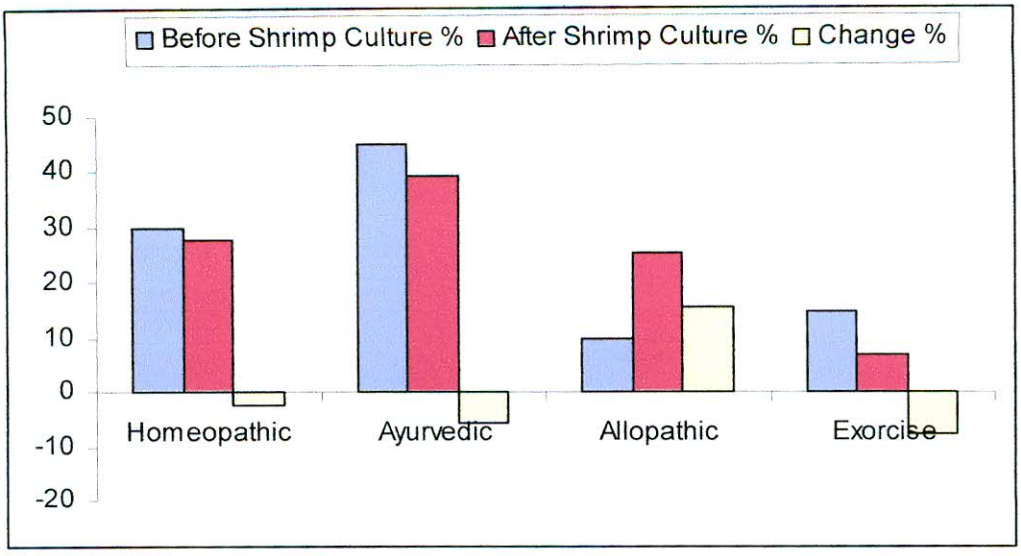
However there are some social problems, according to the respondents. It arises after the change of national or local political leaders.

4.1.10 Medicare Services

If a person becomes financially solvent, usually he tries to avail better medical facilities than before. If we consider allopathic Medicare services are better and expensive than homeopathic, ayurvedic or exorcise services, we can say that, shrimp culture has made the shrimp farmers' solvent enough to avail the allopathic Medicare services.

Table 22: Medicare Services Availed by the Farmers

Pattern of Medicare System	Before Shrimp Culture %	After Shrimp Culture %	**Change** %
Homeopathic	30.0	27.8	-2.2
Ayurvedic	45.0	39.5	-5.5
Allopathic	10.0	25.6	+15.6
Exorcise	15.0	7.1	-7.9



Graph 09: Medicare Services Availed by the Farmers

Table 23: Impact on the Maternity Services

Pattern of Maternity System	Before shrimp culture %	After shrimp culture %	Change
Nurse	19.6	8.18	-11.42
Health Worker	25.38	30.41	+5.03
Rural Doctor	15.90	26.41	-10.51
Exorcist	12.82	5.00	-7.82
Health Care Center	26.30	30.00	+3.7
Govt. Hospital	13.00	19.00	+6.0
Private Clinic	7.00	12.00	+5.0

(Note: Multiple responses is counted)

It is observed in the field that before emerging shrimp and crab culture the people used to avail rural nurse for maternity services in the study area. Before shrimp culture it is seen that maternity services mainly depends on nurse, health worker, rural doctor and exorcists But after starting shrimp culture the trend of Health care center, Private clinic and Government Hospital going people has increased for maternity services in the area and it is considered as positive impact of aquaculture like shrimp and crab culture.

4.1.11 Pattern of Consumption

It is found that after shrimp culture farmer's attitudes to luxurious things is increased. When a man has an economic solvency, he tries to avail the luxurious things. Shrimp and crab culture has no doubt plays a vital role in this respect.

Once a family owned at best a radio, a bicycle and some wooden chairs is now owns TV, motorcycle, sofa set and even refrigerator in their houses. As the consumption pattern of the shrimp and crab farmers have been changed towards luxurious things, their level of income and standard of living have also been risen.

4.1.12 Development of Rural-urban Network and Consciousness

Rural-urban network has been strengthened and consciousness of the rural people has also been increased. Urban people have to come to the shrimp producing area in one hand and rural people have to visit the town for various shrimp marketing activities. So, a communication network and relationship between the rural and urban people have been developed. As a result, consciousness of the coastal rural farmer has been increased.

4.1.13 Changes Toward Modern Life

The socioeconomic conditions of the study villagers have been increased by shrimp and crab culture. In fact economic condition is the main variable by which the people become powerful. The rate of wage is increased. Also, the poor women are employed in shrimp and crab culture related activities. So, once the people who are very poor in the study villages, have become solvent and obey the fair instruction given by the so called *morol* or *matbbar* (leader of the village).

4.1.14 Balance of Social Power

Once, the poor villagers were fully dependent on money of the landlords for their employment and livelihood. Now majority of the land have been occupied by shrimp culture. Moreover, rent of land for shrimp farms are now very lucrative. So, the poor people are earning more and they become more powerful.

4.1.15 Degradation of Norms and Values

According to views of the respondents one of the negative impacts of shrimp culture is the degradation of norms and values. It is seen that, most of the people those whom are engaged in shrimp cultivation are not so educated, even some of them are illiterate. So, most of them do not use their surplus value for social welfare activities, sometimes rather they use it for malpractice of social power or immoral recreation.

4.1.16 Poisoning

According to the respondents of the study villages, some notorious people try to destroy other farms. Way of enmity among the people of the area has got a new

dimension. If there grows any enmity or improper competition between two persons and if one of them holds any shrimp form his counterpart always tries to execute his grievance on that farm of his opponent. A malpractice of poisoning in the shrimp farm is very common in the shrimp farming areas.

4.1.17 Migration

The shrimp culture paves some ways for migration from the study villages to other places. Migration from rural to urban areas due to shrimp culture has two basic dimensions:

1. According to views of the respondents (60%) some poor people evicted from their own land and they have to migrate another place;

2. Some rich people became more benefited economically and they try to migrate in the urban areas.

It is found that eviction from land is a major cause of migration in this shrimp cultured area. During field observation, it has been sometimes heard that, some body had been evicted from his land but none could provide any evidence about it. Nevertheless, it may be true but the rate is very negligible.

4.1.18 Increase Social Relationships

From the social viewpoint, it is found that majority of the large sized shrimp and crab farms are mainly jointly cultivated. So, the share holders live and think together. In this way, a good brotherly relationship grows among the farmers. Not only this, they formed many association between them to help each other.

From the above discussion, social impacts of shrimp and crab culture are not negligible. It has a lot of positive and negative impacts. We can see that shrimp culture is more significant than social impacts. However, to enjoy the blessing of the positive social impact, one should try to eliminate negative social impacts.

4.2 Social Conflicts

A number of social conflicts accompany the development of shrimp culture. This social vulnerability is created by the changing condition of traditional livelihood and increased resource pressure. This conflict arises by the immigrant loyal farm labors from outsides and jobless of the locals. The other conflicts reported are the forceful occupation of land abuse of rights in the common properties, terrorism, non payment of leased money, security of women and reduced opportunity for rice cultivation.

4.2.1 Forceful Occupation of Land

Forceful occupation is the common allegation against the shrimp *gher* owners. In this study, majority of the respondents, (88.24%) viewed that the outsiders even local influential *gher* owners occupy the unwilling neighbors land forcefully to cultivate shrimp.

The outsiders deploy the local people as their agent to grab their land by giving them some share. Sometimes they break the embankments to allow saline water to flood their own land and that of neighboring farmers. Powerful *gher* owners are forced to rent the land of small farmers at a very low rate. Thus acute social conflicts give rise between the *gher* owners and land owners.

The rich, powerful and politically connected local elites use all means and try their best to capture the agricultural land forcefully to cultivate shrimp against the will of the land owners (Karim 2001; Chowdhury *et al.* 2001).

4.2.2 Improper Land Rent Payment

Gher owners frequently take lease of lands adjacent to the *gher* to enlarge the *gher* areas on rent basis. The land rent is locally known as '*hari*'. The rate of lending rent varies with the location, quality of the land and necessity of the *gher* owners as well as the leasing tenure. Some respondents reported that *gher* owners often breach the lease agreement and decline to pay to agreed of lease money. In case of poor land owners, the non payment issue is very frequent.

The local peoples in the shrimp areas are compelled to lease their lands in return of very low rent. Often the agreed amount of lease money is not paid to the small farmers (Rahman 1994; FFP 2001; and Uddin 2003).

4.2.3 Land '*ail*' Afflict

The local word '*ail*' means the land demarcation line, usually narrow earthen ridge, the land *ail* is a very sensitive issue in the shrimping areas. Firstly, during the construction of *bheri* or dike a *gher* owner may cross the land boundary willingly or unfailingly. Secondly, all the lands remain under water for most part of the year the demarcation lines might become damaged. So, land '*ail*' conflict issue is increasing day by day.

4.2.4 Drainage Conflict

In shrimp farm, water is kept stagnant in the land for most part of year to save and facilitate harvesting of cultivated shrimps. The *gher* owners never allow draining out the water from the shrimp *gher*. Moreover, one *gher* owner does not allow passing others water through his *gher*.

The conflicts arisen between the shrimp farmers and rice farmers or landless people caused by inequitable access to water and land generally controlled by the more powerful and politically influential shrimp farmers (DFID 2002).

4.2.5 Right over Common Properties (RCPs)

In this area, shrimp culture has given rise some conflicts among the user groups with respect to access to the common property resources. At present *khas*lands are leased out to the shrimp farmer on flexible terms. The '*khas*' canals also lease out as show take lease document and include the canal into the *gher*. This is due to the lack of effective policies.

The rights of ordinary people over the common property resources like roads, *khals*, *beels*, common grazing grounds, sports grounds, ponds, schools, mosque and temples etc. in shrimping areas have been reduced in home and abroad (Karim 2000; AAI 2001; Islam 2003).

4.2.6 Sexual Harassment

It is alleged that women in the shrimp and crab culture areas are facing social insecurity and are exposed to sexual harassment. The intimate discussion with some

villagers reveals that sexual harassment is not frequent but takes place off and on. In most of the incidents the guards establish rapport with the family particularly where the male members are outside the house. They take the opportunity of the absence of male members. The victim's family does not disclose it due to social problem.

Ghafur *et al.* (1999) reported that violation of women by the guards of the shrimp farms had been a common phenomenon. He added that women were particularly vulnerable since some of their husband have either migrated to find work or are in hiding because of their involvement in protest activities.

Stickings (2001) reported that women working in the shrimp *ghers* admit to being physically abused while doing the work, especially as much of it takes place during the hours of darkness. The women hide this to their husbands and brothers because they might forbid them from continuing to work. The additional work is very necessary to them.

4.3 Economic Impacts

Shrimp culture has also some economic impacts. Economic impacts are raised due to rapid expansion of shrimp culture in the study villages.

4.3.1 Variation of Shrimp Production

It is found that the rate of shrimp production varied according to area of farming size of farm and time of farming.

Table 24: Shrimp Production

Size of farm	Kg / hectare
Large	500
Medium	470
Small	430
Average	466.66

The average rate of shrimp production is found during 2005 to 2006 in the study villages. According to the size of farm, average production in the large farm is the highest and it is about 500 kilograms per hectare and the small is the lowest and it is about 430 kilograms per hectare of land.

According to the views of the respondents there are some probable causes of variation of production. These are as follows:

a) Due to mixed farming system the rate of shrimp production is high. The farmers cultivate simultaneously *golda* and *bagda* in the same year.

b) According to size of farms, average rate of production in the large farms is the highest and it is followed by medium and small farms respectively. It is because, farmers of the large farms are generally rich and they can supply modern scientific techniques and various necessary imputes timely and take care properly. But the medium and small farmers can not afford it.

Also, mixed farming system, proper nursing and farm management, supervision, modern and improved feeding, necessary training programs are very necessary for more production in the shrimp *gher*.

But no new measures like changing the farming method, techniques, protection of natural disaster and prevention of shrimp diseases have taken by the Government or Fishery Department. So, the rate of production of shrimp remains unchanged. It is

necessary to change the methods and techniques to produce more and quality product in the shrimp and crab *gher*.

4.3.2 Profit of Shrimp Culture

Profit is very much essential to the shrimp farmers. If we want to find profit margin, we have to analysis of cost. Cost of farming differs from size to size, farm verity to variety, from year to year, and area to area. Cost of shrimp production varied due to variation of rent of the land, wage of labors, feeding cost and number of fries deposited and price rate of shrimp fries, and other expenditure for maintenance and supervision and others.

Table 24: Per Hectare Cost of Shrimp Production

Size of farm	Cost in US Dollars
Large	1665
Medium	1070
Small	1285
Average	1330

Per hectare average highest of cost of large farm is 1665 US Dollars and lowest in medium farm that is 1070 Dollars and in small farm the production cost is 1285 Dollars and average farm size production cost is 1330 Dollars (Table 24). It may be due to optimum allocation of the related factors involved there. It is because in the large farms the farmers use both IK and ScK for the better production of their farms to get more profit. They use modern techniques and methods more than traditional and indigenous methods and techniques. But small and medium level farms farmers use more IK than ScK. They have less capital and consciousness.

Table 25: Rate of Profit From Shrimp Culture

Size of farm	US Dollars / hectare
Large	1070
Medium	935
Small	600
Average	870

It is found that the profit margin is the highest in large farm that is 1070 US Dollars and is the lowest in small farms that is only 600 US Dollars and in medium size farms is 935 US Dollars (Table 25). So, individually the rate of profit is not similar among various size and types of farms. The respondents who minimize cost of shrimp farm, they can maximize the profit and they are more efficient, more informative and knowledgeable farmers than others. Because, the large farmers use more scientific chemical, knowledge, and methods in the shrimp and crab farming than small and traditional farmers.

4.3.3 Employment

In Bangladesh, total employment associated with the industry (Seed, feed, production, post harvest activities) is estimated three quarters of a million, corresponding 3,50,000 full time equivalent jobs. Shrimp farming requires more labors per hectare than any other traditional crop cultivation. So, employment opportunities are increased in the study villages.

Table 26: Labor Requirement (Per Hectare)

Farms	Number of Labors
Shrimp farm	300
Rice farm	220
Vegetable farm	180

It is found that labors requirement in shrimp culture is much higher than rice and vegetable cultivation. It is in rice or traditional farming 180 to 220 labors required but in shrimp and crab farms 300 labors required in one hectare of land. Because several types of new job opportunities are created relating to shrimp culture in the meantime. These are like basket making, snails collection, fry collection, snails breaking, petty shrimp trading depot or stockiest) business of shrimp, beheading of shrimp, trading of shrimp try, and preparation and repairing of *gher*, shrimp catching from the *gher*, ice producing and trading, shrimp processing and exporting etc. However, it is true that employment opportunities in the traditional agricultural work because of the agricultural land have been converted to shrimp farms. Due to lack of structural adjustment, some labors may be unemployment in the study area.

Table 27: Wages and Hours of Work

Farmers' information				Labors' information			
Shrimp (Taka)	Traditional activities	Shrimp (hours)	Traditional Work	Shrimp	Traditional	Labors	Hours
100	80	10	9	100	80	12	10

According to the respondents, the average of both shrimp laborers 100 Taka per day but hours of work per day are 10 and 9 respectively in shrimp farms (Table 27). That is, working hours supplied by the farm labors are some what different from farm owners. They said the working hour per day is about 11 to 12 hours. We can see that in shrimp farm a labor has to work for a long period but he got fewer wages.

4.3.4 Increase of Export Earning

Shrimp culture has a positive impact on export earnings of Bangladesh.

Table 28: Contribution of Shrimp on Foreign Trade of Bangladesh

Fiscal Year	Total export earnings (million Tk)	Total export of frozen food	Total export of shrimp and crab	Contribution of shrimp and crab to export earnings %	Contribution of shrimp and crab to total export of frozen food %
2000 -2001	2,97,163.75	13,331.32	11,814.75	5.05	88.62
2004 -2005	2,54,911.02	13,761.65	11,822.063	5.56	88.96

Source: BBS 2006

It is seen that that the export trends of frozen foods specially shrimp and crab are increasing day by day. In 2000-2001 and 2004-2005 financial year total export earnings of Bangladesh are 2,97,163.75 million Taka and 2,54,911.02 million taka respectively. In the same period total export earnings from frozen foods are 13,331.32 million taka and 13,761.65 million taka and 5.05 and 5.56 percent export from shrimp and crab of the total export earnings (Table 28).

4.3.5 Utilization of Unused Land

A vast area of coastal land were unused due to over salinity before introducing shrimp culture, that are now utilized for shrimp farm and that are very much fit for work. So, the coastal villagers have started shrimp cultivation in these lands. Moreover, once the ditches beside homes or roads of the village would remain unused is now also use under shrimp cultivation.

4.3.6 Impact on Share Croppers

Shrimp cultivation has negative impact on the sharecropper of the area. It is because once the share croppers had to pay only Taka 8,000 to 9,000 to the land owner one hectare of land per annum. But now, Shrimp farm owners are ready to pay Taka 25,000 to Taka 30,000 for one hectare of land and for this reason sharecroppers are unable to get these lands. But they have not enough, to start shrimp cultivation in a hired land. In fact, more or less they have been knocked out from the land. Also, chicken and duck rearing, cattle rearing, making of traditional fishing equipments, till the land etc. are reduced due to shrimp and crab culture.

4.3.7 Job Abolished or Reduced

i) Dry Season Crops Cultivation

Once, dry season crops cultivation was a common activity in this area. After starting shrimp cultivation there is no scope to cultivate of different crops so many people who involve there who have lost their jobs.

ii) Harvesting of Paddy

Harvesting of paddy is impacted by shrimp cultivation. It is found that laborers who are now involved in shrimp farm and many of them don't come to harvest paddy.

iii) Open Water Fishing

Some Hindu people of the two villages were engaged for open water fishing for their livelihood but due to shrimp culture they have lost their job. So, they become jobless and had to change their occupation.

iv) Mowing

A group of people was dependent on mowing business but due to shrimp culture they have lost their job opportunities for various restrictions.

4.3.8 New Jobs Created

Due to shrimp culture many job opportunities have been abolished, but several types of new job opportunities have been emerged in the area.

i) *Bheri* (Dike) making

It has been seen that a team headed by a leader is engaged for making dikes. Round the year they are engaged in making and repairing the *bheri* of the farms of shrimp.

ii) Guard

Some people are engaged as guard at the shrimp farms. Round the clock they guard the farm and it's a new employment for rural people.

iii) Fry collection

In the area collection of shrimp fries of natural source is a new dimension of work. Many people from outside area came here to collect fries.

iv) Sale of fries

The collectors of shrimp fries from the catchers and sale to the shrimp fry traders at depots or *arat* and some of them directly sale to the shrimp farmers. At the same time, some people collect shrimp fries from hatcheries. So, many people are engaged in different types of jobs.

v) *Arat* or depot business

Arat of shrimp and *arat* of shrimp fries are new type of business here. Many people are engaged in these businesses.

vi) Making of Basket

For shrimp trading a special type of basket in needed. A group of people are involved in the work of making the basket and *atole* that are very useful things in the shrimp farms.

vii) Apply of Ice

For shrimp carrying and preservation ice is needed. So, many new ice factories have been emerged in the area. A lot of people are engaged in ice trading and breaking activities.

viii) Collection of snails

A group of people are engaged to collect snails and sale to the shrimp farmers and some are engaged to break the snails and prepare as food for the shrimps.

ix) Agency business

The petty traders (*faria*) collect shrimp from shrimp farmers. The agents are the middle men and they make contracts with the petty traders and the exporter of shrimps.

x) Feed making

It is found that the shrimp farmers make composite shrimp food in their houses. Some other people are not directly involved in shrimp farming but they make shrimp food for sale. A lot of people are engaged in this work.

Shrimp farming has created various kinds of new jobs and employment opportunity in different stages of shrimp production to shrimp processing and exporting chain (Uddin 2003; Paul 2007).

So, it is observed that socioeconomic impact of shrimp culture is very much positive. There are some negative impacts on the society of the study area. It is undoubtedly evident that the economic impacts of shrimp culture are very much positive in making the livelihood of the respondents sustainable and work oriented. But if they use properly and collaboratively IK and ScK, the positive impacts of shrimp culture might be increased and that is very useful for the area and also for the national economy.

CHAPTER FIVE

ENVIRONMENTAL IMPACT OF SHRIMP AND CRAB CULTURE

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5.1 Environmental Impact of Shrimp and Crab Culture

Shrimp and crab culture has not only socioeconomic impacts but also environmental impacts. It has a massive impact on environment. Some arguments run as shrimp are being cultivated for export purposes in Bangladesh. But its other impact ignored for many years due to shrimp culture increased salinity, loss of other species of native fishes, pollution from diesel driven power etc. These are not considered with adequate attention. Simultaneously it also causes environmental degradation, damaging mangrove forest resources of the Sundarban and destroying a wide variety of other fishes. In addition of it, the shrimp fry collection from natural sources abolishes large number of fin fishes. It may have many implications in destruction of breading grounds, increased discharge of nutrients in a less decomposed form into the open ocean water and destruction of nursery ground for marine fauna (Uddin 2003).

With the intrusion of saline water most of the vegetation begins to die in the study villages. Salt is inundated and is deposited in the shrimp field. It can not be washed out with monsoon rain fall and tilling, shrimp fields are under water for almost 8 months. Consequently the soil remains soft, and does not require tilling for planting. In the long-run it increases the salt load. It replaces some of the nutrients which are valuable for vegetation and crop growth. Fish resources are also depleted due to the increase in catching of fry by nets of very small mesh (Datta 1993).

The green scenarios of the study villages have become brown and pale. Salinity has been increased due to shrimp culture and rate of production of paddy and other crops have gone down to the minimum level in the adjacent lands of shrimp farms. A dangerous vicious circle has been flourished due to increasing salinity and reduction

of production of paddy. To catch shrimp fries from the peripheral rivers of the Bay of Bengal and to carry the shrimps to the depots located in the towns a competition has been started among the shrimp farmers to make engine driven trawler. Due to over number of trawlers, water of the rivers are becoming poisonous. Moreover, the illiterate poor group of people destroying the sources of various other fishes during shrimp fries catching by current net from the rivers. For this reason, availability of other fishes in the rivers is decreasing (Siddiqui-Rahman 1996).

Islam, Islam and Rahman (1997) argued that shrimp culture has some adverse impacts on the environment and those are as: (a) Increasing salinity in the soil and its adverse effects on the land; (b) reduction of the number of domestic animals; (c) abolition of native fishes; (d) reduction of trees and erosion of soil and so on.

