

TRENDS OF SHRIMP FARMING IN BAGERHAT AREA



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TRENDS OF SHRIMP FARMING IN BAGERHAT AREA

A Thesis

By

Md. Moniruzzaman

Examination Roll No: MS-990626

Session: 1998-1999

The thesis submitted in partial fulfillment of the requirements
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November, 2009

TRENDS OF SHRIMP FARMING IN BAGERHAT AREA

Approved as to style and content by



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Declaration

Trends of Shrimp Farming in Bagerhat Area

The results presented in this thesis with the above mentioned title are entirely of the candidate's own investigations and no part of the results has been accepted for any degree nor is it being concurrently submitted for any degree.



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Abstract



A study was conducted between January and June 2009 with a detailed farm survey to describe the shrimp farming trend in Bagerhat area. The field survey was carried out among 60 farmers in three Upazila named Bagerhat Sadar, Fakirhat and Mollahat of Bagerhat district. The study was compared the culture and production system and socio-economic condition of farm owners using five years interval data collection from 1998 to 2008. The farm area ranged from 2,146.08-8,990 ha in 1998, 3,251.5-11,250 ha in 2003 and 3896.05-11690 ha in 2008 in three studied Upazila of Bagerhat District. The farm management systems include dike preparation, pond drying, liming, fertilizing etc. was properly done in 2008 than 1998 and partially done was highest in all three study year and not done was highest in 1998 and least in 2008. The source of shrimp fry was highest 85% wild in 1998, 50% wild in 2003 and 65% both wild and hatchery in 2008 and lowest 5% hatchery in 1998, 25% hatchery in 2003 and 10% wild in 2008. and lowest The stocking density of *Macrobrachium rosenbergii* was 14,250-30,875 fry/ha, in 1998 and increased 21,375-26,125 fry/ha in 2003 and 14,250-16,225 in 2008, *Penaeus monodon* was 7,200-9,500 fry/ha in 1998 and increased 31,500-47500 fry/ha and decreased 18,200-42,500 fry/ha in 2008 and White fish was 237.5-475 fry/ha in 1998 and increased 475-1230 fry/ha in 2003 and 850-1520 fry/ha in 2008 and production of *Macrobrachium rosenbergii* was 237.5-665 kg/ha in 1998 and increased 475-570 kg/ha in 2003 and decreased 380-1187.5 kg/ha, *Penaeus monodon* 190-522.5 kg/ha in 1998 and increased 280-855 kg/ha in 2003 and 430-665 kg/ha in 2008 and White fish 237.5-285 kg/ha in 1998 and increased 280-570 2003 and 630-855 kg/ha in 2008 in Bagerhat Sadar Upazila. The harvested shrimp was kept in bamboo baskets in 1998 and in crates or coops, plastics box, ice box in 2003 and 2008 for transporting from farm to marketing places. The shrimp was sold mainly Depot and local market in 1998 and Depot, Arot, factory and local market in 2003 and 2008. The dike of farm was used for vegetables culturing whose production was increasing day by day. During dry season farms are also used for paddy culture. Socio-economic condition of farm owner includes housing condition, nutritional status and recreational media using were improved from 1998 to 2008. Although the production cost of shrimp is increasing, the farm area is in creasing in Bagerhat region due to higher production than any other agriculture sector.

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List of Abbreviations and non-English Words

BFFEA	Bangladesh Frozen Food Expert Association
DIFTA	Danish Institute of Fisheries Technology and Agriculture
DOF	Department of Fisheries
EU	European Union
GAI	Gate Area Intake
ha	Hectare
Kg	Kilogram
NGO	Non Government Organization
PL	Post Larvae
SPSS	Statistical Package for Social Service
TSP	Triple Super Phosphate
UFO	Upazila Fisheries Officer
US	United State
USA	United State of America

**DEDICATED
TO
MY LATE MOTHER**



CHAPTER - 1



Introduction

Chapter 1

Introduction

1.1. Background of the study

Bangladesh is an impressive contributor as a culture shrimp industry. Every year she earns a lot of foreign currency by exporting frozen shrimp products. The vast majority (more than 90%) of the shrimp exported from Bangladesh are captured from natural waters, with an estimated 60% from Khulna and Bagerhat area, 35% from Comilla and Noakhali areas and 5% from Cox's Bazar area (DIFTA, 1993).

Shrimp (*Penaeus monodon*) culture plays a central part in the fisheries sub-sector in Bangladesh. Cultivation of shrimps experienced a spectacular boost over a period of a decade. This led to a significant change in the structure and composition of Bangladesh's export trade. Through a network of background and forward linkages, shrimp culture has created substantial employment on shrimp farms as well as an increase in ancillary activities such as trade/commerce, processing and marketing (Alauddin and Tisdell, 1998).

Shrimp is considered significant to Bangladesh economy. In Bangladesh, the production of shrimp by aquaculture method is a 100% export-oriented activity producing an average output of 53,000 tons and earning US\$ 530 million, which is some 8.0 per cent of the country's total exports in the 2007-08 fiscal years (July 2007 to June 2008). Shrimp is the second largest foreign exchange earner after garments. The sector employs nearly 1.3 million rural people in forward and backward linkage activities like hatching, nursing, producing, and harvesting, processing, exporting and other logistic support services. It has the highest potential for further development, enough to culture shrimps to earn US\$ 1.5 Billion by 2010 (BFFEA, 2007). Bangladesh is already among the top 10 exporters of shrimp in the world and accounts for some 3 % of global production. The EU (45%), USA (35%) and Japan (4%) are the world's major importers of shrimp from Bangladesh (Uddin, 2008).

Bangladesh has 700 kilometers of coastline and is estimated to have 110,000 hectares of shrimp ponds. At present, these ponds are nearly all extensive. Even though many

traditional users are losing access to some of their resources, there has been less environmental damage associated with extensive than with semiintensive or intensive shrimp farms. If these extensive ponds are turned into intensively managed farms, the ecological and social impacts will be even greater. If these ponds were evenly spread along the coastline, it would imply a continuous belt over 1.5 kilometers wide. Future generations may have a very heavy burden to bear as a consequence of intensive shrimp farming in these countries (Barraclough and Finger-Stich, 1996).

The south-western region of Bangladesh is known as the main zone of shrimp cultivation and about 75% of country's shrimp production is obtained from this region (Huq *et al.*, 2004).

The role of shrimp cultivation in the improvement of nutrition and socio-economic conditions of fish farming communities' inland and coastal areas of Bangladesh can not be over emphasized. In fact recent trend of shrimp culture in the country may provide hope for the rural poor, particularly as means of living to the displaced fishermen and fishing communities, for whom the culture of finfish, shellfish and other aquatic organisms rank among those occupations which have relatively greater potential of contributing to diets and higher income without disrupting their traditional life cycle. In Bagerhat region, most of the shrimp farmers are poor and they are very much interested in maximum production from less input. Farmers are hardly interested in using scientific culture technique that requires investment considerably. Shrimp yield in farms can be increased by applying modern technology such as intensification of culture operation through regularization of farm size, increasing stocking density, adding aeration system, application of fertilization and feeds (Islam, 2008).

1.2 Problem statement

Shrimp farming (or aquaculture), concentrated largely in tropical developing countries for export to the West, and has experienced spectacular growth over recent decades. Initially as part of a 'Blue Revolution' capable of producing food whilst relieving pressure on wild fish stocks, the industry has been widely promoted by aid agencies,

international financial institutions and governments as a means of speeding development and alleviating poverty in producing countries.

Most shrimp produced by commercial farms are tiger shrimp (*Penaeus monodon*), a warm, brackish water species. Such farms require substantial quantities of water, and are primarily located alongside rivers, estuaries and coastal areas. Consequently, the industry's rapid expansion is exacting a serious toll on wetland habitats found in these areas; mangrove forests, which lie in the intertidal zone, have been particularly impacted.

In recent years (since 2000) the increase in demand for shrimp and prawn in the international market has attracted many fish farmers to shrimp and prawn cultivation in different parts of Bangladesh. As a result, prawn farming has also developed in southern Bangladesh, mainly Sathkhria, Bagerhat and Khulna districts.

1.3 Objective of the Study

In view of the problem stated above, the present study was undertaken to know the shrimp farming trend in Bagerhat area.

C H A P T E R - 2



*Literature
Review*

Chapter 2

Literature Review

Sultana (1994) reported that only fifteen years ago nearly all commercialized shrimp were captured from the oceans. Capture of wild ocean shrimp tended to become more seasonal and unpredictable during the second half of the 1980s. In several Asian coastal zones, shrimp were also cultivated for local consumption in traditional *bheri* multicropping aquaculture systems during the dry season in intertidal areas. Brackish estuarine water was allowed to flow into croplands bringing with it crustacean and fish fry which would feed and grow on naturally available plankton and other vegetation. Also, traditional salt makers often used their ponds to cultivate fish and prawns during the rainy season

According to Kamp and Brand (1994) in the late 1980s, this farming practice began to be adopted widely in the original location in the Fakirhat area, where prawns were grown along with carps and rice.

According to Ahmed (1995) it is estimated that about 250,000 ha of land has good potential for coastal aquaculture in Bangladesh. Khan and Hossain (1996) of that, about 180,000 ha is suitable for shrimp culture.

Rahman *et al.* (2002) reported in Bangladesh, shrimp farming started in some coastal areas at the later part of the sixties called brackish water aquaculture of shrimp in the coastal districts. Marine (marine water) shrimp farming over the coastal areas has been expanded and spread during the decades of seventies and its high prices in the world. However, the first growing shrimp industry has been accompanied by concerns over social, economic and environmental impacts.

Bangladesh's coastal brackish water shrimp export sector has grown over the past thirty years in response to expanded global demand for high quality sea food and attempts by successive Bangladesh governments since 1980's to liberalise and diversify the economy (Pokrant *et al.*, 2002).

According to Alam and Phillips (2004) the contribution of coastal aquaculture, particularly black tiger shrimp (*P. monodon*, Penaeidae) culture, to both rural and national economies is major source of export earnings and employment in the coastal areas. The shrimp is the second highest foreign income earner. Bangladesh has a large area of coastal tidal land of which 0.143 million hectares of land has been brought under brackish water shrimp aquaculture.

DOF (2009) reported that coastal aquaculture increased from 141,352.54 ha in 1998-1999 to 217,877.05 ha in 2007-2008 and production from 63,163.78 to 90,574.34 metric tons in the same period. The rapid expansion of shrimp farm development during the last decade, along with the adoption of extensive and improved extensive culture techniques, has caused growing concern as to its adverse effect on the coastal environment and damage to the traditional agricultural systems. The socio-economic scenarios have changed rapidly.



C H A P T E R = 3

*Material and
Methods*

Chapter 3

Materials and Methods

3.1 Study Area

The field survey was carried out among 60 farmers in three Upazila named Sadar, Fakirhat and Mollahat of Bagerhat district. The selected areas have no alternate income option of the people.

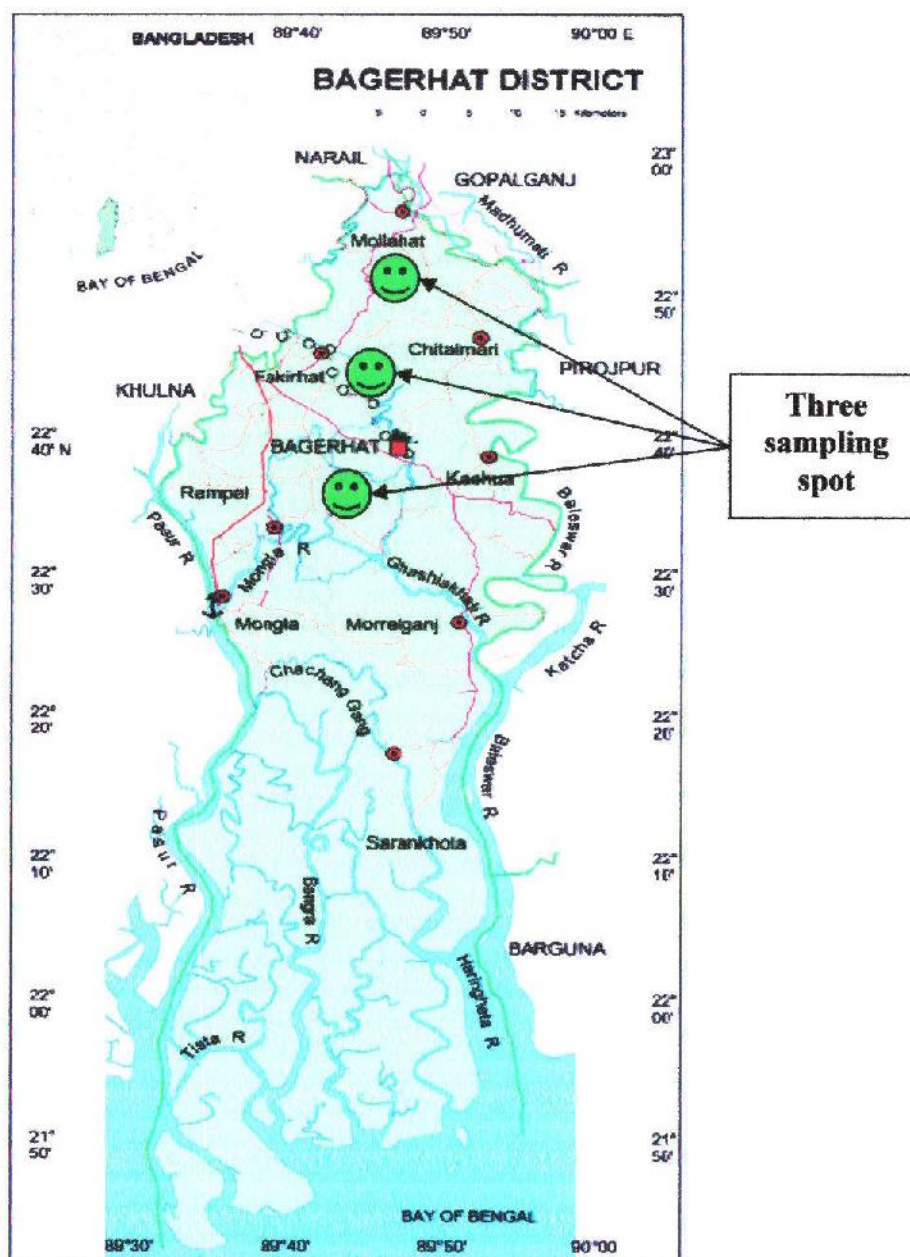


Fig. 1. Map of Bagerhat district

3. 2 Data collection

Data were collected from January to June 2009 using questionnaire with five years interval (1998, 2003 and 2008). A combination of the following survey techniques were used for data collection:

3. 2. 1 Primary data collection: Series of individual interview, semi-structured interview and observation of daily activities were the primary sources of required data and information for this research. A structured questionnaire was used for formal interviews with different stockholder who were involved in shrimp culture. Primary data were collected by using following methods:

3. 2. 1. 1 Questionnaire interviews: A structured questionnaire for individual respondents was used as the instrument for survey. For this purpose 60 individual respondents were randomly selected for interview based on shrimp farming experiences. The questionnaire was designed on the basis on coordination scheme. Farmers were interviewed at their houses and/or gher sites. The interviews focused on history of shrimp farming, culture systems, pond preparation technology, feeding technology, harvesting technology, and cost-benefit involved in shrimp farming.

