THE STUDY OF THE AQUACULTURE ACTIVITIES IN PHULBARI UPAZILA UNDER KURIGRAM DISTRICT

A THESIS

BY

MD. SHAHIDUZZAMAN MIAH

EXAMINATION ROLL NO. 10 Fish Aqua JD-45 M

SEMESTER: JULY- DECEBER, 2011

REGISTRATION NO. 31723

SESSION: 2004 - 2005

MASTER OF SCIENCE (M. S.)

IN

AQUACULTURE

DEPARTMENT OF AQUACULTURE

BANGLADESH AGRICULTURAL UNIVERSITY

MYMENSINGH

NOVEMBER, 2011

THE STUDY OF THE AQUACULTURE ACTIVITIES IN PHULBARI UPAZILA UNDER KURIGRAM DISTRICT

A THESIS

BY

MD. SHAHIDUZZAMAN MIAH

EXAMINATION ROLL NO. 10 Fish Aqua JD-45 M

SEMESTER: JULY- DECEBER, 2011

REGISTRATION NO. 31723

SESSION: 2004 - 2005

Submitted to the Department of Aquaculture
Bangladesh Agricultural University, Mymensingh
In partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE (M. S.)

IN

AQUACULTURE

DEPARTMENT OF AQUACULTURE

BANGLADESH AGRICULTURAL UNIVERSITY

MYMENSINGH

NOVEMBER, 2011

THE STUDY OF THE AQUACULTURE ACTIVITIES IN PHULBARI UPAZILA UNDER KURIGRAM DISTRICT

A THESIS

BY

MD. SHAHIDUZZAMAN MIAH

EXAMINATION ROLL NO. 10 Fish Aqua JD-45 M

SEMESTER: JULY- DECEBER, 2011

REGISTRATION NO. 31723

SESSION: 2004 – 2005

Approved as to style and contents by:

(Professor Dr. M. Ahsan Bin Habib)	**(Professor Dr. Md. Idris Miah)**
Supervisor	**Co-supervisor**

(Professor Dr. Md. Ali Reza Faruk)

Chairman
Examination Committee
And Head
Department of Aquaculture
Bangladesh Agricultural University
Mymensingh

NOVEMBER, 2011

ACKNOWLEDGEMENTS

At first, the author is remembering the almighty Allah, the supreme authority of the universe, who empowers the author to complete the research work and the thesis for the Degree of Master of Science (M.S.) in Aquaculture.

The author finds a great pleasure in expressing his heartfelt indebtedness, sincere appreciation and profound regard to his supervisor ***Prof. Dr. M. Ahsan Bin Habib,*** *Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, for his keen interest, scholastic guidance, valuable suggestions, generous help, affectionate feelings, constant encouragement from the beginning to the end of the research work and preparation of this thesis.*

The author extends his profound gratitude and vast appreciation to his co-supervisor, ***Prof. Dr. Md. Idris Miah****, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, for right guidelines, cordial inspiration and constructive criticism during the tenure of conducting this study. The author is very grateful to him for his suggestion, which will be helpful in the way of life of the author.*

The Author also wishes to express his heartfelt indebtedness to ***Prof. Dr. Md. Ali Reza Faruk,*** *Head, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, for his sympathy and every possible favorable attitude for providing necessary facilities to complete this research work as Head of the Department.*

The Author specially acknowledges Abdul Halim for his continuous help and co-operation at all stages of the research work.

The author expresses his special thanks to his friends, especially Jaynul Abedin, Jayanta, Sujon, Mamun and younger brother, Uzzal for their continuous inspiration, encouragement and generous help during the study period.

Finally, the author expresses his deepest sense of gratitude to his beloved parents and family members for their moral support and constant blessing and also financial help to carry out this study.

The author also expresses heartfelt acknowledges to BAU Campus. The memories of university life will be bared in his heart throughout his life. The author feels proud of his real friends. The author is very grateful to his entire BAU class friends.

The author, 2011

CONTENTS

CONTENTS (Contd.)

CONTENTS (Contd.)

CONTENTS (Contd.)

LIST OF TABLES

LIST OF TABLES (Contd.)

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDIX

ABBREVIATIONS AND ACRONYMS

Parameters	Symbol
Agricultural	Argil.
University	Univ.
Bangladesh Agricultural University	BAU
Bangladesh Fisheries Research Institute	BFRI
Department of Fisheries	DoF
Upazila Fisheries Officer	UFO
Non-government Organization	NGO
Bangladesh Bureau of Statistics	BBS
Gross Domestic Product	GDP
Decimal	Dec
Hectare	ha
Centimeter	cm
Meter	m
Milli Meter	mm
Weight	Wt.
Milligram	mg
Gram	g
Kilogram	Kg
Metric (ton)	t
Taka (Currency unit in Bangladesh)	Tk.
Figure	Fig.
Number	No.
Percent	%
Associates	*et al.*
Etcetera	etc.
Namely	*viz.*
That is	i.e.

ABSTRACT

In order to determine the aquaculture activities in Phulbari upazila under Kurigram district, a questionnaire survey was used in the entire upazila. For this purpose, data were collected from 50 farm owners/managers and 50 general people living near the farms, covering all the unions of the Phulbari upazila under Kurigram district for a period of eight months from December 2010 to July 2011. A tabular method of analysis was followed in analyzing the collected informations. The present study indicated that most of the farms (52%) were established within last decade and majorities were converted from unused land (36%), low land (30%), agricultural land (24%) and wet land (10%). Twelve different fish species were found to be cultured in these farms. Various fertilizers, feeds, nutrients, chemicals and antibiotics were commonly used. Some of the farms exchanged farm waters and wastewaters were thrown into the surrounding area of the farm, e.g., canal, beel, river etc. The effects of farm effluents were observed in the farm areas. The study observed that farmed fishes were usually escaped into the natural environment around the farms. Inadequate measures were found to be taken for highly infected or dead fishes. During the last five years (2003-04, 2004-05, 2005-06, 2006-07 and 2007-2008), the total annual fish production were found to be 32060, 39860, 56960, 73090 and 87070 kg from a total number of farms of 42, 44, 47, 50 and 50, respectively. Annual average productions were 809, 857, 1032, 1154 and 1290 kg/acre in respective years in the surveyed farms. The average production (kg/acre) was found to be increased from year to year. The study showed that the incomes of the farm owners were increased after establishing the farms. The study also identified how the local people were benefited, how they were adversely affected after establishing the farms and the major problems of fish farming faced by the farm owners. Some adverse technical, economic and social problems were found. This study suggests some measures to overcome the existing problems to achieve a sustainable development of aquaculture. Fish farming played an important role in the increase of socioeconomic conditions, opportunity for employment and poverty alleviation of large number of population.

CHAPTER I

INTRODUCTION

Bangladesh is an agro-based developing country of Southeast Asia. It is a small country in terms of area covering 1,47,570 sq. km but large no. of population comprising about 158,570,535 people (BBS, 2011). Agricultural sector is still playing a vital role in the economic development of the country as it contributes nearly 22.23% to the GDP (DoF, 2011).

Fisheries sector plays a vital role in alleviation of poverty, supply of animal protein for food and nutrition, income, employment generation and foreign exchange earnings. Bangladesh has an extensive network of water bodies comprising large and small rivers, ponds, haors, boars, floodplains and bells. Several greatest river systems such as the Padma, the Megan, the Jamuna, the Brahmaputra, the Gomoti, the Karnaphuli, the Teesta, the Surma and their tributaries are about 230 numbers with a total length of about 24,140 km covering the country flow down to the Bay of Bengal (DoF, 2011). Heavy silts deported by rivers during rainy season, thus continuously enhancing the alluvial soil.

The water resources in Bangladesh can be broadly divided into inland water resources and marine water resources. The major four categories of fisheries resources are:

i) Inland open water 4.02 million ha;

ii) Inland closed water (including shrimp farms) 0.62 million ha;

iii) Brackish water 0.14 million ha; and

iv) Marine water 16.61 million ha (DOF, 2011).

Fisheries sector of Bangladesh is mainly divided into two parts capture fishery and culture fishery. In the early 1960's capture fishery contributed a major fraction in respect to total fish production. But recently, the production from capture fishery is not satisfactory because of declining the open water resources. So, we have much been depending on culture fishery in inland closed water bodies to meet up the increasing demand of fish. The potential inland waters suitable for aquaculture have been estimated at 0.62 million hectares and 4.02 million hectares of inland closed water (DoF, 2011).

About 58% animal protein is met by fish as an available and chief source of protein. There are about 14.5 million peoples where livelihood depends directly and indirectly on fisheries sector. Fisheries sector is contributing about 3.74% to GDP and 2.70% of the foreign exchange earnings of the country (DoF, 2011).

Annual fish production of Bangladesh is about 28.99 metric ton (DoF, 2011). Although fish farming increases day by day but the yield and production of fish obtained by the fish farmers are not satisfactory. Various factors are thought to be responsible for such low fish yield and production of so many ponds and tanks. These factors, however, may vary from one location to another.

Moreover, the number of people increases geometrically. People suffer from acute malnutrition problems especially rural people due to the shortage of animal protein supply in their diets. The pressure on animal protein is going up. From the economic point of view, only fish can meet that requirement with great contribution. With the success of fish farming especially pond aquaculture started to develop very fast. Because of various man made and natural causes, the production of fish declined sharply in the open water ecosystem. To fulfill the need of the nation, dependency on culture fisheries and pond aquaculture increased to a greater extent, of which pond aquaculture is of greatest importance. For the improvement of culture system and future planning, information about present aquaculture practices at the grass root level is absolutely necessary. So, survey which is systematic way of collection of information is of great importance.