According to SBCP (2001) that to catch only one *bagda* fry from the natural sources the fry catchers destroy at least 212 fries of other shrimp varieties, 178 of fin fishes and 9096 food particles of shrimps and other fishes.

Similarly a study report of Fish Research Institute (FRI) is commented that shrimp fry catchers or collectors are destroying at least 38 of other shrimp varieties, 6 varieties of fish and 56 varieties of zooplankton.

At first, it is better to clarify types and other features of environment.

5.2 Ecosystem

The interactions between the different components of environment are called eco-system. It is a complex system, which includes the living and nonliving organism interaction with each other.

All natural ecosystems have the capability to run and maintain themselves in a state of dynamic equilibrium automatically without any assistance from outside sunlight is only source of its energy, which keeps natural ecosystems in a functional state (Asthana *et al* 1999).

5.3 Environmental Impacts

5.3.1 Increased Water Logging

Due to shrimp culture water logging increases. More than 70 percent of the study respondents reported the increased water logging problem.

There are several causes of water logging. The process of increased siltation in the river due to lean flow of water arising from the withdrawal of upstream water is one of the main causes. Traditional *gher* culture and lack of proper management of embankment are other reasons for water logging. In the polder area, before shrimp culture, the tidal flood plains at high tide and during low tides the water was recessed out. This regular and continuous water flow maintained a balanced siltation level in and outside the polder area. After shrimp situation, the tidal entry into the enclosed area is blocked to create intentional water logging for facilitating shrimp culture. The silt began to deposit on the riverbeds, gradually raising levels to higher than the lands inside the polders.

So, the water exist is blocked creating permanent water logging. On the contrary, some coastal areas, the entire flood plain areas are embanked with low dikes to prevent direct on mush of tidal water into the shrimp farms. Small channels and *khals* within the fields are also blocked. The high tide water, particularly in the monsoon,

can not enter into field. By silting and rise of river beds, the rivers are carrying water beyond their capacity. This huge water then inundates the home stead areas gardens, rural roads, ponds etc. through the small channels present adjacent to the homestead areas. During the low tide, fall recession of this water could not take place due to undulated land topography. For this reason, in the permanent water logging throughout the monsoon season, even later, dwellers than face a lot of environmental problems such as wash out of traditional latrines contaminates of ponds, tube-wells and communication disruption etc. So, the techniques and scientific knowledge should be use by the shrimp and crab farmers. By using only indigenous knowledge and traditional techniques and methods the environmental impact will never be eradicated.

5.3.2 Soil Salinity Increased

The shrimp culture causes the increase of soil salinity in the study villages. Salinity both in terms of severity and extent is increasing alarmingly. It causes negative externalities contributed the upsurge of shrimp culture in the shrimp growing areas. More than 90 percent respondents observed the allegation.

It is notable that extent of soil salinity which are not harmful to the crop; continuous irrigation with water having similar magnitude of salinity and increase the soil salinity and cause damage to the crops (Soil Resource Development Institute 1999).

The main factors of soil salinity are regular saline tidal flooding, faulty management of sluice gates, willful inundation with brackish water of shrimp farming, fresh water withdrawal from upstream, decrease in water flow to the rivers and distributaries during the dry season and capillary upward movement of soluble salts due to the presence

of high saline ground water table at shallower depth (Karim and Iqbal 2001; Soil Resource Development Institute 2003; Directorate of Environment 2006).

Direct inundation of land and of other water bodies by highly saline water in summer season, is highly injurious (Resource Development Institute 1999) and poor quality (CSSRI 1989). This inundation continues for several months on that land to facilitate shrimp culture are the major causes of increased salinity rather than flooding. The land, which are being used for brackish water shrimp cultivation for several years attain cumulative increment of salinity and eventually made these lands unsuitable for agricultural practices. On the other hand, the low and narrow earthen dikes allow the seepage of saline water to the adjacent non-shrimp agricultural land (if any present), ponds and other water bodies (Rahman *et al.* 1992).

Once soil becomes saline, subsequent floods and monsoon rainfall can not leach out salts completely. There always remains residual soil salinity that increases over time (Karim 2000).

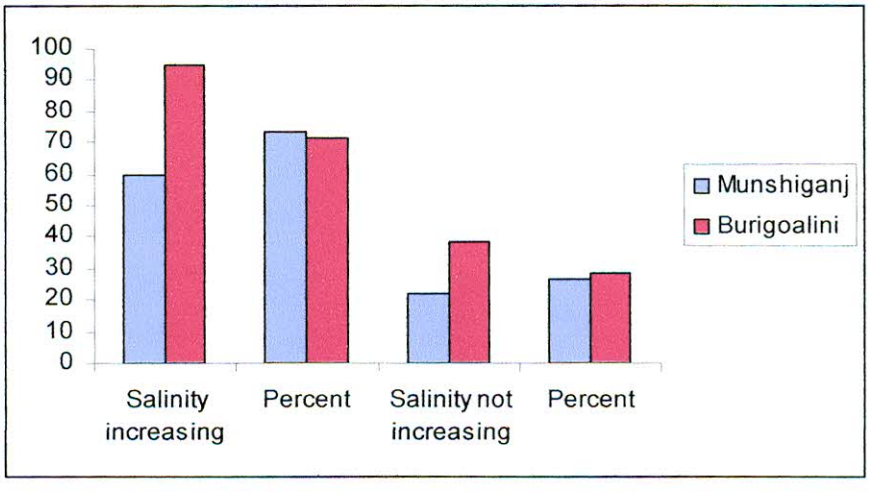
Saline water intrusion has caused problems like loss of crop production, shortage of fresh water aquifers may also be accompanied by salinization of soils (Joyasinghe and De Silva 1990). The cumulative accumulation of salts in the area soils is none posing threat to decline the soil fertility permanently.

A perplexing issue may arise here, whether salinity is increasing due to shrimp culture or shrimp farming is expanding caused by increased salinity. The possible answer may be that, upstream withdrawal of the Ganges water in dry season has significantly reduced the fresh water discharge, and hence salinity is encroaching deeper into the main land (UNEP 2001).

Haq (1999), Karim and Iqbal (2001), SRDI (2003), and Uddin and Islam (1998) stated that the magnitude of salinity is increasing due to shrimp culture among other factors. However, Uddin (2003) argued that, salinity has not been increased for shrimp culture rather shrimp culture has been increased for salinity. Primavera (1994) reported that the release of salt water from shrimp ponds has caused salinization of 45,000 hectors agricultural lands once productive for rice and shrimp farm in central Thailand, has now become an ecological desert. Binh *et al.* (2005) and Lindberg and Nylander (2001) also reported the increased salinity is caused by shrimp culture in Vietnam and Thailand respectively.

Table 29: Salinity Increasing

Respondents	Salinity increasing	Percent	Salinity not increasing	Percent
Munshiganj	60	73.17	22	26.83
Burigoalini	95	71.43	38	28.57



Graph 10: Salinity Increasing

It is found that majority of the respondents (average 72.3%) reported that salinity is increased by shrimp farming in the study villages. But other respondents opposed it. They viewed that it is not the only cause for water and soil salinity. There are other causes for increasing the salinity in the study area. Farmers are not aware of the affect

of salinity of shrimp and crab culture. The researcher observed that salt making field and cyclone and tornado cause some sorts of salinity. This is because of using more indigenous techniques for shrimp culture. If the scientific and planned methods and techniques of shrimp culture will started the salinity intrusion will decrease.

5.3.3 Soil Fertility Decreased

Decrease of soil fertility is a result of shrimp culture in the area. The processes of prolonged water retention and cumulative salinity build up have drastically reduced the fertility of land (Mahmud 1988)). In this context, the ninety to 100 percent villagers agree with it and expressed views that due to shrimp culture, soil fertility is reduced. To facilitate shrimp culture saline water is kept stagnant agricultural field almost year round. It reduces the organic matter replenishment in soil by destroying ground over vegetation cattle grazing and cow-dung addition and least incorporation of rice stubbles in soil. The ultimate result is the decreased soil fertility and poor crop yield.

Moreover, the natural chemical properties of soil are subject to change due to long time submergence. Many essential soil nutrients become in reduced form which are unavailable to plants. Due to shrimp faming, salt load has replaced the useful soil nutrients. Long time inundation of land prevents free nitrogen fixation; mineralization in the soil is halted and fertility drops down sharply with 1 to 2 years (Ham and Nandy 1990).

In the waterlogged soil, nitrogen, the major essential plant nutrient is lost due to de-nitrification leading to reduced soil fertility (Tisdale *et al.* 1990; Brady 1984).

It is clear that the present practice of shrimp culture using saline water would permanently aggravate the soil sterility in lung run and the lands would never be able to use for crop production.

5.3.4 Fruit Plants Depletion

Edible fruit bearing plants production reduced due to shrimp cultivation. Before shrimp culture in this coastal villages, different fruit plants were grown but after the invasion of shrimp, the situation has been changed. Water logging in the shrimp ponds by constructing earthen dikes and consequent inundation of homestead areas by tidal water has resulted in the increased soil salinity. As a result like other natural vegetation, different edible and fruit bearing plants are dying. 95.8 percent respondents depicted and reported this environmental pollution.

Palm (*Borassus flabellifer*) and date palm (*Phonenix sylvestris*) which are mostly grown on the road side, land *ails* and high lands have died. Mango (*Magnifera indica*), jackfruit (*Artocarpus heterophyllus*), betel-nut (*Areca catechu*), lichi (*Lichi chinensis*), banana (*Musa spp.*) also dying off. Coconut (*C. nucifera*) is commonly known as salt loving plant, is suffering badly due to higher degree of salinity beyond their critical tolerance limit. The heads of coconut and betel nut trees have become very thin which are unable to produce or bear fruits. Jack fruits and mangos are disappearing with full pace due to water logging and more salinity of soil in the study area. The other fruit plants that are suffering terribly are amra (*Spondius pinnata*), bilati amra (*S. cythera*), papaya (*Carica papaya*), pomegranate (*Punica granatum*), black berry (*Eugenia jambolana*), wood apple (*aegle marmelos*) etc. In the study villages people have no separate fruit orchard, and income from fruit source has been

reduced significantly. People in this area try to repeatedly plant fruit plants to overcome this problem. But, the saline environment is hindering their efforts.

The depletion of fruits and less fruit bearing have also been reported by Rahman (1994); Miah et al. (2002); Karim (2004) and Haque (2007) in separate studies. All of them viewed the similar picture in the shrimping areas. Adnan (1991) from his study reported that during the period of 1987-90, half of jackfruit and mango were destroyed in coastal area due to shrimp culture.

Dutta and Iftekhar (2004) reported that in southwest coastal district Satkhira increased soil salinity resulted in disappearance of tree species, main of three of them are Swietenin macrophylla, Achras sapota and Spondias pinnata, while others are effected by various diseases.

5.3.5 Abolish of Green Vegetation

The affects of soil salinity causes the loss of natural vegetation and the situation is very alarming. The respondents unanimously reported that eighty to ninety percent green vegetation depleted by salinity. Also ground covering grasses, other flora, reeds etc. is disappearing fast due to the advent of shrimp culture.

Continuous water logging within the shrimp ponds throughout the year has killed ground cover grasses, reeds and other aquatic plant species. The plants become pale or yellowish in high saline time i.e. march to may and comparatively green in the monsoon time when salinity is low. The plants gradually loss their vigor, become weak and ultimately die. Nevertheless, in this hostile environment rain tree (*Samania sanan*) aswathan (*Ficus religiosa*) are surviving successfully (Haque 2007).

Rahman (1994) in a comparative study between south east and southwest coastal areas of Bangladesh, has reported about the declining or disappearance of green vegetation in both regions. Karim (2004) identified the disappearance of various kinds of plants, both aquatic and terrestrial in Rampal Upazila of Bagerhat due to shrimp culture. Manju (2000) also reported the reduction of plants and trees in the shrimp producing areas. Deb (1998) emphasized that in the south western part of the country, the salt water intrusion has caused many problems because of loss of green vegetation among others. Dutta and Iftekhar (2004) reported that increased salinity results in reduction of tree growth and vegetation coverage by 2 and 1.87 percent per year.

5.3.6 Conversion Agricultural Lands to Shrimp Farms

It is found in the study villages that the agricultural land has been changed rapidly and converted to shrimp farms. To reap the more profit, two types of people the local and outsider entrepreneurs are engaged started shrimp cultivation. So, almost all of the agricultural lands have been converted to shrimp farms. In all the newly converted lands, shrimps are cultivated with extensive method without giving due importance to environmental problems. Now, the crop sector is in dangerous position. Hossain *et al.* (2004); Karim (2000) revealed similar findings in Rampal Upazila, Bagerhat district where, as they described about 80 percent of the agricultural land has been converted to shrimp pond during 1975 to 1999.

5.3.7 Changes in Landscape

In pre-shrimp condition there was floodplain in the study villages. In poldered areas the tidal water was regulated by the sluice gates. Introduction and rapid expansion of shrimp farms, has changed the landscape of the area. To convert the lands into shrimp

ponds low earthen dikes have been erected along the boundary of the shrimp farm. To make the dikes top level of the field soil has been cut off as source of earth and to lower land level. For more facilitation of juvenile shrimps, medium deep small canal was being dug within the dike around the whole shrimp farm.

The soil from this source was also used to construct dike of farm. At initial stage the farm size was big. There was no major impact of the dikes as canals but at present, the farm size become small. There is a conflict between local owners and outsider owners. Local villagers are showing interest to cultivate shrimp and there is profit sharing conflict between the owners have led to fragment the large *gher* into a number of smaller *ghers*, the whole areas have been divided by numerous earthen dikes. Removal of topsoil layer and digging of canals within the dikes in association with the prevention of tidal inundation consequently the tidal siltation in plain lands have resulted in the lowering of agricultural land. The flood plain landscape was thus changed of pond areas resulting in the imbalance of coastal ecology.

5.3.8 Rice Production Reducing

Rice production is reducing due to shrimp cultivation due to shrimp cultivation. Before the advent of shrimp cultivation Aus, Aman, were extensively cultivated in the area. Now, shrimp occupies the agricultural lands and this rice production is reduced. About all villagers express the view that issue. Many factors relating shrimp cultivation are related with rice cultivation reducing. Due to saline water preserving for shrimp culture, the rice cultivation is delayed and reduced. The delay of shrimp harvesting leads to late transplantation of *aman* seedlings. If transplantation in done later than mid August, the rice yield may even by halved (Rahman 1999).

On the other hand due to prolonged water logging and direct inundation of agricultural land and water bodies with brackish water in dry season having highest salinity and it causes the rice production reducing.

Karim and Islam (2003), found that rice yield have been decreased by 2.39 metric ton per hectare and 1.1 metric ton per hectare in 1999 compared to 1975 and 1985 respectively in Rampal Upazila. Rahman (1994) also found similar results in southwest and south-east region of Bangladesh.

5.3.9 Cropping Pattern

In the study villages, the cropping pattern of has been changed by shrimp culture. Most of the lands of these study villages have been affected by the varying degree of salinity. The prolonged water logging for shrimp culture has changed the cropping pattern in the area.

5.3.10 Cropping Pattern of the Area

Rabi crop - Aus or Jute - Fallow; Fallow - A us or Jute - Amon; Fallow - fallow - Aman; Fallow - Amon - Pulse; Fallow - Amon - grea pea; Boro - Fallow - Amon etc. (Karim and Iqbal 2001). But after introduction of shrimp cultivation the cropping patterns are: Fallow - shrimp - Aman, Shrimp - Fallow. Almost (90%) the lands of the study villages are occupied by this cropping pattern.

5.3.11 Impact on Domestic Animals

It is a common allegation against shrimp culture grazing lands for domestic animals have been reducing day by day. Number of domestic animals has been reducing. The collected data on livestock have shown in the following table.

Table 30: Decreasing of Domestic Animals

Domestic animals	1980 Munshiganj	1980 Burigoalini	2006 Munshiganj	2006 Burigoalini
Cattle	20,500	30,048	15,203	17,040
Buffalo	620	910	254	486
Goat	10,250	11,854	6,342	9,223
Ram	152	198	95	115

Source: Upazila Livestock Office, Shayamnagar Upazila (Study time May 2008)

It is seen that the number of domestic animals has been reducing in this area after introducing shrimp culture. Total number of cattle in Minshiganj in 1980 was 20,500 but in 2006 the number is 15,203. The percent of decreasing cattle in this village is 30.7. Total number of cattle in Burigoalini in 1980 was 30,048 but in 2006 the number is 17,040. The percent of decreasing cattle in this village is 37.5 (Table 30). Respondents have pointed that Paddy fields are now under canals and *bheries* of shrimp *ghers*. As a result necessity of cattle has been reduced. Grazing lands have been decreased due to shrimp culture. Farmers are using tractor machine to till their land. If the farmers of shrimp and crab use scientific knowledge and modern techniques, then environmental and natural problem will decrease day by day. Because in this area the farmers use their IK in most cases for shrimp and crab farming.

5.3.12 Traditional Shrimp Culture and Deforestation

Deforestation is a common problem around the world. It occurs due to different environmental causes. It is said that shrimp and crab culture are the two of major causes of deforestation in coastal Bangladesh. This view is not supported by the

findings of the present study. In the study area only 5 percent of the respondents viewed that due to shrimp culture, deforestation occurred in the area but 85 percent give opinion against this views and 10 percent didn't give their views. The people who disagreed with this opinion they argued that there was deforestation in the study villages. This happens because of increasing demand of fire wood in the households, and brickfields, making houses, furniture, boats and other wooden materials.

Moreover, shrimp culture causes deforestation by increasing salinity due to water logging. Sometimes farmers use more salt in the *gher.* So it causes deforestation and environmental degradation has been taken place.

5.3.13 Traditional Shrimp and Crab Culture and the Sundarbans

The Sundarbans is the single largest forest in Bangladesh. It is situated in the southwest coastal belt of Satkhira, Bagerhat, Khulna district. Area of this forest is 6,017 square kilometers of it is 4.16 percent of the total area of Bangladesh and 40 percent of the forest area controlled by forest department. There are 334 types of plants and trees, 269 types of birds and beasts in this forest. Total reserve of wood in this forest is about 12.26 million cubic meters (Department of Forestry 2006).

It is said that due to shrimp culture this forest has lost natural beauties and is now in danger. Some arguments in favor of the opinion are stated below: The shrimp fry catchers and collectors are destroying various fin-fishes and food particles of fishes during shrimp fry collection. Some shrimp farmers are making shrimp farms within this forest area. As a result of over salinity several types of trees of this forest are destroying. Due to shrimp culture and collection of shrimp fry in the forest areas human movement have been increased and for this reason life of the birds and beasts

are not safe. As several types of native fishes are going to destroy, the birds and beast depend on those fishes are also going to destroy. But only shrimp culture is not responsible for this matter. There are some other causes–As the Sundarban is situated beside the Bay of Bengal, it is a big reservoir of saline water. Level of salinity of this water varies from 3 to 28 ppt from June to October this level reduces due to rainfall but it increases from December to April for dry season. Also, due to the Farakka Barrage the river Padma remains almost dry round the year. So, fresh water can not enter into the Sundarbans through different rivers. So, salinity has been increased in the water of this belt. As a result, the environment of this coastal area have been affected and for this reason several trees are gong to die and various native fishes have been reduced (Uddin 2003).

5.3.14 Habitat Destruction

Shrimp and crab farming has been widely associated with mangrove destruction. A study by the WWF (World Wildlife Fund) suggests that this is undoubtedly true. It is 10 percent of global mangrove destruction over the past two decades. Also, felling opens up the mangrove habitat allowing easier farm development, mangrove which has been disrupted through dike or road construction and marginal agriculture may be subsequently converted to aquaculture (Humbrey 2003).

5.3.15 Snails and Environmental Pollution

In shrimp farms snails are used as food. It is largely used in the *Golda* farms in the study villages. It is also used in the Golda-Bagda mixed farms of the study villages snails breaking are done very much on traditional method. It is done in the open place. So, the environment becomes unhygienic. The male and female labors use their

indigenous knowledge or experiences to break down the snails. For this reason, the female laborers are very often affected by different skin diseases. There is some sort of lacking of their knowledge and awareness.

5.3.16 Beheading of Shrimps and Environmental Pollution

Shrimps beheading is another unhygienic work related to shrimp culture. Bangladesh basically exports headless shrimps. So, before shrimp processing it is essential to behead the shrimps. The labors and workers in the shrimp farm are not wear hand gloves and other uniform to do this job. Those who are engaged in this work, suffer from various skin diseases.

5.3.17 Shrimp Related Industry and Air Pollution

Wastages of the shrimp and crab farms polluted the air and environment of its peripheral areas. At the same time, it has been found that some fish meal industries have been established in this areas, which use bones of various animals and its bad smelling is intolerable for the people of this area. If they use IK and ScK collaboratively, they can avoid this type of health problem.

5.3.18 Reducing Native Fishes

Different types of native fishes are abolished due to shrimp culture. The field survey data alerts that 77 percent respondents of the study villages reported the disappointing fact that the native fish has been decreasing day by day. It is due to unplanned explosive shrimp farming. Different factors are liable for this. Theses are, *gher* construction in floodplain areas, destruction of habitats and nursery areas, saline water intrusion, reduction of dry season water area of *beel*s and smaller water bodies, use of

curtain nets by fry catchers, use of cross berries in small canals, indiscriminate killing of innumerable fish fries of non target species during PL collection and intensive fishing in small area. These native fishes are, *shing* (Scorpin), *magur* (Cat fish), *kai* (Climbing fish), *bele*, *meni*, *bain*, *khailsa,*, *tengra*, *shail*, *taki*, *foloi*, *sarputhi* (different types of local fishes) and many other fishes. The decrease of these native fishes is due to several causes related to shrimp culture.

i) **Use of Insecticides**

When the shrimp farmers prepare their farms, they use insecticides to kill harmful fishes and lives from the shrimp farms. This practice kills all types of native fin fishes lying there.

ii) **Catching of Shrimp Fry**

Catching of shrimp fries from the natural sources like rivers and seas, the fry catchers use a special type of net. Along with shrimp fries they also catch and kill hundreds of native fin-fishes. They preserve the shrimp fry carefully in their pot left all other fries mercilessly in the mud of the shore and all the fries die there. So, the method of shrimp fry collection causes much destruction of native fish fries.