3. 2. 1. 2 Direct Observation: Direct field observation was also recorded in order to get the additional information the farming practices and to justify cost-benefit aspects. The information collected from direct observation was useful for validation of data collected through structured questionnaire interviews.

3. 2. 1. 3 Crosscheck interviews: Crosscheck interviews were conducted with key informants such as school teachers, local leaders, social workers, Upazilla Fisheries Officers and relevant NGO workers to validate collected primary data. Where information was found contradictory further interviews were carried out.

3. 2. 2 Secondary data collection: Data on Golda farming was collected from relevant Government and non-government organizations such as Department of Fisheries (DOF), and relevant NGOs. In addition, more secondary data was collected from the related journal articles, books, reports and related web page.

3.3 Data processing and analysis

Collected data from various sources were coded and entered into a database system using Microsoft Excel software and SPSS-12.0. Numerical data which were collected in local units due to familiarity for respondents, converted into international units before transfer into computer. Preliminary data sheets were compared with the original coding sheets to ensure the accuracy of the data entered. At each stage of survey, data were checked, edited and coded at the field-level. Data were summarized using descriptive statistics. Most of the analyzed data were presented with graphs prepared with SPSS-12.0.

C H A P T E R - 4



Results

Chapter 4

Results

4.1 Total area of the farms

The figure 2 shows that the highest total area was 8,990 ha in Bagerhat Sadar and the lowest was 2,146.08 ha in Fakirhat in 1998. Similarly the highest total area of farm was 11,250 ha in Bagerhat Sadar and the lowest was 3,251.5 ha in Fakirhat in 2003. Finally in 2008 the highest total area was also 11,690 ha found in Bagerhat Sadar and the lowest was 3,896.05 ha in Fakirhat in 2008. The result exposed that the area of farm was increasing (Appendix. 2).

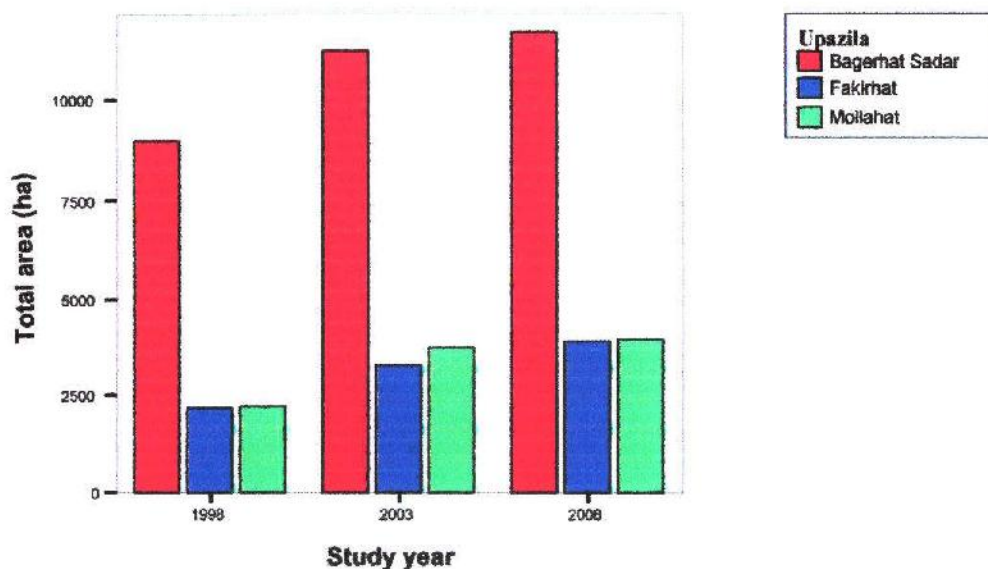


Fig. 2. Total area of farms

4.2 Seasonal activities in farm area

The figure 3 shows seasonal activities of farmer in farming time which varies season to season. The calendar mainly shows present activities of farmer. They stocked Bagda from mid-April to mid-July and sometimes partially continued to mid-October, Golda from mid-February to mid-May and partially also continued to July, White fish from mid-April to mid-July and it was also partially continued to October, Paddy from mid-December to mid-February and Vegetables from May to mid-July. They harvest Bagda from mid-July to November, Golda from mid-September to mid-February, White Fish from mid-September to mid-March, Paddy from March to April and Vegetables from mid-July to mid-November. In 1998 some of the farm only

culture paddy and some of the farm were in stagnant condition. In 2003 and 2008 majority of the farms are now involved in aquaculture.

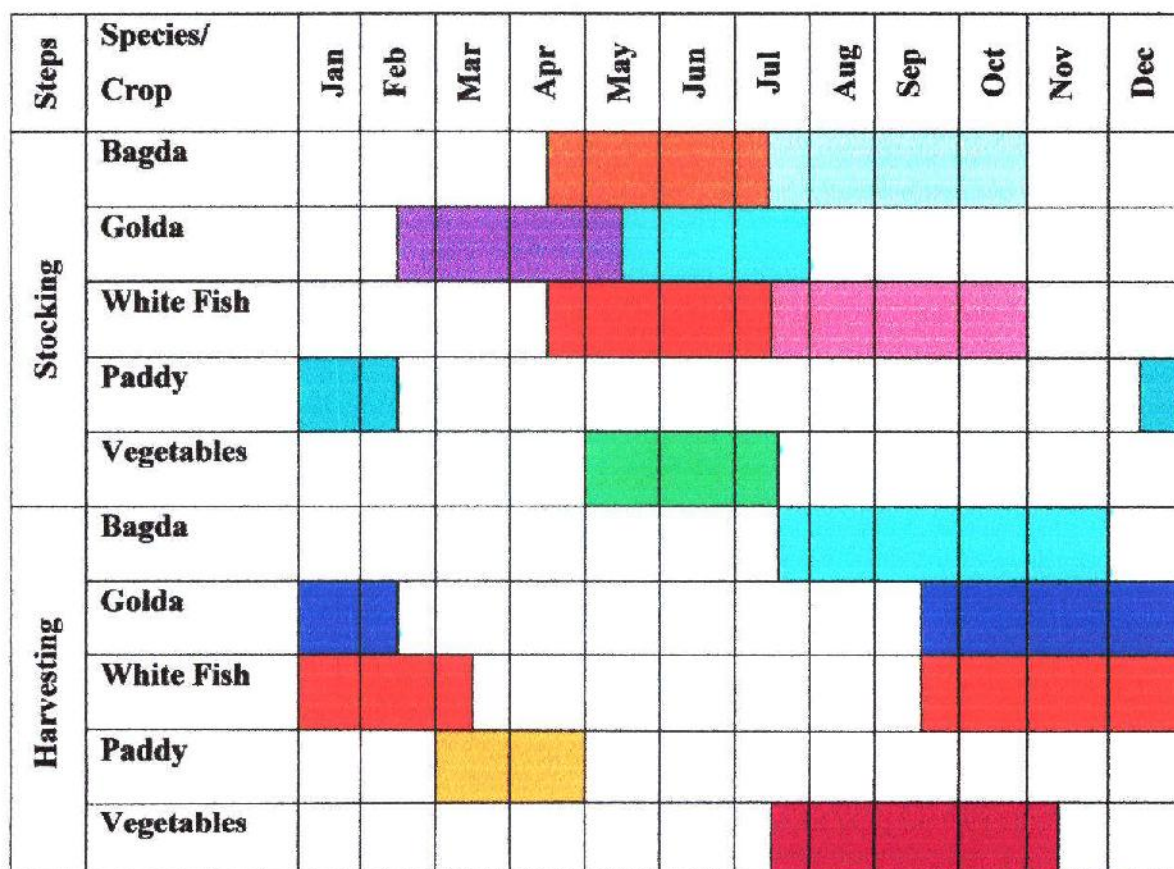


Fig.3. Activities calendar of shrimp and others farming

4.3 Farm management

Farm preparation status such as bottom soil type, pond area, water depth, embankment condition improvement, dewatering, liming, fertilizing, etc. are highly important in assessing the productivity of the farm. The Farm preparation status is described below:

4.3.1 Dike preparation

Dike condition is always rising due to day by day natural disaster affected. Dike of Fakirhat is high than others areas. They prepared and repaired the dike during January to March every year for Bagda (*Penaeus monodon*). The quality of dikes of the surveyed Farms is shown in the figure 4. The 71.43% of the farm had less than 2 feet height and 28.57% had more than 2 feet in 1998. On the other hand 86% of the farm

had more than 2 feet height and 14% had less than 2 feet height in 2003. Finally 91% of the farm had more than 2 feet height and 9% of the farm had less than 2 feet height in 2008 (Fig.4 and Appendix.3).

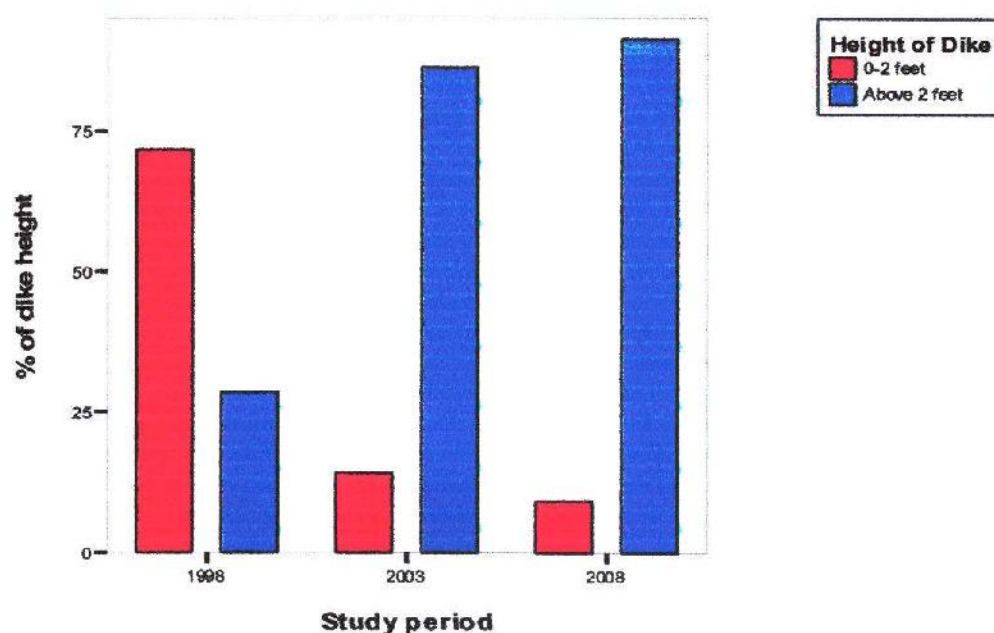


Fig. 4. Dike's height of the Bagda and Golda farm

4.3.2 Drying

In 1998 the highest not drying was 55.56% in Bagerhat Sadar and the lowest was 10% in Mollahat. Inverse result was obtained in case of partial drying. Similar result was obtained for properly drying.

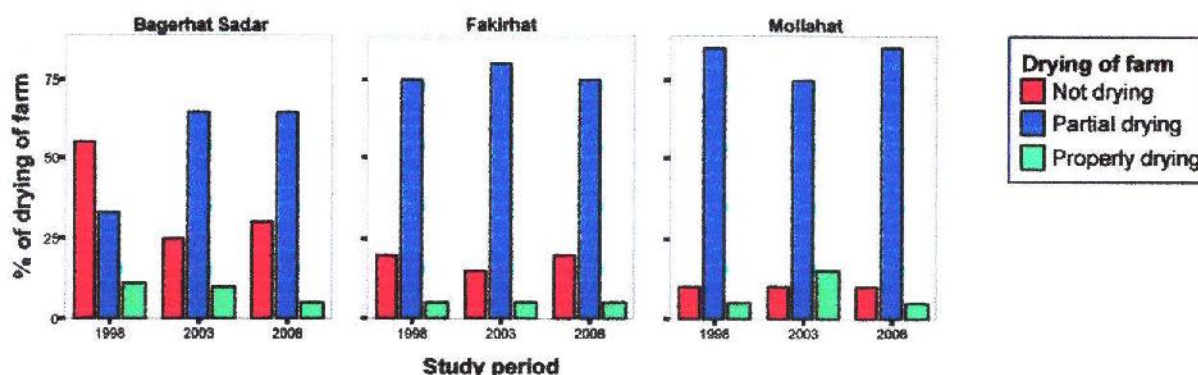


Fig. 5. Drying mode of the Bagda and Golda farm

In 2003 the highest not drying was 25% in Bagerhat Sadar and the lowest was 10% in Mollahat, the highest partial drying was 80% in fakirhat and the lowest was 63% in

Bagerhat Sadar and the highest properly drying was 15% was in Mollahat and the lowest was 5% in Fakirhat. In 2008 the results of not drying and partial drying was similar like 1998. The properly drying was 5% same in three Upazila (Fig. 5 and Appendix. 4).

4.3.3 Liming

Liming pattern of three Upazila observed during study period is shown in figure 6. In 1998 the highest using lime properly was 5% in Bagerhat Sadar and the lowest was 3% in Mollahat. The highest using lime partially was 83% in Mollahat and the lowest was 33.33% in Bagerhat Sadar. The highest no use of lime was 61.67% in Bagerhat Sadar and the lowest was 14% in Mollahat. In 2003 the highest using lime properly was 10% in Bagerhat Sadar and the lowest was 5% in Fakirhat. The highest using lime partially was 80% in Bagerhat Sadar and the lowest was 75% in Fakirhat. The highest no use of lime was 18% in Mollahat and the lowest was 10% in both Bagerhat Sadar and Fakirhat. In 2008 the highest using lime properly was 10% in Bagerhat Sadar and the lowest was 7% in Fakirhat. The highest using lime partially was 83% in Fakirhat and the lowest was 70% in Bagerhat Sadar. The highest no use of lime was 20% in Bagerhat Sadar and the lowest was 10% in Fakirhat (Appendix. 5). The farm owner used lime as CaCO_3 , Dolomite etc.

