# DRIVING FACTORS AND IMPACT OF SHIFTING LAND UNDER RICE TO FISH CULTIVATION IN SOME SELECTED AREAS OF BANGLADESH

**MISS. SHARMIN AKTER**

**DEPARTMENT OF AGRICULTURAL ECONOMICS**
**SHER-E-BANGLA AGRICULTURAL UNIVERSITY**
**SHER-E-BANGLA NAGAR, DHAKA -1207**

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**BY**


## MISS. SHARMIN AKTER

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## Approved by:

| | |
|---|---|
| **(Dr. Md. Sadique Rahman )** | **(Dr. Fauzia Yasmin)** |
| Associate Professor | Director |
| Dept. of Management & Finance | Technology Transfer & Monitoring Unit |
| Supervisor | Bangladesh Agricultural Research Council |
| | Co-supervisor |

**Professor Gazi M. A. Jalil**
Chairman
Examination Committee
Department of Agricultural Economics

**DEPARTMENT OF AGRICULTURAL ECONOMICS**
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

**Date: 15th October, 2020**

## CERTIFICATE

*This is to certify that the thesis entitled* ***"DRIVING FACTORS AND IMPACT OF SHIFTING LAND UNDER RICE TO FISH CULTIVATION IN SOME SELECTED AREAS OF BANGLADESH"*** *submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***Master of Science in Agricultural Economics,*** *embodies the result of a piece of bona fide research work carried out by* ***Miss. Sharmin Akter****, Registration No.* **12-05135** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

*I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.*

***Dated: 15th October, 2020***
***Place: Dhaka, Bangladesh***

***Dr. Md. Sadique Rahman***
***Associate Professor***
***Supervisor***

*DEDICATED TO*

*MY*

*BELOVED PARENTS AND SIBLINGS*

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***Miss. Sharmin Akter***

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# LIST OF ACCRONYMS AND ABBREVIATIONS

| | | |
|---|---|---|
| % | = | Percentage |
| BBS | = | Bangladesh Bureau of Statistics |
| BCR | = | Benefit Cost Ratio |
| BER | = | Bangladesh Economic Review |
| DAE | = | Department of Agricultural Extension |
| DOF | = | Department of Fisheries |
| e.g. | = | exempli gratia (L), for example |
| et al. | = | And others |
| etc. | = | Etcetera |
| FAO | = | Food and Agricultural Organization |
| FY | = | Financial year |
| GDP | = | Gross Domestic Product |
| g | = | Gram (s) |
| GR | = | Gross Return |
| GM | = | Gross Margin |
| IOC | = | interest on Operating Capital |
| ha | = | Hectare |
| i.e. | = | id est (L), that is |
| Kg | = | Kilogram (s) |
| Kg/ha | = | Kg per hectare |
| Km | = | Kilometer |
| MOP | = | Muriate of Potash |
| MoYS | = | Ministry of Youth and Sports |
| No. | = | Number |
| NR | = | Net Return |

| | | |
|---|---|---|
| P | = | Probability |
| SAAO | = | Sub-Assistant Agricultural Officer |
| STD | = | Standard Deviation |
| Tk. | = | Taka |
| TSP | = | Triple Super Phosphate |
| TVC | = | Total Variable Cost |
| TFC | = | Total Fixed Cost |
| UNDP | = | United Nations Development Programme |
| VIF | = | Variance Inflation Factor |

# ABSTRACT

The study was conducted to explore the socio-economic status, relative profitability, determinants of adoption and livelihood changes of farmers due to shifting cultivation. Primary data were collected from 100 selected farmers using multistage random sampling technique through face-to-face interview during September to October, 2019. Descriptive statistics and Probit regression were used to achieve the objectives of the study. Per hectare variable and total cost of non-shifted farmers (rice farmers) were Tk. 148370.88 and Tk. 232156.88, respectively whereas it was Tk. 952315.4 and Tk. 1206185.4, respectively for shifted farmers (fish farmers). Net return of non-shifted and shifted farmers was Tk. -15625.08 and Tk. 691139.6 , respectively. Shifted cultivation was more profitable with BCR 1.57 compared to non-shifted farmers with BCR 0.93. Human labor, land use value and fertilizer costs were dominating cost items in rice farming whereas for fish farming, feed cost and land use value were important cost contributor. Econometric analysis shows that occupation, training, farm size and perception of cereal price had a significant influence on the decision of land shifting. The land shifting has significant impact on the livelihood of respective farm household. The different constraints respondents faced includes capital scarcity and high feed price in land shifting. Providing necessary training facilities and formal loan at low interest rate may help further investment decision of the shifted farmers.