From the field survey data 60 percent farmers agree with this opinion but then 40 percent shrimp farmers wanted to say that several types of native fishes cultivated simultaneously with shrimp in the shrimp farms. But whatever may be the volume of production of such fishes, the varieties are very few. As for example, the shrimp farmers are producing a lot of *tengra* and *paisha* in the shrimp farms but production of several types of native fishes have been reaches close to zero.

The findings of this investigation are supported by Paul (1996); Hoq (1999); Karim (2000); Hagler (1997); Rahman (1994); Wahab (2003) and ICZMP (2003). All of them unanimously reported about open water fish reduction, merciless killing of other fish fries during traditional shrimp fry collection and threats of extinction of some indigenous fish species.

The inter-tidal and mangrove habitat serve as nursery areas for many species of fish and shell fish. The fishermen and fry catchers destroy also these habitats leading to decline in capture fishes. Undesirable felling of mangroves for *charcoal* and fuel wood, poldering of large areas and conservation to agriculture road building and over fishing probably all contributed to the decline (Muir 2003; Chowdhury *et al.* 1999).

Shrimp produced by an intensive form of aquaculture are exported overseas, while the local need for high protein foods goes unmet. Declining fish catches due to loss of mangrove habitats adversely affect traditional fishermen in areas of intensive shrimp farming (Bailey 1988).

It can be concise the following as environmental impact of traditional shrimp and crab farming in the area. It deteriorates the water quality in confined bays. It deposits of uneaten feed and faces beneath cages. It changes of benthic fauna and benthic cage. It introduces of exotic species for culture which later escape into the surrounding ecosystem. It spreads different diseases of native fishes. The possible use of antibiotic resistant bacteria through the use of feed containing antibiotics. Hybridization between native and domestic species of fishes is necessary to protect the native fishes in this area.

5.3.19 Reduction of Poultry

Poultry birds are important for the poor households as it can provide a small regular income for them. It provides protein support from egg and meat to the household members. Now poultry birds are facing threats from shrimp culture in the area. This view is supported and reported by 84 percent respondents of the study villages.

Table 31: Reduction of Poultry

Munshiganj and Burigoalini	Chicken Per Household		Change %
	Before Shrimp Farming	After Shrimp Farming	
	22.42	8.5	13.92
	Ducks Per Household		Change %
	Before Shrimp Farming	After Shrimp Farming	
	16.20	4.1	12.1

Source: ULO, Shyamnagar Upazila.

The chicken production in the study villages is very hard task. The shrimp ponds remain water logged by saline water around the year. Also rice production has been reduced drastically. It is reduced by 13.92 percent in this area. So, the chicken can not collect food by scavenging in the crop field resulting in food shortage for them. On the other land, the house stead areas of households nearby the shrimp *ghers* are often waterlogged due to high tide and heavy rain. The shrimp farmers have imposed strong restrictions on their movements. So, ducks farming can not rise. It is reduced by 12.1 percent. The common water bodies like small *khal*, water channel etc. is engulfed by the adjacent shrimp farmers.

From a study in Khulna and Cox's Bazar area, Rahman (1994) reported 36 percent poultry reduction in Khulna area due to shrimp culture. On the other hand, Karim (2000) reported that in Rampul Upazila of Bagerhat District, due to shrimp farming ducks and poultry has been reduced by 35.19 percent and 21.56 percent respectively in 1999 compared to 1985.

5.3.20 Biomass Fuel Reduction

Use of biomass as fuel is a common practice in the rural households of the coastal villages. The coastal people use biomass fuel for domestic cooking, parboiling of paddy, *gur* (molases) making and brick manufacturing.

Domestic cooking and parboiling together account for practically the total demand for biomass fuel as brick manufacturing uses only a very small quantity of fuel by comparison (ESCAP 1988).

Before advent of shrimp culture, coastal people used crop residues, cow-dung, branches and fallen leaves of standing plants, roots of felled trees for cooking and other purposes. After introduction of shrimp culture the biomass fuel source is reduced. It is because of conversion of agricultural lands into waterlogged shrimp ponds, clearance of grasses, reeds and other aquatic plants, reduction of rice production and eradication of jute and sugarcane etc. Also, due to more salinity, the most common fuel wood trees decreased. So, most of the coastal villagers of the area have to purchase fuel wood with high price which are posing pressure on their livelihood pattern.

ESCAP (1998); Kendrick (1994); Rahman *et al.* (1993), Tutu (2004) also reported the reduction of biomass fuel induced by the introduction of shrimp culture. Their findings seem to be supported by the findings of this study.

5.3.21 Impact on Health

In Bangladesh almost 8o percent of all illness is related to water borne diseases. The health impact of polluted water and hard labor pertaining to shrimp culture is revealed through skin diseases, diarrhea and other intestinal diseases. Epidemiological data arising from shrimp culture is not available. In this study, an attempt has been made to asses the diseases coming out from shrimp culture.

Table 32: Health Impact of Shrimp and Crab Culture

Diseases Incidence	Respondents' Opinion in Favor of the Issue (%)
Diarrhea	19.75
Fever	60.50
Headache	72.10
Jaundice	11.25
Nail rotten	50.30
Respiratory diseases	52.40
Skin diseases	57.65
Sneezing	90.80
Sore between fingers	70.75

It is observed that field level workers related to shrimp cultivation suffer from above diseases (Table 32). All of them occur very commonly. The infestation of the diseases

varied on the level of salinity of water. The diarrhea and jaundice are not severe, the respondents reported. But they reported that the common diseases are occurred in shrimp and crab farms are: Sneezing 90.80 percent, Sore between fingers 70.75 percent, skin diseases 57.65 percent and respiratory diseases 52.40 percent. The shrimp related workers, particularly the *gher* labors and *gher* owners, are not concern about the diseases. They consider it as a normal phenomenon.

Battacharya *et al.* (1999) and Miah *et al.* (2002) separately reported that the skin disease, diarrhea and other intestinal diseases are infested due to shrimp culture. Lindberg and Nylander (2001) also reported the health problem of shrimp related people in Thailand.

The loss of mangrove habitat eliminates nursery grounds for larvae shrimp and fish. Mangrove forests are critically important habitats for the reproduction and growth of shrimp post larvae and juveniles (Turner 1986).

Their replacement by shrimp ponds will adversely affect the recruitment of larvae fish and shrimp (Zimmerman et al. 1989).

Bangladesh is still dependent on collecting wild shrimp post larvae to stock shrimp ponds (Olsen 1989). Depletion of local populations of shrimp post larval can occur due to this collecting (Basirullah 1989; Turner 1986).

Eutrophication of surrounding coastal area as from nutrients discharged in shrimp pond effluents can effect receiving waters. This is especially true for intensive and shrimp culture systems for the high feeding, fertilization and water exchange rates require frequent discharge of pond effluents. Chemicals used for predator and pest

control, for example the sad cake and malachite green and for pond soil sterilization, calcium carbide, may kill non-target organisms after discharge of pond effluents. Copper compounds used for algae control in shrimp farms can be toxic to crustaceans and benthic fauna (Clifford 1992).

Intensive and semi intensive shrimp culture involving discharging large amounts pond water can affect estuary or other receiving waters. Since ponds are shallow, evaporation is greater than in neighboring mangrove or estuary. Effluents discharged form these ponds will be more saline and during period's low flow can affect the salinity of receiving waters. Shrimp pond effluents are often high in organic matter; both suspended and dissolved (Byod 1992). This high biological oxygen demand can cause oxygen depletion in receiving waters especially since these estuaries already receive organic waste from nearby urban and agricultural areas. If all the ponds are pumping out effluents during periods of low water, problems can arise due to this surplus organic matter and increased salinity (Twilley 1986). Salt water intrusion into the water table of nearby agricultural land can occur when shrimp ponds discharge effluents into the irrigation systems supplying farmlands (Chamberlin 1991).

Even if the presence of an exotic species of shrimp innocuous, diseases and parasites can spread to local *panaeid* species from the exotic cultured shrimp, cultured shrimp are vulnerable to a wide assortment for parasitic fungi and virulent bacteria and viruses (Brock *et al.* 1992). The use of antibiotics in shrimp feed has led to the occurrence of antibiotics in shrimp tissue (Weidner 1992).

The present chapter is intended to trace out the affect of shrimp and crab culture on coastal environment. There are alarming conditions of coastal shrimp and crab

aquaculture caused by the hazards. It has multimode affect on the coastal environment and on the health of the people of the area as well. Some of them are occurred due to the use of IK of the coastal people and others are occurred due to overall affect of coastal aquaculture.

CHAPTER SIX

COLLABORATIVE USE OF IK AND SCIENTIFIC KNOWLEDGE

6.1 IK and Scientific Knowledge

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- 6.1.2 Methodological and Epistemological Differences
- 6.1.3 Contextual Differences

6.2 Importance of Indigenous Knowledge

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- 6.4.1. Shrimp Fry Collection:
- 6.4.2. Fry Marketing
- 6.4.3. *Gher* Place Selection and *Gher* Preparation
- 6.4.4. Dikes Making
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- 6.4.6. *Gai* Making and Control of Water
- 6.4.7. Point Making and Fry Stocking
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- 6.4.9. Disease Management
- 6.4.10. Catching and Marketing of Shrimp

6.5 IK and ScK in the Crab Hardening and Fattening

- 6.5.1 Catching of Juvenile Crab
- 6.5.2 *Gher* Preparation
- 6.5.3 Fence Making Surrounding the *Gher*
- 6.5.4 Sludge Removal and Water Intake or Change
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- 6.5.6 Feeding of Crab
- 6.5.7 Testing of *Gonad* of the Female Crab
- 6.5.8 Disease Management of the Crab
- 6.5.9 Grading of Crab
- 6.5.10 Catching and Binding the Legs of Crab with Taps

Collaborative Use of IK and ScK in Shrimp and Crab Management

Generally, IK means an ancient, communal, holistic and spiritual knowledge that wraps every aspect of human existence. But at present more emphasis is given on wisdom than on knowledge. Some say that IK must be understood within a spiritual realm, because knowledge can not be separated from the reality, as IK is unique to each tradition and it is closely associated with a given territory.

In the decades since Second World War, the rhetoric of development has gone through several stages from its focus on economic growth, to growth with equity, to basic needs, to participatory development, to sustainable development (Bates 1988; Black 1993). Today IK is seen as pivotal above all in discussions on sustainable resource use and balanced development (Brokensha *et al.* 1980; Gupta 1992; Warren 1990).

The focus on IK clearly heralds a long overdue move. It represents a shift away from the pre-occupation with the centralized, technically oriented solutions of past decades, which failed to improve the prospects of most of the peasants and small farmers. By highlighting the possible contribution to be made by the knowledge which is in the hands of the marginalized poor, current chapter focuses on incorporation of scientific knowledge in indigenous knowledge activities of shrimp and crab resources in the study villages.

6.1 IK and Scientific Knowledge

IK differs from the international scientific knowledge in several ways. According to Simon Brascoupe and Howard Mann (2001) IK and ScK have some differences.

Table 33: Comparison between IK and Scientific Knowledge

Factors	Indigenous Knowledge	Scientific Knowledge
Approaching	Holistic	Compartmental
Communication	Oral	Written
Teaching	Observation, Experience	Lectures, Theories
Explanation	Spiritual, Social values	Theory, Value free

Also IK differs from western or scientific knowledge on

1. Substantive grounds- because of differences in the subject matter and characteristics of IK and ScK;

2. Methodological and epistemological grounds- because the two forms of knowledge employ different methods to investigate reality;

3. Contextual grounds- because IK is more deeply in its environment (Banuri and Apffel-Marglin 1993; Chambers 1980; Warren 1989 and 1990).

To ignore peoples' knowledge is almost to ensure failure in development (Brokensha *et al.* 1980). So, IK should be gathered and documented in a coherent and systematic fashion (Warren *et al.* 1993).

6.1.1 Substantive Differences

There are differences between IK and ScK with respect to their history and distinctive characteristics. However, the presumption that IK is concerned with the immediate

and concrete necessities of peoples daily livelihoods, while western ScK attempts to construct general explanations and is one step removed from the daily lives of people.

At the same time, many writers on IK agree that it also encompasses non-technical insights, wisdom, ideas, perceptions and innovative capabilities (Thrupp 1989).

6.1.2 Methodological and Epistemological Differences

Some indigenous knowledge (IK) theorists have argued that science is open, systematic, objective and analytical. It advances by building rigorously on prior achievement. IK, however, closed, non-systematic, holistic rather than analytical, without an overall conceptual framework, and advances on the basis of new experiences, not on the basis of a deductive logic (Banuri and Apffel Marglin 1993; Howes and Chambers 1980).

Feyerabend's (1975) attacks on the dogmatism and intolerance of scientists towards insights and methods of inquiry outside established, institutionalized science are sufficiently on target that even his avowed critics accept them (Tibbetts 1977). At the same time, as Dirks et al. (1994) remark, it was the virtual absence of historical investigation in anthropology which made cultural systems appear timeless, at least until ruptured by culture contact'. In such a situation it is impossible to insist upon the openness of science to attempts aimed at dislodging it, or the closed nature of traditional knowledge systems.

6.1.3 Contextual Differences

IK is often seen to exist in a local context, anchored to a particular social group in a particular setting at a particular time. Scientific knowledge, on the other hand, has

been divorced from an epistemic framework in the search for universal validity (Banuri and Apffel Marglin 1993).

One of the most devastating critiques of technical solution-oriented development polices of the last five decades has been that they ignored the social, political and cultural contexts in which they were implemented (Agrawal 1994). But it attempts to implement western technically oriented solutions failed because they did not recognize the imperatives entitled by different socio-political cultural contexts; it is likely that the so called technical solutions are as anchored in a specific milieu as any other system of knowledge.

Contemporary philosophers of science, focus on the social moorings of science, and in so doing question the stock assessment of science as objective and rational.

More recent accounts emphasize scientific practice and the context upon which scientists draw to create scientific products, such as instruments, facts, phenomena and interpretations. By insisting on the multiplicity, patchiness and heterogeneity of the space in which scientists work (Pickering 1992), This view of science as practice and culture successfully go beyond not just earlier epistemologies rooted in rationalism, but also the later reductive representations that saw science as relative to culture (Kuhn, Feyerabend) or as relative to interests (Sociology of scientific knowledge) (Pickering 1992). The discursive space thus purchased foregrounds the practices of science, and can form a valuable resource for the construction of epistemic foundations. To successfully build new epistemic foundations, accounts of innovation and experimentation must bridge the IK and western knowledge divide.

In examining specific forms of investigation and knowledge creation in different countries and different groups of people, we can allow for the existence of diversity within what is commonly seen as western or as indigenous. At the same time there is a link of IK and ScK.

Currently, there appears to be some tension between the contributions of IK and formal science.

IK is parochial and culturally relative, its local embedded ness is intrinsic to its success, where as science strives for a generic and global perspective. Scientists need beware of misinterpreting IK. It is mistaken to recode and interpret it scientifically (Sillitoe 1998). If science sets the parameters from the broader circumstances that critically inform them. Outsiders decide what is relevant, not those who possess the knowledge. The indigenous technical knowledge out of cultural content both devalues and threatens to misinterpret it. It becomes a convenient abstraction, consisting of bit sized chunks of information that can be slotted into western paradigms, fragmented, dis-contextualized, a kind of quick fix (Ellen & Harris 1997).

6.2 Importance of Indigenous Knowledge

Indigenous knowledge provides the basis for problem solving strategies for local communities especially solving strategies for local communities especially the rural poor. IK is an important component of global knowledge on development issue. Learning from IK, by investigating first, what local communities and have, can improve understanding of local conditions and provide a productive context for activities designed to help the communities understanding IK can increase responsiveness to clients. Adapting international practices to the local setting can help

improve the impact and sustainability of development assistance. Sharing IK within and across communities can help enhance cross cultural understanding and promote the cultural dimension of development harvesting in the exchange of IK and its integration into the assistance programs of the World Bank and its development partners.

The integration of IK is a process of exchange of information from one community to another. The process of exchange of IK involves six steps (World Bank 1998).

1. **Recognition and identification**: Some IK may be embedded in a mix of technologies or in cultural values, rendering them unrecognizable at first glance to the external observer.

2. **Validation**: This involves an assessment of its significance and relevance (to solving problems), reliability, functionally, effectiveness and transferability.

3. **Recording and documentation**: This is a major challenge because of the tacit nature of IK it is typically exchanged through personal communication from master to apprentice, from parent to child etc. In some cases, modern tools could be used while in other circumstances it may be appropriate to rely on modern traditional methods (e.g., taped narration, drawings).

4. **Storage in retrievable repositories**: Storage is not limited, to text document or electronic format; it could include tapes, films, story telling etc.

5. **Transfer**: This step goes beyond merely conveying the knowledge to the recipient; it also includes the testing of knowledge in the new environment.

6. **Disseminations**: It is a wider community adds this developmental dimension to the exchange of knowledge and could promote a wider and deeper ripple impact of the knowledge transfer.

IK is an instrument of development that has not received the needed attention in rural development. This is changing day by day the importance of IK in the development process grows now the country to begin elaborating specific policies in support of acquiring, absorbing and communicating knowledge. Most IK exchange is likely to rely more on traditional instruments.

Some experts make caution against any attempt to transfer IK because it is believed that IK should be exchanged across communities. And it could be irrelevant or even harmful outside its original cultural content.

Western science is incapable of appreciating traditional cultures, sensitive approaches will, therefore, be needed to reduce the potential risk of disempowerment of local communities, without compromising the principle of global knowledge partnership for the benefit of all communities. The Global knowledge conference (Toronto, June, 1997) emphasized that urgent need to learn, preserve and exchange of IK. In his recent call for a new inclusive approach to rural development, the president of the World Bank has stressed the need for a frame work that deals inter alias with people and their knowledge. (James. D. Wolfenson, Former President World Bank address to the 1998 Annual meeting of the World Bank and the IMF). Indigenous technologies, practices and knowledge system have been given more importance by the social anthropologists. The features of IK, and by which it distinguishes broadly from other scientific knowledge (Ellen and Harris 1996).

IK is local. It is a set of experiences generated by people living in those communities. Separating the technical from the non technical, the rational from the non rational could by problematic, but scientific knowledge is based on fully rational basement and technology. IK is tacit, so it is not easily codifiable but Scientific Knowledge is not tacit so it is easily codifiable.

IK is transmitted orally as through imitation and demonstration. But scientific knowledge is very difficult to transmit. IK is given importance in experimental rather than theoretical knowledge. Experience and trial and error, tested in the rigorous laboratory of survival of rural local communities constantly reinforce IK. IK is learned through repetition, which is a defining characteristic of tradition even when new knowledge is added. Repetition aids in the retention and reinforcement of IK. IK is constantly changing, being produced as well as reproduced, discovered as well as lost, though it is often perceived by external observers as being some what static.

IK is an integral part of any development process of local communities. According to 1988-89 world development Report, knowledge, not capital, is the key to sustainable social and economic development. So, basic component of any country depends on IK.

Governments and international institutions can certainly help countries with the daunting task of shifting through international experience, extracting relevant knowledge to local conditions. Sharing knowledge with the poor is most effective when we also solicit knowledge from them about their needs and circumstances.

A better understanding of the local conditions help to better intricate global technologies to solve the problems facing local communities in the least developed countries. The challenge for the socio-economic development is to find better ways to

learn about the indigenous practices and where necessary adapt modern techniques to the local practices. Only then will global knowledge render relevant to the local people needs. The key factor in the adaptation process is the involvement of those who posses indigenous knowledge (World Development Report 1998-99).

Indigenous knowledge is an important part of the lives of the poor. It is an integral part of the ecosystem. It is the key element of social capital of the poor; their main asset to invest in the struggle for survival, to produce food, to provide for shelter or to achieve control of their own lives. IK also provides problem solving strategies for local communities and helps shape local visions and perceptions of environment and society (World Bank 1998).

IK is important, however all IK need to be scrutinized for their appropriateness just as any other technology. In addition of scientific proof, local evidence and the socio-cultural background in which the practices are embedded also need consideration in the process of validation and evaluation. Indigenous practices can adapt in response to gradual changes in the social and natural environment since they are closely interwoven with people's cultural values and passed down from generation to generation (World Development Report 1998/99).

A greater awareness of the important role that IK can play in the development & success is likely to help preserve valuable skills, technologies, artifacts, and problem solving strategies among the local communities.

Table 34: Importance of IK in the Shrimp Culture of the Study Villages

Importance of IK	Munshiganj	Burigoalini	Total	Percent
It causes less environmental pollution	15	19	34	29.6%
It can increase more shrimp production	12	23	35	30.4%
It cause less virus attacking in the shrimp *gher*	09	15	24	20.9%
It has less impact on biodiversity	09	13	22	19.1%

It is observed that 29.6 percent respondents reported that IK causes less environmental pollution; 30.4 percent agreed it increases the shrimp production; 20.9 percent agreed, it causes less virus diseases in the shrimp farm and 19.1 percent respondents viewed, it has less impact on coastal biodiversity. So, according to the respondents, IK has less affects on the environment of study villages. But real scenario is far different from this data. It is because of the ignorance and lack of consciousness of the respondents. They think IK is more important and useful than ScK. ScK occurs more virus diseases than IK in case of their shrimp and crab farms.

IK is important for both the local communities and the global community. So, special efforts should be given to understand, document and disseminate IK for preservation, transfer or adoption and adaptation elsewhere to aquatic resources management especially in coastal area in Bangladesh.

6.3 Collaboration between IK and ScK

Recent interest in the value of farmer's dissatisfaction with modernization approaches in dealing with poverty, a situation exacerbated by the seeming inability of science

and technology to improve living standard for the poor people of the coastal area. With specific reference to coastal shrimp and crab aquaculture, IK has wide range of socio-economic and ecological base.

IK of the coastal people help them to survive against the nature. It has dominated their livelihood very much. Because, IK is operating in their agriculture, aquaculture, mangrove collecting, etc. Also it is harmonized with nature, coalition of life and environment. Because of this, there is a greater sympathy for the view that IK represents a complementary, not competing, set of knowledge, and it somehow represents a sense of modernity.

6.4 Collaborative Use of IK and ScK for Shrimp Culture

Shrimp aquaculture is mainly based on traditional method in the study area. Farmers, owners of the *gher*, fry catchers and collectors and labors of the *gher* use their IK or traditional knowledge and experience to do job of shrimp culture. They know and exchange knowledge from their neighbors, seniors and other successful farmers about the process and method of shrimp and crab aquaculture.

At the same time the young boys and girls, fishermen and women caught fish in the river of the Sundarbans area, and they saw that there were shrimp fries in their net and they were more profitable in the market due to increasing demand for shrimp *gher*. So, they used to catching shrimp fry and use many hand made net, mosquito net, in collecting these aquatic resources. The respondents of the study villages use mixed methods for shrimp aquaculture. So, they have to use some scientific or formal knowledge to culture of shrimp properly.