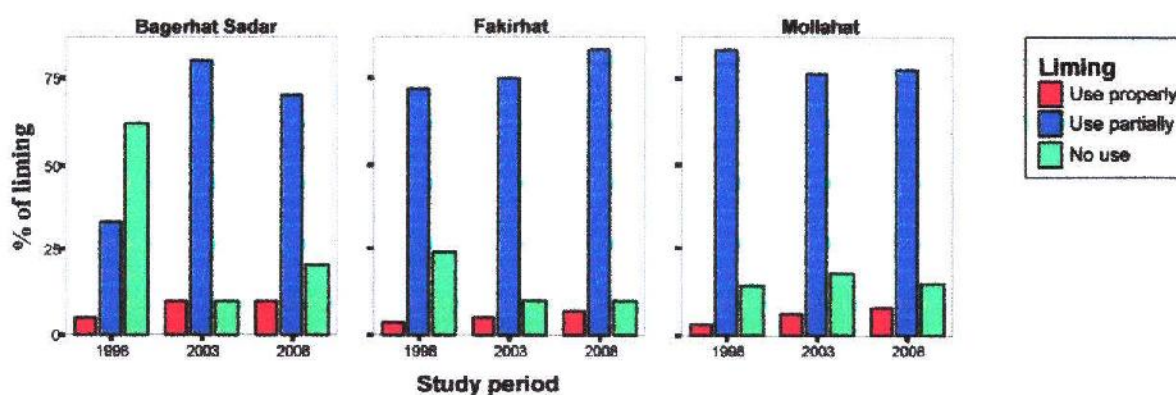


Fig. 6. Application mode of liming

4.3.4 Fertilization

In 1998 the highest properly using fertilizer was 6% in Bagerhat Sadar and the lowest was 2% in Mollahat. The highest partially using fertilizer was 58% in Mollahat and

the lowest was 25% in Fakirhat. The highest no use of fertilizer was 72% in Fakirhat and the lowest was 40% in Mollahat.

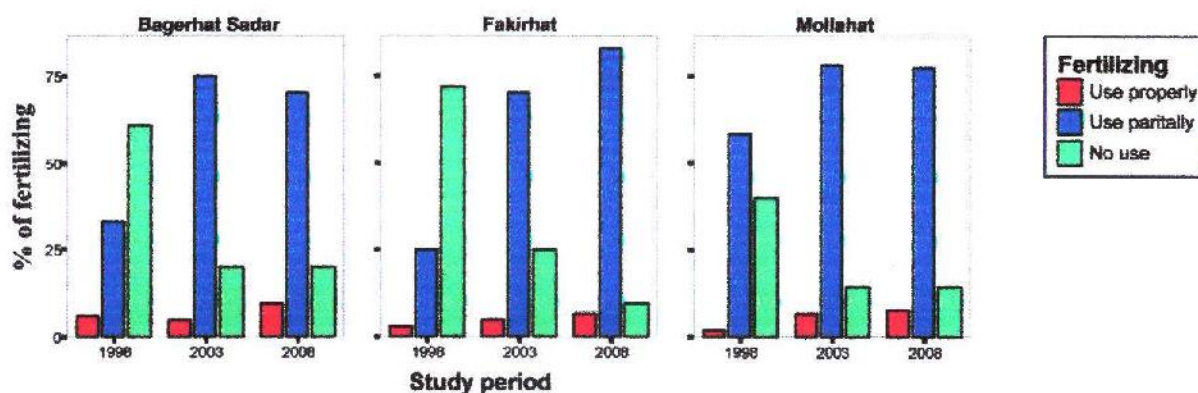


Fig. 7. Application mode of fertilizing

In 2003 the highest properly using fertilizer was 7% in Mollahat and the lowest was 5% in both Bagerhat Sadar and Fakirhat. The highest partially using fertilizer was 78% in Mollahat and the lowest was 70% in Fakirhat. The highest no use of fertilizer was 25% in Fakirhat and the lowest was 15% in Mollahat. In 2008 the highest properly using fertilizer was 10% in Bagerhat Sadar and the lowest was 7% in Fakirhat.. The highest partially using fertilizer was 83% in Fakirhat and the lowest was 70% in Bagerhat Sadar. The highest no use of fertilizer was 20% in Bagerhat Sadar and the lowest was 10% in Fakirhat (Fig. 7 and Appendix. 6). The farm owner used fertilizer as Cow dung, Urea, TSP etc.

4.3.5 Source of fry

In 1998 the highest wild fry stocking was 85% in Fakirhat and the lowest was 50% in Mollahat, the highest hatchery fry stocking was 10% in Mollahat and the lowest was 5% in Fakirhat and the highest both wild and hatchery fry stocking was 40% in Mollahat and the lowest was 10% in Fakirhat. In 2003 the highest wild fry stocking was 50% in Fakirhat and the lowest was 35% in Bagerhat Sadar, the highest hatchery fry stocking was 30% in Bagerhat Sadar and the lowest was 5% in both Mollahat and Fakirhat and the highest both wild and hatchery fry stocking was 35% in both Bagerhat Sadar and Mollahat and the lowest was 25% in Fakirhat. In 2008 the highest wild fry stocking was 30% in Mollahat and the lowest was 10% in both Bagerhat and Fakirhat, the highest hatchery fry stocking was 32% in Mollahat and the lowest was 25% in Bagerhat Sadar and the highest both wild and hatchery fry stocking was 65%

in Bagerhat Sadar and the lowest was 38% stocked in Mollahat (Fig. 8 and Appendix. 7).

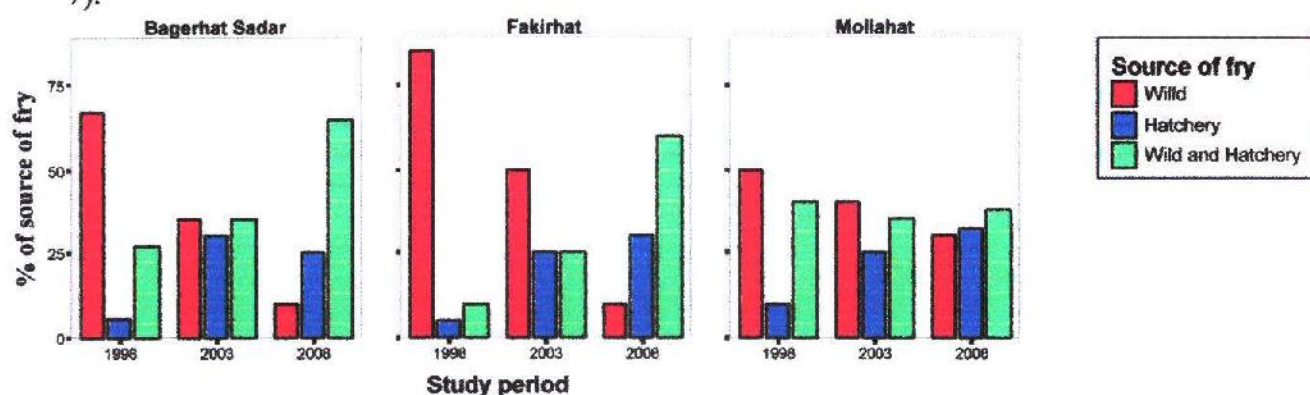


Fig. 8. Source of fry

4.3.6 Stocking density of Shrimp and White fish

The study showed that in 1998 the highest average stocking density of Golda was 30,875 per ha in Mollahat Upazila and the lowest average was 11,875 per ha in Fakirhat, the highest average stocking density of Bagda was 9,500 per ha same in both Bagerhat Sadar and Fakirhat Upazila and the lowest average was 7,200 per ha in Fakirhat. The highest average stocking density of White fish was 475 per ha in Mollahat and the lowest average was 237.5 per ha both in Bagerhat Sadar and Fakirhat Upazila.

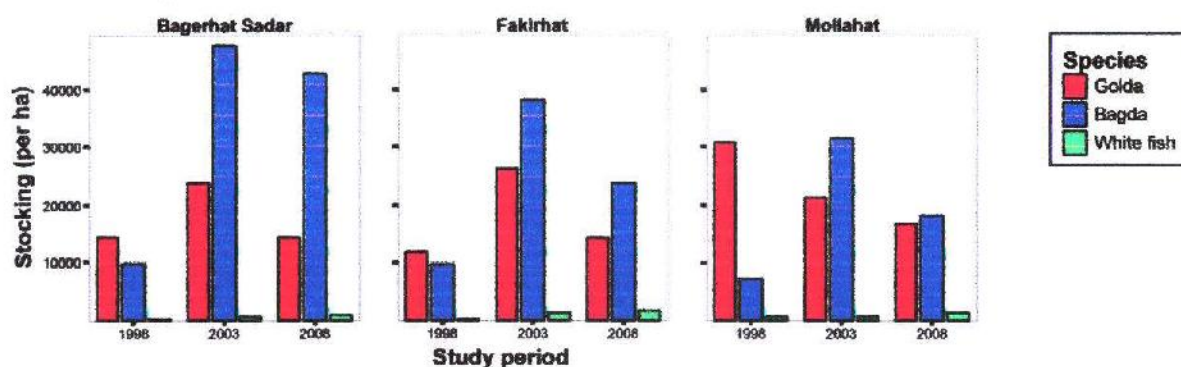


Fig. 9. Stocking density of shrimp and white fish

On the other hand in 2003 the highest average stocking of Golda was 26,125 per ha in Fakirhat and the lowest average was 21,375 per ha in Mollahat, the highest average stocking of Bagda was 47,500 per ha in Bagerhat Sadar and the lowest average was 38,000 in Mollahat, and the highest average stocking density of White fish was 1,230 per ha in Fakirhat and the lowest average was 475 per ha both in Bagerhat Sadar. Finally in 2008 the highest average stocking of Golda was 16,625 per ha in Mollahat

and the lowest average was 14,250 per ha in both Bagerhat Sadar and Fakirhat, the highest average stocking of Bagda was 42,500 per ha in Bagerhat Sadar and the lowest average was 18,200 in Mollahat and the highest average stocking density of White fish was 1,520 per ha in Bagerhat Sadar and the lowest average was 850 per ha Bagerhat Sadar (Fig. 9 and Appendix. 7).

4.3.7 Feeding

The study revealed that in 1998 the highest home made feed (means rice polish, oil-cake, molasses, salt etc. mix) was used 55% in Mollahat and the lowest was used 44.44% in Bagerhat Sadar, the highest commercial feed was used 27% in Fakirhat and the lowest was used 10% in Mollahat, the highest both home made and commercial feed was used 15% in both Fakirhat and Mollahat and the lowest was used 11.11% in Bagerhat Sadar and the highest no feed was used 33.33% in Bagerhat Sadar and the lowest was used 5% in Fakirhat. On the other hand in 2003 the highest home made feed was used 21% in Mollahat and the lowest was used 10% in Fakirhat, the highest commercial feed was used 80% in Fakirhat and the lowest was used 50% in Mollahat, the highest both home made and commercial feed was used 25% in Mollahat and the lowest was used 6% in Fakirhat and the highest no feed was used 4% in both Fakirhat and Mollahat and the lowest was used 5% in Bagerhat Sadar.

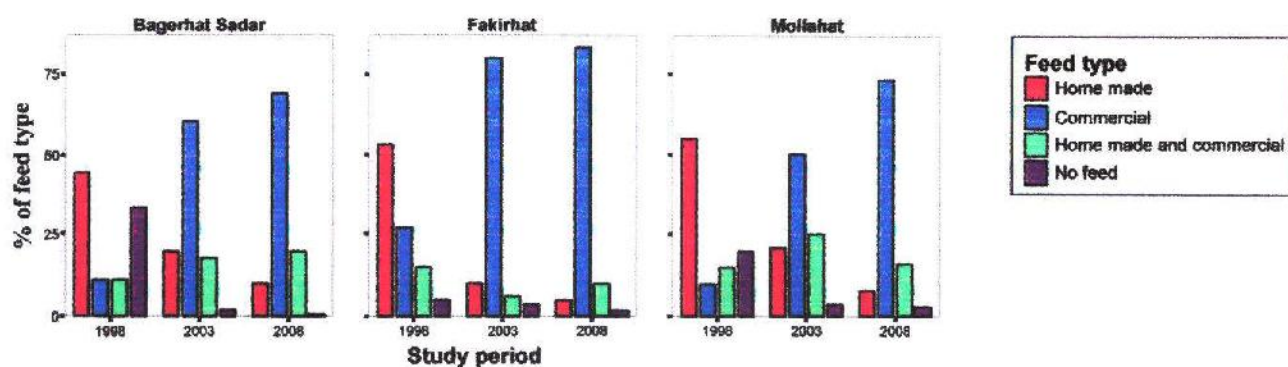


Fig.10. Feed type and feeding percentage

Finally in 2008 the highest home made feed was used 10% in Bagerhat Sadar and the lowest was used 5% in Fakirhat, the highest commercial feed was used 83% in Fakirhat and the lowest was used 69% in Bagerhat Sadar, the highest both home made and commercial feed was used 20% in Bagerhat Sadar and the lowest was used 10%

in Fakirhat and the highest no feed was used 3% in Mollahat and the lowest was used 1% in Bagerhat Sadar (Fig. 10 and Appendix. 9).

4.4 Harvesting and Marketing management

4.4.1 Harvesting

Harvesting, the last activity of shrimp culture is carried out after 90- 120 days of extensive shrimp farming. Harvesting usually takes place during full and new moon of a lunar cycle. A cycle consists of 5-7 days. During that period, water is drained out to 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 were practiced in harvesting farmed shrimp in the study area.

4.4.1.1 GAI method

A very small portion of the farm is converted into a rectangular shaped harvesting area. This area is prepared at the adjacent to 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 used by individual farmers is laterally placed a short distance from the canal to prevent escaping of shrimp and other fishes. The well off farmers, either individual or group category now use plastic pipe to make this fence for durability and longevity. The total harvesting area is locally called GAI.