Various aquaculture practices are being conducted in the villages of the Phulbari upazila. All unions have been selected for the present study. It is to be further noted that selected villages can serve as the representative of northwestern aquaculture practices.

The study is performed to fulfill the following objectives:

i) To determine the status and practices of aquaculture activities in Phulbari upazila, Kurigram;
ii) To identify the important factors responsible for fish production ; and
iii) To identify specific socio-economic and technical problems associated with pond production with policy implementation.

CHAPTER II

REVIEW OF LITERATURE

Review of related literature is necessity in the sense that it provides scope for reviewing the stock of knowledge and information relevant to the proposed research. Despite the fact that a few numbers of works have been done in Bangladesh related to this research, there are some published reports and related activities. However, the limited numbers of works so far published are mentioned here along with other related works. A short description on the available literature relevant to the present investigation has been presented below:

Mollah *et al.* (1990a) conducted a study on fish production of ponds in Laxmipur of Bangladesh. They revealed that 8.8% pond owners were illiterate. Again 65% and 16.3% of pond fish farmers had primary and secondary level of education. About 24% of farmers had higher secondary level of education and only 6.3% pond fish farmers having graduation degree and above. Rice cultivation was the main occupation and main source of income other than fish production.

Mollah *et al.* (1990b) conducted a study in Laxmipur. He concluded that the socioeconomic constraint's played important role in production of fishes. Among the major constraints, 72.50% of farmers reported theft was one of the main problems followed by financial problems (40%), lack of contact with fisheries officer (37.75%) and lack of feeds (23.75%) which hampered the production.

Rahman (1995) determined the status of fish culture in Gouripur thana under Mymensingh district and concluded that the higher level of inputs used resulted in higher output. He found that the average annual fish yield was 4923 kg/ha and it ranged from 4505 kg to 5413 kg/ha. The average gross returns were Tk.72, 910 and Tk.15, 833/ha, respectively.

Saha *et al.* (1995) found that average per ha return over operation expenses of pond fish production per year were 2892, 3035, 2803, and 1847 kg in Netrokona, Ghabtali, Bhaluka and Pakundia with net return of Tk. 15611, 75028, 51489 and 23560/ha, respectively. The organic matter and inorganic fertilizers were used. He observed that 1% increase in stocking of fish seeds might result in 0.5% increase in outputs and net return.

Robbani (2002) conducted a survey on fisheries resources in Mymensingh, Jessore and Laxmipur region. Fish production of carps was found 1-2 t/acre/year. Majority of farmers showed their preference for culturing Indian major carps. Inbreeding problems, lack of quality seeds, inadequate technical knowledge on scientific fish culture, fish disease, poor credit facilities, security and multiple ownership were identified as the constraints to fish culture.

Biswas (2003) collected data from 40 farm owners and 40 general peoples covering all upazilas of Mymensingh district. The sample farms were grouped into commercial (45%) and homestead (55%). Fourteen different fish species were found to culture in these farms. Fish farming was the primary income source for 60% and secondary for 40% farm owners. Various fertilizers, feed, nutrients, chemicals and antibiotics were commonly used in the farms. Many farms (90%) exchange farm waters. The total fish productions were 350, 445, 510, 850 and 980 t and the average productions were 4199, 4446, 3705, 4693 and 4816 kg/ha in the year of 1996-97, 1997-98, 1998-99, 1999-2000 and 2000-2001, respectively. Various diseases outbreaks were noticed.

Rahman (2003) conducted a survey on socio economic aspects of carp culture development in Gazipur district and observed that 90% farmers cultured both Indian major carps and exotic carps. The average pond size was 0.12 ha and the stocking density of carp fry was found to be 25250/ha. Rice bran, oil cake and wheat bran was mainly used for feeding. The average annual yield of carp was estimated about 2925 kg/ha.

Ahmed (2004) collected data from 100 farm owners and 100 local peoples covering different Upazilas of Naogaon district. The sample farms were grouped into commercial (58 %) and homestead (42%). Fifteen different fish species were found to culture in these farms. Various fertilizers, feed, nutrients, chemicals and antibiotics were commonly used. Many farms (52%) released waste water. The total fish productions were 200, 221, 265, 324, 432 and 625 t and the average productions were 2714, 2800, 2896, 3101, 3302 and 3453 kg/ha, in the year of 1997-98, 1998-99, 1999-2000, 2000-2001, 2001-2002 and 2002-2003, respectively. Various diseases outbreaks were noticed.

Saha (2004) conducted a survey on socio-economic aspects of aquaculture in Tangail Sadar Upazilla and observed that the average pond size was 0.19 ha, 37% ponds were seasonal and 74.5% ponds were single ownership's and 21% farmers multiple ownerships. The average stocking density was found to be 17419 fry/ha. Rice bran and mustard oil cake (4827 and 634 kg/ha) were used respectively for fish production.

Shohel (2007) found that the most important social problem was theft of fish from pond (53%) followed by multiple ownership (23%) and interference by influential persons (17%), respectively. The fish farmers faced the problems of scientific knowledge and technology, non availability of fish seed, insufficient contact of concerned agencies to a greater extent (37%, 33% and 30%).

Ali *et al.* (2008) studied in Baghmara upazila Rajshahi district, average pond size was 0.13 ha with single (64%) and multiple ownership's (36%). It was observed that the minimum water depths of 35% farms were within 0.75-1.5 m and 65% farms were within 1.51-3.0 m, respectively. Average annual incomes of majority of fish farmers were above Tk. 75,000. Lack of scientific knowledge and lack of capital for fish culture were the major constraints.

Akhter (2009) conducted a study covering a total of 60 pond fish farms were selected randomly from two villages namely Boilor and Dhanikhola at Trishal Upazila under Mymensingh district. It was estimated that per ha gross cost of pond fish production was Tk. 176759.88 while gross and net return were Tk. 315361.2 and Tk. 138601.32 per ha, respectively. The study also identified some problems faced by the producers in producing pond fish.

Kabir (2009) collected data from 50 fish farmers in some selected areas of Trishal Upazila, Mymensingh. The average farm size was 0.525 ha in the surveyed areas. About 8% of the farmers were illiterate. About 34% of the ponds were seasonal and 66% were perennial. They also used both surface and underground water in their farm. Almost all the farmers (90%) have improved their socio-economic conditions through fish farming. 10% farmers reported that they have not gained any significant benefits from their involvement in fish farming.

Masum (2009) collected data from 50 farmers from eight unions in Pabna sador upazila, Pabna. Most of the fish farmers belonged to moderately low knowledge category. The personal characteristics of the farmers were observed to be significant and positively related with their fisheries or aquaculture knowledge. But age, religious affiliation, major profession and family size of the respondents had no relation with aquaculture knowledge.

Islam (2010) collected data from 100 fish farmers in Maulvibazar district. The average pond size was 0.11 ha with 87% of the ponds of single ownership and 13% having multi ownership. It was observed that 40% of the ponds were seasonal and 60% were perennial. Various farms used fertilizers, feeds, nutrients, chemicals, and antibiotics. The constrains for sustainable pond fish farming in the areas were lack of technical knowledge.

Rahman (2010) carried out a study on aquaculture management practices followed by the fish farmers. Data were collected from 96 randomly selected fish farmers (out of 651) from two unions of Pakundia upazila, Kishoregonj district. A total 15 aquaculture management practices were selected. The findings indicated that majority of the respondents (64.60%) had moderate extent of practice compared to 35.42% of them having high extent of practice. Some problems were identified by the fish farmers; lack of capital is most common problem in the study area.

Kamruzzaman (2011) studies on the fish culture system and socio-economic condition of pond owners in Bhaluka upazilla, Mymensingh. Density of the stocking pond of Pangus is about 25,000-50,000/ha and in polyculture system is between 25,000-225,000/ha. Higher stocking density of fish affects the water environment of the culture system. The average production were found to be 20,000-50,000 kg/ha/yr in Prawn's farms and 20,000-65,000 kg/ha/yr in polyculture farms. Most of the farm owners did not use fertilizer and manure but they use poultry litter in their pond. Water management practices were not followed in the Pangus and polyculture farms.

Tanjina (2011) studied on Shinghorkhali beel in Dinajpur district. Data were collected from 15 fishermen, and showed their socio-economic condition and problems. There are 17 available fish species under 5 orders were found during the study period. Various fishing gears were observed in the study beel. The total fish production in last five years were highest in 2006 (9,672 kg) and lowest in 2010 (8,556 kg). There are 33 genera of plankton were recorded in the beel,. Crustacean was the dominant group of zooplankton followed by *Rotifers*. One third (33.33%) of the low income of the fishermen was of 76,000 Tk. only.

CHAPTER III

MATERIALS AND METHODS

3.1 Introduction

In this research a scientific and logical methodology was used. The study was based on field survey where primary data were collected both from the farm owners and the local people living near the farm. The type of primary data was collected depending upon the nature of study and its objectives. The survey method was chosen for the present study because it was thought to be more advantageous. The methodology included; the selection of the study area, identification of the target groups, data collection and selection of analytical method. The design of the survey for the present study involved some necessary steps which are outlined in Fig.1.