6.4.1. Shrimp Fry Collection:

They use their own technique, knowledge and method to catch and collect shrimp fry. They use baskets, bags and nets to store the fries that are also made by them or local people.

To fulfill the increasing demand of the fry, the hatchery shrimp fry supply will be started. Farmers of the study area (41%) use hatchery fry for their *gher*. But they viewed that this fry has less growth rate than natural fries. So, they always want natural fries.

6.4.2. Fry Marketing

Most of the hatchery of the country is located in Chittagong, Cox's bazar and Khulna area. So, hatchery fries come in the study area, under controlled environment. So, it needs to maintain temperature and humidity.

6.4.3. *Gher* Place Selection and *Gher* Preparation

The respondents normally select a clay and saline land to make it as *gher* of shrimp. At first, they till the soil, break down the soil and mix some lime and fertilizer to make the soil fertile like for shrimp growing. They mix different organic manure (cow dung, composts); to increase fertility of the *gher* land. They process the crowduing and make the compost by leaves, grass and many things.

The farmers themselves can not test salinity of the soil and the alkalinity of the water. So, they have to take help from the different officials of Upazila and district level.

Most of the shrimp farmers use tractors to till the *gher* land and break down the soil for shrimp culture.

6.4.4. Dikes Making

When the soil is ready, the respondents make dikes around the *gher*. They make dikes about 4 to 6 feet high. Dikes protect from other *gher* and loss of shrimp fry.

6.4.5. Sludge Removing and Water Intake

There are many unnecessary things in the *gher*. The respondents throw out the sludge and dirt outside the dikes and water intake into the *gher*.

6.4.6. Gai Making and Control of Water

The respondents make rectangular *gai* to control water in the corner of the *gher* and at the time of low tide in the rivers they change the water of the *gher*.

The shrimp farmers use many different fertilizers and chemicals (Aqua-Z, TSP, Potash and Lime) to make the *gher* fertile. The idea of using level of the fertilizers came from different officials of the Upazila and District level.

6.4.7. Point Making and Fry Stocking

The respondents make a point or nursery on the highland outside of *gher*. The function of the point is, to test the tolerant level and make the fries big; to put in the *gher*. By this, they could examine, how many fries are lost. At the same time, they acquire knowledge from another farmer about density and stocking the fries of the *gher*.

6.4.8. Water Exchanging

The respondents are able to know that dirty water is injurious to the fries. So, they change the water and intake new water of the *gher*. Also they throw out the dead shrimp outside the *gher* however the water becomes dirty and poisonous.

6.4.9. Disease Management

The respondents are using their traditional knowledge to manage the diseases. Most of the respondents viewed, they can not do anything, because still it is unknown of the cause of shrimp virus or white spot disease. But their view is that natural or wild fry of the river is better than hatchery fries. As virus attacking of hatchery fry is more than wild fry. So, the respondents want more natural fry for their *gher* and they believe that it is cost effective.

The farmers of the study area viewed, they apply different fertilizers and medicine to decrease the viral diseases of the shrimps. Though it gives less result, they always try to do it.

6.4.10. Catching and Marketing of Shrimp

The respondents use different types of hand made instruments - like net, *atole* etc. to catch the shrimp. Women labors are employed for catching the shrimp by their hands, clothes or mosquito curtains. They put *atole* (a local instrument made by bamboo sticks) in the water and shrimps are caught.

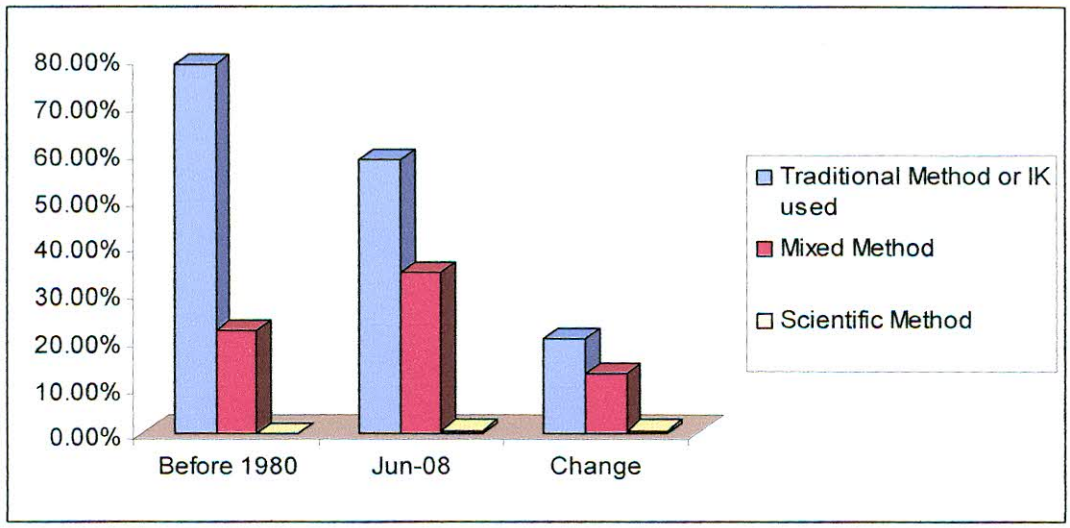
After catching the shrimp, the farmers use to keep it in a basket or a bag. But the *depot* owners apply ice and preserve the shrimp in a scientific way.

After catching the shrimp, they store and keep the shrimp, in the bag or basket which is also made by them. Then they go to the *depot* (selling place) of the shrimp to sell.

The data collected from the study area shows that IK and Scientific Knowledge use shrimp culture in the area.

Table 35: Knowledge Use for Shrimp Culture in the Area

Method	Before 1980	June 2008	Change
Traditional Method or IK used	78.3%	58.3%	20%
Mixed Method	21.7%	34.2%	12.5%
Scientific Method	0	0.5%	0.5%
	100%	100%	



Graph 11: Knowledge Use for Shrimp Culture in the Area

It has been observed that Indigenous knowledge of shrimp culture is used by 58.3 percent and mixed knowledge is used by 34.2 percent respondents but only scientific knowledge is used by only 0.5 percent respondents. The shrimp farmers think that scientific instruments methods and techniques are costly and they are fit for the area. But educated and conscious respondents think that it is not true. Scientific knowledge

and chemicals have some sort of side effects. But if this knowledge and techniques is properly used, it is very useful for better and quality production of shrimp.

Table 36: IK and Sc K for Shrimp culture

Opinion of Respondents	Munshiganj	Burigoalini	Total	Percent
IK is fit for shrimp culture	27	48	75	65.2 %
Mix method is good	13	16	29	25.2 %
Scientific Knowledge is good	05	06	11	9.6 %

It is reported by the respondents that 65.2 percent respondents viewed IK is fit for shrimp aquaculture in the study villages, 25.2 percent viewed that both IK and ScK is good and only 9.6 percent viewed that ScK is fit for shrimp aquaculture in the study villages (Table 36). But real scenario is that in the farms the farmers apply mixed method and scientific knowledge. They have good harvest than the small or medium farmers. Though, for this reason their production cost is high, rate of production rate is more than that of costing. So, they think that if they use more scientific knowledge, the rate of WSS (White Spot Syndrome) or common name virus attacking is decreased.

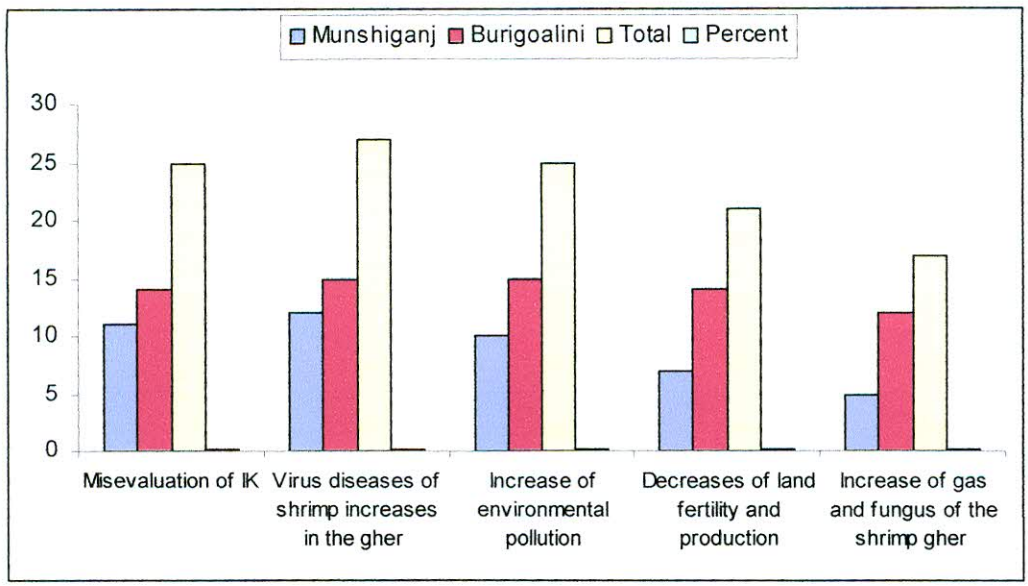
Table 37: Problems of Using IK in Shrimp Culture

Problems of Using IK	Munshiganj	Burigoalini	Total	Percent
Not enough for existence	11	23	34	29.6 %
Not fit for sustainable development	14	23	37	32.2 %
Make the works slow	09	10	19	16.6 %
Degradation of environment	11	14	25	21.7 %

It is observed that 29.6 percent respondents viewed IK is not enough of for existence from external attacking. 32.2 percent agreed that IK is not fit for sustainable development, 16.6 percent agreed IK makes all the works slower, and only 21.7 percent agreed that IK can degrade the environment. So, IK has good and bad impact on society and environment at the coastal area of Bangladesh.

Table 38: Problems of Using ScK in Shrimp Culture

Problems of Using ScK	Munshiganj	Burigoalini	Total	Percent
Misevaluation of IK	11	14	25	21.7 %
Virus diseases of shrimp increases in the *gher*	12	15	27	23.5 %
Increase of environmental pollution	10	15	25	21.7 %
Decreases of land fertility and production	07	14	21	18.3 %
Increase of gas and fungus of the shrimp *gher*	05	12	17	14.8 %



Graph 12: Problems of Using ScK in Shrimp Culture

It is found that 21.7 percent respondents report that scientific knowledge is mostly western or international knowledge, it can not evaluate the IK or local knowledge, 23.5 percent respondents viewed, using scientific knowledge increases virus diseases in the study villages (Table 38), 21.7 percent agreed that it increases environmental pollution, 18.3 percent agreed that its excessive use can decrease land fertility and it is the cause of low production rate and 14.8 percent agreed that it increases gas and fungus in the shrimp *gher*. In the earlier, in chapter two, it is seen that 16.2 percent respondents are illiterate and 41.9 percent respondents are primary educated, majority of them are not aware of ScK for their shrimp farming properly.

Table 39: Complementary use of IK and ScK

Opinion	Respondents	Percent
IK and ScK is complementary	50	43.5
IK and ScK is not complementary	42	36.5
No Opinion	23	20.0

IK and ScK are complementary and collaboratively usable. Among the respondents 43.5 percent respondents agreed that both IK and ScK are complementary; 36.5 percent agreed IK and ScK are not complementary and 20.0 percent respondent have no comment about the matter. It is observed that only ScK is not useful for environment friendly shrimp culture, both ScK and IK of the respondents are necessary for the sustainable shrimp culture.

6.5 IK and ScK in the Crab Hardening and Fattening

Crab aquaculture of coastal area of Bangladesh, fully depends on IK of farmers. They are used to culture juvenile mud crab (Scylla serrata: Scientific name of local mud crab) in clay and marshy land of the study villages. Crab farmers use some sort of ScK and IK collaboratively for better production of crab in farms.

6.5.1 Catching Juvenile Crab

The crab farmers use their IK or own technique or methods to catch the juvenile crab from the mangroves and the river of the Sunderbans. They use a long rope and bind pieces of fish with a peg to catch small crab. Then they use baskets, pots to store the juvenile crab.

6.5.2 *Gher* Preparation

Crab farmers generally select a low clay land as crab *gher* as the water enter in it easily. They break the soil and mix lime and fertilizer with the soil.

For protecting the soil from dirt, to make the soil clean and good, the crab farmers use lime and some fertilizers. It also cleans the water of the *gher*.

6.5.3 Fence Making Surrounding the *Gher*:

When the soil is clear and pure, they make fence or wide dikes around the crab *gher*. It must be strong otherwise crab can go outside the *gher*. It is made of bamboo, mud and Tin. Over the dike or fence they use a net.

6.5.4 Sludge Removal and Water Intake or Change:

They have to remove or waste out the dirt and sludge from the *gher* and use to intake water into the *gher* by turns. When the water becomes very dirty they change the water.

6.5.5 Stocking and Carrying of Crab

The crab catcher and collectors carry big pots and baskets to carry the crabs. The baskets are also made by them. The crab farmers buy the juvenile crabs for hardening and fattening from the collectors. Then they keep the juvenile crabs into the crab *gher*.

6.5.6 Feeding of Crabs

The crab farmers give different types of food. At first they cut the food into small pieces to give them in the *gher*, twice or thrice a day. They can understand whether the crabs are hungry.

6.5.7 Testing of *Gonad* of the Female Crab

They understand very easily of the female crab's gonad is matured and then the crabs become fatty and hard.

6.5.8 Disease Management of the Crab

Normally, crabs have no disease; but sometimes the virus or white spot disease occurs in the *gher*. Then some crabs die in the *gher*. They always try to collect the dead crab and throw out them of the *gher*. Otherwise other crabs may get sick.

6.5.9 Grading of the Crab

According to weight, hardness and presence of gonad of the crab are the criteria of a good crab.

The respondents argued that depot owners, N.G.O workers and Upazila Fishery Officer gave them some information for grading the crab.

6.5.10 Catching and Binding the Legs of Crab with Taps:

The crab farmers catch the crab with net, *atole* (locally made instrument) and also hand. Then they bind the legs of the crab with taps and go to *depot* to sell them.

From the field observation and collected data from the respondents, it is found that almost in all cases, they use IK or traditional knowledge for hardening and fattening the juvenile and soft crab. They use very little of scientific knowledge for water and soil purification and grading of the crabs. They themselves learn from experience, to catch juvenile crab from jungles, rivers and mangroves of the Sunderbans. At the same time, some crab farmers were interested to cultivate crab because of their high price, more demand and profitability. Majority of respondents (90%) viewed that the hardening and fattening is les expensive but more profitable. Also it needs very small amount of investment. So many farmers of the study villages started to culture the mud crab very efficiently.

From the data of the study villages, it has been found that 100 percent crab farmers use indigenous or traditional or local knowledge, but in some extent they use some lime, fertilizer to make the soil and water clean and for protecting different infectious diseases. They have no knowledge about the diseases and medicine of the crab. So,

normally they can not do anything whenever crabs are affected by virus or white spot disease. They are able to gain knowledge about the density of crab, area of the *gher*, apply food in the *gher* and others from their experience and view exchange with other farmers. Also 26.5 percent respondents viewed that they got training from Caritas and Uttaran (Non Government Organizations) to gain some knowledge about crab farming in the study villages.

Table 40: Knowledge Using in Crab Culture

Type of Knowledge	Percent (in earlier)	June 2008
Traditional Knowledge	100.00	93.1
Mixed Knowledge	0	6.9
Scientific Knowledge	0	0

It had been reported that 100 percent of the respondents of crab farmers use IK for crab culture, at present only 6.9 percents both scientific and IK and none use scientific knowledge for crab hardening and fattening of the study villages.

Table 41: Sources of Juvenile Crab

Name of Source	Munshigaj	Burigoalini	Total	Percent
River	16	36	52	52.0
Mangroves	13	22	35	35.0
Shrimp gher	04	04	8	8.0
Others	04	01	5	5.0

It has been found that 52.0 percent respondents agreed that juvenile crabs are caught from the rivers, 35.0 percent are caught from mangroves; 8.0 percent from shrimp

gher and 5.0 percent from other sources. Rivers of the Sundarbans are the main source of small and soft mud crab of the study villages.

Table 42: IK and ScK of Crab Culture

Opinion about IK and ScK	Munshiganj	Burigoalini	Total	Percent
Production with IK is good	25	50	75	75.0 %
Production with mix method is good	06	07	13	13.0 %
Production with Sc knowledge	04	04	08	8.0 %
No Opinion	02	02	04	4.0 %

It has been found that most of the respondents (75.0%) viewed that IK is good and fit for crab fattening and hardening and it had no effect on environment. It is because of their lack of proper knowledge of crab culture. 13.0 percent respondents viewed that both IK and ScK are good as combined and only 8.0 percent respondents reported that production with ScK is good and only 4.0 percent respondents have no opinion. As it is seen in earlier that majority of the respondents are only uneducated and primary educated. They are not conscious about the importance and use of ScK. So they supported only for IK. They think that IK is only more applicable than other techniques.

Table 43: IK for Crab Culture

IK for crab *gher*	Munshiganj	Burigoalini	Total	Percent
Culture of crab *gher*	19	19	38	38%
Cleaning the soil and water timely	12	13	25	25.0%
Throwing out the dead crab quickly outside the *gher*	04	14	18	18.0
Making and using of compost and natural manure	02	17	19	19.0%

It has been reported that 38.0 percent respondents viewed, they were making the crab *gher*, 25.0 percent respondents agreed that they clean the soil and water; 18.01 percent respondents viewed that they throw the dead crab quickly outside the *gher* and only 19.0 percent respondents viewed that they make natural manure and processing of cow dung by themselves.

Table 44: IK and ScK Complementary in Crab culture

Opinion	Number	Percent
Yes	**66**	**66.0**
No	**31**	**31.0**
No opinion	**03**	**03.0**

It has been found that 66.0 percent respondents viewed that mix method is good or IK and ScK complementary. 31.0 percent respondents viewed that IK and ScK is not complementary and only 03.0 percent respondents have given no opinion about the matter.

Table 45: Importance of IK in Crab culture

Importance of IK for Crab culture	Munshiganj	Burigoalini	Total	Percent
Less environmental pollution	13	15	28	28.0 %
Socio-economic development	11	16	27	27.0 %
Less virus attacking	08	09	17	17.0 %
Less impact on biodiversity	04	23	27	27.0 %
No opinion	01	00	01	1.0 %

It is reported that majority (94.5%) of the respondents viewed that their IK of crab aquaculture is fit and good for their development. Among them 28.0 percent respondents agreed IK has minimum effect on environment. So, it causes less environmental pollution, 17.0 percent respondents agreed, if they use IK for crab aquaculture, then less virus attacking occurs. 27.0 percent respondents viewed that IK of crab aquaculture has very few effects on coastal biodiversity and mangroves, 27.0 percent respondents agreed that by using IK of crab aquaculture they have economically solvent and only 1.0 percent respondents did not give any opinion about this subject.

So, it is clear from the above discussion that IK is used by the respondents of study villages. They also use ScK and IK for their shrimp and crab culture. They think that IK is fit and for shrimp and crab culture and it has minimum effects on environment, but it has a great impact on our national economy. So, importance of shrimp and crab aquaculture is very necessary for socio-economic development of the area as well as the coastal area of Bangladesh.

CHAPTER SEVEN

PROBLEMS OF IK IN SHRIMP AND CRAB CULTURE

7.1 Shrimp Culture Related Problems

- 7.1.1 Mixed Fries Problem
- 7.1.2 Irregular and Inadequate Supply of Fries
- 7.1.3 The Constraints of Fry Trade
- 7.1.4 Constraints of Shrimp Culture
- 7.1.5 Virus Problems
- 7.1.6 Pressure by the Shrimp Farm Owners
- 7.1.7 Inadequate Allocation of Credit
- 7.1.8 Natural Disasters
- 7.1.9 Non-cooperation of the Fishery Officials
- 7.1.10 Lack of Skill and Efficiency
- 7.1.11 Impaired of Partnership
- 7.1.12 Problem in Payment
- 7.1.13 Lower Quality and Insufficient Supply of Fishmeal
- 7.1.14 Transport Problems
- 7.1.15 Sheer Lack of Government Care
- 7.1.16 Attitude of the Shrimp Companies
- 7.1.17 Exporting Problem

7.2 Problems of Crab Hardening and Fattening

- 7.2.1 Virus Problem
- 7.2 .2 Irregular and Insufficient Supply
- 7.2.3 Credit Problem
- 7.2.4 Flood and Natural Disaster
- 7.2.5 Negligence of the Fishery Officials
- 7.2.6 Inefficiency and Ignorance of Farmer
- 7.2.7 Cash Customer Problem
- 7.2.8 Problem of Feed
- 7.2.9 Security Problem
- 7.2.10 Communication and Transport Problem
- 7.2.11 Monopoly Attitude of the Crab *Depot* Owners
- 7.2.12 Problems Crab Export

Problems of IK in Shrimp and Crab Culture

In the previous discussion, it is observed that effects of shrimp and crab culture on society, economy and environment aspects count both positive and negative sides. In addition to socioeconomic and environmental impacts, it has some major problems. In this chapter the major problems related to shrimp and crab culture have been discussed.

7.1 Shrimp Culture Related Problems

7.1.1 Mixed Fries Problem

Mixed fries problem is a major problem of shrimp culture of the study villages. The farmers of different categories of the study villages were often cheated by dishonest traders. The cheaper fries are mixed with the good one and then supplied to the farmers. Generally *bagda* fries are added to *golda* fries. Moreover sometimes the fry traders mixed various materials which look like shrimp fries. This is a common problem in the study villages.

7.1.2 Irregular and Inadequate Supply of Fries

Day by day the number of shrimp farms is increasing. So, the number of shrimp farms, area under shrimp farms, demand and supply of shrimp fries and other inputs are not available and they are not regulated by any authorities. There is no systematic management in this regard. For this reason, there is irregularity in the supply of shrimp resources. So, the farmers of different categories are unable to get shrimp fries timely. The problem is raising in almost all seasons in the study villages.

7.1.3 The Constraints of Fry Trade

There is poor handling of the product after harvesting and inadequate quality control in some processing plants. Also, insufficient container space for the shipment of the frozen product from Satkhira, Khulna to Chittagong to connect with ocean going container ships. There are some inappropriate aid programs. It is because of Lacking extension and training programs (Nurruzaman 1993).