# CHAPTER ONE
# INTRODUCTION

Bangladesh is a lower middle income country. As a developing country, it has been combatting for rapid development of its economy. The country has a population of 163.7 million encompassing an area of 56977 sq. miles or 147570 sq. km (BER, 2019). About 75.15 percent of total population lives in rural areas (BBS, 2017). The agriculture sector has also performed relatively well in the recent years due to increased productivity, emerging diversification into value added products, such as fruits, vegetables, poultry, dairy and fish, and self-sufficiency in rice production, the main rice crop for the people of the country. This accomplishment was achieved in spite of a large population, scarce cultivable land, a very high population density and the regular occurrence of natural calamity. However, still a large portion of population is under poverty line (21.8%), with most of the poor concentrating in the rural areas (BER, 2019). Other rice like wheat, maize etc. and non-rice like fish, livestock, forestry etc. are also cultivated to ensure its food security and Bangladesh has achieved tremendous success in agriculture in recent past.

## 1.1 Background of the Study

The use of low-lying paddy fields was mostly confined to Broadcast Aman (B. Aman) rice production until 1960s (Akteruzzaman, 2005). With the introduction of modern rice farming technology, the farmers started to produce Boro rice in Rabi season and B. Amwan rice in Kharif season. With the passage of time, aquaculture technologies have been evolved and the farmers realized that fish farming is more profitable than rice cultivation, and then they started to utilize their paddy fields for alternate rice-fish farming and rice-cum-fish farming. Now a days, aquaculture based crop production system is in practice in more than 25% of the low-lying paddy fields (Akteruzzaman, 2005). Conversion of rice fields in to fish ponds has brought up a change in the livelihood patterns of the rural farmers. The areas where the farmers involved themselves in the new production systems were fingerling collection, transportation and marketing of fry and fingerlings. During 1960s to 1970s, a few people used to culture fish in the permanent ponds for their own consumption, the species produced were rohu, catla, mrigal, ghainna, long whiskered catfish, freshwater shark (boal), snake head (shol) etc. Small fishes like climbing perch, stinging catfish, walking catfish, carp, minnows etc. were available in the rice fields during monsoon season

(Akteruzzaman, 2005). In 1980s to mid-1990s, some rice fields were converted into fish ponds and the people started to produce fish for commercial purposes (Akteruzzaman, 2005). When rice-fish farming became profitable, a large number of people started converting their rice fields in to rice-fish culture ponds. Culture of some exotic fishes like silver carp, tilapia, grass carp etc. also started in the paddy fields. Higher income from fish farming contributed positively in improving the housing, sanitation and education system in the study areas. It is seen that the medium and medium high lands were only used for alternate rice fish farming. The net income was high in any fish based cropping system that motivated the farmers to introduce fish based cropping system in the low-lying inland areas (Akteruzzaman, 2005). Bangladesh is one of the leading fish producing country with a total production of 4.276 million MT in FY 2017-18 (DOF). Through this remarkable Bangladesh, first time in the history, became self-sufficient country in fish production proving 62.58 g of fish per person in daily dietary consumption. Last 10 years average growth performance of this sector is 5.26%, which seems quite consistent and encouraging. Government is trying to sustain this growth performance, which eventually ensures to achieve the projected production target of 4.55 million MT by 2020-21 (DOF). Bangladesh is also one of the many developing countries to experience the proliferation of aquaculture, now the world's fastest growing food production sector, during a period of decline in capture fisheries (Belton and Thilsted, 2014).

### 1.2 Importance of Shifting Cultivation

Bangladesh's economy is dominated by agriculture characterized by monoculture of rice cultivated in 14.9 million hectares (ha) land which constitutes 78 percent cultivable land (Gurung *et. al*, 2016). Almost 15 million farm families in the country grow rice (Gurung *et al*, 2016). Due to rapid population growth (1.37 %) per year, urbanization, industrialization and diversification of agriculture (redistribution of land between agricultural sub-sectors), per capita cropland has been decreasing over time. As a consequence, efficient use of the small pieces of land is becoming a great challenge for the farm households of Bangladesh. Crop selection is one of the critical activities of farms, traditionally based on resource fixity, ancestor profession and neighbor land use decision. Monoculture causes soil degradation, reduces soil fertility, decreases soil quality, and ultimately reduces the productivity. In recent years, it is seen that paddy price is decreasing and causes income threats for growers.