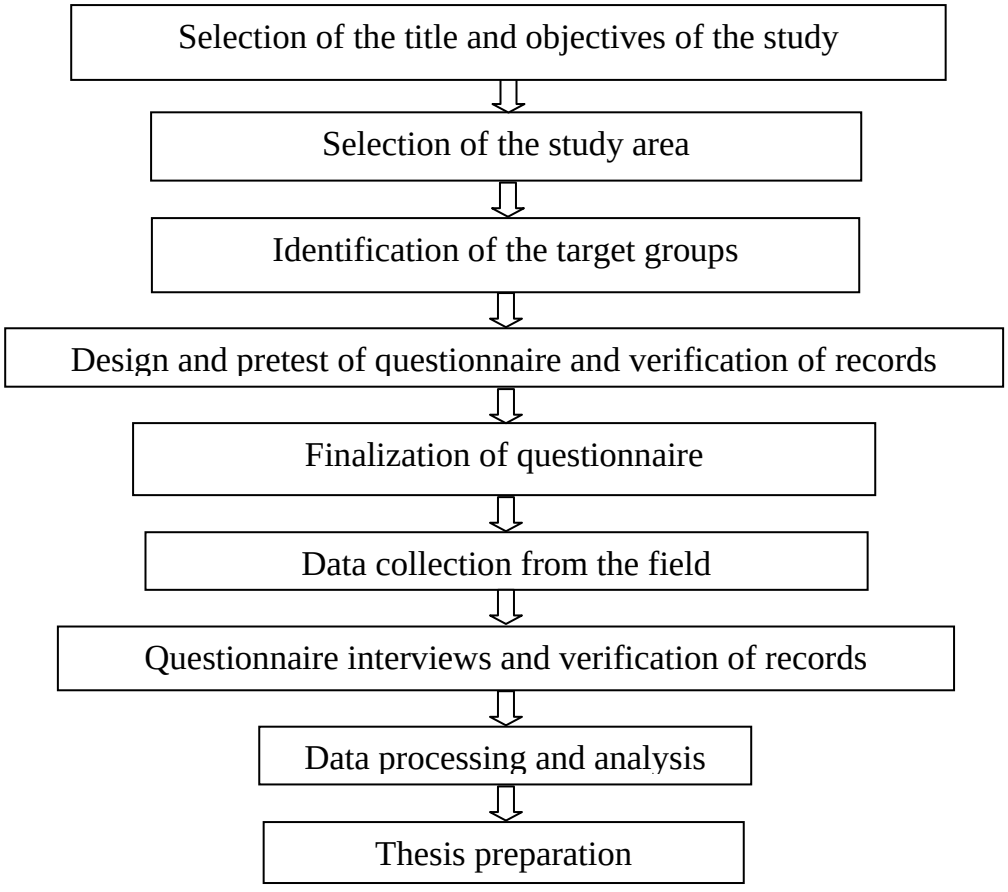

Fig. 1. Flow diagram of the research methodology.

3.2 Selection of the study area

Selection of the study area is an important step for aquaculture activities study. The selection of an area for aquaculture activities investigation depends on the objectives or purpose set for the study. Study area was in the northern side of Bangladesh. Primary information was collected in Phulbari Upazila under Kurigram district covering six Unions of Phulbari Upazila and from the upazila fisheries office (Fig. 2). Finally data were collected from 50 farm owners/managers and 50 local people living near the farm randomly covering the selected study area.

The main reasons for selecting these areas for the study were as follows:

- There were large number of pond farms in these areas;
- Increasing number of fish farmers;
- Social norms and common beliefs were well known by the researcher; and
- No research was conducted in this respect.

Fig. 2. Map of selected study areas of Phulbari Upazila under Kurigram district (unions were Phulbari, Bara bhita, Bhangamour,Shimulbari,Nawdanga and Kashipur)**.**

3.3 Preparation of the survey schedule

According to the objectives of the study, a survey schedule (consisting of two parts, one is for farm owners and another is for local people living near the farm) was prepared to collect the expected data. At first a draft was prepared in accordance with the objectives of the study. Then the schedule was pre-tested to verify the relevance of the questions and the nature of the sample producers. After pre-testing and necessary adjustment, a final schedule was developed.

3.4 Selection of sample producers

It was not possible to include all the farms under the study because of limitation of time and resources. A responsible size of sample to achieve the objectives of the study was considered. Considering these aspects 50 sample farms and 50 general people living near the farms were selected randomly for the study.

3.5 Period of data collection

For these studies, data were collected intensively by using structured survey schedule in recall method. The data were collected for a period of eight months from December 2010 to July 2011.

3.6 Collection of data

Data were collected by direct interviews. With a set of interview schedule designed for this study, each respondent was given a brief introduction about the nature and purpose the study during the interview. Besides, the researchers asked the questions systematically in a very systemic manner with explanations wherever it was felt necessary and the information were recorded.

Plate 1: Showing the data collection from farm manager

Plate 2: Showing the data collection from fish farmer

Plate 3: Showing the data collection from fish farmer

Plate 4: Showing the data collection from fish farmer

3.7 Problems encountered during data collection

During data collection, the researcher encountered the following methodological problems were faced:

- Most of the farmers in the study area had no idea about a research work and it was therefore, difficult to explain the purpose of this research to convince them;
- Most of the farm owners were initially in hesitation to give answer of the questions;
- Most of the farm owners were not interested to give accurate cost, investment and production data; and
- The respondents were not maintaining any written records of their farming business.

Therefore, the investigator had to depend on data supple by respondents for their memory. On some cases farm owners were no available at home and in such cases the investigator had give extra effort and time to collect information from them.

3.8 Processing and analysis of data

After the phase of data collection, the collected data were summarized, tabulated and analyzed according to the objectives of the study. A tabular method of analysis was followed in analyzing the collected information.

CHAPTER IV

RESULTS

The results of the present study are presented below:

4.1 Union-wise distribution of farms

Data were collected from 50 farm owners and 50 local peoples living near the farms of different Unions of Phulbari Upazila under Kurigram district. Union-wise distributions of surveyed farms are shown in Table 4.1. The name of unions were Phulbari, Bara bhita, Bhangamour, Shimulbari, Nawdanga and Kashipur and the number of surveyed farms were 15, 9, 5, 6, 7 and 8, respectively out of the total 50 farms.

4.2 Type of farms

The highest percentages of fish farms were found in Phulbari union and lowest were found in Bhangamour union. The sample farms were grouped into two categories as; commercial and homestead. Distributions of the type of farms are shown in Table 4.2. Table shows that the commercial and homestead farms were 34% and 66%, respectively among 50 farms.

4.3 Farm establishment year

On the basis of year of establishment of sample farms, the number and percentage distribution of farms shown in Table 4.3. It was found that 52% were established between 2000 and 2009, 28% farms were established between 1990 and 1999, 10% farms were established between 1980 and 1989, 6% farms were established between 1970 and 1979, 4% farms were established between 1960 and 1969.

Table 4.1 Union-wise distribution of surveyed farms

Name of Unions	Number of farms	Percentage
Phulbari	15	30
Bara bhita	9	18
Bhangamour	5	10
Shimulbari	6	12
Nawdanga	7	14
Kashipur	8	16
Total	50	100

Table 4.2 Distribution of the type of farms

Farm type	Number of farms	Percentage
Commercial	17	34
Homestead	33	66
Total	50	100.00

Table 4.3 Distribution of the farms in different establishment year

Year interval	Number of farms	Percentage
1960-1969	2	4
1970-1979	3	6
1980-1989	5	10
1990-1999	14	28
2000-2009	26	52
Total	50	100.0

4.4 Size of farms

The sample farms were groups into three categories depending upon their different sizes in the surveyed areas, i.e.

i. Small farm (0.1-1.5 acre)
ii. Medium farm (1.51-3.0 acre)
iii. Large farm (above 3.0 acre)

It was observed that 74% of the sample farms were within category of small farm, 16% were medium size farm and the rest 10% were found to be large size farm (Table 4.4).

4.5 Category of land ownership of farms

Sampled fish farms were classified into three categories according to the ownership pattern of land used for farming activities such as own, leased and both (own and leased). It was found that 88% farms were established on the own land of farm owner, 2% were on leased land and 10% were on both (own and leased) land out of total 50 sample farms (Table 4.5).

4.6 Aquaculture as an income source of farm owners

Aquaculture has become not a main income source for the majority of farm owner's. It was observed that fish farming was the primary income source for 14% farm owners and was secondary income source for 86% farm owners in the studied areas (Table 4.6).

Table 4.4 Distribution of the size of farm

Farm size (acre)	Number of farms	Percentage
Small farm (0.1-1.5)	37	74
Medium farm (1.51-3.0)	8	16
Large farm (above 3.0)	5	10
Total	50	100.0

Table 4.5 Distribution of the category of land ownership of farms

Land category	Number of farms	Percentage
Own	44	88
Leased	1	2
Both (own and leased)	5	10
Total	50	100.0

Table 4.6 Distribution of the type of income sources of farm owners from aquaculture

Type of income sources	Number of farm owners	Percentage
Primary	7	14
Secondary	43	86
Total	50	100.0

4.7 Land used before farm establishment

Number and percentage distribution of land used before farm establishment is shown in Table 4.7. Before the farm establishment, they were agricultural land, wet land, low land and unused land in the surveyed areas. It was found that 24% farms were agricultural land, 10% were wet land, 30% percent were low land and 36% were unused land.