7.1.4 Constraints of Shrimp Culture

The culture has lack of establishment of the shrimp hatcheries in the country particularly the hatchery for Peneid shrimps. It has shortage of good quality of shrimp fry. The high prices of shrimp fry especially in the Khulna- Satkhira area. Poor shorting, handling, transportation and lack of acclimatization of shrimp fry during stocking and absence of nursery management practices in most cases. It destructs the nursery areas especially the coastal mangrove forests. In shrimp culture there is poor pond design and construction; lack in water quality management. It has lacking of clear cut policy regarding shrimp culture. It has shortage of animal dung for fertilizing ponds due to its use as fuel for cooking in the rural areas. The respondents have lacking of appropriate knowledge in use of fertilizers and supplementary feeds. Shrimp culture in the study villages has inefficient traditional harvesting methods and culture technology (Nuruzzaman 1993). The respondents are using in most cases the indigenous knowledge and methods to for culturing the shrimp in the study villages. Also, they are aware of about international technical knowledge and unconsciously they use their own indigenous technical knowledge. For this reason, there arise some problems.

7.1.5 Virus Problems

Virus is a common problem in almost all shrimp farms in the study area. Every year virus attacks many shrimp farms and within a few days all the shrimps of the respective shrimp farms die. Almost all respondents agreed that virus is a common problem in this locality. But no preventive measure is available to them. They added none helped them in this regard. The experts told it may be occurred due to water pollution by chemicals or may be due to use of virus affected fries from fry traders. The Upazila Fishery Officer (UFO) of Shyamnagar Upazila told that he also knew nothing about the prevention of the virus disease of shrimp in the area. Some skilled and expert farmer added that use of hatchery fry is a cause of virus disease and fries from natural source are tolerant and adjustable for the shrimp farms. Almost all the farmers viewed this opinion whenever may be cause; it is like an epidemic for the shrimp farms in this area.

7.1.6 Pressure by the Shrimp Farm Owners

Sometimes, the large neighbor farm owners create pressure on the small farm owners to merge their land or farms with their (the large farmers) large farms. This type of unethical practice is a discouragement for the small rural shrimp farm owners to continue shrimp culture. Majority of the respondents (70%) of farm owners viewed this opinion of the study villages. This occurs mostly in *bagda* farms. In these farms require larger area of land for shrimp culture.

7.1.7 Inadequate Allocation of Credit

Majority of shrimp farmers mentioned about the problem of credit. It is the most important problem to them. They (50%) also mentioned that supply of institutional

credit for shrimp farms is insufficient, and they need more credit for sunning the profession. On the other hand, the system of credit disbursement by the financial institutions is very problematic. Moreover the rate of interest is high and a lot of dishonest personnel are involved in this sector. So the poor shrimp farmers are forced to take credit at a higher rate of interest from the money lenders of the rural areas. A union parishad member of Munshigonj Union Nikhil Kumer Mridha mentioned his experience in this respect. He told that credit is not available for the shrimp cultivators of the area and its procedure is very much critical. So, most of the village shrimp farmers take credit from rural rich money lenders and naturally the rate of this credit is very high. It is 15 to 25 percent per month and 120 to 130 percent per year. Moreover, availability of credit is insufficient and for this reason the farmers are bound to take *dadan*(rural usury business by rich people and village *matbar*). The terms and conditions of *dadan* are very much exploiting for the shrimp farmers. He also added that those who have not own capital and land they are not getting actual benefit from shrimp culture in this area.

Mridha also opined that they should not be taken the shrimp culture as the only profession but an extra source of income. He further mentioned that mortgage is essential to have the government credit, so the share cultivators of shrimp do not have credit and so they go to NGO's or money lenders of the locality where the rate of interest is very high.

Some of the poor respondents 20 (%) expressed their experience in this respect. They told that they received money from lenders on conditions that at the end of season they have to pay back with interest at the high rate. But suddenly their shrimp resources attacked by virus and they got back very few money from the aquatic

resource. Consequently they could not pay money back to money lenders. He charged extra interest for their delayed payment. The shrimp producers are impelled to receive such financial exploitation in their disastrous low producing environment.

7.1.8 Natural Disasters

Flood and other natural disasters are mostly regular problem for shrimp culture. Every year natural disasters affect the shrimp stock in the *ghers* of the study villages. Majority of the respondents (96%) of the two study villages agreed that the close proximity of the Bay of Bengal causes several natural disasters such as flood, tornado, flush flood, tidal upsurge and the like for the study villages. The environmental adversity leave, negative condition for the shrimp production. The size of *bagda* farms is very large. So, it is difficult to protect the farms during natural disaster.

7.1.9 Non-cooperation of the Fishery Officials

There is a fishery office in Shyamnagar Upazila and some trained officials are employed in the office. Majority of the respondents (80%) viewed that they didn't get any effective cooperation from the Fishery Officials. It is due to their negligence of duty and they are reluctant to address and solve the problems the shrimp farmers face in their daily production.

7.1.10 Lack of Skill and Efficiency

During the field visits, it is observed that many shrimp farmers are unskilled, semiskilled and they are not efficient much to ensure quality shrimp aquaculture in the area. It is due to lack of gathering knowledge about the appropriate method and proper harvesting. Also many of the shrimp farmers (52%) viewed that they had no

practical experience or view exchange about good shrimp aquaculture in the area. Most of them are self trained. So, there exists some ignorance. For this reason, the shrimp farmers of the area follow only traditional method of shrimp aquaculture, rather than semi-intensive or highly intensive or scientific shrimp culture methods. But some local based non government organization give some short term training programs to the shrimp farmers. During the field visit, it is found that there are same interested shrimp farmers (40%) who felt the necessity of training. Some of them expressed their grievances to the government. They viewed that many researcher had come to collect information but the problems of the shrimp farmers have not yet been solved. They also viewed that government earns a lot of foreign currency from this sector and it is the contribution of the illiterate and ignorant shrimp farmers. So, if they are properly trained and financially supported by Government and Non Government organizations, the yield of shrimp production and its earning will be multiplied. Some of them do not believe the researchers. They think it is not for the betterment of the shrimp farmers but the researcher himself.

7.1.11 Impaired of Partnership

It means the problems created by small shareholders of the shrimp farms. The farmers who have small land, they want to join as a shareholder of a big farm, sometimes, they want to mortgage their land and sometimes they want to keep the farm under his own control for another use like paddy cultivation. It hampers the project. The other share holders try to occupy his land by any means. This problem is common in the study area.

7.1.12 Problem in Payment

Customer especially cash customer is also a major problem for shrimps aquaculture in this coastal area. In the shrimp harvesting season, many small petty shrimp traders are moving from one farm to another for buying shrimp, but they possess very small amount of money. They work just like commission agents, because, when they buy shrimps from the farmers they do not pay the entire price in cash at a time. They sale it to the *depot* (sale center of shrimp fry and shrimp) owners or to the shrimp exporters and after getting price from them, the small petty traders pay to the due price to the shrimp farmers. For this reason, the shrimp farmers always do not get their dues properly in time.

7.1.13 Lower Quality and Insufficient Supply of Fishmeal

There are some problems faced the shrimp farmers in having fishmeal supply. Factories produce inadequate amount of fishmeal that is insufficient to meet the demand of the shrimp farms. Moreover it is not available all the time and it is costly so that poor farmers' can not afford it. Additionally, its quality is not up to the mark. For this reason, the shrimp farmers of this area depend on natural feeding materials. Some farmers do not use artificial food in shrimp farms. The low quality and insufficient supply of fishmeal causes the lower yield of shrimp production.

7.1.14 Transport Problems

The shrimp farms are lying in the very remote, interior and coastal areas of Bangladesh. So, communication and transport network is very poor in the study villages. Due to lack of communication and transport, the farmers do not get the

information about shrimp marketing and it is impossible to carry their product to the companies to get higher price.

7.1.15 Sheer Lack of Government Care

Though shrimp exporting is a source of major foreign currency income but the government has not yet taken required proper care for its quality production. The respondents (40%) reported that if the production point collapses, the shrimp culture will be shrank. Consequently, the image of quality shrimp export must have to face a great adversity in the world market and its ultimate result causes the decrease of foreign currency income. It is evident that the government organizations are very fatalistic in taking care of this golden aquatic resource.

7.1.16 Attitude of the Shrimp Companies

Shrimp companies perform important activities in shrimp marketing. They always try to monopolize the marketing of shrimp as their desire. So, due to monopoly attitude of the shrimp companies, the shrimp farmers do not get due price of their shrimps. Shrimp companies are very few in number and they are the customers of shrimps at the final stage in Bangladesh and thus they exercise their monopoly power infixing the price rate of shrimps. Majority of the shrimp farmers (70%) reported that the company personnel deal with the farmers in un-courteous fashion. So, it is a great problem for all the shrimp farmers and it belittles the farmers' zeal in the quality production.

7.1.17 Exporting Problem

No doubt, foreign exchange earning shrimp has been increasing day by day. On the other hand, our export market of shrimp is not smooth. This is not well organized and

adversity-free for the shrimp traders. The shrimp traders and *arotder*s reported that many problems they have to face in the export market.

i) Quality of shrimp is the main issue. So, quality of our exportable shrimps is not always up to the mark. But in the foreign markets, especially in the Japanese and European markets, shrimp with slightest trace of pesticide or antibiotics causes hundred percent rejection of the consignment. So, the excessive use of pesticides and antibiotics in shrimp aquaculture, constantly keeps our shrimp exporting in the high risk and it causes a hazard or critical situation in the market. Also, the laboratories control all ingredients used, such as salts, spices, vegetables, liquids and so on. Some controlling process is also concerned with packaging materials, weights and accurate descriptions of the products. Sometimes shrimp traders and exporters adopt illegal practice to overcome these inadequacies. As a result, they loss the faith of the foreign buyers or the consumer countries.

ii) Shrimp farmers do not get reasonable price. It is because of the drawback prevailing in the present procurement system.

iii) Credit facilities especially intuitional credit facilities are insufficient in shrimp sector. The farmers and traders or exporters bound to manage fund from the private sources due to insufficient credit facilities, cumbersome lengthy process and unethical lost of having the institutional credit. As a result, the marketing cost increases which induce to increase the price of the shrimp.

iv) Malpractice adopted by government officials and authorities is also problem to expand shrimp sector.

v) There is lacking of modern shrimp processing plants and cold storage facilities, at the shrimp producing area and adjacent to the shrimp farms is also an important problem of shrimp marketing system.

vi) Irregularity or interruption of power supply is also a barrier of shrimp aquaculture. The charge of electricity is also high for shrimp sector. So, cost of processing increases.

vii) Shrimp aquaculture system in Bangladesh is very much traditional. So, average product per hectare is low, and for this reason average cost is high. On the other hand, backwardness of technology, lack of infrastructure facilities, skilled personnel, expert technicians and proper information system about international market, our export market of shrimp can not expand as much as we expect.

viii) Fish inspection and Quality Control Department of the government issues a certificate after laboratory test of the processed product. Export is not possible without this certificate. But this certification system is very much time consuming which hampers the export activities.

7.2 Problems of Crab Hardening and Fattening

7.2.1 Virus Problem

Like shrimp culture, crab aquaculture also faces with virus problem. It is a major problem for crab culture in the study area. More or less every year virus attacks crabs of many *gher*s and within five to seven days many crabs die. Preventive measure is unknown to the crab farmers. They simply change the water and keep the dead crabs outside the *gher*. Some expert category farmers told that it may be due to poisonous

water of the farms and it is the result of the chemicals used for *gher* making and water purification. Whatever may be the cause, virus is a problem for the crab farmers in this area.

7.2 .2 Irregular and Insufficient Supply

Total number of crab farms, area under crab farms, demand and supply of crab lings and other inputs are not regulated either by the government or by any other proper authority. There is no systematic management in this regard. So, the supply of crab lings is most irregular. Almost in every year demand for crab lings does not match with its supply. Crab farmers fail to get supply of crab lings timely. In most cases it is true in the study area.

7.2.3 Credit Problem

Majority of the respondents mentioned that credit problem is the main problem in the crab aquaculture in the study area. It is most important to them and institutional credit is very insufficient. They need more and more credit for crab aquaculture. The system of credit disbursement is also difficult. Many dishonest personnel are involved in this profession. So, the poor crab farmers are farced to take credit from money lenders of the villages. A crab farmer, Shibu Paul of Munsigonj village mentioned his own experience in this respect. He told that institutional credit is not available for the poor crab farmers. Majority of the crab farmers 77% of the study villages have to take credit from the rich moneylenders. Farmers have to take *dadan* which are very much exploiting for the crab farmers.

7.2.4 Flood and Natural Disaster

Flood and other natural disasters are the major problem for the crab farming. It is because the study villages are very close to the Bay of Bengal. So, flood and disaster can easily damage the crab farms.

7.2.5 Negligence of the Fishery Officials

There is a fishery office in Shyamnagar Upazila and trained officials are employed there. But they are not helpful to the crab farmers. On the other hand, they know very little about crab hardening and fattening.

7.2.6 Inefficiency and Ignorance of Crab Farmer

The crab farmers are unskilled. This is due to lacking of training about crab culture. As, most of the crab farmers are self trained. So they are inefficient. The crab farmers follow traditional method for crab culture.

7.2.7 Cash Customer Problem

Cash customer's problem is also vital problem for the crab farmers. In the crab catching time, farmers catch the crab and go to *depots* to sell the crabs. But they possess very small amount of money. They *depot* holders are just like commission agents. Because, they buy crabs from the farmers and do not pay the entire cash at a time and the farmers do not get the dues properly and fully in time in time.

7.2.8 Problem of Crab Feed

Supply of crab feed, like eel fish, tilapia fish, rice bran and other feed is sometimes insufficient. The farmers depend on natural sources of feed for crab farming. Day by

day, the crab farming increases in this coastal area. But on the other hand the feeding sources do not increase simultaneously.

7.2.9 Security Problem

There is security problem of crab farming in this area. A notorious group of people live in the areas who try to steal the crab from the farms by any means. So, farmers are bound to deploy security guards in their farms.

7.2.10 Communication and Transport Problem

Majority of the crab farms are situated in the very interior and remote coastal area. So, the communication and transport problem is a common to the coastal crab farms. For this reason, the crab farmers are in very problematic situation. They do not know the latest information of the market and they are unable to carry their product to the depots to get higher price.

7.2.11 Monopoly Attitude of the *Depot* Owners

The *depot* owners show the monopoly attitude about the crab marketing. So, the crab farmers do not get the real price of crabs. As the exporters are very few in numbers, they hold monopoly power. So, sometimes they use to misbehave with the traders or depot owners.

7.2.12 Problems Crab Export

Now Crab is one of our major export items. Day by day, the export earning is increasing but it does not get proper care and the export market of crab is not smooth and well organized. It can be summerized the problems of crab export in the study villages.

1. Excessive use of chemicals damage the market demand of the crab.

2. Insufficiency of shipment facilities is another problem.

3. Crab farmers of the rural remote coastal villages do not get reasonable price due to the traditional system of crab culture.

4. Institutional credit facilities are insufficient for crab farmers.

5. Lack of modern crab processing plant and cold storage facilities at the crab culturing area or adjacent to the crab farms is also an important barrier of crab exporting.

6. Crab hardening and fattening is very much traditional. So production rate is low and average cost is high.

In chapter seven the researcher discusses about the problems of shrimp and crab culture in the study villages. There states many problems which are very much included with the shrimp and crab management. The farmers of shrimp and crab of the study villages are facing problem of salinity in the water and soil, technological know how because their techniques and methods of shrimp and crab culture is very much traditional and their knowledge is also indigenous. So, the farmers of shrimp and crab should follow both of the traditional knowledge (IK) and International and formal scientific knowledge (ScK). Because of matching of the competitive world it is very necessary to upgrade the methods of production of these two aquatic resources to increase the production rate and avoid the problems of shrimp and crab culture.

CHAPTER EIGHT

WOMEN'S ROLE IN IK FOR SHRIMP AND CRAB CULTURE

8.1 Low Wage Rate and Exploitation of Wage

8.2 Constraints of Women in Shrimp and Crab Culture

8.3 Insecurity of Women

8.4 Organization Capacity and Import

8.5 Challenges of Women

8.6 Women Workers in Processing Plants

8.7 Inadequate Income for Female Workers

8.8 Protection against Contingencies and Uncertainties

8.9 Harassment at Workplace

8.10 Health and Safety

8.11 Inefficiency and Ignorance

Women's Role in IK for Shrimp and Crab Culture

Shrimp aquaculture in the coastal area of Bangladesh has led to the change of the total landscape. Environmental degradation, decrease of mangrove forest and convert the agricultural land to shrimp farms. The ecological change is a major factor behind floods and cyclones in the coastal areas alongside the health hazards of the local people (UBINIG 1997). Many villagers lack adequate shelter, since the non-concrete (mud and bamboo) houses have deteriorated due to the constant dampness caused by flooding. Apart from such natural environmental degradation, the activity of fry catching with very thin nets is environmentally harmful. The people while catching fries kill other species of marine resources in a ratio of 1 fry to 500 other species (UBINIG 1997).

The adverse impact of shrimp production on environment has negatively affected the situation of women as well. Ahmed (1996) points out that women used to collect cow dung, leaves and wood but they can't do so since the trees are gone. Women and girls also spend more time and energy each day a minimum three hours in collecting safe drinking water and fuel for cooking due to the dwindling supplies of firewood and cow-dung.

Furthermore, it is a noticeable fact that the influential *gher* owners force the marginal people to have the ownership of ancestral homestead plots. Due to various malpractices in commercial shrimp culture the landless people get no access to the use of *khas* land.

The health condition of the poor women and children is suffered from the transformation of the landscape and declining income. Villagers can no longer

produce or purchase adequate nutrition for them. In particular, their diet lacks protein from fresh water fish, dairy products, meat and poultry. Poor nutrition has resulted in increased birth defects, stunted growth, night blindness, and various childhood diseases, as well as in an increase in miscarriages and maternal mortality and morbidity (Ain O Shalish Kendra 1994).

Majority of the respondents (60%) agreed that male and female of different ages collect shrimp fry for their livelihood. There are men, women, boys and girls who are the catcher of shrimp fry. But young girls or women are the dominant groups. They could harvest fry even at day time. This is possible because they have already broken the traditional norms of society by coming out of their houses. Some of qualitative information which was collected through FGDs showed that majority (50%) who are engaged in this profession were separated or deserted by their male family members.

About 85 percent of the women in the south western coastal Bangladesh are engaged in shrimp fry collection from rivers as it does not interfere with their day to day household work and helps supplement the household income (Shelly and Costa 2002).

The women of the study villages actively engage in various kinds of work in shrimp farms, i.e. dike construction and maintenance, liming, harvesting and other farm related activities. Women also work in the *depot*s, factories and in places where the trading takes place playing an important role in fish grading and packaging.

Considerable tracts of land in south western Bangladesh have are converted into saline ponds where shrimp are cultured. In many areas, land is forcibly taken by richer farmers from poorer people for shrimp farms and often these shrimp farm owners are outsider of the area. The rural women then become laborers who collected wild

shrimp fry from coastal rivers and marches (Datta 1995). Also the increasing salinity will decrease the productivity of land, pushing communities but more to women, because of either limited work opportunity or restricted mobility further into poverty.

Consequently, women's livelihood is being put in risk in the various ways. Women are displaced from their traditional role by shrimp and crab aquaculture. They have over dependence on cash crop and loss of traditional safely nets. There is a lack of the national and community support during transition phase. Women also exacerbate and marginalize by the shrimp and crab aquaculture in the study villages.

Moreover as women are involved in the shrimp fry catching in the nearly rivers, they are also contributing towards reducing the future stock of shrimp. With the loss of subsidiary work and increase of female headed households as males migrated outside the area looking for employment. This will further worsened with climate change and increased salinity of the land (Guhathakurtha 2003).

The experience of shrimp farming and its relations with the livelihood of women in southwestern Bangladesh clearway illustrates that poverty; food insecurity and environmental degradation are clinical development problems that have a disproportionate negative impact on rural women; due to their inferior socio-economic, legal and political status (Vosti and Reardon 1997).

Women are the largest losers in the shrimp aquaculture, where the economic benefit is according to the large producers while the poor, both men and women end up with their lands which have lost its fertility because of salinization so nothing other than shrimp can be produced in the future.

Particularly in all areas of the developing countries, women are contributing to the growth of economy through participation in various types of economic activities and shrimp aquaculture is one such important sector. Women in shrimp aquaculture contribute a great deal to this sector, either directly by harvesting, processing and marketing or indirectly by providing vital extra income, food crops and a host of supporting activities that ensure the well being of the family.

Women involvement in shrimp cultivation is a common phenomenon all over Bangladesh. They work in the shrimp *gher* as wage laborers. They build the embankments around the *ghers*, they maintain service roads, weeding the shrimp and crab *ghers* and liming in the shrimp *ghers*. They have been working from very early period. It is about 20 years. They and their children do various types of work related to shrimp production. Majority of the female of study villages maintain their livelihood by collecting and catching shrimp fry, preparing *gher* as day laborers, clearing the *shaowla* (fungus) and working in the processing plant.

During peak fry collection period (locally known as *Ghone*), women spend the entire night collecting fries. Shrimp fry collection starts from the month of *Boishakh* (Mid April) and peaks from the month of *Jaishtho* (mid May). This fry collection continues through the month of *Bhadro* (mid September) when the numbers of fry collected start falling. The women and children spend early dawn hours or the late evening catching the shrimp fry from the rivers, canals etc. During the full moon the fry availability increases and collectors work any hours that they are available (Halim 2004).

The *gher* owners prefer women workers to male workers. It is because women could be paid less than the male workers and usually women never resist such exploitation. The labor requirements in the *gher* are to repair and reconstruct *gher* embankments, which require earth excavation and movement, clearing the weed and other aquatic plant from the *gher* land.

The preparatory work begins from Choitro (mid March) and Boisakh (mid April) when the *ghers* are prepared for stocking. Generally, women are engaged in the *ghers* for five hours beginning at 7 am and extending till 1 pm.

Daring the lean period, some of the women continue providing services to the *ghers,* while other seek employment in homesteads, repairing homes, processing crops or for domestic services. Majority of the women respondents of the study area, were wage labors, some are small *gher* owners.

8.1 Low Wage Rate and Exploitation of Wage

The women (80%) in the study villages reported that the wage rate for *gher* preparation is lower than that of their male counterparts. The average wage rate for female workers per day is between Taka 45 to 50. In all the activities related to shrimp production women receive lower wage compared to their male counterparts. The participants drew attention to the fact that men get preferential treatment in terms of wages, although both men and women are engaged in similar type of activities. The female workers reported that they receive Taka 50 to 60 per day for earth excavation in the *gher*, while their male counterparts receive Taka 90 to 100 per day. For cleaning and beheading the shrimp they receive Taka 45 to 65 per day while their male counterparts receive Taka 80 to 90 per day (FGD conducted in Munshiganj).