Land shifting has been suggested as a viable option to stabilize and raise farm income, enhance agricultural growth, and increase employment opportunities.The land which was once dominated by rice and is now occupied by freshwater ponds for fish as to fulfill the protein requirement domestically and to increase the farm income substantially. For retaining soil fertility shifting cultivation is must. Farmers can replace their rice to other rice, rice to non-rice like vegetables, fruits etc. and also can replace their agronomic field with non-agronomic agricultural production like fish cultivation, livestock and poultry farming. These land shifting provides farmers with diversified sources of income reducing the loss of crops.

### 1.3 Justification of the Study

Bangladesh is blessed with huge open water resources with a wide range of aquatic diversity. Biodiversity is also enriched, comprising almost 267 freshwater fish species. Most of studies focus on the profitability of rice–cum-fish cultivation. No studies are found on the driving factors impacts of shifting land under rice to fish cultivation. My research revealed the actual situation of the farm communities who shifted their land from crop to fish. Findings may help the farmers and the policy makers to identify the factors affecting the shifting. This research will also help the policy maker to formulate friendly policy to flourish this farming.

### 1.4 Objectives of the Research Work:

The specific objectives of the study are as follows:

a) To assess the socio-economic characteristics of the farmers;
b) To identify the determinants affecting the shift of land from rice to fish cultivation; and
c) To assess the changes on the livelihood status of the farmers.

### 1.5 Key Research Questions of the Study

The key research questions of the study are as follows:

a) What is the socio-economic status of the respondents?
b) How much cost incurred during the farming practices?
d) What is the relative profit margin of the farmers?
e) What are the factors those affect the land shifting from rice to fish cultivation.
f) What is the extent of impacts of land shifting on the farmer’s livelihood?

### 1.6 Outline of the Thesis

The study consists of 9 chapters. Chapter one describes introduction of the study. Relevant review of literature, methodology, socio-economic characteristics of the sample farmers, profitability analysis of rice and fish farmers, factors affecting shifting land, land shifting changes on livelihood of farmers, problems, and summary and conclusion are presented in Chapter two, Chapter three, Chapter four, Chapter five, Chapter six, Chapter seven, Chapter eight and Chapter nine, respectively.

# CHAPTER TWO
# LITERATURE REVIEW

This chapter represents the review of the research works, conducted in recent past, that are related to the present study. A few researches have been done on fish cultivation in Bangladesh. However, driving factors and impact of shifting land under rice to fish cultivation is hardly ever found in the existing literature. Several important studies on rice and fish production, which have been conducted in the recent past, are discussed below:

**Monirul *et al.*2019.** Conducted a study to identify the factors determining land conversion in Bangladesh and evaluate farmers' perception about the changing land use decision. Study showed that average household and farm size of the farmers were 5.0 and 0.47 hectare, respectively in the study area. It is also demonstrated that most of the respondents experienced climatic changes having negative impacts on agricultural activities. Natural calamities caused stern damage to respondents' cultivable land, assets, agricultural enterprises and basic livelihood necessities. From Farming experience, disaster loss, farmer's educational level, annual income, access to credit, farmer's age and saline water intrusion were the significant determinants of changing land use decision in the study areas. Farmers' livelihood assets were improved to a noticeable extent after their land shifting decision. The study recommended that training provision, motivational programs and extension contact should be properly implemented by the government as well as non-government organizations to aware the farmers about pros and cons of land conversion and to choose the best land use decision for livelihood improvement.

**Gurung *et al.*2016.**Examined the transformation from rice farming to commercial aquaculture and its implications for gender roles and relations, women's access to and control over resources, household food security, and livelihood. Commercial aquaculture increased both farm income and income inequality, brought in new sources of employment, changed gender roles and relations, altered women's access to and control of resources, altered household food consumption patterns, and increased market dependence for staple food. Commercial aquaculture not only decreased the workload of women but also weakened their access to and control over agricultural products. Women became more dependent on the husband's income and

had lesser control over its use. Farm mechanization reduces women farmer's drudgery and diversification of rice monoculture toward rice based high-value crops and aquaculture improves the welfare of everyone in society. This implies that poor farmers, including women, should be provided better access to improved technologies and credit.