4.8 Sources of farm water

Distribution of the sources of farm water in the study area can be divided into three main categories. It was shown that 52% farms depend on surface water, 16% farms depend on underground water and rest of the farms depends on both surface and under ground water (Table 4.8).

4.9 Minimum pond water depth of farms

The distribution of farms according to the minimum pond water depth is shown in Table 4.9. From the table, it was observed that the minimum water depths of 70% farms were within 0.30-1.0 m and 30% farms were within 1.10-2.0 m, respectively.

Table 4.7 Distribution of the land used before farm establishment

Type of land	Number of farms	Percentage
Agricultural land	12	24
Wet land	5	10
Low land	15	30
Unused land	18	36
Total	50	100.0

Table 4.8 Distribution of sources of farm water

Type of source	Number of farms	Percentage
Surface water	26	52
Under ground water	8	16
Both (surface and under ground water)	16	32
Total	50	100.0

Table 4.9 Distribution of the farms according to the minimum pond water depth

Water depth (m)	Number of farms	Percentage
0.30-1.0	35	70
1.10-2.0	15	30
Total	50	100.0

4.10 Species cultured in farms

A large number of species were culture in the study area, both indigenous and exotic species were cultured. The percentage distribution of farms according to the species cultured is shown in Table 4.10. It was found that about 100% of farm owners like to culture rui, catla, mrigal, silver carp and grass carp. The percentage of farmers who like to culture mirror carp, common carp, sharpunti and kalibaush were 98, 86, 84, and 54% respectively. A lower percentage of farmers like to culture tilapia, bata and chital that is 12, 6, and 4%, respectively in the surveyed 50 farms.

4.11 Uses of fertilizer

Use of organic and inorganic fertilizers is an important means of nutrient supplement in order to produce natural food in the pond. The percentage distribution of the farms according to the uses of fertilizer shown in Table 4.11. It was found that almost all of the farms (84%) used urea, 60% farms used TSP, 32% used MP, 86% used cow dung, 10% used poultry excreta and 2% used compost out of 50 surveyed farms.

Table 4.10 Distribution of species cultured in farms

Species	Number of farms	Percentage
Rui *(Labeo rohita)*	50	100
Catla *(Catla calla)*	50	100
Mrigal *(Cirrhinus cirrhosus)*	50	100
Silver carp (*Hypophthalmichthys molitrix*)	50	100
Grass carp (*Ctenopharyngodon idellus*)	50	100
Mirror carp *(Cyprinus carpio var. specularis)*	49	98
Common carp *(Cyprinus carpio var. communis)*	43	86
Sharpunti *(Puntius sarana)*	42	84
Kalibaush *(Labeo calbasu)*	27	54
Tilapia (*Oreochromis mossambicus)*	6	12
Bata *(Labeo bata)*	3	6
Chital (*Notopterus chitala)*	2	4

Table 4.11 Distribution of the farms according to the uses of fertilizers

Fertilizers	Number of farms	Percentage
Urea	42	84
TSP	30	60
MP	16	32
Cow dung	43	86
Poultry excreta	5	10
Compost	1	2

4.12 Supplementary feeds and nutrients used in farms

It is very essential to use supplementary feeds and nutrients to increase farm fish production. The percentage distribution of farms according to the use of supplementary feeds and nutrients are shown in Table 4.12. It was observed that some of the farms in the surveyed area used supplementary feeds. The utilization of wheat bran, rice bran, mustard oil cake and soybean meal were 30, 28, 24 and 12% of the farms, respectively. A few farms (6%) were used pelleted feed, fish meal, rice polish, wheat flower and about 2% of farms used meat meal and soybean oil cake. The uses of other feeds were in usual manner.

4.13 Use of methods in the farms for controlling aquatic weeds and undesirable species

There are some methods used in the farms of controlling aquatic weeds and undesirable species during pond preparation. It was observed that some of the farmers used manual methods (24%) and mechanical (16%) methods to control aquatic weeds and undesirable species. Majority of the farmers (60%) did not use any methods to control aquatic weeds and undesirable species out of 50 surveyed farms (Table 4.13).

4.14 Water exchanges in the farms

It is essential to exchange the wastewater from the farm to keep the quality of farm water and to get the optimum production. It was observed that 22% farm owners exchanged their farm water and 78% farm owners did not exchange their farm water (Table 4.14).

Table 4.12 Distribution of the farms according to the use of supplementary feeds and nutrients

Feeds and nutrients	Number of farms	Percentage
Wheat bran	3	6
Rice bran	3	6
Mustard oil cake	1	2
Soybean meal	6	12
Pelleted feed	14	28
Fish Meal	3	6
Rice polish	15	30
Wheat flower	3	6
Meat meal	12	24
Soybean oil cake	1	2

Table 4.13 Distribution of the farms according to the use of methods for controlling aquatic weeds and undesirable species

Methods	Number of farms	Percentage
Manual	12	24
Mechanical	8	16
No measures	30	60
Total	50	100.0

Table 4.14 Distribution of the farms according to the exchange of farm water

Water exchange	Number of farms	Percentage
Present	11	22
Absent	39	78

4.15 Discharging place of farm water

Waste waters were discharged from the farm in many places, such as surrounding areas of the farm, canal, beel, river etc. According to the survey that 22% farms thrown their discharged waste waters into surrounding areas, 6% were discharged into the canal, 8% were discharged into the beel and 2% were discharged into the river of surveyed 50 farms (Table 4.15).

4.16 Changes in the receiving water or area due to discharge of farm effluents

Various changes were observed due to the discharge of farm effluents in the receiving water of the farm areas. The effects of farm effluents are shown in Table 4.16. It was observed that 12% farms were involved to increase turbidity and small percentages (4%) were involved to increase fish death.

4.17 Chemicals and antibiotics used in the farms for disinfection, prevention and control of fish diseases

Several chemicals and antibiotics are widely used for disinfection, prevention and control of fish disease. The result shows that (Table 4.17) 44% were used lime, 42% farms used salt, 18% farms used $KMnO_4$, 4% farms used formalin, 4% farms used methylene blue, 4% farms were used copper sulphate and 2% farms were used calcium hypochlorite among 50 surveyed farms.

Table 4.15 Distribution of the farms according to the place of discharge of farm water

Place of discharge	Number of farms	Percentage
Surrounding area	11	22
Canal	3	6
Beel	4	8
River	1	2

Table 4.16 The effects of fish farm effluents observed in survey of fish farms

Type of effects	Number of farms	Percentage
Increased turbidity of water	6	12
Fish die	2	4

Table 4.17 Distribution of the farms according to the use of chemicals and antibiotics for disinfection, prevention and control of fish diseases

Chemicals and antibiotics	Number of farms	Percentage
Salt	21	42
Lime	22	44
Formalin	2	4
Methylene blue	2	4
Calcium hypochlorite	1	2
KMnO4	9	18
Copper sulphate	2	4

4.18 Measures taken for highly infected or dead fishes

Percentage distribution of number of cases according to the measures taken for highly infected or dead fishes are presented in table 4.18. The result shows that, highly infected or dead fishes were selling to the market, thrown into open environment, given to the local people and the percentage of cases were 22, 8 and 14. It also observed that there are majority of the cases (56%) found, where no measures taken for highly infected or dead fishes.

4.19 Escape of farmed fishes

Fishes can escape from the farm and enter into open environment through several ways. Percentage distributions of number of cases according to the ways of escaping of farmed fishes are presented in table 4.19. It was found that the fishes were escaped during over flood, jump and runoff/rain water and through broken the embankment of pond and the percentage of escapes were 35.09, 28.07, 21.05 and 15.79, respectively among the surveyed 50 farms.

4.20 Birds and mammals in aquaculture

Birds and mammals usually enter to the farm for feeding, living and for other purposes. Percentage distributions of number of cases according to measure or devices were used to control birds and mammals are presented in table 4.20. It was found that the measures or devices were used manually through producing sound or thrown a small stone, fencing, poisoning bait, traps and nets across the pond and the percentage of cases were 14.28, 14.28, 17.86, 21.43 and 32.14, respectively in the surveyed of 50 farms.

Table 4.18 Percentage distribution of the number of cases according to the measures taken for highly infected or dead fishes

Measures	Number of cases	Percentage
Sell	11	22
Thrown into open environment	4	8
Given to the local people	7	14
No measures	28	56
Total	50	100.0

Table 4.19 Percentage distribution of the number of cases according to the method of escaping of farmed fishes

Method Of escaping	Number of cases	Percentage
Over flood	20	35.09
Jump	16	28.07
Runoff/rain water	12	21.05
Breaking the embankment of pond	9	15.79
Total	57	100.00

Table 4.20 Percentage distribution of the number of cases according to the measures taken/devices used to control the birds and mammals

Type of measures/devices	Number of cases	Percentage
Manually through producing sound or thrown a small stone	4	14.28
Fencing	4	14.28
Poisoning bait	5	17.86
Traps	6	21.43
Nets	9	32.14
Total	28	100.0

4.21 Production of fish

Fish production is continuously increasing in the surveyed area. Year-wise total and average fish productions of surveyed farms are represented in Table 4.21. It appears that total fish productions were 32060, 39860, 56960, 73090 and 87070 kg/acre in the year of 2003-04, 2004-05, 2005-06, 2006-07 and 2007-2008, respectively and the farms number were 42, 44, 47, 50 and 50, in the respective years. It also appears from the same table that the average productions were 809, 857, 1032, 1154 and 1290 kg/acre in the year of 2003-04, 2004-05, 2005-06, 2006-07 and 2007-2008, respectively.