The female workers continue to accept the low wage only to maintain their subsistence. They are forced to receive lower wages.

1. The supply is more than the demand for female workers; therefore, the employer takes the advantage of the situation and exploits female workers.

2. Absence of any other better alternative is compelling female to do such works with low wage.

3. Employers claimed that male workers work more than female workers.

Another type of wage exploitation is bonded labor. Poor male and female workers take loans in advance from local wealthy people. This system of taking loan is known as *dadan*. Majority of the poor female (95%) of the study villages take *dadan* from the *faria* (local small scale buyers of fries who sell the friy to the market) during their crisis period. The precondition of such *dadan* giving is to sell the collected shrimp fry to the *faria* from whom *dadan* was taken. The *faria*s exploit the poor female workers because they (*faria*) buy the shrimp fry for less than the market price. If the member of any family, who has taken *dadan* from *faria*, does not collect fry, the *faria* creates pressure on them to do so.

Women fry collectors sell their catching fries at shore or at home, they have to agree to whatever rate in offered. Men fry collectors on the other hand can travel up to trading points or centers where they can compare rates of several purchasers and decide whom to sell to and at what rate. Women are forced to sell to the *faria* alone, who is the sole buyer, controlling the price to his advantage. The above finding is

similar to the findings of many other developing countries (FAO 1990), Where marketing, supervision and management of fish production remains a male domain.

Shrimp fry collection by net has attracted the women across classes. In the study area, women from the affluent section are also catching fries. It has given them an additional source of income, which they enjoy for petty luxuries. Some women of the area spent some time catching large *bagda* shrimp fry during the season and this venture has been rewarding as the catch trades for good cash and it helps to break the traditional gender barriers in certain gender specific tasks.

However, employment for women in shrimp aquaculture is seasonal, menial and poorly paid. The income of female workers from working in shrimp production has to be set against a reduced contribution of their traditional unpaid work in agricultural activities and household production. With such a low paid women respondents mentioned that they cannot manage their family properly. Large numbers of female respondents (70%) expressed that they did not consider them engagement in shrimp fry collection and ancillary services to be of significance in terms of improving their overall living conditions. The daily rearing barely covers for two meals. All other essential expenditure for their family's upkeep, for example, others, medical treatments etc. are left unattended because of poverty.

Some reports that female workers' shrimp related cash income had given them some economic independence, raising their status in the family but their income contribution does not necessarily help improve the status of fisher women as a group nor does it significantly improve women's control over their development (FAO

1990). Women see employment in shrimp as the only resort in a no-choice situation where opportunities for productive engagements are scarce.

8.2 Constraints of Women in Shrimp and Crab Culture

The female workers do their routine household tasks and the involvement in shrimp production has increased their total workload. They reported that their house keeping activities has also been increased particularly due to increasing shortage of drinking water and also to collect fuel wood and biomass. In FGD the women participants (50%) of the study villages mentioned that previously they used to spend an hour for the collection of wood. These days fuel collection takes about two hours. Women mentioned that because of the heavy workload in shrimp farms they couldn't do family work. If women fail to prepare meal on time their husbands usually beat them up.

8.3 Insecurity of Women

The workplace environment is not free of problems. Women have to encounter some problems while they work in the shrimp production. During shrimp fry collection from the river, especially young girls and women are harassed either physically or verbally by the male counterparts. Women do not feel secured while they collect shrimp fry from the river especially in the early hours of the morning. In focus group discussion, the women participants (40%) reported their insecurity in shrimp aquaculture. The women participants mentioned some major points,

1. Insecurity of women and children has been increased in this sector.

2. Although the apparent monetary benefit attracts the women and children to work in shrimp related activities, they work against the context of occupational risks, hazards as well as absence social laws.

3. The women have no means to challenge these obstacles.

Majority of the female labors stated that harassment and violence against women is quite visible in the area. The main problems identified by the women are as follows

1. They were not allowed to leave the shrimp producing activities even if they feel sick.

2. They were jeered at and verbally and physically harassed by male guards, managers and male youth inside the *gher*.

3. They were fired from work if they arrived late at work.

During FGD, Women pointed out that it is because of women's helplessness and vulnerable position in shrimp trade that women are left at the whims and wishes of those engaging then in work.

Furthermore, the women and children fry catchers are exposed to different diseases because of the nature of work women are not aware of the diseases that might be caused for being in the water for such long periods. There is a lack of proper health care facilities in this area further, unequal power relationships between men and women hinder women to get access to whatever health service is available.

8.4 Organization Capacity and Import

The prevailing social and cultural norms prevent women from having a public role. Therefore, in the study area there is no such incidence of women collectively

protesting for low wage and sexual harassment. The FGD participants mentioned that they (women) have little option of seeking justice to such harassment, violence, torture or bondage. The women participants considered the following reasons for harassment and discrimination.

The number of women and children are available in the study villages. They are willing to be engaged in shrimp farm activities by the farm owners. They are proving a scope to the employers and to suppress them and their legal rights.

Increase of status, influence and power among *gher* owners, fry traders, etc. have made them more arrogant, and in the absence of proper practice of law and order, these people behave in whatever manner they deem appropriate.

The sudden rise in cash income from the shrimp farming sector also provides some men to resort to gambling, alcohol and womanizing and verbal or sexual harassment.

There are some large national NGOs like BRAC, Grameen (rural) Bank who are working with the rural women in the study area and their major focus on credit disbursement and not on local justice issues. FGD reports show that majority of women in the study area are the members of organizations such as CARITAS, BRAC, GANAUNNAYAN, Shushilon (NGO). FGD reports reveal that the lack of organizational support to women in the study area is depriving them of justice. The role of local organization is not satisfactory in terms of women's interest. The absence of organizational support is preventing women from mobilizing in groups. The women participants (90%) need legal education and other support to deal with the local power structure and other problems.

Women participants (60%) mentioned that they do not have frequent contacts with the elected members of Union Parishad through whom they expected to get assistance.

8.5 Challenges of Women

Majority of the women's livelihood is dependent on shrimp producing activities. As mentioned earlier in the past these poor women used to engage in agricultural or household activities. These traditional occupations are now less available as women have been increasingly entering into the cash economy by taking wage work in shrimp *ghers*. However, in shrimp farms have no standard of labor. It is reported that the social protection for women and a social security system for seasonal, part time, temporary workers are not provided up to mark. Against these circumstances the legal provision that is most relevant for addressing women's equality related to employment, including the right to work and receive equal pay for equal work as stated in (Article 11) of Convention on the Elimination of All forms of Discrimination Against Women (CEDAW) (Halim 2004).

8.6 Women Workers in Processing Plants

Women workers work inside and outside the shrimp processing plants. Both permanent and casual workers are working in the processing plants. Majority of the women workers (90%) are casual in nature of work contract. These casual workers are sometimes employed through the contractors.

Women employed through contractors do not fall under the purview of factory laws and inspection by the concern government inspectors. The factory owners maintain no

timetables. The policy of the processing plants in that during the peak season the plants contract the contractors to supply them with women workers.

The employment of these women depends upon the production of raw shrimp i.e. during the period of the supply of the raw shrimp. The peak season of the study of shrimp is between March and October. Women workers have to work 24 hours (3 shifts 9 day) during peak season. During off-season, there is almost no work in the shrimp processing plants. The permanent workers work from 9 a.m. to 9 p.m. and 6 days a week and can take leave for 12 days without pay. Minor girls work in the shrimp processing plants.

8.7 Inadequate Income for Female Workers

The women of *ghers*, depots and processing plants are paid very low wage to the women workers in the shrimp and crab related activities. Casual women workers do not pay by the owners directly but the permanent women workers paid by the owners of the *ghers*. The contractors paid the casual workers in the *ghers* and are maintained separately and independently by the contractors. They (contractors) who are responsible for their discipline maintain their attendance sheet. They are hired and fired by the contractors on which the management of the *gher* and plants has no control at all. Therefore, the casual women workers are surviving on the mercy of the contractors.

These women laborers are not aware of the amount of money paid for their hard labor to the contractor by the owners. It is revealed from the field investigation that the owners fix a price for a unit of work processing (one kilogram of the raw shrimp). The contractors get the full amount from the owners but they distribute it to the

workers according to their own ways. Sometimes they (contractors) delay the payment of the women workers.

8.8 Protection against Contingencies and Uncertainties

There are no formal policies in terms of work related benefit. The *gher* owners provide no extra financial benefit to the women workers. Women come from areas adjacent to the study area and sometimes employers do not provide them with any housing facilities. However, women workers are not encouraged to stay in such temporary residence. Women workers do not get exact monetary benefit for working long hours and they do not get ill treatment from the *gher* owners.

8.9 Harassment at Workplace

Sexual harassment is reflected in the words, looking or other gesture, which offends the target woman worker. Such harassment can range from jokes and mere touching to blackmails and physical assaults. Women workers (50%) also mentioned that if a male worker harasses a women worker, the employers do not respond to provide justice.

8.10 Health and Safety

Many workers, especially women workers suffer from various diseases in the shrimp related activities such as colds, severe muscle strain, back pain, irritation of the eye, diarrhea, stomach related diseases and cuts and bruises. They (women workers) do not get medical treatment from the *gher* owners (Halim 2004).

In general, the more intensive ways of shrimp farming are much less integrated into the coastal communities where they are situated. Employment opportunities for the

local people often limited to unskilled and low paid jobs, such as watchman and harvester. This often leads to conflicts with the local people. The farmers family who loss the land, will leave to the cities for low skill job. Women and children are the most fragile group related to changing in social structures (Siregar 2004).

8.11 Inefficiency and Ignorance

The rate of education of women in coastal villages is very low. They are not socially, economically solvent. They are unconscious about their rights. They are very inefficient in their indigenous traditional agricultural work and shrimp and crab aquaculture. Also, they are ignorance about their wage and disease management of shrimp and crab aquatic resource management in the area.

Women's role is not encouraging in the area, especially; in the big scale shrimp farming. But in small and medium sized shrimp farms and in all types of crab farms women play a vital role in every sector of aquaculture. So, in using IK of aquaculture women are the main determinants. Because they use IK in maximum shrimp and crab related activities.

CHAPTER NINE

CONCLUSION

9.1 Findings of the Study

9.2 Suggestions

9.3 Limitations

9.4 Conclusion

9.1 Findings of the Study

Shrimp is the second highest foreign currency earning aquatic resource of Bangladesh and accounts for 5.2 percent of the total export earning. Crab is also another aquatic resource for which Bangladesh is earning foreign currencies significantly. Shrimp and crabs are cultivated in southeast and southwest coastal regions. By 2005-06, shrimp area has increased by 420.51 percent as compared to 1983-84. The south west coastal region is highly suitable for shrimp culture and covers 79 percent of total shrimp area, giving 78.9 percent of Bangladesh total shrimp production. Horizontal expansion of shrimp culture has social, economic and environmental impacts, both beneficial and harmful. Environment friendly and sustainable shrimp culture is needed to optimize the use of natural resource and to protect the fragile coastal ecosystem from irreversible and adverse changes. The main findings as conceived in the study are as follows.

CHAPTER 2

The water quality over the study area, with a high degree of uniformity of salinity, water temperature, transparency, ammonia and dissolved oxygen content.

The soil and climate of this area are suitable for some vegetables and shrimp culture and hardening and fattening of crab.

In the study area, shrimp and crab farming continued almost year round due to the presence of moderate to high salinity in the water.

The saline zone of the study area of Bangladesh is suitable for crab culture and a crab takes only 2 to 4 weeks to grow up.

CHAPTER 3

There are three types of shrimp culture practices in Satkhira district and these are exclusively golda and bagda as well as golda-bagda mixed farming. Paddy and white fishes are also cultivated with all of these three types of farming.

Shrimp culture methods and practices in the study area are neither intensive, nor semi-intensive, nor extensive in all respect rather native and traditional.

Shrimp farmers use their indigenous knowledge and indigenous technical knowledge to culture shrimp and crab.

Shrimp and crab farmers practiced older indigenous or traditional methods for shrimp farming in the study area.

In the major cases, the culture and practice by the different farm owners are almost similar.

Shrimp culture of Bangladesh has no glorious past. Basically, commercial shrimp farming started in between late 1970s to early 1980s and continues till today. Though, it has become a vital sector of foreign currency earning of Bangladesh, efficiency, system, methods or knowledge and productivity of this sector has not simultaneously increased with its growth and development.

Crab culture practices at present in the study areas are fully native or traditional in nature.

Traditionally farmers collect shrimp fries from rivers and canals of the Sundarbans fry catchers collect from river and sell shrimp fry to the *arotdars* or farmers.

For the successful growth and survival of the organisms and shrimp fry, the farmers dry the bottom of the *gher* carefully.

Most of the farmers first prefer wild or natural fry because according to them, this fry is stronger and easily adjusted to the local water parameters.

This is true for intensive or traditional shrimp culture systems for the high feeding, fertilizer and water exchange very frequently.

Gher owners make point or nursery at the highland outside their *gher*. The function of the point is to test the survival level of the fry.

The crab farmers culture crab in their own traditional way. They use very few techniques of scientific method, tools for hardening and fattening the juvenile crab.

For preparation of the crab *gher*, they make dike, fence and give water cow-dung, and natural manures (compost).

Crab catchers are catching or collecting the small or juvenile crab by net or big long rope and keep in baskets to bring in the shore and sell to the crab farmers.

Farmers change the water within seven to ten days and observe the *gonad* (the ovary of the female crab), whether it is matured.

CHAPTER 4

Shrimp culture has increased to the extent and severity of soil and water salinity in the study area due to year round stagnancy of saline water in agricultural field. Soil fertility of the study area has been reduced drastically due to shrimp culture resulting from reduced organic matter content, destroying of ground cover vegetation, absence

of cattle grazing. It also caused least incorporation of rice stubbles into soil, unavailability of many essential plant nutrients due to prolonged submergence as well as hampered nitrogen fixation and stagnancy of mineralization.

Shrimp culture has increased the water logging in the study area due to the intentional water trapping, siltation in the riverbed and carrying of water by the rivers beyond their capacity in monsoon. Ultimately it submerges the homestead areas, gardens, rural roads, ponds etc. followed by absence of full recession due to uneven topography.

Before shrimp culture, there was different cropping patterns. Now, mainly two cropping patterns exist such as: Fallow - Shrimp - Aman, and Shrimp - Fallow. The shrimp based major two cropping patterns have exposed the local people to the risk of food insecurity.

Gher construction in flood plain areas destruction of natural habitats, spawning and nursery grounds, habitats, indiscriminate killing of innumerable fish fries of non-target species during bagda post larvae collection, killing of non-select fish species in *gher*s, intensive fishing in small areas and dry catch practices have reduced the open water fishes.

The male and female workers of shrimp *gher* suffer from a number of diseases like nail rotten, sore between fingers, various types of skin diseases, respiratory diseases, sneezing, diarrhea, fever, headache and jaundice.

The lifestyle of the shrimp farmers has been improved. Using the profit of shrimp culture they have improved housing structure, sanitation pattern. Shrimp culture has

given rise to a number of interrelated social conflicts. The outsiders are forcefully occupying land of others. *Gher* owners take lands from small land owners on rental basis but they do not pay full amount of land rent.

Gher owners took lease *Khas*land, ponds and other water bodies on flexible terms. So, the poor people can't do fishing in the water bodies.

The terrorism like occupation of others land, eviction from *gher* and forceful harvesting of shrimp are found in the study areas and the opponents are subject to torture, violence and even killing.

The pious Muslim women face '*purdah*' (curtain) problem in the study area, because the *gher* guards and other workers gather to watch the *gher*. Sometimes the women are facing social insecurity and sexual harassments though its frequency is low.

Shrimp culture has positive impacts on employment due to creation of different jobs. The jobs include fry catching, transportation and trading, hatcheries, shrimp feed mills, depots, shrimp processing and exporting industries, dike construction, guard, ice factories, small trading and dike agriculture.

Shrimp has changed in profession of the *gher* workforce who were mainly day labors, fishers, small traders and rickshaw van pullers. Shrimp culture has increased the *gher* guard's monthly income and decreased monthly income of professional fisher community.

Several types of new jobs have been created relating to shrimp culture basket making, snails collection, fry collection and catching, snails breaking, petty shrimp trading,

depot business, beheading of shrimp, trading of shrimp fry, preparation and repairing of *gher*, ice producing and trading, shrimp processing and exporting etc.

The shrimp has negative impact on crop diversification because; there is no scope to cultivate of different crops. Also share croppers are unable to get the lands for higher rented lands.

Some people engaged for open water fishing for their livelihood but due to shrimp culture they have lost their job.

Crab culture is easier but profitable and its' investment is low. A juvenile crab takes only 10 to15 days to be hard or fat.

The crab *gher* owners try to improve their houses. The straw shed and mud house are now wooden or brick built houses.

Crab farmers' economic condition has been increasing due to financial benefit. From this study it has been seen that, as compared to pre-crab situation, katcha or traditional unhygienic toilet have been reduced more significantly.

By the advent of crab culture, food and nutritional intake affected seriously. Intake of rice, meat, fish, egg and milk has been changed remarkably. Open water fish, cattle have been reduced by crab farming.

Crab culture has brought a change of consumption pattern and change towards modern life. The increase of income and savings of money are the determinant of modern life.

By crab farming, farmers become financially solvent. So, the crab farmers try to avail medicare services. They go to Thana Sadar Hospital and District Level Hospital for better treatment.

CHAPTER 5

Shrimp farmers practice IK that they assume that scientific knowledge is harmful to their environment and native knowledge. But actual scenario is different from this. Because, quality production of shrimp and crab and fulfillment of foreign buyers' demand, it is necessary to apply ScK for sustainable shrimp and crab culture in the area.

The rapid and unplanned expansion has created different social and environmental tensions at the local level including its sustainability, benefit cost distribution and equity.

Shrimp culture has aggravated the portable water scarcity in the study area by degrading the pond water quality, contaminated by submergence of the homestead areas, washing out of latrines and increased salinity of the pond water now is turbid, less tasty and below the Bangladesh standard for drinking water quality. Shallow tube-well water quality of the study area has been degraded and has become worse, less tasty and odorous. The tube-well water scarcity is acute in the study villages due to the absence of deep tube-well and insufficient shallow tube-well.

Before shrimp culture, there was diverse varieties of fruit plants with satisfactory production. Now, water logging in the shrimp ponds and consequent inundation of homestead areas by tidal saline water has increased soil salinity. As a result, most of

the edible and economically important fruit bearing plants are dying at high pace. The surviving plants have lost their growth, vigor, become pale or yellowish along with reduced fruit setting, premature fruit drop and even no fruit setting. Within and in the immediate vicinity of shrimp farms, various kinds of ground plant species and other vegetation had almost been destroyed from the water logging of saline water.

The vast tract of flood plain agricultural land is now crisscrossed with numerous low earthen dikes giving spider net like look. Furthermore, modernly deep small canals have been dug within the boundary of the *gher* for rearing and preservation of juvenile shrimp. As a result landscape has been changed.

Shrimp culture has eventually led to the shortage of grazing land, scarcity of fodder and grasses, intake of saline and contaminated water etc. which has exposed the cattle to various diseases, high mortality and eventual reduction.

Biomass fuel availability has been reduced due to poor yield of rice, reduction of grazing cattle and depletion of green vegetation due to higher salinity.

Different terrestrial and aquatic plant species, common in pre-shrimp time are now reducing day by day due to over salinity.

The numbers of wildlife were reducing due to loss habitat and safe breeding places and scarcity of food.

Diseases and symptoms of shrimps due to poor farm environment for the mortality rate of shrimp fry increase.

The green sceneries of the areas have become brown and pale, salinity has been increased due to shrimp culture and rate of paddy and crops production have gone down to the minimum level in the adjacent lands of shrimp farms.

The intentional water logging for facilitating shrimp culture, the tidal entry into the endorsed area is blocked and the silt began to deposit on the riverbeds.

Wastage of the shrimp farms has polluted the air of the peripheral area. Also, extra food occurs bad smelling that is very intolerable to the worker and the villagers.

The shrimp farmers use insecticides to kill harmful organism but this type of ignorant work kills different types of fin fishes lying in the lands.

Respondents argued that IK has less environmental pollution; IK increases the shrimp production; IK causes less virus diseases of shrimp. But actual scenery is different from their idea, by wastage of traditional shrimp and crab culture, environment is polluted very roughly and virus infection is increased day by day in the area and production decreases.

CHAPTER 6

Due to shrimp culture, the soil salinity has increased. It is very alarming. For damaging crop producing and fertility have decreased in the area.

Due to shrimp culture, there was no major deforestation. The respondents argued these are increasing demands of fire wood in the households and brickfields, making houses, furniture, boats and other wooden materials.

The people of study villages use IK for the shrimp and crab farm very traditional way, because they have much knowledge of their own and they try to enrich and exchange this type of traditional knowledge by view exchanges and informal meetings and gossiping.

IK is nonsystematic oral, holistic closed on the other hand, scientific knowledge is within compartmental, analytical, open and systematic.

The shrimp fry catchers use their own technique and knowledge and materials to catch and collect shrimp fry from local rivers and canals.

The shrimp farmers have agreed that natural river or wild fry is better than artificial hatchery fry.

The shrimp farmers use different scientific knowledge that is: to test the soil, liming the *gher*, use of hatchery fry, use of different fertilizers and insecticides for better production.

It has been found in the study area that some respondents use mixed method both traditional and scientific technology but some farmers use scientific or modern technological knowledge in shrimp farming.

CHAPTER 7

Rate of shrimp production in this area is very low as compared to other shrimp producing countries in the world and it is only 266 kilograms in average per hectare area per year.

Most of the shrimp and crab farms in this area are not registered and for this reason government has no control over the shrimp and crab producing, harvesting and marketing activities operated in the study area.

The shrimp farmers need financial support from different sources very badly to use modern techniques for better production, but 30 percent farmers do not need it.

The farm sizes are becoming smaller day by day and most of the farms were operated by the individual or group enterprise.

In the shrimp farm a labor has to work for a long period but he gets small wage.

The shrimp fry catchers are destroying the sources of other fishes during shrimp fry catching by current net from the rivers. So, availability of other fishes in the rivers has been decreasing.