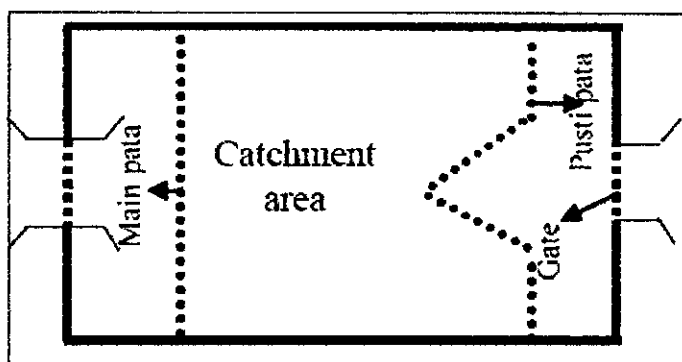


Fig. 11. Schematic diagram of a GAI

Figure 11 shows the diagram of a GAI. Shrimp enter into the catchment area through a narrow passage in the fence, and these cannot go back to the rearing area of the farm. While inflow 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 area is totally drained out and the last piece of shrimp is caught manually. This system is repeated during a lunar cycle.

4.4.1.2 Trap method

Trapping is another way of harvesting shrimp. Some bamboo traps, of various sizes (standard 2 ft x 2.5 ft x 2 ft) is placed at 8-10 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 specially the outside lessee usually set up the traps frequently where shrimp during tidal wave are unable to move to the GAI.

4.4.1.3 Net method

Cast net is practiced for harvesting shrimp when fewer amounts of shrimp is caught in the GAI or in the Trap. The farm owner hired some cast net owners in a particular period.

4.4.2 Marketing

For carrying shrimp and fish from farm to marketing place the container, vehicle used which are described below.

4.4.2.1 Container

In generally the study of the three Upazila exposed that in 1998 the farm owner 100% used basket made of bamboo. On the other hand in 2003 the farm owner used 80% Basket (bamboo basket), 13.33% Krates (plastic) and 6.67% others (means ice box, plastics box etc). Finally in 2008 the farm owner used 90% crates and 10% others (Fig. 12 and Appendix. 10).

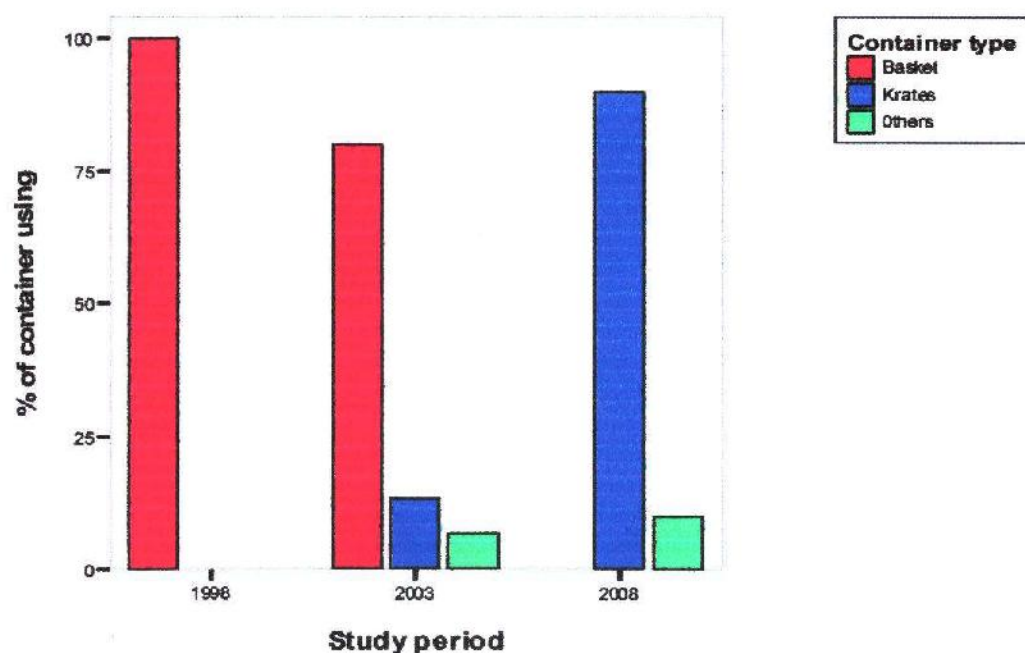


Fig. 12. Container of marketing

4.4.2.2 Transportation

In generally the study of the three Upazila exposed that in 1998 the farm owner used 90% Van, 4% Tempo and 6% both Van and Tempo for transportation.

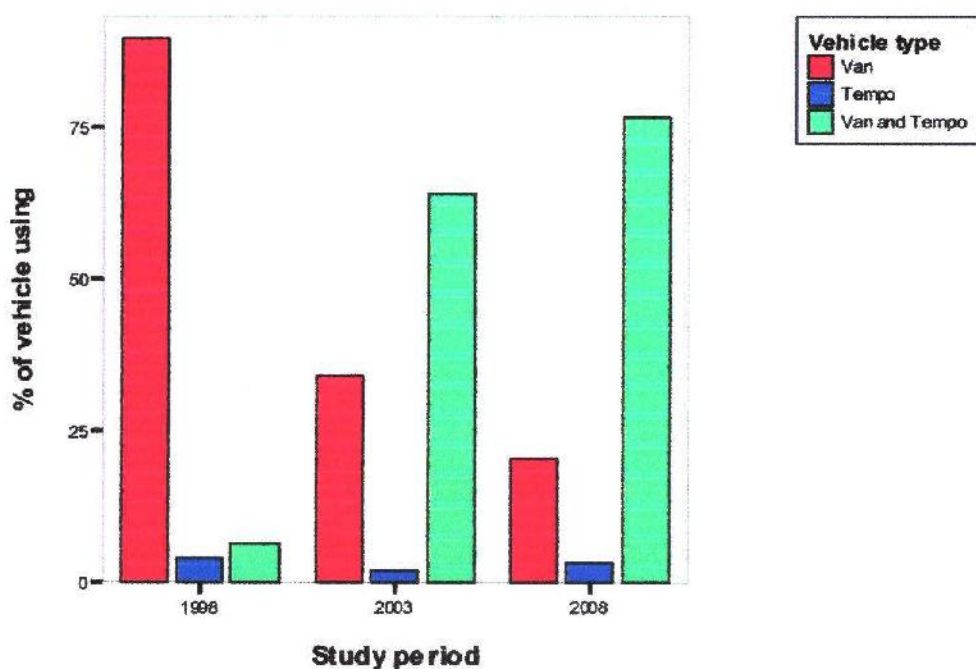


Fig. 13. Vehicle of marketing

On the other hand in 2003 the farm owner used 34% Van, 2% Tempo and 64% both Van and Tempo for transportation. Finally in 2008 the farm owner used 20% Van, 3.33% Tempo and 76.67% both Tempo for transportation (Fig. 13 and Appendix 11).

4.4.2.3 Place of marketing

In generally the study of the three Upazila showed that in 1998 the farm owner sold shrimp 65.31% in Depot, 14.28% in Arot, 6.12% in both Arot and Depot and 14.29% in local market. On the other hand in 2003 the farm owner sold shrimp 60% in Depot, 20.33% in Arot, 14.67% in both Arot and Depot and 5% in local market. Finally in 2008 the farm owner sold shrimp 33.33% in Depot, 54.67% in Arot, 10% in both Arot and Depot and 2% in local market (Fig. 14 and Appendix 12). Farm owner sold shrimp both Aroth and Depo in Bagerhat Sadar, mainly Arot in Fakirhat and mainly Depo in Mollahat.

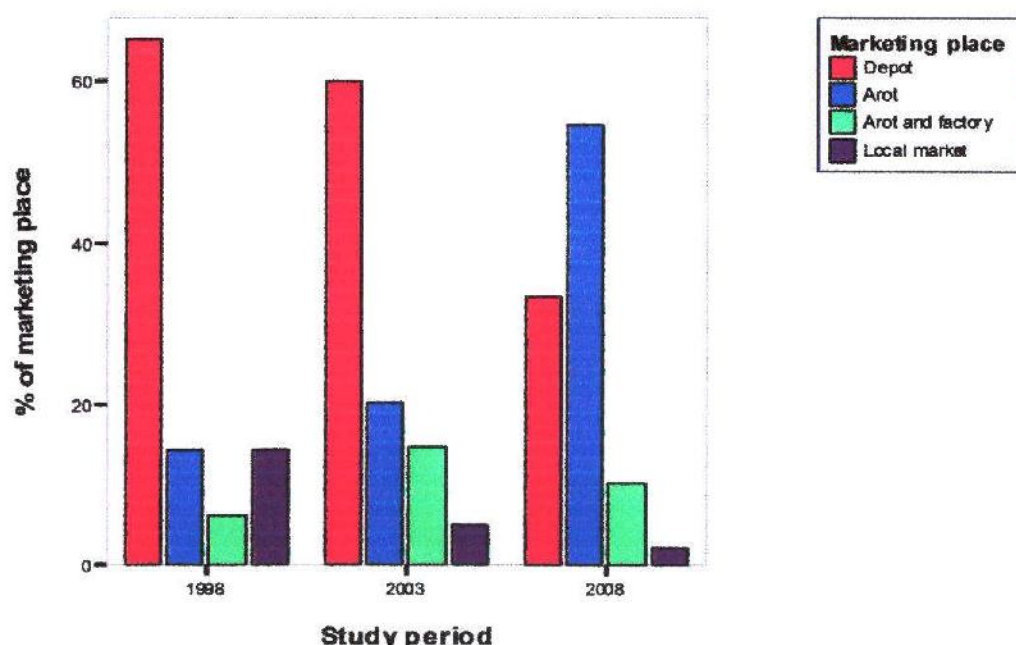


Fig. 14. Place of marketing

4.5 Production from the shrimp farm

The study revealed that in 1998 the highest average Golda production was 665 Kg per ha in Molahat and the lowest average was 237.5 Kg per ha in Fakirhat, the highest average Bagda production was 522.5 Kg per ha in Bagerhat Sadar and the lowest average was 190 Kg per ha in Fakirhat, the highest average White fish production was 285 Kg per ha in both Bagerhat Sadar and Mollahat and the lowest average was 237.5 Kg per ha in Fakirhat, the highest average paddy production was

2755 Kg per ha in Bagerhat Sadar and the lowest average production was 1100 Kg per ha in Fakirhat and the highest average vegetables production was 1500 Kg per ha in Fakirhat and the lowest average was 610 Kg per ha in Bagerhat Sadar. On the other hand in 2003 the highest Golda production was 570 Kg per ha in both Fakirhat and Mollahat and the lowest was 475 Kg per ha in Bagerhat Sadar, the highest Bagda production was 855 Kg per ha in Fakirhat and the lowest was 475 Kg per ha in Bagerhat Sadar, the highest White fish production was 570 Kg per ha in Fakirhat and the lowest was 285 Kg per ha in Bagerhat Sadar, the highest paddy production was 2375 Kg per ha in Bagerhat Sadar and the lowest was 1900 Kg per ha in Fakirhat, and the highest vegetables production was 2850 Kg per ha in Mollahat and the lowest was 1187.5 Kg per ha in Bagerhat Sadar.

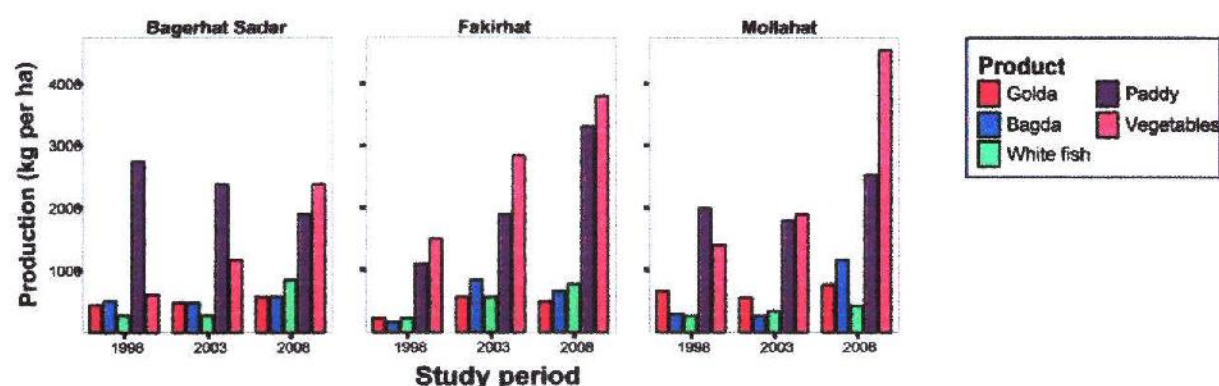


Fig. 15. Production from shrimp farm over the years

Finally in 2008 the highest Golda production was 760 Kg per ha in Mollahat and the lowest was 522.5 Kg per ha in Fakirhat, the highest Bagda production was 1187.5 Kg per ha in Fakirhat and the lowest was 285 Kg per ha in Bagerhat Sadar, the highest White fish production was 855 Kg per ha in Bagerhat Sadar and the lowest was 760 Kg per ha in Fakirhat, the highest paddy production was 3325 Kg per ha in Fakirhat and the lowest was 1900 Kg per ha in Bagerhat, and the highest vegetables production was 7125 Kg per ha in Mollahat and the lowest was 2375 Kg per ha in Bagerhat Sadar. The production rate of production in the studied area is shown in figure 15 (Appendix. 13).

4.6 Production cost

The study revealed that in 1998 the highest average production cost of shrimp and white fish was 1,09,250 Taka/ha in Fakirhat and the lowest average was 94,520 Taka/ha in Mollahat, the highest average production cost of paddy was 24,560

Taka/ha in Bagerhat Sadar and the lowest average was 21,500 Taka/ha in Mollahat and the highest average production cost of vegetables was 2,325 Taka per ha in Mollahat and the lowest average was 2,200 Taka per ha in Bagerhat Sadar. On the other hand in 2003 the highest production cost of shrimp and white was 1,95,900 Taka/ha in Fakirhat and the lowest average was 1,39,175 Taka/ha in Mollahat, the highest average production cost of paddy was 27,480 Taka/ha in Bagerhat Sadar and the lowest average was 24,865 Taka/ha in Mollahat and the highest average production cost of vegetables was 3,520 Taka per ha in Fakirhat and the lowest average was 3,480 Taka per ha in Bagerhat Sadar.