4.22 Sources of dietary fishes for general people living near the farm

Fish is a part of meal for general people. They can obtain dietary fishes from various sources. Percentage distributions of number of cases according to the sources of dietary fishes for general people living near the farm are presented in Table 4.22. Table showed that, the sources of dietary fishes were market, river, beel and own pond, and the percentage of cases were 41.32, 28.10, 25.62 and 4.96, respectively in the surveyed of 50 farms.

4.23 Benefits of fish farm for local people

Local people were benefited from fish farm through various ways. Percentage distributions of number of cases according to the benefits of local people from the fish farms are presented in Table 4.23. Table showed that, the benefits were increased ingestion of fish, poverty alleviation and employment opportunity and the percentage of cases were 55.74, 26.23 and 18.03, respectively in the surveyed of 50 farms.

Table 4.21 Year wise total and average fish production in the surveyed farms

Year	Number of farms	Total production (kg)	Yield (kg/acre/yr)
2003-04	42	32060	809
2004-05	44	39860	857
2005-06	47	56960	1032
2006-07	50	73090	1154
2007-08	50	87070	1290

Table 4.22 Percentage distribution of the number of cases according to the sources of dietary fishes for general people living near the farm

Sources	Number of cases	Percentage
Market	50	41.32
River	34	28.10
Beel	31	25.62
Own pond	6	4.96
Total	121	100.0

Table 4.23 Percentage distribution of the number of cases according to the benefits of fish farm for local people

Benefits	Number of cases	Percentage
Increased ingestion of fish	34	55.74
Poverty alleviation	16	26.23
Employment opportunity	11	18.03
Total	61	100.0

4.24 Problems faced by the local people after establishing the farm

Local people were faced many problems after establishing the farm. Percentage distributions of number of cases according to the problems faced by the local people after establishing the farm are represented in Table 4.25. Table showed that, the problems were decrease crop production, decrease live stock production and the percentage of cases were 7.70 and 3.84, respectively and also found that no problems were found in majority of the cases (88.46%) in the surveyed of 50 farms.

4.25 Problems of fish farming

Major problems of fish farming faced by the farm owners are shown in Table 4.26. Several problems of fish farming were identified in the study areas. For analytical convenience the problems were broadly categorized into technical, economic and social. It was observed that technical problems were non-availability of land, lack of scientific and technical knowledge, lack of manpower, attack of fish diseases and iron in water which were reported by 28, 30, 28, 4 and 2% farm owners, respectively. The economic problems were lack of credit facilities, loss of fish during flood, high price of various inputs, low product price and lack of marketing facilities which were the problems of 50, 22, 10, 10 and 6% farm owners, respectively. The social problems were theft of fish and poisoning the pond water which were problems of 12% and 4% farm owners, respectively.

Table 4.24 Percentage distribution of the number of cases according to the problems faced by the local people after establishing the farm

Type of problems	Number of cases	Percentage
Decrease crop production	4	7.70
Decrease live stock production	2	3.84
No problem faced	46	88.46
Total	52	100.0

Table 4.25 Major problems of fish farming faced by the farm owners

Nature of problems	Number of farm owners	Percentage
A. Technical problems		
i. Non-availability of land	14	28
ii. Lack of scientific and technical knowledge	15	30
iii. Lack of manpower	14	28
iv. Attack of fish diseases	2	4
v. Iron in water	1	2
B. Economic problems		
i. Lack of credit facilities	25	50
ii. Loss of fish during flood	11	22
iii. High price of various inputs	5	10
iv. Low product price	5	10
v. Lack of marketing facilities	3	6
C. Social problems		
i. Theft of fish	6	12
ii. Poisoning the pond water	2	4

CHAPTER V

DISCUSSION

In this chapter findings of the present study have been discussed, compared with findings of others studies.

5.1 Union-wise distribution of Farms

Data were collected from 50 farm owners and 50 local peoples living near the farms of different Unions of Phulbari Upazila under Kurigram district. The name of unions were Phulbari, Bara bhita, Bhangamour, Shimulbari, Nawdanga and Kashipur and the number of surveyed farms were 15, 9, 5, 6, 7 and 8, respectively out of the total 50 farms. On the other hand Rahman (2010) also stated that data were collected from 96 randomly selected fish farmers (out of 651) from two unions of Pakundia upazila under Kishoregonj district. Akhter (2009) also stated that a study covering a total of 60 pond fish farms selected randomly from two villages namely Boilor and Dhanikhola in Trishal Upazila under Mymensingh district. Masum (2009) also collected data from 50 farmers from eight unions in Pabna sador upazila under Pabna district. Ahmed (2004) also collected data from 100 farm owners and 100 local peoples covering different Upazilas of the Naogaon district. Biswas (2003) also stated that the data were collected from 40 farm owners and 40 general peoples covering all upazilas of Mymensingh district. These authors' findings were more or less similar to the findings of the present study.

5.2 Type of farms

The highest percentages of fish farm were found in Phulbari union and lowest was found in Bhangamour union. The sample farms were grouped into two categories as; commercial and homestead. Study shows that the commercial and homestead farms were 34% and 66%, respectively among 50 farms. On the other hand, Ahmed (2004) also stated that the farms were commercial (58%) and homestead

(42%) in Naogaon district. Biswas (2003) also found that the farms were commercial (45%) and homestead (55%) in Mymensinghregion. These authors' findings were below to the findings of the present study.

5.3 Farm establishment year

On the basis of year of establishment of sample farms, it was found that 52% were established between 2000 and 2009, 28% farms were established between 1990 and 1999, 10% farms were established between 1980 and 1989, 6% farms were established between 1970 and 1979, 4% farms were established between 1960 and 1969. On the other hand, Biswas (2003) stated that most of the farms (85.0%) were established between 1993 and 2002 and 10% farms were established between 1983 and 1992 and only 5% farms were established between 1973 and 1982 in Mymensingh district. These authors' findings were higher than the present results, the authors' maximum of the farms (85.0%) were established within last decade (1993-2002), but the present study shows that only 52% farms were established within last decade (2000-2009).

5.4 Size of farms

The sample farms were groups into three categories depending upon their different sizes in the surveyed area, i.e. i) Small farm (0.1-1.5 acre); ii) Medium farm (1.51-3.0 acre) and; iii) Large farm (above 3.0 acre). It was observed that 74% of the sample farms were of small farm, 16% were medium size farm and the rest 10% were found to be large size farm. On the other hand, Islam (2010) reveals that average pond size was 0.11 ha in Maulvibazar district. Kabir (2009) also found that the average farm size was 0.525 ha in the surveyed areas in Trishal Upazila under Mymensingh District. Ali *et al.* (2008) stated that average pond size was 0.13 ha in Baghmara upazila Rajshahi district. Ahmed (2004) stated that the sample farms were groups into i.e. Small farm (up to 2.0 ha); Medium farm (2.1-8.0 ha) and Large farm (8.1 ha and above) and observed that 66 % were of small farm, 24% were medium farm and the rest 10%were large size farm in Naogaon district. Saha (2004) also observed that the average pond size was 0.19 ha in Tangail

Sadar Upazilla. Biswas (2003) stated that the sample farms were groups into i.e. Small farm (up to 5.0 acre); Medium farm (5.1-20.0 acre) and Large farm (20.0 acre and above) and observed that 60 % were of small farm, 30% were medium farm and the rest 10 % were large size farm) in Mymensingh. Rahman (2003 conducted that the average pond size was 0.12 ha) in Gazipur district. The present findings did not agree with the findings of the authors.

5.5 Category of land ownership of farms

Sampled fish farms were classified into three categories according to the ownership pattern of land used for farming activities such as own, leased and both (own and leased). It was found that 88% farms were established on the own land of farm owner, 2% were on leased land and 10% were on both (own and leased) land out of total 50 sample farms. On the other hand, Islam (2010) stated that 87% of the ponds of single ownership and 13% having multiple ownership in Maulvibazar district. Kabir (2009) found that about 78% of the farms were under single ownership and 10% under multiple ownership and 12% were under both single and leased system in Trishal Upazila under Mymensingh District. Ali *et al.* (2008) stated that single ownership (64%) and multiple ownership (36%) farms were found in Baghmara upazila under Rajshahi district. Saha (2004) stated that 74.5% ponds were single ownership's and 21% farmers having multiple ownerships in Tangail Sadar Upazilla. These authors' findings were lower the findings of the present study.

5.6 Aquaculture as an income source of farm owners

Aquaculture has become not a main income source for the majority of farm owners. It was observed that fish farming was the primary income source for 14% farm owners and was secondary income source for 86% farm owners in the studied area. On the other hand Ahmed (2004) stated that fish farming was the primary and secondary income sources of farm owners were about 70% and 30%, respectively in the studied areas of Naogaon district. Biswas (2003) stated that the fish farming was the primary and secondary income sources of farm owners were

about 60% and 40%, respectively in the studied areas in Mymensingh region. Mollah *et al.* (1990a) conducted that rice cultivation was the main occupation and main source of income other than fish production in Laxmipur of Bangladesh. These authors' findings were higher than the present findings in the primary income sources of farm owners, but lower than the secondary income sources.