The main factors of soil salinity are: regular saline tidal flooding; faulty management of sluice gates; willful inundation with brackish water of shrimp cultivation; fresh water withdrawal from up stream and decrease in water flow during dry season.

The present practice of shrimp culture using saline water will permanently aggravate the soil sterility in the long run and the lands will never be able to be used for crop production.

Traditional shrimp farming has been associated with mangrove destruction through dike or road construction and marginal agriculture might be converted to aquaculture.

Snails breaking and other feed of shrimp farms are done in a very unhygienic condition. So, workers are very often affected by different skin diseases. But they are not aware of the unhygienic health conditions.

Many farmers still do not know how to prevent virus and other diseases of the shrimp.

The respondents of this study viewed some sort of problems of IK in shrimp culture in this area. They are- IK is not enough for their existence; Only IK is not suitable for sustainable development of this study area; IK makes the works slower; and IK has some environmental effect on the study area.

Moreover, scientific knowledge can not evaluate the IK of the study villages. It causes some sorts of environmental degradation. It also decreases the fertility of the land. It increases gas and fungus in the water of shrimp farm.

Majority respondents argued that in their daily shrimp and crab management activities that both the IK and ScK are complementary to each other and collaboratively usable. Two types of knowledge are necessary for shrimp and crab culture in the study area.

The cheaper fries are mixed with the good ones and they are supplied to the farmers. It decreases the shrimp and crab production rate in the study area.

Day by day shrimp farms are increasing but shrimp farm related and other imputes is not available in the area.

Virus is a common problem in almost all shrimp farms in the study area but the farmers can not prevent the virus diseases. They are not aware of the protection of the golden aquatic resource from virus disease.

Small crab (180 gm), Juvenile and female crab (without *gonad*) are cultured in the crab *ghers*.

Most of the farms are not registered in this area and for this reason Government has no control over the shrimp and crab culture practices in the study areas.

CHAPTER 8

Women catch the shrimp fry by their hands or clothes or mosquito curtains.

The women are the main working group of shrimp and crab culture. They catch the fry and *gher* preparation work and shrimp-crab catching. This is possible because they have already broken the traditional norms of society by coming out of their houses.

Women livelihood of the coastal area is being put in the risk in the various ways. They are displaced from their productive role. They lost their traditional profession.

Women's traditional knowledge plays a vital role to the aquaculture like shrimp and crab farming. They are involved either directly in harvesting, processing and marketing or indirectly in providing extra income and host of supporting activities that ensure the well being of the family.

The shrimp and crab *gher* owners prefer women workers to male workers. It is because women can be paid less than the male workers and usually they never resist such exploitation.

The employer takes the advantage of the situation and exploits labor because the supply is more than the demand for women labors.

The sheer lack of any other better alternative work, women are compelled to do low paying works. So, they have to face economic adversity in maintaining familial survival.

On the other hand, this small amount of cash income paves the ways of economic independence and social status in their family.

9.2 Suggestions

The present research work reveals that the traditional knowledge and methods of shrimp and crab culture in the study area has impacts on the society, economy and the environment of coastal Bangladesh. Simultaneously, it has been proved that aquaculture is more profitable than any other cropping in the study area. But question has arisen about methods and knowledge of the shrimp and crab farms. Farmers mostly use their IK in this regard and additionally they also incorporate and scientific knowledge in some production activities. Either IK or traditional technological knowledge is good or ScK external technological knowledge is good for shrimp and crab aquaculture in the area.

For minimization of the socio-economic and environmental impact and problems of shrimp and crab culture, it requires the following necessary steps and initiatives:

To maintain safety and quality standard set by international buyers, it is needed to apply planned, scientific knowledge to compete with other shrimp and crab producing countries of the world.

Law and order situation should be improved in the shrimp farming areas. So, the existing laws should be properly implemented by the law enforcing authority. At the same time, necessary new laws should be made by the Government.

Shrimps and crab farmers should form cooperatives to protect undue interference and to establish their legal rights.

At least in every union of the shrimp or crab farming areas, a consulting centre should be made from where necessary and emergency consultation should be provided to farmers.

High productive semi-intensive method of shrimp culture should be introduced and for this reason the farmers should be trained up properly. Most experienced and successful shrimp farmers should be sent abroad. So, they can gather knowledge from different field observation and practice.

Supply of electricity must be ensured in all over the shrimp and crab farms to apply modern technology in the shrimp and crab farms.

Credit facilities for shrimp and crab farmers should be easy and available.

The inputs and other necessary instruments should be made available and duty free.

The feed which pollute the quality of water should be banned to protect water pollution.

The shooting net, current net or any other harmful nets by which shrimp fries are caught from the rivers should be banned to protect other native fish fries.

All concerned should come forward to build awareness of the fry catchers regarding the detrimental effect of indiscriminate killing of other fish species.

Government should divide the large *ghers* into cluster of small units with provision of independent inlet and outlet and reduce the farm size to 1 to 10 hectares for better management of the farms.

All concerned should develop echo-friendly techniques for better and improved production of shrimp and crab in the coastal area.

Government should enforce the implementation of regulation against catching of wild Post Larvae.

Government should prohibit further conversion of mangroves for shrimp farming and promote mangrove reforestation.

All concerned develop a code of conduct for shrimp farming in this country.

Farmers should establish separate canals for supply of water and drainage of waste water.

Government should try to develop the infrastructural facilities for different types of farming practices.

Government should try to regulate of zonation of coastal areas on the basis of soil quality, water salinity and ecological conditions.

Government should try to introduce Best Management Practices (BMP) to promote sustainable shrimp and crab aquaculture in the coastal villages.

Necessary steps should be taken on an emergency basis to solve the multifarious problems being faced by the shrimp and crab culture.

Motivation and public awareness should be built though media in this area.

All concerned develop acceptable water quality standards for shrimp farm effluents.

All concerned should try to establish aqua-health centers in each of the major shrimp farming areas for increasing hygiene and sanitation facilities of the shrimp farms.

Government should regularize on the use of drugs and chemicals in shrimp farms.

Government should develop shrimp culture under the overall Coastal Zone Management Plan (CZMP).

Government should establish diagnostic laboratories in the major shrimp and crab farming areas for immediate detection of diseases out breaks.

Trained personnel on shrimp and crab health management should be developed.

Farmers training on sustainable shrimp and crab farming including shrimp and crab health management should be organized by GOs and NGOs in collaboration with relevant institutes.

Depending on agro-ecosystem, the coastal areas should be categorized on the basis of salinity level to ensure proper use of valuable land resources and to avoid land use conflict.

Considering the potentiality and feasibility of shrimp and crab culture in different location of coastal areas, improved traditional and semi-intensive culture system should be introduced to increase the production.

The land can be leased out on condition that lessons will get production share of shrimps depending upon the size of their leased out land ratter than getting a fixed amount as each rent. In this case, the main entrepreneur should get the profit share of capital invested.

A crop diversification model should be established. An integration of shrimp fish, crop, livestock, horticulture and forestation should be established in the study area.

The population of the area should be made area of the environmental and social impacts of shrimp farming through publishing looks or booklets in Bangla on the basis of field observation.

Efficient extension support should be provided to ensure knowledge of preventing diseases at farm level in this area.

9.3 Limitations

It is obvious that no research work can cover all aspects of a problem. Exercising the principles of parsimony is the only way to select the priority areas. This study is limited only to Bagda shrimp (*P. monodon*) and crab cultivation activities operated in two villages Munshiganj and Burigoalini of Shyamnagar Upazila in Satkhira District. Time limitation, financial constraints and social adversity proneness of the study area compelled the researcher to select these limited areas for the study. In the study areas, along with bagda, golda (M. rosenbergii) and golda-bagda' mixed culture also prevail, shrimp (bagda) and crab culture practices methods and use of IK and ScK and their impacts on environment had been addressed but other aspects had not been included in the preview of this study. The research work emphasized more on the traditional knowledge and environmental issues followed by socioeconomic aspects emerging from the brackish water shrimp culture.

The present study is aptly wedded to asses the indigenous knowledge that farmers use to culture the shrimp and crab; the importance of IK and collaboration of IK and ScK in shrimp and crab culture and socio-environmental impact of shrimp and crab culture. A few subjects could not be determined due to ignorance, non-cooperation, and reluctance of some shrimp and crab farmers. Also many aspects of shrimp and crab culture could not be included within the scope of this research work.

Despite the limitations indicated here, the present research work is a comprehensive one. Indigenous knowledge for shrimp and crab aquaculture, IK and environmental impact and women's role of using IK in this sector have given this work a new and special dimension.

9.4 Conclusion

Thousands of coastal people are engaged directly or indirectly in profitable shrimp and crab aquaculture activities. Though these are foreign currency earning sectors in Bangladesh, it is done at the cost of degrading overall environment and deprived mass people. This study identifies that the people of coastal Bangladesh use their IK in their more than two-third activities and other activities, they incorporate ScK and IK. On the other hand, almost all crab culture activities are based on farmers' IK and their experiences. The study also identifies a number of positive and negative impacts of shrimp culture on the socio-economy and environment of the study area. It is evident that negative impacts are dominant than positive impacts. Nevertheless, it would not be justified to eradicate the shrimp culture because efforts should be taken up to reduce the negative impacts of shrimp culture and to enhance its positive impacts. Moreover, crab culture has minimum effect on socioenvironmental condition of the coastal areas of Bangladesh. So, harmonization as well as implementing some existing policies and adoption of new policies may be required. To minimize the negative impacts of coastal aquaculture, the proper environmental management plan is to be operationalized in time. Also, awareness building among the coastal people and proper adequate collaboration between IK and ScK are required to do sustainable environment friendly aquaculture in Bangladesh.

ANNEXURE

Interview Schedule

FGD Schedule

Case Studies

Photographs

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UFO
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UPO
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INTERVIEW SCHEDULE

001 Identification Number ☐

002 Interviewers Code: ☐ Name: ☐ Date. ☐

Confidentiality and Consent: The answers of the respondents are completely confidential. Name of respondents and information will never be used by the researcher in written form. You do not have to answer any question that you do not want to answer and you may end this interview at any time you want to. However your honest answer will help the people better understand about indigenous knowledge for aquatic resource management of coastal Bangladesh. The researcher greatly appreciates your help in responding to this survey.

1. Demographic and Personal Information of the Respondents

	Gender							Occupation		Monthly Income				
Name	Male	Female	Age	Relation	Education	Religion	Marital status	Main	Subsidiary	Service	Agriculture	Business	Other	Total

2.0 Information about Occupation of the key informants.

2.1 What is your main occupation?
☐ Shrimp farming ☐ Crab farming ☐ Agriculture ☐ Service ☐ Labor ☐ Others.

2.2 What is your subordinate occupation?
☐ Shrimp ☐ Crab farming ☐ Agriculture ☐ Service ☐ Labor ☐ Others.

2.3 Why did you come to this profession?
☐ Unemployment ☐ Want of capital ☐ Less agricultural production ☐ More profit ☐ Salinity of water
☐ Salinity of land ☐ Others.

2.4 How many years did you engage with this profession?
☐ 5 ☐ 10 ☐ 15 ☐ Above 15years.

2.5 Why did you change your previous profession?
☐ Financial ☐ Less agricultural production ☐ Salinity of land Salinity of water ☐ Less of capital ☐ Others.

2.6 What are the other members professions of your family?
☐ Shrimp farming ☐ Crab farming ☐ Agriculture ☐ Service ☐ Labor ☐ Others.

2.7 Have you get any training? ☐ Yes ☐ No ☐ No response

2.8 If yes, from where you got training ?
☐ Govt. ☐ Non govt. ☐ NGO ☐ Others.

3.0 Information about social conditions of the respondent

3.1 How long did you live here?

3.2 What is the type of your family?
☐ Nuclear ☐ Joint ☐ Extended ☐ Others.

3.3 No. of dependent members in your family.
□ Boy □ Girls □ Total
3.4 Do you think that social structure of coastal area is changing?
□ Yes □ No □ No answer.
3.5 If yes what type of change been occurred?
□ Family □ Rituals □ Norms □ Food habit □ Dressing.

4.0 Information about economic conditions of the respondent

4.1 How much land do you have?
4.2 What type of land have you got?
□ Dwelling □ Cropping land □ Uncultivable □ Other
4.3 Ownership of your land.
□ Inheritance □ Self purchase □ Lease □ Other
4.4 Housing typology.
□ Pacca □ Pacca tin □ Katcha straw □ Mud □ Other
4.5 Previous economic condition □ Very good □ good □ Satisfactory □ Not good.
4.6 Did you get any loan? □Yes □ No □ No response
4.7 From where you got loan? □ Bank □ N G O □ Moneylender □ Usurer □ Other
4.8 Your economic condition at present. □ Very good □ Good □ Satisfactory □ Not good.
4.9 Causes of your economic development.
□ Shrimp farming □ Crab farming □ Agriculture □ Integrated farming □ Other.

5.0 Information about environmental conditions of the study area

5.1 Climate of the area is- □ Temperate □ Extreme □ Not extreme □ Others.
5.2 What are the causes of environmental pollution of the area?
□ Particle of dust □ Shrimp □ Crab □ More salinity of water □ Salinity of land
□ Rotten of fries □ Natural calamity □ Others.
5.3 What are the causes of air pollution of the area?
□ Particle of dust □ Shrimp □ Crab □ More salinity of water □ Salinity of land
□ Rotten of fry □ Natural calamity □ Others.
5.4 What are the causes of water pollution of the area?
□ Particle of dust □ Shrimp □ Crab □ More salinity of water □ Salinity of land
□ Rotten of fries □ Natural calamity □ Others.

5.5 What are the causes of soil pollution of the area?
□ Particle of dust □ Shrimp □ Crab □ More salinity of water □ Salinity of land
□ Rotten of fry □ Natural calamity □ Others.
5.6 Was there any physical impact of shrimp cultivation on fishers?
□ Yes □ No □ No answer.

5.7 If yes, What are the diseases caused by shrimp cultivation?
□ Skin disease □ Tuberculosis □ Elephantiasis □ Cough □ Cold □ Asthma □ Others.
5.8 Environmental disadvantages of using IK on shrimp cultivation-
□ Erosion of land □ Less fertility of land □ Less crop production □ More salinity of water □ Salinity of land □ Rotten of fries □ Natural calamity □ Obstruction of crop diversification □Others.
5.9 What is the impact of IK on human health?
□ Skin disease □ Tuberculosis □ Elephantiasis □ Cough □ Cold □ Asthma □ Dysentery □ Others.
6.0 What are the natural resources of the area ?- □ Agricultural □ Aquatic □ Mangrove □ Forest □ Marine □ Others.

6.1 What are the aquatic resources of the area ?- □ Shrimp □ Crab □ Mangrove □ Sea-grass □ Sea-weeds
□ Others
6.2 Typology of mangroves found in the area- □ Sundary □ Gaywa □ Garan □ Sea-weeds □ Others
6.3 Do you cultivate sea-grass and sea-weeds?
□ Yes □ No □ No answer.
6.4 If yes, what are the sea-grass and sea-weeds?
□
□
□
□
□

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for shrimp farmers

1.1 When did shrimp culture start in this coastal area? □1960-65 □1965-70 □1970-75 □1975-80.

1.2 What are the reasons of shrimp culture in this area? □ Due to coastal area □ Tidal area □ Salinity of water □ More profitable than agriculture □ Integrated farming □ Others.

1.3 How do the fishers collect shrimp fries? □By net □By clothing □ Traditional method □ Others.

1.4 What are the IK of the fishers using in shrimp fry collection?

□
□
□
□

1.5 What are the IK of the fishers using in shrimp farming?

□
□
□
□
□

1.6 What are the IK of the fishers using in the growth of the shrimp?

□
□
□
□
□
□

1.6 What are the IK of the fishers using to catch and conserve of the shrimp?

□
□
□
□
□
□

1.7 What are the IK of the fishers using to protect diseases of the shrimp?

□
□
□
□
□

1.9 What are the IK of the fishers using to feed of the shrimp?

□
□
□
□

1.10 Is there any loss of other fish fries at the time of shrimp fry collection?

□ Yes.... □ No □ No answer □ Don't know

1.11 If yes, what type of loss of other fish fries at the time of shrimp fry collection?

□.
□
□
□
□

1.12 What are the benefits of shrimp culture in the coastal area?
☐ Employment opportunities ☐ Economic development ☐ Social progress
☐ Integrated farming ☐ Others.
1.13 What are the physical disadvantages of shrimp culture in the coastal area?
☐ Skin diseases ☐ Elephantiasis ☐ Tuberculosis ☐ Asthma ☐ Cough ☐ Cholera ☐Others.

1.14 What are the environmental disadvantages of shrimp culture in the coastal area?
☐ Water salinity ☐ Soil salinity ☐ Water pollution ☐ Air pollution ☐ Land erosion
☐ Loss of fertility of land ☐ Deforestation ☐ Hamper of crop diversification ☐ Others.

1.15 What are the socio-economic effects of shrimp culture in the coastal area?
☐ Bad impact on traditional agriculture ☐ Impact on employment opportunity
☐ Social progress ☐ Integrated farming ☐ Others.

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for crab farmers:

1.1 When did crab culture start in the area? □1960's □ 1970's □1980's □1990's decade.
1.2 What are the indigenous method of crab culture in Bangladeshi coastal area?
□
□
□
□
1.3 What are the indigenous methods of collection of crab fries in the area?
□
□
□
□
1.4 What are the IK of crab culture in coastal Bangladesh?
□
□
□.
□
1.5 What are the IK of crab growth in coastal Bangladesh?
□.
□.
□
□

1.6 What are the IK of catching and conserve of crab in coastal Bangladesh?
□
□
□
□
□.
□
1.7 What are the IK of preventing diseases of crab in coastal Bangladesh?
□
□
□

□
□
1.8 What are the advantages of crab culture in coastal Bangladesh?
□ Economic development □ Employment opportunities □ Social Progress □ Integrated farming □ Others
1.9 What are the physical disadvantages of crab culture in coastal Bangladesh?
1.10 □ Skin diseases □ Elephantiasis □ Tuberculosis □ Asthma □ Cough □ Cholera □ Others.
1.11 What are the environmental disadvantages of crab culture in the coastal area?
□ Water salinity □ Soil salinity □ Water pollution □ Air pollution □ Land erosion □ Loss of fertility of land □ Deforestation □ Hamper of crop diversification □ Others.

1.12 What are the socio-economic effects of crab culture in the coastal area?
□ Bad impact on traditional agriculture □ Impact on employment opportunity
□ Social progress □ Integrated farming □ Others.

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for Big Gher owner : Shrimp

1.1 Type of Gher owner- □ Large □ Medium Small
1.2 Area of land under the Gher (in hectare) □ Own □ Others Total
1.3 Rate of rent per hectare: 2000 2003 2006

1.4 Year wise revenue yielding of this year (in taka)

Name of the product	2004	2005	2006
Shrimp			
Other fishes			
Rice			
Vegetables			
Others			
Total			

1.5 Educational status of the respondent:

Level of education	No of children
Illiterate	
Five years schooling	
Six to ten years schooling	
Up to H Sc level	
Bachelor Degree	
Master Degree	

:

1.5 Type of housing

Types of housing	No at present	No before
Building		
Tin shed building		
Tin or Bamboo made house		

1.6 Availed health care system:

Pattern of treatment	At present	Before
Allopathic		
Homeopathic		
Ayurvedic		
Exercise		

1.8 Sources of drinking water:

Name of the sources	At present	Before
Deep tube well		
Pond		
Ring well		
River / Canal		

1.9 Total production obtained from this gher:

Name of item	2004	2005	2006
Golda			
Bagda			
White fish			
Paddy			

1.10 What are the sources of your capital ?

Own Bank loan Dadan Others.

1.11 How do you repay the loan?

.
.
.
.

1.12 What are the problems in selling the shrimp?

1.13 From where do you collect the shrimp fries?

1.14 What are the problems to collect the shrimp fries?

□
□
□

1.15 Due to shrimp culture the following problems have been arisen . If you agreed put tick mark and if not put cross in the box.

□ Rate of deforestation increasing
□ Salinity of water and soil increasing
□ Native fishes reducing
□ Terrorism increasing
□ Unemployment problem increasing
□ Number of domestic animals reducing

1.16 What type of food do you supply in your Gher?

□
□
□
□

1.17 What type of assistance do you get from the Government for shrimp culture?

□
□
□

1.18 What are the main problems you have to face in shrimp culture?

□
□
□
□
□
□

1.19 What are the indigenous knowledge you have to use for shrimp culture in the area?

□
□
□

1.20 What are the main problems you have to face in using indigenous knowledge for shrimp culture?

□
□
□
□

1.21 Do you think that using indigenous knowledge for shrimp culture is sufficient ?
□ Yes □ No □ No answer.

1.22 If not, what are the problems of using indigenous knowledge for shrimp culture?

□
□
□
□

1.23 What are the modern / scientific knowledge using shrimp culture in the area?

□
□
□

1.24 Are the indigenous knowledge incorporating in modern / scientific knowledge using shrimp culture in the area?
□ Yes □ No □ No answer.

1.25 What are the problems of scientific knowledge in aquatic resource management in the area?

□
□
□
□

1.26 If yes, how indigenous knowledge incorporating in modern / scientific knowledge using shrimp culture?

□
□
□

1.27 What are the importance of IK for shrimp culture?

□
□
□

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for Gher Owner : (Crab)

1.1 Type of Gher owner- □ Large □ Medium □ Small
1.2 Area of land under the Gher (in hectare) □ Own □ Others □ Total
1.3 Rate of rent per hectare: □ 2000 □ 2003 □2006

1.4 Year wise revenue yielding of this year (in taka)

Item	2004	2005	2006
Shrimp			
Crab			
Mud crab			

1.5 What are the sources of your capital ?
□ Own □ Bank loan □ Dadan □ Others.
1.7 How do you repay the loan?
□
□
□
□
□
□
1.8 What are the problems in selling the crab?
□
□
□
□

1.8 From where do you collect the crab fries?
□
□
□
□
1.9 What are problems to collect the crab fries?
□
□
□
□
1.10 What type of assistance do you get from the Government for crab culture?
□
□
□
□
□
□
1.11 What are the main problems you have to face in crab culture?
□
□
□
□
□
□

1.12 What are the indigenous knowledge you have to use for crab culture in the area?

□

□

□

1.13 What are the main problems you have to face in using indigenous knowledge for crab culture?

□

□

□

1.14 Do you think that using indigenous knowledge for crab culture is sufficient ?

□ Yes □ No □ No answer.