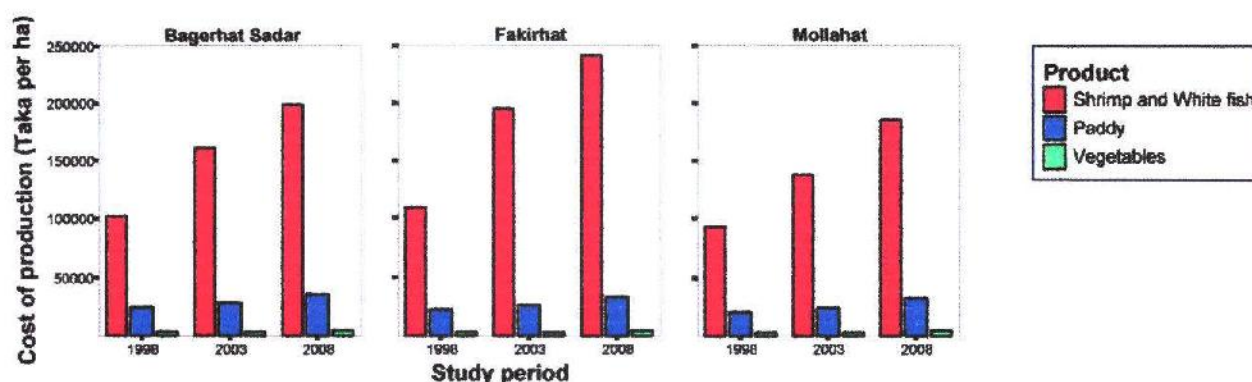


Fig.16. Cost of production over the years

Finally in 2008 the highest production average cost of shrimp and white fish was also 2,41,300 Taka/ha in Fakirhat and the lowest average was 1,86,620 Taka/ha in Mollahat, the highest average production cost of paddy was 34,540 Taka/ha in Bagerhat Sadar and the lowest average was 32,580 Taka/ha in Mollahat and the highest average production cost of vegetables was 4,825 Taka per ha in Bagerhat Sadar and the lowest average was 4340 Taka per ha in Mollahat. Cost of production is shown in figure 16 (Appendix. 14).

4.7 Socio-economic characteristics of the farmers

4.7.1 Age of farmers

In generally the study of three Upazila exposed that the present age range of farm owner was 5% less than 35 years, 21.33% 35-40 years, 40% 40-45 years, 22% 45-50 years and more than 50 years was 11.67%. The highest range was 40-45 years old people and the lowest range was less than 35 years people (Fig. 17 and Appendix. 15).

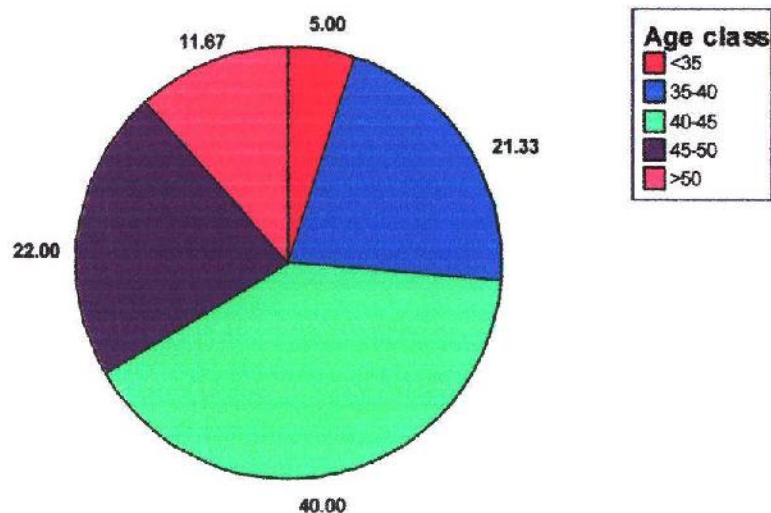


Fig. 17. Age class of farmer in Bagerhat area

4.7.2 Education

The figure 18 showed the education level of farmer in 1998 when this study was begun. The percentage of literate was 11.67%, sign only 30%, upto primary was 35%, upto secondary was 15% and above secondary was 8.33%. The highest education was upto primary and the lowest was above secondary (Appendix. 16).

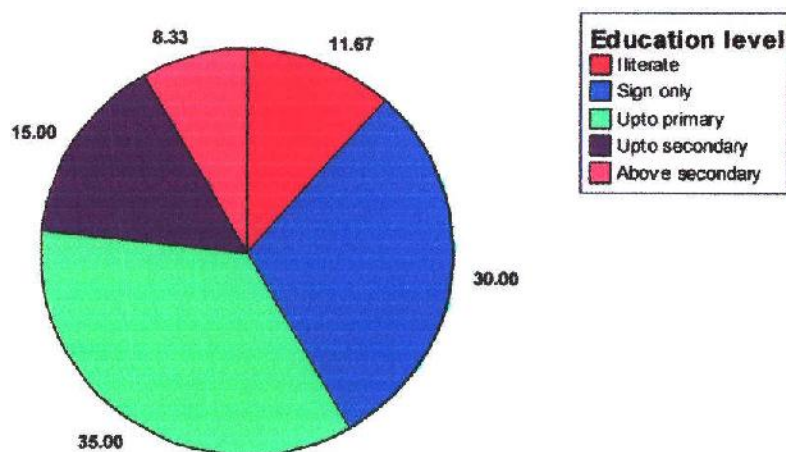


Fig. 18. Education level of farmer in Bagerhat area

4.7.3 Family type

The study exposed that in 1998 the single family percentage was 61.67% and joint family percentage was 38.33%. On the other hand in 2003 the single family percentage was 85% and joint family percentage was 15%. Finally in 2008 the single family percentage was 91.67% and joint family percentage was 8.33%. In the studied

three Upazila showed that Joint family type was decreasing and single family type was increasing (Fig. 19 and Appendix. 17).

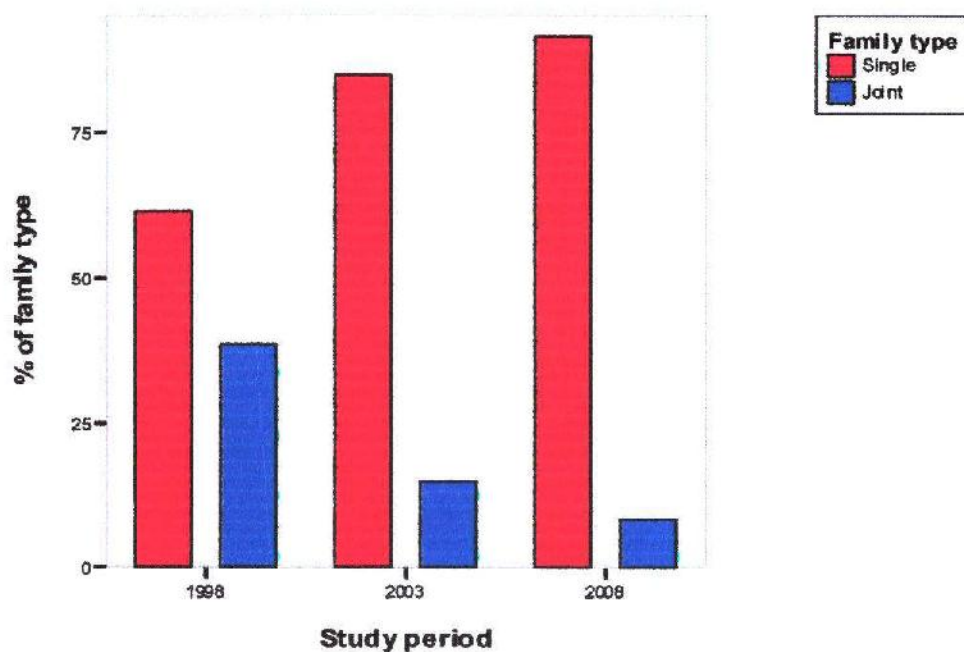


Fig. 19. Family type of farmer in Bagerhat area

4.7.4 Condition of house

The study showed that in 1998 the percentage of mud made house was 89.67%, the semi pacca house 8.33% and Pacca house (means concrete made) 2%.

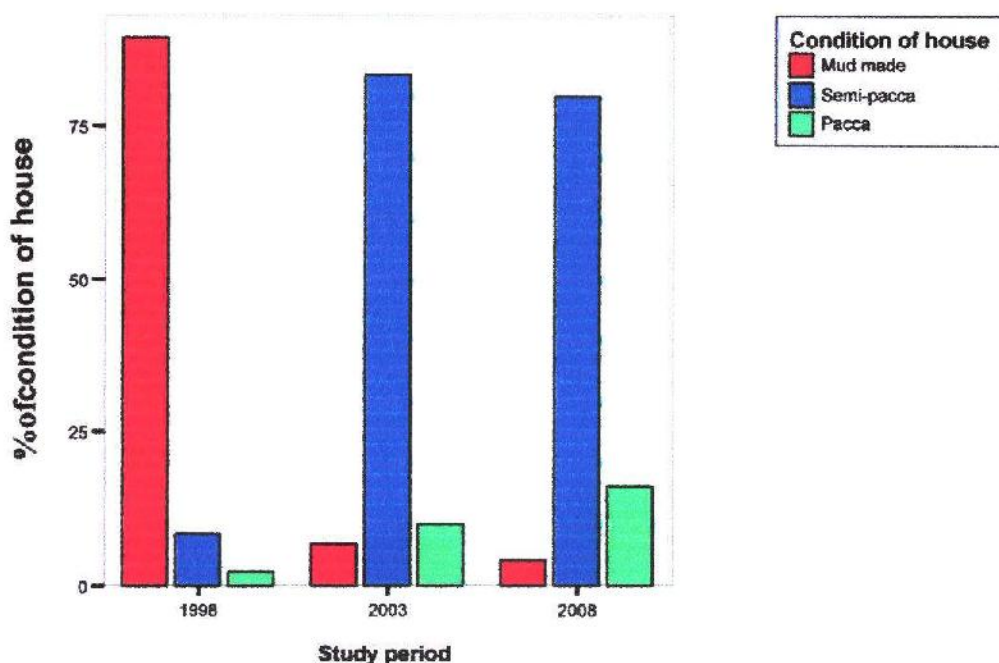


Fig. 20. Farmers house condition in Bagerhat area

On the other hand in 2003 the percentage of mud made house was 6.67%, the semi pacca house 83.33% and pacca house 10%. Finally in 2008 the percentage of mud made house was 4%, the semi pacca house 80% and pacca house 16%. (Fig. 20 and Appendix.18).

4.7.5 Occupations

The study exposed that in 1998 occupation of farm owner was only fishing 21.67%, fishing, fishing and agriculture 36.67% and 36.66% others (means daily labour, green vegetables business etc). On the other hand in 2003 occupation of farm owner was only fishing 10%, fishing and agriculture was 78.33% and 11.67% others. Finally in 2008 occupation of farm owner was only fishing 8.33%, fishing and agriculture 80% and 11.67% others. The study showed that the farmer's involvement in fishing and agriculture was increasing and others involvement was decreasing (Fig. 21 and Appendix. 19).

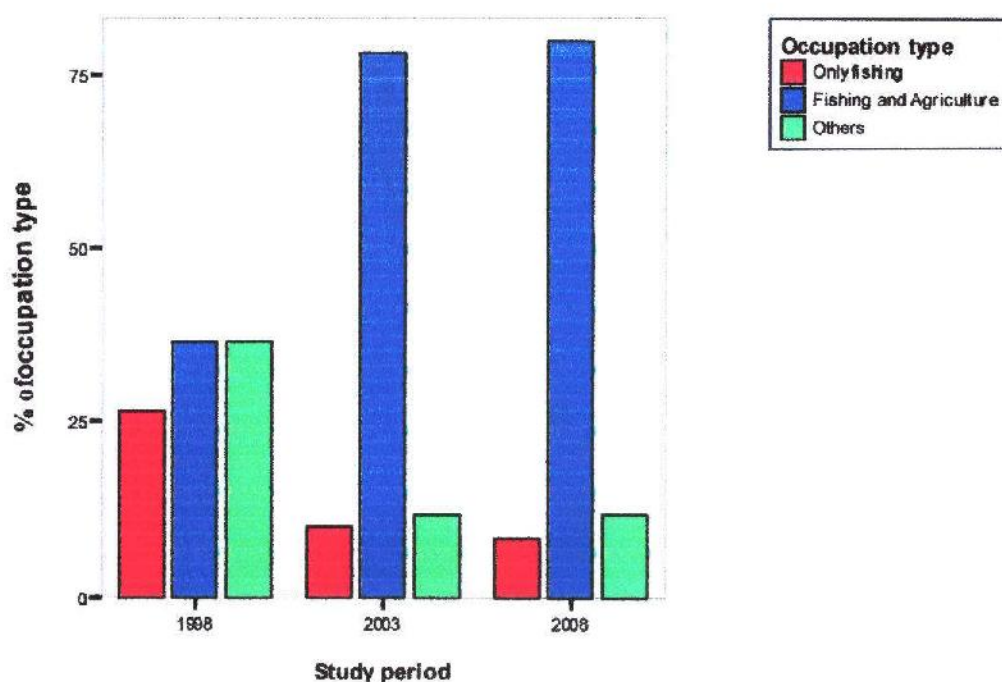


Fig. 21. Occupational change in Bagerhat area

4.7.6 Nutrition

The study showed that the farmer taking food was changed and they took nutritive food. In 1998 the frequency of fish/shrimp was 3 day per week, vegetables were 7 day per week and meat was 1 day per week. On the other hand in 2003 the frequency of fish/shrimp was 4 day per week, vegetables were 7 day per week and meat was 2 day

per week. Finally in 2008 the frequency of fish/shrimp was 4 day per week, vegetables were 7 day per week and meat was 2 day per week (Fig. 22 and Appendix. 20).