5.7 Land used before farm establishment

Before the farm establishment, lands were agricultural land, wet land, low land and unused land in the surveyed area. It was found that 24% farms were agricultural land, 10% were wet land, 30% percent were low land and 36% were unused land. On the other hand, Ahmed (2004) mentioned that 50% farms were converted from agricultural land in Naogaon district. Biswas (2003) found that (82.5%) farms were converted from agricultural land in Mymensingh district. These authors' findings were higher than the present findings in the agricultural lands were converted to fish farms.

5.8 Sources of farm water

Distribution of the sources of farm water in the study areas can be divided into three main categories. It was shown that 52% farms depend on surface water, 16% farms depend on underground water and rest of the farms depends on both surface and underground water. On the other hand, Islam (2010) observed that 40% of the ponds were seasonal and they depend on surface water and underground water and 60% were perennial in Maulvibazar district. Kabir (2009) stated that about 34% of the ponds were seasonal and 66% were perennial and the farm owners used both surface and underground water in their farm in Trishal Upazila under Mymensingh District. These authors' findings were more or less similar to the findings of the present study.

5.9 Minimum pond water depth of farms

The distribution of farms according to the minimum pond water depth was observed that the minimum water depths of 70% farms were within 0.30-1.0 m and 30% farms were within 1.10-2.0 m, respectively. On the other hand, Ali *et al.* (2008) stated that the minimum water depths of 35% farms were within 0.75-1.5 m and 65% farms were within 1.51-3.0 m, respectively in Rajshahi district. These authors' findings were higher than the present findings in the pond water depth of the fish farms.

5.10 Species cultured in farms

A large number of species were culture in the study areas; both indigenous and exotic species were cultured. The percentage distribution of farms according to the species cultured were found that about 100% of farm owners like to culture rui, catla, mrigal, silver carp and grass carp. The percentage of farmers who like to culture mirror carp, common carp, sharpunti and kalibaush were 98, 86, 84, and 54% respectively. A lower percentage of farmers like to culture tilapia, bata and chital that is 12, 6, and 4%, respectively in the surveyed 50 farms. On the other hand, Tanjina (2011) stated that there were 17 available fish species under 5 orders were found during the study period in Shinghorkhali beel in Dinajpur district. Ahmed (2004) also stated that there are about 15 different fish species were found to culture in the farms in Naogaon district. Biswas (2003) stated that there are about 14 different fish species were found to culture in the farms of Mymensingh district. These authors' findings were more or less similar to the findings of the present study.

5.11 Uses of fertilizer

From the present study it was found that almost all of the farms (84%) used urea, 60% farms used TSP, 32% used MP, 86% used cow dung, 10% used poultry excreta and 2% used compost, out of 50 surveyed farms. On the other hand, Kamruzzaman (2011) studied on the fish culture system of pond owners and showed that most of the farm owners did not use fertilizer and manure but they use

poultry litter in their pond in Bhaluka upazilla, Mymensingh. Islam (2010) stated that various farms used fertilizers in Maulvibazar district. Ahmed (2004) also stated that various fertilizers were commonly used in the farms of Naogaon district. Biswas (2003) stated that various fertilizers were commonly used in the farms in Mymensingh district. Saha *et al.* (1995) conducted that the average dose of organic matter and inorganic fertilizers were used 15280 kg/ha and 432 kg/ha, respectively for all ponds in Netrokona, Ghabtali, Bhaluka and Pakundia. In the present study farm owners used both organic and inorganic fertilizers in the farm, but these authors' findings were showed that the farm owners used neither organic nor inorganic fertilizers.

5.12 Supplementary Feeds and Nutrients used in farms

From the present study it was observed that some of the farms in the surveyed area used supplementary feeds. The utilization of wheat bran, rice bran, mustard oil cake and soybean meal were 30, 28, 24, and 12% of farms, respectively. A few farms (6%) were used pelleted feed, fish meal, rice polish, wheat flower and about 2% of farms used meat meal and soybean oil cake. The uses of other feeds were in usual manner. On the other hand, Islam (2010) stated that various farms used feeds and nutrients in Maulvibazar district. Ahmed (2004) also stated that various feed and nutrients were commonly used in the farms of Naogaon district. Biswas (2003) stated that various feed and nutrients were commonly used in the farms of Mymensingh district. Rahman (2003) conducted that various feeds as rice bran, oil cake and wheat bran were mainly used for feeding in the farms in Gazipur district. Saha *et al.* (1995) conducted that farmers did not apply any feed of animal origin. The average dose of rice bran and oil cake were used 5192 and 734 kg/ha with range of 1025-11780 kg/ha respectively, for all farms in Netrokona, Ghabtali, Bhaluka and Pakundia. These authors' findings were more or less similar to the findings of the present study.

5.13 Water Exchanges in the farms

From the present study it was observed that 22% farm owners exchanged their farm water and 78% farm owners did not exchange their farm water. On the other hand, Ahmed (2004) stated that about 52% farms released waste water in Naogaon district. Biswas (2003) stated that about 90% farms exchange farm waters in Mymensingh district. These authors' findings were higher than the present findings in the exchange of farm waters.

5.14 Discharging place of farm water

Waste waters were discharged from the farm in many places, such as surrounding areas of the farm, canal, beel, river etc. According to the survey, that 22% farms thrown their discharged water into surrounding area, 6% were discharged into the canal, 8% were discharged into the beel, and 2% were discharged into the river of surveyed 50 farms. On the other hand, Ahmed (2004) stated that farms threw waste waters into the surrounding areas in Naogaon district. Biswas (2003) stated that farms threw waste waters into the surrounding areas in Mymensingh district. In the present study farm owners discharged waste waters of the farm into many places, as surrounding areas of the farm, canal, beel, river etc, but these authors' findings were showed that the farm owners threw waste waters only into the surrounding areas of the farm.

5.15 Chemicals and antibiotics used in the farms for disinfection, prevention and control of fish diseases

From the present study the result shows that 44% were used lime, 42% farms used salt, 18% farms used $KMnO_4$, 4% farms used formalin, 4% farms used methylene blue, 4% percent farms were used copper sulphate and 2% farms were used calcium hypochlorite among 50 surveyed farms. On the other hand, Islam (2010) stated that various farms used chemicals and antibiotics in Maulvibazar district. Ahmed (2004) also stated that various chemicals and antibiotics were commonly used in the farms in Naogaon district. Biswas (2003) stated that various chemicals

and antibiotics were commonly used in the farms of Mymensingh district. These authors' findings were more or less similar to the findings of the present study.

5.16 Production of fish

Fish production is continuously increasing in the surveyed area. It appears that year-wise total fish productions were 32060, 39860, 56960, 73090 and 87070 kg in the year of 2003-04, 2004-05, 2005-06, 2006-07 and 2007-2008 respectively and the farms numbers were 42, 44, 47, 50 and 50, in the respective years. It also appears from the same table that the average productions were 809, 857, 1032, 1154 and 1290 kg/acre in the year of 2003-04, 2004-05, 2005-06, 2006-07 and 2007-2008, respectively.

On the other hand, Tanjina (2011) stated that the total fish production in last five years were highest in 2006 (9,672 kg) and lowest in 2010 (8,556 kg) in Shinghorkhali beel in Dinajpur district. Ahmed (2004) stated that total fish productions were 200, 221, 265, 324, 432 and 625 metric tons in the year of 1997-98, 1998-99, 1999-2000, 2000-2001, 2001-2002 and 2002-2003 respectively. It also appears that the average productions were 2714, 2800, 2896, 3101, 3302 and 3453 kg/ha in the respective year of the surveyed farm in Naogaon district. Biswas (2003) stated that total fish productions were 350, 445, 510, 850 and 980 metric tons in the year of 1996-97, 1997-98, 1998-99, 1999-2000 and 2000-20011 respectively and the farms number were 18, 21, 28, 36 and 40, in the respective years. It also appears that the average productions were 4199, 4446, 3705, 4693 and 4816 kg/ha in the respective year of the surveyed farm in Mymensingh district. Rahman (1995) stated that the average annual fish yield was 4923 kg/ha and it ranged from 4505 kg to 5413 kg/ha in Gouripur thana under Mymensingh district. Saha *et al.* (1995) stated that average per ha of pond fish production per year were 2892, 3035, 2803, and 1847 kg in Netrokona, Ghabtali, Bhaluka and Pakundia. These authors' findings are higher than the present findings in the average annual fish productions of the surveyed area.

5.17 Problems of fish farming

Several problems of fish farming were identified in the study areas. For analytical convenience the problems were broadly categorized into technical, economic and social. It was observed that technical problems were non-availability of land, lack of scientific and technical knowledge, lack of manpower, attack of fish diseases and iron in water which were reported by 28, 30, 28, 4 and 2 % farm owners, respectively. The economic problems were: lack of credit facilities, loss of fish during flood, high price of various inputs, low product price and lack of marketing facilities which were the problems of 50, 22, 10, 10 and 6 % farm owners, respectively. The social problems were: theft of fish and poisoning the pond water which were problems of 12% and 4% farm owners, respectively.