1.15 If not, what are the short comings of using indigenous knowledge for crab culture?

□

□

□

1.16 What are the modern / scientific knowledge using crab culture in the area?

□

□

□

□

1.17 Are the indigenous knowledge incorporating in modern / scientific knowledge using crab culture in the area? □ Yes □ No □ No answer.

1.18 What are the problems of scientific knowledge in crab culture?

□

□

□

□

1.19 If yes, how indigenous knowledge incorporating in modern / scientific knowledge using crab culture?

□

□

□

□

□

□

1.19 What are the importance of IK for crab culture?

□

□

□

□

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for Gher Labor: (shrimp)

1.1 What are the level of your education?
Primary Secondary Graduate Post graduation

1.2 What is the rate of your wage?
□50- 100 □101-150
□ 151-200 □201-250 □ Above 250

1.2 How many hours you have to work?
□ 4-8 hours □ 8-12 hours □ 12-16 hours □ Above

1.3 Why do you not cultivate shrimp in your own land?
□
□
□
□

1.4 What are the main problems you have to face in shrimp culture?
□
□
□
□

1.5 Have you evicted from your land by the shrimp cultivators?
1.6 □ Yes □ No □ No answer.
1.7 What are the indigenous knowledge of shrimp culture ?
□
□
□
□

1.8 Do you think that the indigenous knowledge using in shrimp is unscientific and unusable?
□ Yes □ No □ No answer.
1.9 If yes, What are the reasons of your opinion?
□
□
□
□

.
Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for gher Labor (Crab)

1.1 What are the level of your education?
□ Primary □ Secondary □ Higher secondary □ Degree and above

1.2 What is the rate of your wage?
□50- 100 □101-150
□ 151-200 □201-250 □ Above 250

1.3 How many hours you have to work?
□ 4-8 hours □ 8-12 hours □ 12-16 hours □ Above

1.4 Why do you not cultivate crab in your land?
□
□
□
□

1.5 What are the main problems you have to face in crab culture?
□
□
□
□

1.6 Have you evicted from your land by the crab cultivators?
a. Yes b. No c. No answer.

1.9 What are the indigenous knowledge of crab culture ?
□
□
□
□

1.10 Do you think that the indigenous knowledge using in crab is unscientific and unusable?
□ Yes □ No □ No answer.

1.10 If yes, What are the reasons of your opinion?
□
□
□
□

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for UP Chairman / Member:

1.1 How many shrimp / crab ghers are there in your Union / Ward?
1.2 How many hectares of land under these ghers?
1.3 How many families have become landless due to shrimp / crab culture in your Union/ ward?
1.4 How many people have been evicted from their land by the shrimp / crab cultivators?.
1.5 Do you think that terrorism have been expanded in your area due to shrimp / crab culture? Yes /No.
1.6 Does the government implement any program by you for the development of shrimp / crab culture ? □Yes □ No □ No answer.
1.7 If yes, what type of program/s?
□
□
□
□

1.7 How many families of your area have been migrated towards town or in other areas due to shrimp / crab culture?
□
□
□

1.8 What type of problems have been arisen due to shrimp / crab culture in your area?
□
□
□
□
□
□

1.9 What type of new activities have been emerged in the locality and what of activities have been stopped for shrimp / crab culture?

Emerged	Stopped
□ □ □ □ □ □ □	□ □ □ □ □ □ □

1.10 Do you think that the farmers use indigenous knowledge for shrimp / crab culture ?
□ Yes □ No □ No answer.
1.11What are the positive effects of IK for shrimp / crab culture?
□
□
□
□

1.11 Is the IK has side effects for the coastal environment?
□ Yes □ No □ No answer.

1.12 If yes, what type of effects of IK on environment?

- ☐
- ☐
- ☐
- ☐

1.14 What necessary steps do you suggest to decrease the disadvantages of shrimp / crab culture?

- ☐
- ☐
- ☐
- ☐
- ☐
- ☐

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for NGO worker / Social worker / Teacher:

Name: _____ **Institutio** _____

1.1 What type of the following problems have been created due to shrimp / crab culture in your locality? * (put tick mark when it is applicable)

- ☐ Terrorism has been increased
- ☐ Eviction from the land have been increase
- ☐ Deforestation problem has been increased
- ☐ Domestic animals have been decreased
- ☐ Native fishes have been reduced
- ☐ Unemployment problems have been increased
- ☐ Income disparity has been increased.

1.2 Do you think that the farmers use indigenous knowledge for shrimp / crab culture ?
Yes No No answer.

1.4 Is the IK has side effects for the coastal environment?
Yes No No answer.

1.4 What are the positive effects of IK for shrimp / crab culture?

1.5 What type of effects of IK has on environment?

1.6 What necessary steps do you suggest to decrease the disadvantages of shrimp / crab culture?

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for Upazila Nirbahy Officer (UNO):

Name: Upazila:

1.0 Basic information of the Upazila:

1.1 Area of the Upazila.....

1.2 Number of Unions.....

1.3 Number of Pouroshova.....

1.4 Number of villages.....

1.5 Number of Mouzas.....

1.6 Area of agricultural land.....

1.7 Area of forest.....

1.8 Total population.....Male. Female.

1.9 Literacy rate.

1.10 Number of shrimp ghers

1.11 Number of crab ghers

1.12 Number of registered shrimp ghers

1.13 Number of registered crab ghers

2.0 What are the method of shrimp / crab culture in your Upazila?

Method of Shrimp	Method of crab

2.1 What are the problems related to shrimp / crab culture in your Upazila?

☐ ☐

☐ ☐

2.2 How these problems can be solved?

☐ ☐

☐ ☐

2.3 Is the indigenous knowledge of the shrimp / crab farmers effects the environment?

Yes No No answer.

2.4 If yes, how IK incorporate with the scientific knowledge ?

☐ ☐

☐ ☐

2.5 What type of programs does the government implement through you for the development of shrimp / crab culture in your area?

☐ ☐

☐ ☐

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for Upazila Fishery Officer (UFO):

Name: Upazila:

1.1 How many numbers of shrimp and crab ghers in your area? □ Shrimp……. □ Crab……..

1.2 How many ghers are registered among these ghers? □ Shrimp : □ Crab:

1.3 Rate of shrimp / crab production per hectare in your Upazila? □ Shrimp: □ Crab:

1.4 What are the main causes of low rate of shrimp / crab production?

□ □
□ □

1.5 What necessary steps should be taken to increase the rate of production of shrimp / crab?

□
□
□
□

1.6 What are the indigenous knowledge farmers use for shrimp / crab culture?

□
□
□
□
□
□

1.6 Do you think IK for shrimp / crab culture is unscientific and it degrades the coastal environment? □Yes □ No □ No answer.□ Don't know

1.7 If yes, what are the reasons of your opinion?

□
□
□
□
□
□

1.8 Do you think that modern scientific knowledge is destroying the indigenous knowledge for shrimp and crab culture?

□ Yes □ No □ No answer □ Don't know

1.9 If yes, how does modern scientific knowledge destroys the indigenous knowledge for shrimp and crab culture in coastal area ?

□
□
□
□
□
□

1.10 What type of assistance you provide to the shrimp / crab farmers?

□
□
□
□

1.12 Do you agree with the view that due to shrimp / crab culture various types of native fishes are reducing?

☐ Yes ☐ No ☐ No answer ☐ Don't know

1.13 What are the reasons of reducing various types of native fishes ?

☐
☐
☐
☐

1.14 How many metric tons of shrimp /crab have been produced in your Upazila in the following years ?

Item	2004	2005	2006
Shrimp			
Crab			

1.14 What type of programs does the government implement through you for development of shrimp / crab culture?

☐
☐
☐
☐

1.15 What are the main problems related to the shrimp / crab culture?

☐
☐
☐
☐
☐
☐

1.15 How the problems can be solved?

☐
☐
☐
☐

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for Upazila Livestock Officer (ULO)

Name: Upazila:

1.1 Statement of the number of domestic animals in your Upazila.

Animals	2003	2004	2005	2006
Cattle				
Goat				
Buffalo				

1.2 Do you think that number of domestic animals are reducing day by day?
☐ Yes ☐ No ☐ No answer ☐ Don't know

1.3 What are the IK of the coastal people using for shrimp / crab culture?
☐
☐
☐
☐
☐

1.4 What are the main problems of shrimp / crab culture in your area?
☐
☐
☐
☐
☐

1.11 How these problems can be solved?
☐
☐
☐
☐

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for Upazila Agriculture Officer (UAO):

Name: Upazila:

1.1 How many hectares of agricultural land in your Upazila?.....

1.2 How many tons of paddy produced in your Upazila in the following years?

□1994:.....□.1998:.....□ 2002:.....□.2006:.....

1.3 How many hectares of land were under paddy cultivation in the following years?

□1994:.....□1998:.....□2002:.....□2006:.....

1.4 What are the IK of the coastal people using for shrimp / crab culture?

□

□

□

□

1.5 What are the main problems of shrimp / crab culture in your area?

□

□

□

1.6 How these problems can be solved?

□

□

□

1.7 Do you think IK for shrimp / crab culture is unscientific and it degrades the coastal environment?

□ Yes □ No □ No answer □ Don't know

1.8 If yes, what are the reasons of your opinion?

□

□

□

□

□

□

Signature of the interviewee
Date:

Signature of the interviewer
Date:

Interview Schedule for Upazila Police Officer (OC):

Name: Upazila:

1.1 How many cases have been filed in your thana in the following years?
□1994:.....□1998:.....□2002:.....□.2006:.....

1.2 How many cases have been filed in connection with shrimp / crab culture in the following years? □1994:.....□1998:.....□2002:.....□.2006:.....

1.3 How many murder cases have been filed in the following years?
□1994:.....□1998:.....□2002:.....□2006:.....

1.4 How many people have been murdered in connection with shrimp / crab culture in the following years? □1994:.....□1998:.....□2002:.....□.2006:.....

1.5 What type of problems you have to face related to shrimp / crab culture ?

Shrimp	Crab

1.6 How these problems can be solved?

□
□
□
□

Signature of the interviewee

Signature of the interviewer

CHECKLIST FOR FGD

1. Shrimp Farmers IK and Views (03 Sessions)

(i) What do you mean by IK?

(ii) What opinion do you think of your age about IK?

(iii) Do you think coastal people use IK in shrimp culture?

(iv) How long did you have practiced IK for shrimp culture?

(v) Is there any difference between IK and ScK?

(vi) Do shrimp culture is harmful to coastal environment?

(vii) How shrimp culture is harmful to coastal environment?

(viii) Do shrimp culture is a threat for food security?

(ix) Has the production of agricultural products decrease by the advent of shrimp culture?

(x) Has the vegetation of this area decreased by the advent of shrimp culture?

(xi) Do the children and women are vulnerable condition by the advent of shrimp culture?

(xii) What steps have to taken for environmentally sustainable shrimp culture?

(xiii) Do shrimp culture improve the socio-economic conditions of the coastal area?

(xiv) How shrimp culture pollute the air of the area?

(xv) How shrimp culture pollute the water of the area?

(xvi) Do the native varieties of fishes decrease by the shrimp culture?

(xvii) Do salinity of water increases in the area by the advent of shrimp culture?

(xviii) Do the shrimp fry catchers damage the others fish fries?

(xix) Do extra food can pollute the water of the *gher*?

2. Male labors and female labors of shrimp and crab culture (02 Sessions)

(i) What are wage of your per day work?

(ii) Is there any difference between male and female labors wage?

(iii) Do the farmers use IK for shrimp and crab culture in the area?

(iv) What are causes of using IK for shrimp and crab culture in the area?

(v) Do the owners of *gher* give low wage to the female labors?

(vi) What do you mean by IK?

(vii) What opinion do you think of your age about IK?

(viii) Do you think coastal people use IK in shrimp culture?

(ix) How long did you have practiced IK for shrimp culture?

(x) Is there any difference between IK and ScK?

(xi)Do shrimp culture is harmful to coastal environment?

(xii) How shrimp culture is harmful to coastal environment?

(xiii) Do shrimp culture is a threat for food security?

(xiv) Has the production of agricultural products decrease by the advent of shrimp culture?

(xv) Has the vegetation of this area decreased by the advent of shrimp culture?

(xvi) Do the children and women are vulnerable condition by the advent of shrimp culture?

(xvii) What steps have to taken for environmentally sustainable shrimp culture?

(xviii) Do shrimp culture improve the socio-economic conditions of the coastal area?

(xix) How shrimp culture pollute the air of the area?

(xx) How shrimp culture pollute the water of the area?

(xxi) Do the native varieties of fishes decrease by the shrimp culture?

(xxii) Do salinity of water increases in the area by the advent of shrimp culture?

(xxiii) What are the impacts of shrimp and crab culture on health?

(xxiv) Do the shrimp fry catchers damage the others fish fries?

(xxv) Do extra food can pollute the water of the *gher*?

3. For crab farmers (02 Sessions)

(i) What do you mean by IK?

(ii) What opinion do you think of your age about IK?

(iii) Do you think coastal people use IK in crab culture?

(iv) How long did you have practiced IK for crab culture?

(v) Is there any difference between IK and ScK?

(vi)Do crab culture is harmful to coastal environment?

(vii) How crab culture is harmful to coastal environment?

(viii) Do crab culture is a threat for food security?

(ix) Has the production of agricultural products decrease by the advent of crab culture?

(x) Has the vegetation of this area decreased by the advent of crab culture?

(xi) Do the children and women are vulnerable condition by the advent of crab culture?

(xii) What steps have to taken for environmentally sustainable crab culture?

(xiii) Do crab culture improve the socio-economic conditions of the coastal area?

(xiv) How crab culture pollute the air of the area?

(xv) How crab culture pollute the water of the area?

(xvi) Do the native varieties of fishes decrease by the crab culture?

(xvii) Do salinity of water increases in the area by the advent of crab culture?

(xviii) Do the crab fry catchers damage the others fish fries?

(xix) Do extra food can pollute the water of the *gher*?

Case Studies: 01 to 06

Case: 01

Abul Hashem, age 40, a farmer and gher owner of Munshiganj village. He had three bighas of land. He had one *gher* of his own land and another one in leased land. He viewed that somebody is causing harm to environment while cultivating shrimp. When he had began shrimp culture ten years ago on his land, there were no tree on that plot because it is naturally saline prone area. He had planted several types of saplings including mango trees. He had got very good yield of guava. But they had kept in mind that the characteristics of soil here, is very salty. They get good yield if they plant trees or cultivate crops which are suitable in this type of soil. However, cultivation of shrimp culture causes some impact on the soil since it needs preservation of saline water for a long period of the year. They had not expected a good yield of paddy on a piece of land which was used for shrimp farming some years. This is a loss. But compared to the amount of profit, the extent of such loss is minimum. According to him, shrimp cultivation alone should not be blamed for change or degradation of the soil. Several decades ago when there was no embankment in the Sundarbans belt, the influx of saline water during tides did not allow them to cultivate rice. At the starting time, he was a small farmer, now he is a big farmer. His socio-economic condition was improved but he was not aware of the impact of shrimp culture on environment.

Case: 02

Drijen Mallik, age 55, a shrimp farmer of Munshiganj vlllage. He had cultivating shrimp for about 20 years in the coastal area. In his boyhood, he was a agricultural farmer but due to salinity of the soil and water and the impact of other shrimp farms, he compelled to cultivate shrimp in his own land. He had 10 bighas of land and took 20 bighas of land as lease from other people. He used to cultivate shrimp in traditional way and made all necessary instruments but in some cases he uses scientific or technical knowledge. He had no training. Now his economic condition is better than before. He thought that though it is financially profitable, it pollutes the environment. He viewed that they normally use the wild or natural shrimp fry and it is better than

hatchery fry. Because the wild fry collected from natural environment, as a result they can tolerate more salinity and others. But now-a-days wild fry are not available. So, farmers have to depend on hatchery fry.

Case: 03

Subrata Rostan, age 40, of Buri Goalini village. He owns a piece of land he had inherited from his father. In this land, he started shrimp farming for 15 years. He engaged in shrimp fsrming for eight monthes and rest of the time he had caught shrimp fry in the river. He realized that though shrimp culture is economically profitable to the farmers but it has caused a significant loss not only traditional agriculture but also to the environment. All the trees are destroying by the salinity of the shrimp *ghers*. There is no fruit bearing trees around the area. He viewed that during February to March, the concentrations of salinity on the soil become severe causing deforestation over the years. He thinks that the people of the area have accepted the shrimp cultivation as their livelihood because of its economic benefits.

Case: 04

Dipen Mallik is a shrimp fry collector cum labor of shrimp and crab farm. He is 35 years old and lives in Buri goalini village. He had no land of his own. So, he had to take other profession than agriculture and shrimp farming. Originally he was a *bawali* but at present he had to taken profession as shrimp fry collector. This profession has given him more profit with no risk of life since they do not need to enter into the deep forests any more. But still they remain dependent on the Sundarbans where they got more fries inside the forest compared to the quantity they get from river banks. According to him, the shrimp fry collectors are damaging some other native fish fry and it is very harmful to our national economy. Most of the fry catchers use very native or traditional method and tools and instruments to catch fries. As a result, it causes damage to other fish fries and they are not aware about it.

Case: 05

Motiur Rahman is a big and old crab farmer in Harinagar Mouza, Munshiganj village. He is 42 years of age. His main profession is crab farming and depot owner of crab in

the Harinagar bazar. He was basically an agricultural farmer but he had only 01 bigha of land and at that time his monthly income was only three thousand taka and at present his income is seven thousand taka per month. So, he thinks that crab farming in the area is very profitable because the investment in crab farming is very low and profit margin is high. He said that he uses all hand or locally made instrument and goods for crab farming He gives some food everyday and within twenty days the small and soft crab become big and hard. He had learnt the techniques of crab farming from the neighboring farmers and exchange of views from other farmers. He had not taken any training and got some loan from local NGO. He had usually used traditional or indigenous knowledge for crab hardening and fattening. He thinks that crab culture has no impact on their local environment. Now crab is exported in many countries of the world and demand of mud crab is expanding day by day. He thinks that it is necessary for the farmers of the area that Government and NGO give them proper training of shrimp and crab culture, and also distribute financial help to them, so that they can adopt proper culture of the aquatic resources in the area to alleviate poverty.

Case: 06

Shibu Podder is a big and pioneer shrimp and crab farmer in Munshiganj village. He is 45 years of age. His main profession is crab farming. He had 08 bighas of land and took 05 bighas of land as lease from other people. He used to cultivate crab in traditional method and made all necessary instruments but in some cases he uses scientific or technical knowledge. He had no training. Now his economic condition is better than before. He thought that though crab farming is financially profitable, some cases it pollutes the environment of the *gher* area. He viewed that the shrimp farmers usually use the wild or natural crab. Because the wild crab collected from canals and rivers of Sundarbans area, as a result they can tolerate more salinity and others. He thought that if the government and all concern give them training and financial support, they can properly culture the crab in the area. Moreover, he viewed that only own traditional knowledge is not enough for the sustainable shrimp farming. So, some scientific knowledge is necessary for sustainable and better management of crab farming.

Photo 1: Discussion with farmers on knowledge, techniques and method of shrimp culture

Photo 2: A female worker is pulling net to catch shrimp fry

Photo 3: Both male and female workers are cleaning the fungus and algae

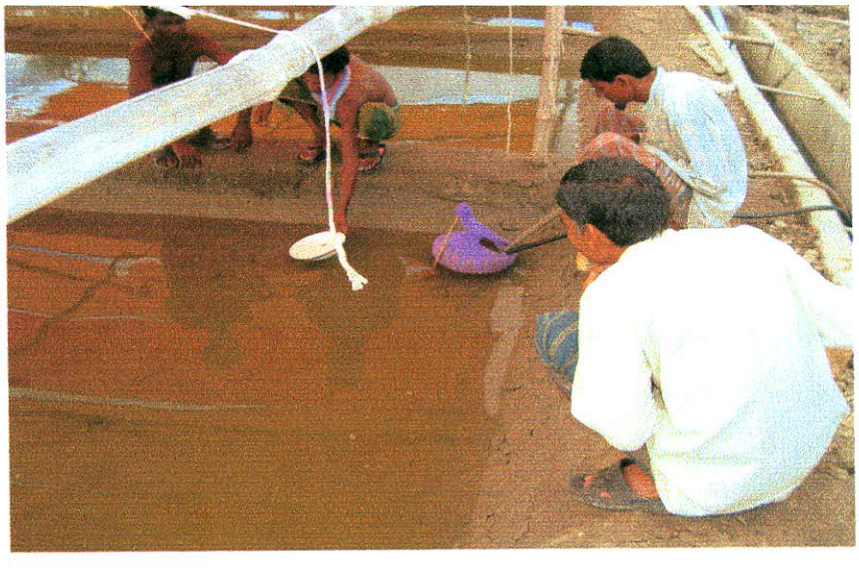

Photo 4: Test of shrimp fry in shrimp point

Photo 5: Female workers are breaking the cow-dung for shrimp *gher*

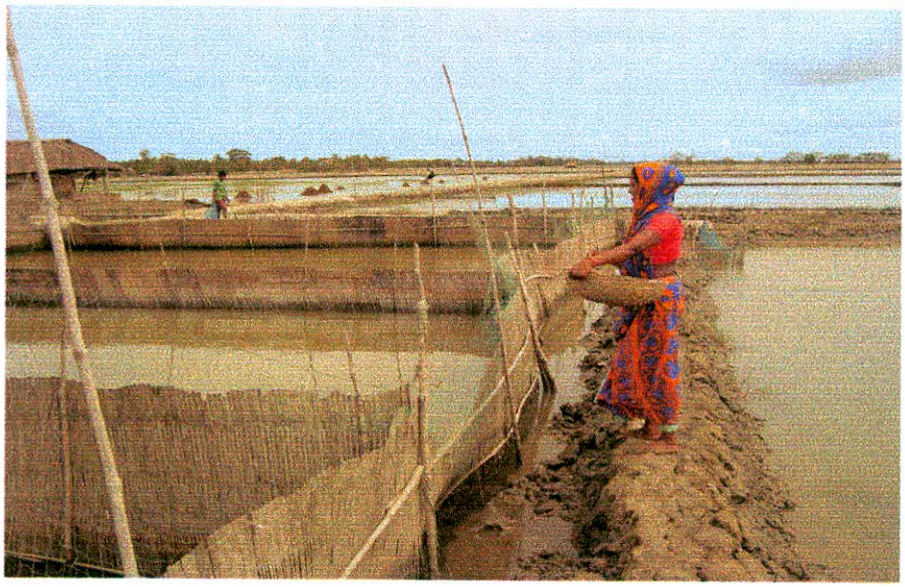

Photo 6: A female worker is giving food in the crab farm