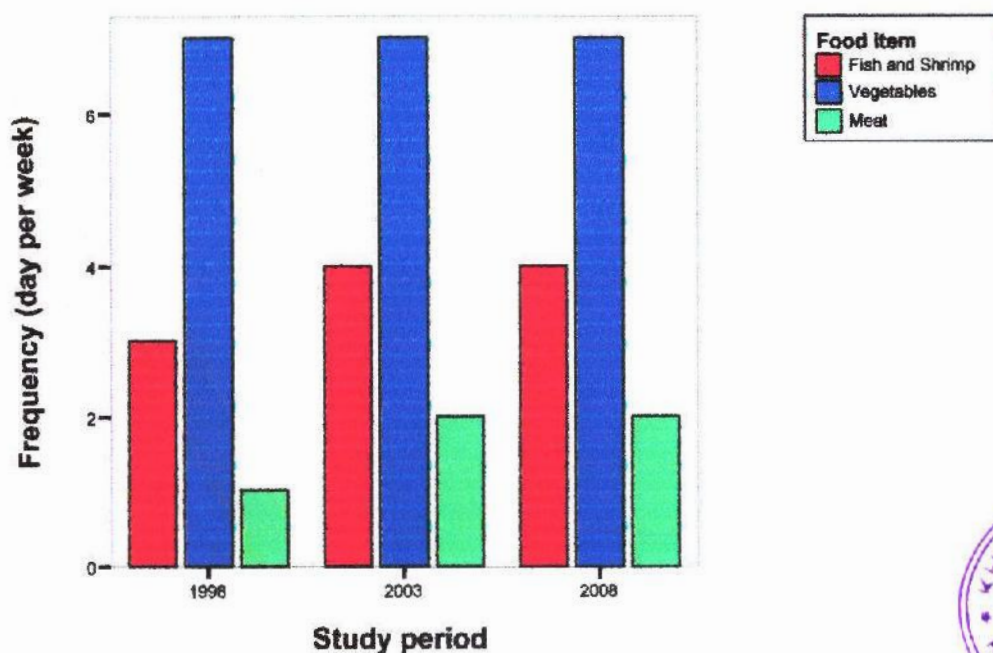


Fig. 22. Changing of food items of farmer in Bagerhat area

4.7.7 Annual net incomes

The study exposed that in 1998 the highest average net income of farmer was 1,18,750 Taka/ha in Bagerhat Sadar and the lowest average was 95000 Taka/ha both in Fakirhat and Mollahat.

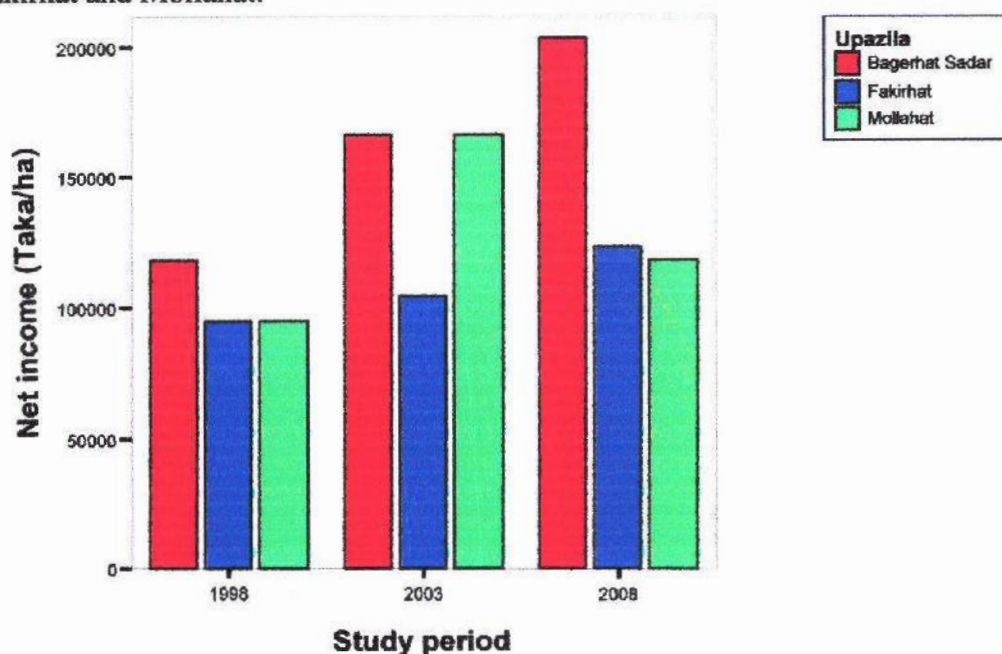


Fig. 23. Net income change in Bagerhat area

On the other hand in 2003 the highest average net income of farmer was 166250 Taka/ha in Bagerhat Sadar and the lowest average was 1,04,500 Taka/ha in Fakirhat. Finally in 2008 the highest average net income of farmer was 2,04,250 Taka/ha in Bagerhat Sadar and the lowest average was 1,18,750Taka/ha both in Mollahat (Fig. 23 and Appendix. 21).

4.7.8 Family expenditure

The study uncovered that in 1998 the highest average family expenditure of farmer was 50000 Taka/year in Fakirhat and the lowest average was 37000 Taka/ha both in Bagerhat Sadar. On the other hand in 2003 the highest average family expenditure of farmer was 58000 Taka/ha in Fakirhat and the lowest average was 52000 Taka/year in Bagerhat Sadar. Finally in 2008 the highest average family expenditure of farmer was 68000 Taka/year in Fakirhat and the lowest average was 58000 Taka/ha in Bagerhat Sadar (Fig. 24 and Appendix. 22).

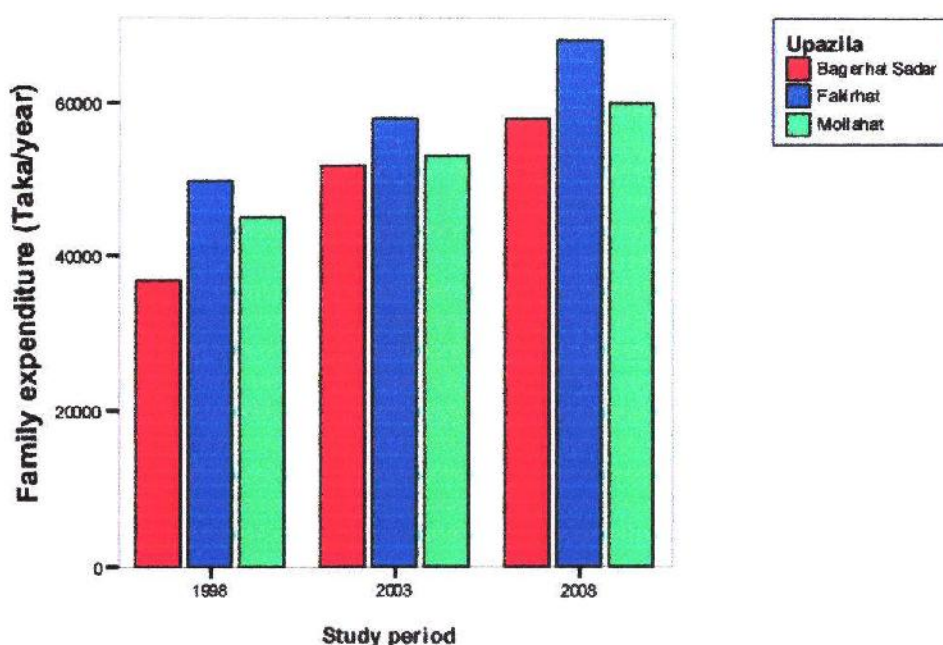


Fig. 24. Family expenditure in Bagerhat area

4.7.9 Recreational media

The study uncovered that in 1998 the people watch TV was 20.41%, TV+Cinema 30.61% and the rest of people not any recreation media. On the other hand in 2003 the people watch TV was 58.34%, TV+Cinema 8.33%, and Visiting+Picnic 33.33%. Finally in 2008 the people watch TV was 31.67%, TV+Cinema 8.33%, and

Visiting+Picnic 60% (Fig. 25 and Appendix. 23). The farm owner of Bagerhat Sadar gets recreation more than others areas.

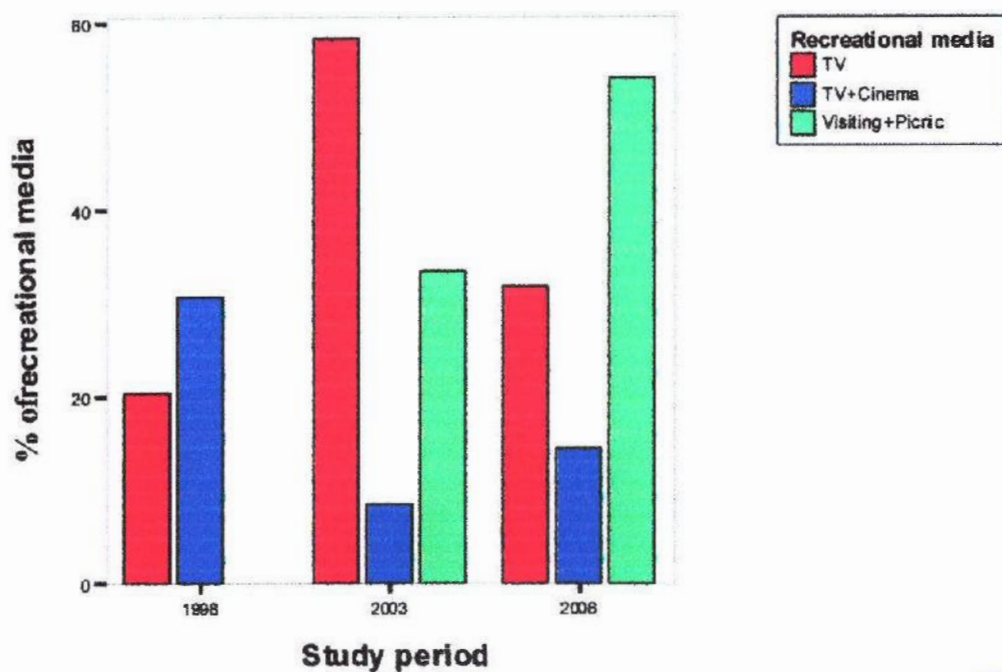


Fig. 25. Recreational media change in Bagerhat area



C H A P T E R - 5



Discussion

Chapter 5

Discussion

There are two prawn farming systems in Bangladesh: pond and gher. Approximately 71% of farmers were involved in Gher farming systems and remainder in pond farming systems (Muir, 2003). In pond systems, farmers usually stock hatchery produced postlarvae during April to May. In southwest Bangladesh, the cultivation of prawn in modified rice fields is locally referred to as 'gher' (Rutherford, 1994). The Bengali term 'gher' is an enclosure made for prawn or shrimp cultivation by modifying rice fields through higher dikes around the field and excavating a canal inside the periphery to retain water during the dry season (Kendrick, 1994). According to Kamp and Brand (1994), gher farming is a 'quiet, indigenous technological revolution', suitable for the cultivation of prawn, fish and rice. Gher farming can be considered as a method of integrated aquaculture-agriculture on one spot. The present study shows that most of the farm of Bagerhat region is Gher farming system.

In the present study shows that range of shrimp farming area was 0.25-0.90 ha in 1998, 0.37-1.12 ha in 2003 and 0.45-1.16 ha in 2008 in three studied Upzila. However, Ahmed (2001) reported that the average prawn farm size was .23 ha in the Bagerhat area, with thousands of tiny farms and only a few large units; the largest farm size was 1.01 ha and the smallest was 0.06 ha.

Embankment is the most important part of the aquaculture farm. Embankment must be high enough to protect the farm from flooding. It provides the physical structure of the farms and obstructs the prawn to escape from the farms. Proper compaction must be employed both in the construction of embankment and the treatment of the bottom of the farms to support the water retention. The embankment should be wide enough to allow the worker to walk around the farms in carrying feeds, monitoring, harvested product, and harvesting gears (New and Singholka, 1985).

Most of the farmers of surveyed areas did not follow the dose of lime prescribed by TFO or local NGO's. The most of the farmer used lime partially. The rate of liming

was 190 Kg per ha. Liming about 1 Kg/ decimal did give highest production (BFRI, 2008).

The present study farmers were not used fertilizer properly. They use partially. The use of inorganic fertilizer is not widespread and only a few farmers use a mixture of urea and TSP together with cow dung. The average rate is 42.75 Kg per ha of cowdung, 95 Kg per ha of Oilcake, 21.375 Kg per ha of Urea and 14.25 Kg per ha of TSP. On the other hand Ahmed (2001) reported that the average annual fertilization rate is 1467 Kg per ha of cowdung, 403 Kg per ha of urea and 217 Kg per ha of TSP at varying frequency. The farmer of the studied region use less fertilizer than recommended dose because the productivity of water body of this region higher that means natural foods are available.

The peak season of Shrimp farming in farms is from May to January. Bagda post larvae (PL) are stocked from mid-April to mid-July and sometimes partially continued to mid-October and harvested partially from mid-July to November, Golda PL are stocked from mid-February to mid-May and partially also continued to July and harvested from mid-September to mid-February, and White fish stocked from mid-April to mid-July and it was also partially continued to October and harvested from mid-September to mid-March. Farmers cultivate paddy in the central part of the farms during the dry season from mid-December to mid-February and originally avoided cultivation of monsoon season aman rice during June to October when the prawns are in the farms, because of the perceived negative effects on prawn growth. Vegetables are stocked in May to Mid-July and harvested from Mid-July to Mid-November. Similar findings were noted by (Ahmed, 2001).

In case of polyculture, selection of species is the most important task to ensure that, proper utilization of feed and of proper growth. So the species is selected in such a way that the food of all trophic level of the Gher used properly. In the surveyed farms stocking density of prawn and other fin fish did not follow any sequence or specific rate. The stocking density of Golda was decreasing and Bagda was increasing in 2003 but decreasing in 2008. The stocking density of White fish is gradually increasing. The stocking density of Bagda ranging from 7,200-9,500 per ha in 1998, 31,500-47,500 per ha in 2003 and 18,200-42,500 per ha in 2008. The stocking density of

Golda ranging from 11,875-30,875 per ha in 1998, 21,375-26,125 per ha in 2003 and 14,250-16,625 per ha in 2008. The stocking density of White fish ranging from 237.5-475 per ha in 1998, 475-1,230 per ha in 2003 and 875-1,520 per ha in 2008. The average annual stocking density of postlarvae (PL) of prawn is 20,680 per ha (Ahmed 2001), ranging from 10,000 to 30,000 per ha (Rosenberry, 1992 and Muir, 2003).

Supplementary feeds are used by all farmers in farms systems. A variety of feeds are used but the preferred feed is the freshwater snail, *Pila globosa* (Ahmed, 2001). The use of snail meat as prawn feed is widespread in prawn farming areas and snail populations are reported to have declined heavily due to excessive harvesting. A wide variety of people including women and children are involved in snail harvesting during June to October. Overall, the supply of snails has generated a number of employment opportunities, in catching, processing, transporting and marketing activities. An average 66.5 Kg per ha per day of snail meat is applied for feeding of prawns during June to October (Ahmed, 2001).