On the other hand, Tanjina (2011) stated that the socio-economic condition and problems of fishermen on Shinghorkhali beel in Dinajpur district. Islam (2010) showed that the constrains for sustainable pond fish farming in the studied areas were lack of technical knowledge of fish farmers in Maulvibazar district. Rahman (2010) carried out a number of problems against fish farming were identified by the fish farmers; lack of capital is most common problem in the study area in Pakundia upazila under Kishoregonj district. Akhter (2009) conducted some problems faced by the producers in producing pond fish. The problems were mainly associated with economic, technical and social aspects in the villages namely Boilor and Dhanikhola at Trishal Upazila under Mymensingh district. Kabir (2009) stated that 10% farmers reported that they have not gained any significant benefits from their involvement in fish farming in some selected areas of Trishal Upazila under Mymensingh District. Long-term sustainability of their livelihoods was questionable because of their poor knowledge on fish farming and lack of capital for fish culture.

Masum (2009) stated that most of the fish farmers belonged to moderately low knowledge category in Pabna sador upazila under Pabna district. Shohel (2007) stated that the fish farmers faced the problems of scientific knowledge, and

technology, non availability of fish seed, insufficient contact of concerned agencies to a greater extent (37%, 33% and 30%) in Kahaloo upazila, Bogra. Ahmed (2004) stated that various diseases outbreaks were noticed due to intensification production of aquaculture causing losses in Naogaon district. Biswas (2003) stated that various diseases outbreaks were noticed due to intensification production of aquaculture causing loss in some cases of the study farms in Mymensingh district.

Robbani (2002) stated that majority of farmers faced various problems as; inbreeding problems, lack of quality seed, inadequate technical knowledge on scientific fish culture, incidence of fish disease, poor credit facilities, security, marketing, multiple ownership and lack of feed were identified as the constraints to fish culture in Mymensingh, Jessor and Laxmipur region. Mollah *et al.* (1990b) conducted that the farmers have major constraints as; 72.50% of farmers reported theft was one of the main problems followed by financial problem (40%), lack of contact with fisheries officer (37.75%), lack of fish seeds (27.50%) and lack of feeds (23.75%) which hampered the production in Laxmipur district.

These authors' findings were lower than the present findings in the problems of fish farming of the surveyed areas. These authors' findings are showed that the farm owners faced some specific problems in the study, but in the present study farm owners faced several problems of fish farming were broadly categorized into technical, economic and social. As a result, in the present findings the average annual fish productions of the surveyed areas decreased.

CHAPTER VI

SUMMARY AND CONCLUSION

The present study was conducted to determine the aquaculture activities study. The research work was carried out in all the six Unions of Fulbari Upazila of the Kurigram district. In this study, data were collected from 50 farm owners/managers and 50 general people (each living near each farm). The data were collected for a period of eight months from December 2010 to July 2011.

The collected data were summarized, tabulated and analysed according to the objectives of the study. A tabular method of analysis was followed in analysing the collected informations. From the tabular analysis, it was found that 34% farms were commercial, 66% farms were homestead and 52% farms were established during last 10 years. It was observed that 74% of the sample farms were within the category of small farm, 16% were medium size farm and the rest 10% were found to be large size farm. Fish farming was the primary occupation of 14 % farm owners and secondary occupation to rest of 86% farm owners. Most of the farms (88%) were established on their own land and 2% farms were established on leased land, and rest 10% were on both (own and leased) types of land. It was found that 24% farms were agricultural land, 10% were wet land, 30% were low land and 36% were unused land.

In the surveyed farms 12 different fish species (both indigenous and exotics) were cultured, but most commonly cultured species were rui *(Labeo rohita)*, catla *(Catla calla)*, mrigal *(Cirrhinus cirrhosus)*, silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idellus*), mirror carp *(Cyprinus carpio var. specularis)*, common carp *(Cyprinus carpio var. communis)*, sharpunti *(Puntius sarana)*, kalibaush *(Labeo calbasu)*, tilapia (*Oreochromis mossambicus)*, bata *(Labeo bata)* and chital (*Notopterus chitala)*. Different fertilizers were used in the ponds, most commonly used fertilizers were urea, TSP, MP, cow dung,

poultry excreta and compost and all farms used supplementary feeds. Chemicals and antibiotics were commonly used in the farms. Most of the farms (22%) exchanged the farm wasters and the wastewaters were thrown into the surrounding area of the farm, canal, beel, river etc.

The study also describes how the farmed fishes escaped from the farm to the outside environment, what measures were taken for highly infected or dead fish, what measures were taken to prevent birds and mammals come into the farms to eat fish and how local people were benefited after establishing the farm.

Fish production is continuously increasing in the surveyed area. The total fish productions were 32060, 39860, 56960, 73090 and 87070 kg/acre in the year of 2003-04, 2004-05, 2005-06, 2006-07 and 2007-2008, respectively and the farms number were 42, 44, 47, 50 and 50, in the respective years. Annual average productions were 809, 857, 1032, 1154 and 1290 kg/acre in the year of 2003-04, 2004-05, 2005-06, 2006-07 and 2007-2008, respectively.

The present study also explored some major problems which were faced by the local people after establishing the farms and the problems faced by the farm owners. Problems faced by the local people were: decreased crop production and decreased live stock production. Some others problems faced by the farm owners were: non-availability of land, lack of scientific and technical knowledge, lack of manpower, attack of fish diseases, iron in water, lack of credit facilities, loss of fish during flood, high price of various inputs, low product price and lack of marketing facilities, theft of fish and poisoning the pond water.

Although there are some adverse socio-economic and environment impact, fish farming plays a vital role in the uplifting of the socio-economic condition, opportunity for employment, poverty alleviation of large number of population and earning of foreign currency in the study area as well as allover Bangladesh. Ecological disasters may occur as a result of unsustainable use, abuse and misuse

of natural resources. It is clear that long-term and sustainable development can be achieved only through sound environmental management. It may be concluded that we have to reduce all of the adverse constrains of aquaculture to achieve sustainable growth in the future.

According to the major findings of the study, the following recommendations were made to improve the production and profit of fish farmers:

i. Well planning and management strategies should be developed;
ii. Appropriate technologies should be developed and applied to reduce adverse impacts;
iii. Control measures should be taken on the indiscriminate use of fertilizers, chemicals, disinfectants, antibiotics, hormones and other toxic substances in the farms;
iv. Indiscriminate introductions of exotics should be prohibited by appropriate authorities and escape of farmed fishes should controlled;
v. Supply of various types of inputs should be ensured at low cost and government should control and check the quality of inputs;
vi. Reasonable price of fish, fingerlings and other inputs should be ensured;
vii. Bank loan and other institutional credit should be made available on easy terms and conditions to the farm owners;
viii. All Government and public hatcheries should be taken under common government regulation and quality seed production should be ensured;
ix. Government and other agencies should take programme to minimize the adverse socioeconomic and environmental impacts on aquaculture;
x. Effective linkage should be developed between Upazila Fisheries Office and farm owners.

REFERENCES

Ahmed, R. 2004. Impact of Aquaculture practices in and around fish farms in Naogaon District. M. S. Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, 81 pp.

Akhter, M. 2009. An economic analysis of pond fish culture in some selected areas of Mymensingh District. M. S. Thesis. Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh, 66 pp.

Ali, M. H., Hossain, M. D., Hasan, A. N. G. M and Basher, M. A.2008. Assessment of the livelihood status of the fish farmers in some selected area of Baghmara upazila Rajshahi district. *J. Bangladesh Argil. Univ*. **6 (2):** 367-374.

BBS, 2011. Statistical year book of Bangladesh. Bangladesh bureau of statistics, Statistical division, Government of People's Republic of Bangladesh, Dhaka, 90-110 pp.

Biswas, D. 2003. Study of the Impacts of Aquaculture in and around fish farms in Mymcnsingh District. M. S. Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymcnsingh, 68 pp.

DoF, 2011. Jatio Matshaw Saptaha Sankalan 2011. Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. 13-24 pp.

Islam, S. 2010. Studies on pond fish farming and livelihoods of rural farmers in some selected areas of Maulvibazar district. M. S. Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, 36 pp.

Kabir, M. S. 2009. Assessment of the livelihood status of the fish farmers in some selected areas of Trishal Upazila under Mymensingh District. M. S. Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, 39 pp.

Kamruzzaman, 2011. Study of Aquaculture practices of Bhaluka upazilla, Mymensingh. M. S. Thesis. Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. 69 pp.

Masum, S. M. 2009. Assessment of the aquaculture knowledge of the fish farmers of sadar Upazila under Pabna District. M. S. Thesis. Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, 61 pp.

Mollah, A. R., S. N. I. Chowdhury and M. A. B. Habib. 1990a. Input output relationship in fish production under various pond sizes, ownership pattern and constraints. *Bangladesh J. Train. Dev*., **3(2):** 87-101.

Mollah, A. R., S. N. I. Chowdhury and M. A. B. Habib. 1990b. An economic analysis of fish production of pond in Laxmipur of Bangladesh. *Bangladesh J. Aquacul*., **13**: 37-45.

Rahman, M. M. 1995. An economic study of ponds fish culture in some selected area of Mymensingh district. M. S. Thesis. Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh, 94 pp.

Rahman, M. M. 2003. Socio-economic aspects of carp culture development in Gazipur, Bangladesh. M. S. Thesis. Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, 72 pp.

Rahman, M. 2010. Aquaculture management practices followed by the fish farmers in Kishoregonj District. M. S. Thesis. Department of Agricultural Extension, Bangladesh Agricultural University, Mymensingh, 66 pp.

Robbani, M. G. 2002. Survey of certain parameters of fish farming in three selected areas of Bangladesh. M. S. thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, 67 pp.

Saha, N. C., M. S. Islam, J. K. Saha and P. C. Modak. 1995. Economics of pond fish production in some selected areas of Bangladesh, *Bangladesh J. Aquacul*., **17**: 13-18.

Saha, S. K. 2004. Socio-economic aspects of Aquaculture in Tangail Sadder Upazilla. M. S. Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, 77 pp.

Shohel, M. A. 2007. Aquacultural activities and livelihoods of the farmers in some selected areas of Kahaloo upazila, Bogra. M. S. Thesis. Department of Fisheries Management. Bangladesh Agricultural University, Mymensingh. 108 pp.

Tanjina, M. 2011. A study on problems of Shinghorkhali beel in Dinajpur District. M. S. Thesis, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. 66 pp.

APPENDIX

Questionnaire for Study of the Aquaculture activities.

Part I, Interview schedule for the farm owner

1. Name of the farm:

   Address:

   Village: ……, Union: …….., Upazila: ……, District :……..

2. Year of establishment: ……

3. Name of the respondent: ……

   Age: ……, Education: ……..

   Relation of the respondent to the farm:

   Farm owner ☐ Farm manager ☐ Other (please specify) ☐ ……...

4. Type of farm:

   Commercial ☐ Homestead ☐

5. Income sources of farm owner:

   a) Main source: ……..

   b) Other (Secondary) source: ……..

6. Area of the farm: ……..

7. Category of land ownership

   Own ☐ Leased ☐ Both ☐

8. Before farm establishment the area was:

   Agricultural land ☐ Wet land ☐ Low land ☐ Forest area ☐ Unused land ☐ Grazing place ☐ Brick field ☐ Others ☐ ……..

9. Number of pond in the farm: …….

10. Sources of farm water:

    Surface water ☐ Underground waters ☐ Both (surface and underground water) ☐

11. Depth of pond water:

    Maximum……. m, Minimum…….. m.

12. Species cultured and stocking density:

Species		Stocking density/acre
i)	Rui	
ii)	Catla	
iii)	Mrigal	
iv)	Silver carp	
v)	Grass carp	
vi)	Mirror carp	
vii)	Common carp	
viii)	Sharpunti	
ix)	Kalibaush	
x)	Tilapia	
xi)	Others……	

13. Do you control aquatic weeds from your ponds?

Yes ☐ No ☐

If yes, how?

Manually ☐ Mechanically ☐ Using chemicals ☐ Biologically ☐

Others ☐ …….

If using chemicals what chemicals are used?

Copper sulphate ☐ Copper cytrate ☐ Sodium arsenate ☐ 2,4D ☐

Others ☐…….

14. Do you control pests, predators and undesirable species before stocking?

Yes ☐ No ☐

If yes, how?

Pond drying ☐ Netting ☐ Using chemicals and other toxic

Substances ☐ Others ☐ ……

When using chemicals and other toxic substances, what are these?

Rotenone ☐ Teaseed cake ☐ Derries powders ☐ Phostoxin ☐

Bleaching powder ☐ Dipterex ☐ DDT ☐ Endrin ☐ Aldrin ☐

Diesel ☐ Others ☐……

15. Do you apply lime in the ponds?

Yes ☐ No ☐

16. Do you use fertilizer in your ponds?

Yes ☐ No ☐

If yes, fertilizers are:

Urea ☐ TSP ☐ MP ☐ Cow dung ☐ Poultry excreta ☐

Others ☐…. …….

17. Sources of fish fry /fingerling:

Hatchery ☐ Natural ☐

If hatchery, hatchery is:

Own ☐ Others ☐

If own, what disinfectant, anesthetic and hormone are used in the hatchery? Malachite green ☐ Calcium hypochlorite ☐ Carbonic acid ☐

MS 222 ☐ Sodium bicarbonate ☐ PG ☐ HCG ☐ LH ☐

GnRH ☐ Steroids ☐ Others ☐……..

18. Foods and feeds used for farm fishes:

a) Do you feed the fish?

Yes ☐ No ☐

If yes, from when you used feed? Year …….

b) What types of feeds do you use?

i) Dry feed:

Pellet feed ☐ Fish meal ☐ Meat meal ☐ Bone meal ☐ Poultry offal meal ☐ Shrimp meal ☐ Soybean meal ☐ Mollusks meal ☐

Rice bran ☐

Rice polish ☐ Wheat bran ☐ Wheat flour ☐ Others ☐ ...……

ii) Moist/wet feed:

Mustard oil cake ☐ Linseed oil cake ☐ Soybean oil cake ☐

Others ☐ ……..….

iii) Fresh feed:

Trash fish ☐ Snail meat ☐ Silkworm ☐ Others ☐ ...…….

iv) Live food:

Duck weed ☐ Banana leaf ☐ *Rotifer* ☐ *Moina* ☐ *Daphnia* ☐

Tubifex ☐ Others ☐……

c) Feeding rate (daily)……% body weight and time …….

19. Water exchange in the farm

a) Do you exchange/discharge your farm water?

Yes ☐ No ☐

If yes, where waste water is thrown?

Surrounding area ☐ canal ☐ River ☐ ake ☐ l ☐

Others ☐ ……..…

b) Did you observe any change in the receiving water due to discharge of farm water?

Yes ☐ No ☐

If yes, changes were:

Algal bloom ☐ Eutrophication ☐ Smell ☐ Fish kill ☐ Increased turbidity of water ☐ Deteriorate fishery ☐ Others ☐ ……..

20. Did you face any disease problem in the farm?

Yes ☐ No ☐

If yes, what was it?

	Disease	**Ranking**
i)	EUS	
ii)	Tail & Fin rot	
iii)	Dropsy	
v)	Nutritional deficiency	
Vi)	Gas babble disease	
vii)	Oxygen deficiency disease	
Viii)	Argulosis	
ix)	Saprolegniasis	
x)	Others……	

21. Prevention and control of diseases

a) What were the preventing and controlling measures taken against disease?

	Measures	Ranking
i)	Use chemicals	
ii)	Use antibiotics	
iii)	Kill the diseased fish	
iv)	Remove sick fish to another area	
v)	Change water	
Vi)	Appropriate feeding	
vii)	Stop fertilizing	
Viii)	Aeration	
ix)	Others	

b) If used chemicals and antibiotics, what were these?

Salt ☐ Lime ☐ Formalin ☐ Ethylene blue ☐ Calcium Hypochiorite ☐

Malachite green ☐ $KMnO_4$ ☐ Copper sulphat ☐ Dipterex ☐

Sumithion ☐ Malathion ☐ Oxytetracyclin ☐ Terramycin ☐

Streptomycin ☐ Salfamerazine ☐ Others ☐ ...…….

c) What is done for highly infected or dead fish?

Sell ☐ Put under the soil ☐ Thrown into open environment ☐

Others ☐……..……

22. Was the farm over flooded in any year?

Yes ☐ No ☐

If yes, in.……year.

23. Were the farmed fishes yet escaped from the farm?

Yes ☐ No ☐

If yes, how?

Jumped ☐ Runoff/rain water ☐ Through breaking the embankment of pond ☐ During exchange the water ☐ Others ☐…….

24 Are birds and mammals come into the fish farm for feeding or other purposes?

Yes ☐ No ☐

If yes, do you take any control measure against them?

Yes ☐ No ☐

If yes, what devices are used to control them?

Nets ☐ Traps ☐ Fencing ☐ Poisoning bait ☐ Bamboo ☐

Ratttat ☐ Flash guns ☐ Wind mills ☐ Others ☐ ……

25. Annual fish production in the farm

Year	**Total production (Kg)**	**Yield (kg/acre/yr)**
2003-04		
2004-05		
2005-06		
2006-07		
2007-08		

26. Do you think that local people are benefited after establishing the farm?

Yes ☐ No ☐

If yes, how?

Poverty alleviation ☐ Employment opportunity ☐ Increased ingestion of fish ☐ Others ☐……

27. Have the socio-economic condition of the farm owner improved after fish farming?

Yes ☐ No ☐

28. What are the problems of fish farming?

a) ……

b) ……

c) ……

d) ……

e) ……

Part-II. Interview schedule for the general people living near the farm.

l. Name of the respondent:

Address:

Village: ……..…..., Upazila : ……., District : ……

2. Age: …….Year

3. Occupation: …….

4. From where you get fish for eating?

Sources	**Ranking**
Own pond	
Market	
Nearby farm	
Beel	
Lake	
River	
Others…….	

5. Did you observe any change in the species composition around the farm?

Yes ☐ No ☐

If yes, changes are:

Reduction in the local species ☐ New species (exotic) in the nature ☐

Reduction in the total species ☐ Increasing the local species ☐ Increasing the total fish species ☐ Changes in the size and shape of the local species ☐

6. Did you observe any new disease after establishing the farm in the nature around it?

Yes ☐ No ☐

If yes, state the name of disease(s):

EUS ☐ Tail and fin rot ☐ Argulosis ☐ Others ☐ ……..

7. Did you face any conflict with the farm owner?

Yes ☐ No ☐

8. Did you face any problem after establishing the farm?

Yes ☐ No ☐

If yes, state the problems:

Problems	**Ranking**
Decrease in the production of crop	
Decrease in the production of livestock	
Shortage of water for drinking or irrigation	
Pollution in the surrounding environments	
Increase human health hazards	
Others……	

9. Do you think that locally/your village people are benefited after establishing the farm?

Yes ☐ No ☐

If yes, how?

Poverty alleviation ☐ Employment opportunity ☐ Increased ingestion of fish ☐ others ☐ ……