In general, chopped snail meat is given twice a day in the morning and evening. If excessive snail meat floats up in the water, feed supply is reduced, and it is increased if it does not float in the water. The supply of snail is irregular and therefore farmers also use home made feed mixing by cooked rice, rice bran, oil cake and fish meal, or use industrially manufactured pelleted feed. The present study shows that most of farmers are used packet feed means pelleted feed. A very much similar findings were noted by Ahmed *et al.* (2008) and Islam (2008).

Farmers harvest fish partially which allows small fish to grow. Similar result obtained by Ahmed (2001) and the result was the peak season of prawn harvesting is from November to January. Farmers harvest their prawns by using cast nets and seine nets, usually netting several times at a few weeks' intervals. Cast nets are generally used for small farms and seine nets for large farms. A cast net can be operated by a single farmer, while a seine net is operated by a group of 3-4 commercial harvesters rather than the producers themselves.

The average production of Golda was 580 Kg/ha, Bagda was 570 Kg/ha, White fish was 855 Kg/ha in Sadar Upazila in 2008. According to Department of Fisheries of

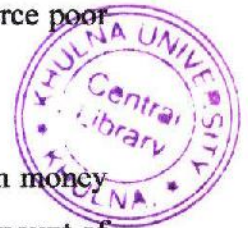
Bangladesh (2007) the average production was Golda 650.75 Kg/ha, and Bagda was 389.5 Kg/ha. Production rate of Bagda is increasing due to increasing farming knowledge (Islam, 2008).

The most of the farmer sold shrimp to Depot in 1998 and 2003 and Arot in 2008. In 2008 the farmer took loan from Arotdar so they are bound to sell shrimp to them. They used vans in 1998 and van and tempo in 2003 and 2008. They used basket for carrying shrimp in 1998 and 2003 and Cates and Drum in 2008. A very much similar findings were noted by Ahmed (2004) and Islam (2008).

A quite substantial amount of money is required in prawn cultivation. Costs of prawn production have increased significantly in recent years as a result of increased price of seed, feed and wage rates of laborers. One of the main problems for small and marginal farmers is the shortage of operating capital. Inadequate and costly finance is therefore a constraint for the efficient and profitable prawn farming by resource poor farmers.

A study in southwest Bangladesh reported that 68% of farmers use their own money for prawn farming while the rest receive loan (Ahmed, 2001). The average amount of credit received by a farmer is US\$228 year⁻¹. Farmers apply a wide variety of strategies to develop prawn farming. The finance comes mainly from a broad mix of personal and informal sources. Farmers primarily finance their prawn farming operations through disposing of household assets. Some have their own capital, either savings or proceeds from sales of personal assets, especially cows, gold jewellery and timbers (Kendrick, 1994).

Access to credit is considered to be one of the important factors influencing prawn production. Over recent years several institutions providing credit to the prawn farmers include banks, NGOs, prawn traders and local moneylenders. Local branches of national banks provide credit to the prawn farmers, collateral against land at a 15% yearly interest rate. The Grameen Bank, a specialized bank for micro credits that was awarded the Nobel Peace Prize for 2006, is active in several villages of prawn farming areas.



Some farmer took training on shrimp and fish farming which helped them to introduce new techniques of culture. They took help Government and non-government organization.

Education is a pre-requisite for acceptance and adoption of aquaculture practices. Education helps a farmer to gain necessary ideas and judge the profitability of aquaculture enterprises in socio-economic development. In the present study, shrimp farming knowledge of the farmers was positively correlated with farmers' educational status. It was found that the educated farmers had more knowledge on shrimp farming practices. A very much similar findings were noted by Ahmed (2004), Alam (2004) and Azad (2005). The number of school going children is increasing due to increasing of income. The housing condition also improved and most of the farmers live in semi-pacca house.

The study revealed that the livestock population also increased with aqua-farming. The opposite finding was founded by Rahman *et al.* (2002). They found that livestock population and its conditions were better before shrimp culture compared with shrimp culture. The vegetables culture on the dike provides extra production which also increased income source of farmer. The farmer saved extra earning money in bank named DPS system. The recreational activities also increased.

C H A P T E R - 6



*Problems
and
Recommendations*

Chapter 6

Problems and Recommendations

6.1 Problems

The study is identified the following problems:

- ❖ Lack of proper technical knowledge of farmer.
- ❖ Lack of infrastructure facilities.
- ❖ Uncertainty of land use right and lease agreement policy.
- ❖ Unavailability of quality Post Larvae (PL) of shrimp.
- ❖ Higher mortality rate and varieties of diseases of shrimp.
- ❖ Unavailability of quality shrimp feed.
- ❖ Lack of water exchange facility.
- ❖ Length of marketing channel and international marketing policy.
- ❖ Fall of product price during harvesting season.
- ❖ Lack of farmers modern harvesting system and processing technology.
- ❖ Gap of application of Government rules and regulation.
- ❖ Not to follow the shrimp farmers traceability/coding system.

6.2 Recommendations

The following statements should be considered:

- ❖ Application of modern technology.
- ❖ Application of suitable land use or lease policy.
- ❖ Establish or maintain HACCP in culture method.
- ❖ Use antibiotic free food and fry.
- ❖ Require knowledge about prevention and protection of diseases.
- ❖ Government attention about re-excavation of local khals and channels for proper water flow or drainage facility.
- ❖ Encourage the farmer's for diversified culture practice and crop rotation.
- ❖ Shortcut the marketing channel.
- ❖ Strengthening and empower the local community based shrimp farmers association for counseling about their rights.

- ❖ Socio-economic and environmental research is essential, to ensure that shrimp farming is responsible and suitable and that consumer attitudes our products (both in international and domestic markets) remain positive.
- ❖ The use of suitable harvesting, handling and processing techniques are also important to ensure that our products are high quality.
- ❖ Awareness build up to the water management committee or local sluice gate management committee.

C H A P T E R = 7



Conclusion

Chapter 7

Conclusion

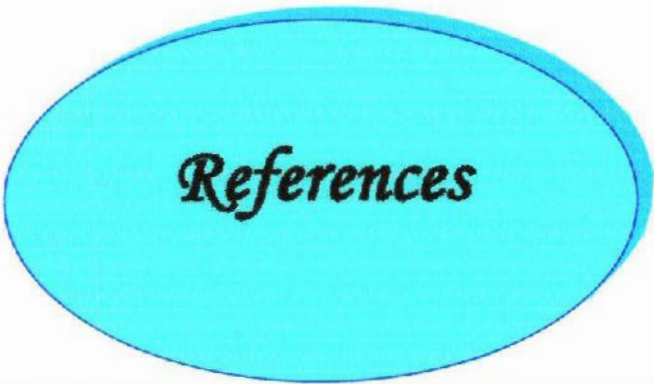
Shrimp farming plays an important role in the economy of Bangladesh, earning valuable foreign exchange and contributing to increased food production, diversifying the economy and increased employment opportunities. In spite of several problems, the practice of shrimp farming has offered an opportunity to increase incomes for farmers and associated groups. Shrimps require particular care during harvesting, processing and marketing. Poor quality shrimps have been marketed in the past. This must be avoided, particularly if export potential is to be achieved and sustained. The use of suitable harvesting, handling and processing techniques are also important to ensure a quality product for export markets. It would appear that the most appropriate form of action would be to enhance quality, traceability and marketing systems.

The future for shrimp farming is bright but requires dynamism to exploit fully. A range of public and private sector investments and initiatives are needed to realize the potential for growth and expanding economic output from this sector. The realization of its potential must be aided by improvements in production technology and hatchery operation. Better broodstock management is required for successful operation of shrimp hatcheries. A number of low-cost locally produced ingredients feed industries would help to increase farmer's profit margins, reduce the negative environmental impacts of snail harvesting, and increase job opportunities.

Although numerous constraints can be recognized, the prospects for shrimp farming are positive, and the recent record of production and export value demonstrates the emerging strength of this sector. However, a number of significant challenges particularly socioeconomic and environmental issues are vital in translating its benefits effectively to the thousands of rural poor involving in this sector.

Therefore research would be required as quantitative and qualitative environmental impacts for sustainable shrimp farming. In addition, research in areas such as seed and feed production may need to be given particular attention, considering existing technology, the transfer, adaptation and development of new technology.

C H A P T E R - 8



References

Chapter 8

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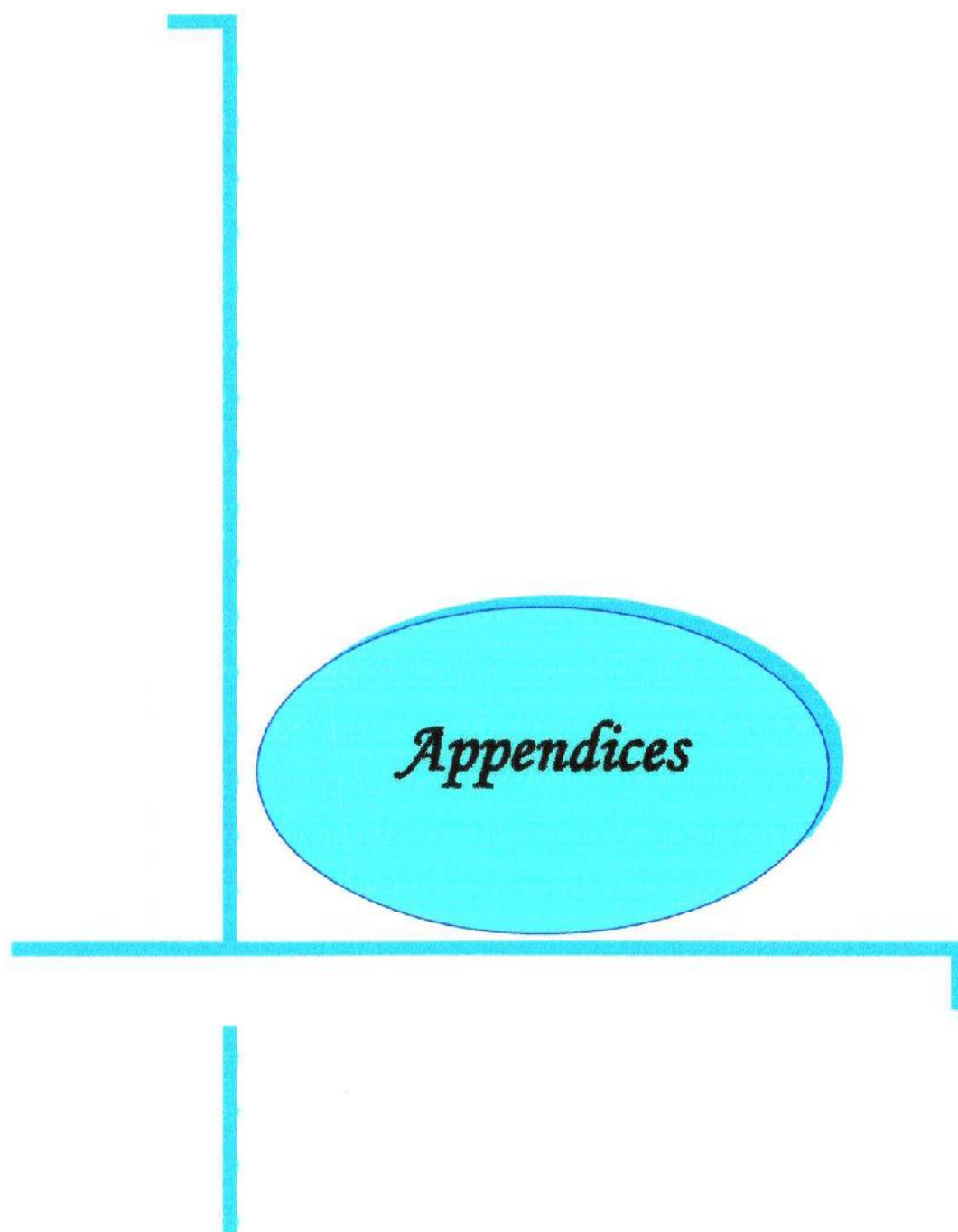
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Appendices

Appendix. 1

Questionnaire

Title: Farming trend of Shrimp in Bagherhat area

Information on farming and its management type

1. Name of the Farm:
2. Address:
3. Types of farm: Pond Gher
4. Area of the farm:
5. Ownership of farm: Own Lease
6. If lease the year of leasing:
7. Seasonal calendar:

AN-1432.

Steps		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Preparation	Shrimp												
	Fish												
	Paddy												
	Others												
Stocking/ planting	Shrimp												
	Fish												
	Paddy												
	Others												
Harvesting	Shrimp												
	Fish												
	Paddy												
	Others												

8. Water quality management:

- a. Use of lime (use accurately=1, use partially=2, no use=3): 1998 2003 2008

b. Fertilizer used in farm per decimal:

Name	Quantity(kg/decimal)		
	1998	2003	2008
Cowdung			
Oil cake			
Urea			
TSP			
others			

9. Pattern of culture:

a. Species of culture (fry released/decimal)

Species	Quantity(ind /decimal)		
	1998	2003	2008

b. Crop rotation (Yes=1/No=2): 1998 ☐ 2003 ☐ 2008 ☐10. Source of fry (Wild=1/Hatchery=2): 1998 ☐ 2003 ☐ 2008 ☐

11. Disease aspect

1998: Name Remedy 2003: Name Remedy 2008: Name Remedy

12. Supplementary feed used in farm:

1998:

2003:

2008:

13. Pattern of harvesting: full ☐ partial ☐

14. Post harvesting (preservation):

1998: Yes ☐ No ☐ if yes what technique: 2003: Yes ☐ No ☐ if yes what technique: 2008: Yes ☐ No ☐ if yes what technique:

15. Marketing:

a. Place:	1998	2003	2008
b. Transportation:	1998	2003	2008
c. Container:	1998	2003	2008

16. Cost:

a. Rent of land:	1998	2003	2008
b. Liming cost:	1998	2003	2008
c. Fertilizing cost:	1998	2003	2008
d. Per acre cost of fry:	1998	2003	2008
e. Feeding cost:	1998	2003	2008
f. Harvesting cost:	1998	2003	2008
g. Marketing cost:	1998	2003	2008
h. Guarding /enforcement cost:	1998	2003	2008
i. Meeting conveyances cost:	1998	2003	2008
j. Net purchase and net repairing cost:	1998	2003	2008
k. Dadon/loan(Tk.):	1998	2003	2008

17. Gross production:

Year	Production (Kg/decimal)
1998	
2003	
2008	

18. Income:

a. Product price variation:

Product	Price(Tk./Kg)		
	1998	2003	2008
Shrimp			
Fish			
Paddy			
Others			

b. Gross income from farm:

Year	Income(Tk/decimal)
1998	

2003	
2008	

19. Deforestation (Yes=1/No=2): 1998 ☐ 2003 ☐ 2008 ☐
20. Pressure of extortionist (Yes=1/No=2): 1998 ☐ 2003 ☐ 2008 ☐
21. Take any training on prawn farming (Yes=1/No=2): 1998 ☐ 2003 ☐ 2008 ☐
22. Take any help from any organization for farming (Yes=1/No=2):
1998 ☐ 2003 ☐ 2008 ☐
23. Why you choice it:

24. Problem faced in farm management:

Information on livelihood of status of shrimp farmer

- Date of interview:
- Name of the Shrimp farmer:
- Shrimp farmer's age:
- Shrimp farmer's address
Village: B. union: C. Upazila:
- Shrimp farmer's sex (male-1, female-2): ☐
- Shrimp farmer's education
(illiterate=1/sign only=2/upto primary=3/up to secondary=4/above secondary=5):
1998 ☐ 2003 ☐ 2008 ☐
- Family types (Single=1/Joint=2): 1998 ☐ 2003 ☐ 2008 ☐
- House holds members: 1998 ☐ 2003 ☐ 2008 ☐
- School going children: 1998 ☐ 2003 ☐ 2008 ☐
- Condition of living house (kacha-1, semi pacca-2, pacca-3): 1998 ☐ 2003 ☐ 2008 ☐
- Main occupation
(only fishing=1/fishing+agricultuire=2/fishing+pitytrade=3/others=4):
1998 ☐ 2003 ☐ 2008 ☐
- Gross annual income (Tk.): 1998 ☐ 2003 ☐ 2008 ☐
- Income trends (increase -1, static-2 decrease-3.): 1998 ☐ 2003 ☐ 2008 ☐
- Family expenditure: 1998 ☐ 2003 ☐ 2008 ☐
- Saving: 1998 ☐ 2003 ☐ 2008 ☐

17. Nutritional status:

Items	Quantity (g/day)		
	1998	2003	2008
Fish/Shrimp			
Vegetables			
Meat			
Others			

18. Recreational medium (TV=1 /radio=2 /cinema=3/picnic=4 /visiting=5/others=6):

1998 2003 2008

Appendix 2. Area of farms

Upazila	No. of farm (Gher)	Study year		
		1998	2003	2008
		Area of shrimp farm (ha)	Area of shrimp farm (ha)	Area of shrimp farm (ha)
Bagerhat Sadar	10,058	8990	11250	11690
Fakirhat	8,696	2146.08	3251.5	3896.05
Rampal	6,090	13965	14823	15375
Mongla	5,381	7790.5	10340.5	10895.72
Mollahat	11,420	2205	3710	3925
Chitalmari	15,500	3500	4815	4920
Kochuya	1,870	701	796	834.00
Morolgong	7,535	8292.05	10277.15	10637.60
Shronkhola	695	120.75	160.85	175.30

Appendix. 3. Height of the embankment of the farm.

Study Period	Dike slope (Feet)	Percentage (%)
1998	0-2	71.43
	2<	28.57
2003	0-2	14
	2<	86
2008	0-2	9
	2<	91

Appendix. 4. Drying of farm.

Study period	Upazila	Activities	Percentage (%)
1998	Bagerhat Sadar	Not drying	55.56
		Partial drying	33.33
		Properly drying	11.11
	Fakirhat	Not drying	20
		Partial drying	75
		Properly drying	5
	Mollahat	Not drying	10
		Partial drying	85
		Properly drying	5
2003	Bagerhat Sadar	Not drying	25
		Partial drying	65
		Properly drying	10
	Fakirhat	Not drying	15
		Partial drying	80
		Properly drying	5

2008	Mollahat	Not drying	10
		Partial drying	75
		Properly drying	15
	Bagerhat Sadar	Not drying	30
		Partial drying	65
		Properly drying	5
	Fakirhat	Not drying	20
		Partial drying	75
		Properly drying	5
	Mollahat	Not drying	10
		Partial drying	85
		Properly drying	5

Appendix. 5. Application mode of liming.

Study period	Upazila	Liming	Percentage (%)
1998	Bagherhat Sadar	Use properly	5
		Use partially	33.33
		No use	61.67
	Fakirhat	Use properly	4
		Use partially	72
		No use	24
	Mollahat	Use properly	3
		Use partially	83
		No use	14
2003	Bagherhat Sadar	Use properly	10
		Use partially	80
		No use	10
	Fakirhat	Use properly	5
		Use partially	75
		No use	10
	Mollahat	Use properly	6
		Use partially	76
		No use	18
2008	Bagherhat Sadar	Use properly	10
		Use partially	70
		No use	20
	Fakirhat	Use properly	7
		Use partially	83
		No use	10
	Mollahat	Use properly	8
		Use partially	77
		No use	15



Appendix. 6. Application mode of fertilizing.

Study period	Upazila	Fertilizing	Percentage (%)
1998	Bagherhat Sadar	Use properly	6
		Use partially	33.33
		No use	60.67
	Fakirhat	Use properly	3
		Use partially	25
		No use	72
	Mollahat	Use properly	2
		Use partially	58
		No use	40
2003	Bagherhat Sadar	Use properly	5
		Use partially	75
		No use	20
	Fakirhat	Use properly	5
		Use partially	70
		No use	25
	Mollahat	Use properly	7
		Use partially	78
		No use	15
2008	Bagherhat Sadar	Use properly	10
		Use partially	70
		No use	20
	Fakirhat	Use properly	7
		Use partially	83
		No use	10
	Mollahat	Use properly	8
		Use partially	77
		No use	15

Appendix. 7. Source of fry.

Study period	Upazila	Source	Percentage (%)
1998	Bagherhat Sadar	Wild	66.67
		Hatchery	6
		Wild and Hatchery	27.33
	Fakirhat	Wild	85
		Hatchery	5
		Wild and Hatchery	10
	Mollahat	Wild	50
		Hatchery	10
		Wild and Hatchery	40
2003	Bagherhat Sadar	Wild	35
		Hatchery	30

	Fakirhat	Wild and Hatchery	35	
		Wild	50	
		Hatchery	25	
		Wild and Hatchery	25	
	Mollahat	Wild	40	
		Hatchery	25	
		Wild and Hatchery	35	
	2008	Bagherhat Sadar	Wild	10
			Hatchery	25
Wild and Hatchery			65	
Fakirhat		Wild	10	
		Hatchery	30	
		Wild and Hatchery	60	
Mollahat		Wild	30	
		Hatchery	32	
		Wild and Hatchery	38	

Appendix. 8. Average stocking density of shrimp and white fish.

Study period	Upazila	Species	Stocking rate (per ha)
1998	Bagherhat Sadar	Galda	14250
		Bagda	9500
		White fish	237.5
	Fakirhat	Galda	11875
		Bagda	9500
		White fish	237.5
	Mollahat	Galda	30875
		Bagda	7200
		White fish	475
2003	Bagherhat Sadar	Galda	23750
		Bagda	47500
		White fish	475
	Fakirhat	Galda	26125
		Bagda	38000
		White fish	1230
	Mollahat	Galda	21375
		Bagda	31500
		White fish	650
2008	Bagherhat Sadar	Galda	14250
		Bagda	42500
		White fish	850
	Fakirhat	Galda	14250
		Bagda	23750

	Mollahat	White fish	1520
		Galda	16625
		Bagda	18200
		White fish	1200

Appendix. 9. Feed type and feeding percentage.

Study Period	Upazila	Feed	Percentage (%)
1998	Bagherhat Sadar	Home made	44.44
		Commercial	11.11
		Home made and Commercial	11.11
		No feed	33.33
	Fakirhat	Home made	53
		Commercial	27
		Home made and Commercial	15
		No feed	5
	Mollahat	Home made	55
		Commercial	10
		Home made and Commercial	15
		No feed	20
2003	Bagherhat Sadar	Home made	20
		Commercial	60
		Home made and Commercial	18
		No feed	2
	Fakirhat	Home made	10
		Commercial	80
		Home made and Commercial	6
		No feed	4
	Mollahat	Home made	21
		Commercial	50
		Home made and Commercial	25
		No feed	4
2008	Bagherhat Sadar	Home made	10
		Commercial	69
		Home made and Commercial	20
		No feed	1
	Fakirhat	Home made	5
		Commercial	83
		Home made and Commercial	10
		No feed	2
	Mollahat	Home made	8
		Commercial	73
		Home made and Commercial	16
		No feed	3

Appendix. 10. Container of marketing.

Study period	Container	Percentage (%)
1998	Basket	100
	Krate	0
	Others	0
2003	Basket	80
	Krate	13.33
	Others	6.67
2008	Basket	0
	Krate	90
	Others	10

Appendix. 11. Vehicle of marketing.

Study period	Transportation system	Percentage (%)
1998	Van	90
	Tempo	4
	Van and Tempo	6
2003	Van	34
	Tempo	2
	Van and Tempo	64
2008	Van	20
	Tempo	3.33
	Van and Tempo	76.67

Appendix. 12. Place of marketing.

Study period	Place	Percentage (%)
1998	Depot	65.31
	Arot	14.28
	Arot and factory	6.12
	Local market	14.29
2003	Depot	60
	Arot	20.33
	Arot and factory	14.67
	Local market	5
2008	Depot	33.33
	Arot	54.67
	Arot and factory	10
	Local market	2

Appendix. 13. Average production from the shrimp farm.

Study Period	Upazila	Product	Production (Kg per ha)
1998	Bagherhat Sadar	Golda	427.5
		Bagda	522.5
		White fish	285
		Paddy	2755
		Vegetables	610
	Fakirhat	Golda	237.5
		Bagda	190
		White fish	237.5
		Paddy	1100
		Vegetables	1500
	Mollahat	Golda	665
		Bagda	300
		White fish	285
		Paddy	2000
		Vegetables	1425
2003	Bagherhat Sadar	Golda	475
		Bagda	475
		White fish	285
		Paddy	2375
		Vegetables	1187.5
	Fakirhat	Golda	570
		Bagda	855
		White fish	570
		Paddy	1900
		Vegetables	2850
	Mollahat	Golda	570
		Bagda	280
		White fish	332.5
		Paddy	1820
		Vegetables	1900
2008	Bagherhat Sadar	Golda	580
		Bagda	570
		White fish	855
		Paddy	1900
		Vegetables	2375
	Fakirhat	Golda	522.5
		Bagda	665
		White fish	760
		Paddy	3325
		Vegetables	3800
	Mollahat	Golda	760
		Bagda	1187.5
		White fish	430
		Paddy	2540
		Vegetables	7125

Appendix. 14. Average cost of production.

Study Period	Upazila	Product	Cost of Production (Taka per ha)
1998	Bagherhat Sadar	Shrimp and White fish	102125
		Paddy	24560
		Vegetables	2200
	Fakirhat	Shrimp and White fish	109250
		Paddy	23270
		Vegetables	2150
	Mollahat	Shrimp and White fish	94520
		Paddy	21500
		Vegetables	2325
2003	Bagherhat Sadar	Shrimp and White fish	161500
		Paddy	27480
		Vegetables	3480
	Fakirhat	Shrimp and White fish	195900
		Paddy	25390
		Vegetables	3520
	Mollahat	Shrimp and White fish	139175
		Paddy	24865
		Vegetables	3490
2008	Bagherhat Sadar	Shrimp and White fish	199500
		Paddy	34540
		Vegetables	4825
	Fakirhat	Shrimp and White fish	241300
		Paddy	33325
		Vegetables	4460
	Mollahat	Shrimp and White fish	186625
		Paddy	32580
		Vegetables	4340

Appendix. 15. Age class of farmer in Bagherhat area.

Age class (year)	Percentage (%)
<35	5
35-40	21.33
40-45	40
45-50	22
50<	11.67

Appendix. 16. Education level of farmer in Bagherhat area.

Education level	Percentage (%)
Illiterate	11.67
Sign only	30
Upto primary	35
Upto secondary	15
Above secondary	8.33

Appendix. 17. Family type of farmer in Bagherhat area.

Study period	Types of family	Percentage (%)
1998	Single	61.67
	Joint	38.33
2003	Single	85
	Joint	15
2008	Single	91.67
	Joint	8.33

Appendix. 18. Farmers house condition in Bagherhat area.

Study period	Types of house	Percentage (%)
1998	Mud made	89.67
	Semi-pacca	8.33
	Pacca	2
2003	Mud made	6.67
	Semi-pacca	83.33
	Pacca	10
2008	Mud made	4
	Semi-pacca	80
	Pacca	16

Appendix. 19. Occupational change in Bagherhat area.

Study period	Types of occupation	Percentage (%)
1998	Only fishing	26.67
	Fishing and Agriculture	36.67
	Others	36.66
2003	Only fishing	10
	Fishing and Agriculture	78.33
	Others	11.67
2008	Only fishing	8.33
	Fishing and Agriculture	80
	Others	11.67

Appendix. 20. Changing of food items of farmer in Bagherhat area.

Study period	Food items	Frequency (day/week)
1998	Fish/Shrimp	3
	Vegetables	7
	Meat	1
2003	Fish/Shrimp	4
	Vegetables	7
	Meat	2
2008	Fish/Shrimp	4
	Vegetables	7
	Meat	2

Appendix. 21. Average net income change in Bagherhat area.

Study period	Upazila	Average income (Taka/ha)
1998	Bagherhat Sadar	118750
	Fakirhat	95000
	Mollahat	95000
2003	Bagherhat Sadar	166250
	Fakirhat	104500
	Mollahat	166250
2008	Bagherhat Sadar	204250
	Fakirhat	123500
	Mollahat	118750

Appendix. 22. Average family expenditure in Bagherhat area.

Study period	Upazila	Average expenditure (Taka/Year)
1998	Bagherhat Sadar	37000
	Fakirhat	50000
	Mollahat	45000
2003	Bagherhat Sadar	52000
	Fakirhat	58000
	Mollahat	53000
2008	Bagherhat Sadar	58000
	Fakirhat	68000
	Mollahat	60000

Appendix. 23. Recreational media change in Bagherhat area.

Study Period	Recreational media	Percentage (%)
1998	TV	20.41
	TV+Cinema	30.61
2003	TV	58.34
	TV+Cinema	8.33
	Visiting+Picnic	33.33
2008	TV	31.67
	TV+Cinema	8.33
	Visiting+Picnic	60