**Palash *et al.*2015.**Conducted the research to find out the decision-making quantitative and qualitative variables that devise the different types of farmers' involvement in freshwater fish farming in Bangladesh. Researchers considered explanatory variables under the category of economic, socio-economic, institution, ecology, and geography to find out the appropriate causes of increasing or decreasing the fish land ratio. The research showed that five economic factors (Crop and fish labor requirement, availability of rice food, least crop area and availability of feed), and one geographical factor (distance of extension office) have a significant effect on making the decision of fish land use. Among the significant factors, fish feed availability plays the vital role to make the decision of freshwater fish farming in Bangladesh.

**Sarker *et al.*2015.** Investigated to find out the causes, challenges and opportunity of crop land shift to mango orchard in Barind areas. The dominant mango orchard based patterns are: i) Wheat-Fallow-T. Aman (30%); and ii) Mustard-Fallow-T. Amam (29%). About 75% farmers are transforming crop land into mango orchard because of water scarcity, high profitability, easy cultivation process, land suitability and favourable environment for mango cultivation. Mango farmers obtained on average 231 kg/ha yield in 1st quarter (year 1-3) and then production increased sharply and reached 2,190 kg/ha in 5th quarter (year 13-15). The highest gross return of mango was found in the 5th quarter. The estimated net present worth (NPW) of the project was Tk 99,588 per hectare, which indicates that mango cultivation was profitable in Rajshahi area. The internal rate of return (IRR) was 28%, which is higher than the opportunity cost of capital. However, increasing life span of mango orchard increases yield loss of both rice and non-rice crops. In 11-year-old mango orchard, intercrop yield reduced drastically (65%). More than 83% farmers obtained increased income and about 67% achieved better livelihoods due to mango cultivation. However, there is a possibility to decrease food grain, pulses, oil seed and vegetable production in the long run. Therefore, planned mango cultivation is needed along with ensured credit

facilities through both institutional and non-institutional sources for mango cultivation, preservation and marketing.

**Khandoker *et al.*2014.**Attempted to assess the socioeconomic status of jujube farmers, relative profitability of jujube cultivation, and factors influencing the shifting lands from rice to jujube cultivation. The study was conducted in three districts, namely Pabna, Natore and Chapai Nababgonj during 2012-13. The total cost of jujube cultivation was around 50% higher than the costs incurred for different cropping patterns. The net return of jujube cultivation was 57% higher compared to different cropping patterns. The shifting of rice lands to jujube cultivation was reported to be a profitable enterprise as indicated by higher BCR (1.47), and internal rate of return IRR (94%) of jujube cultivation. Relative income and education turned out to be positively significant, whereas age and food crop requirements at home negatively significant for shifting decision from rice to jujube cultivation. Disease and insect infestation, lack of training facilities, and lack of access to credit were the major constraints for jujube cultivation. Jujube cultivation may be encouraged from state authority to increase farmer's income.

**Mehta.2009.** Examined the role of both price and income, along with the role of food-security goals, in the decision-making of farmers regarding shift from low-value crops (food crops) to high-value commercial crops (horticultural crops). It has been shown that higher food requirements at home inhibit the extent of crop-substitution decision of the farmers. However, farmers are less responsive to the changes in the prices of food grains (in terms of changing their consumption) as higher income from high-value crops provide adequate money to purchase food crops from the market. Relative income (not the relative price) of the crops has been found to explain the crop-substitution decisions of the farmers. The farmers have been reported to calculate the aggregate gain from the crop rather calculating only the price of the crop, while making the decision to shift. Their capacity to generate higher productivity along with better market prospects have been recorded to explain farmers' decision to shift area.

**Akteruzzaman.2005.** Studied the evolutionary process of converting low-lying paddy fields into fish farms and its impact on agrarian communities in some selected areas of Mymensingh district. With the evolvement of aquaculture technologies the farmers

realized that fish farming is more profitable than rice cultivation, and then they started to utilize their paddy fields for alternate rice-fish farming and rice-cum-fish farming. Now a days, aquaculture based crop production system is in practice in more than 25% of the low-lying paddy fields. When rice-fish farming became profitable, a large number of people started converting their rice fields in to rice-fish culture ponds. Higher income from fish farming contributed positively in improving the housing, sanitation and education system in the study areas. On the other hand, the social, economic and technical problems which are acting as constraints to rapid expansion of fish production system were reported from the interviewee.

**Ahmed and Lorica.2002.** Provided a framework for examining aquaculture's linkages to food and nutritional security by elucidating key hypotheses concerning the role of aquaculture in household food and income systems in developing countries. Taking examples from developing Asia, where aquaculture showed a steady growth over the last decade, the implications of aquaculture development are examined from the standpoint of its impact on employment, income and consumption. Analysis revealed clear evidence of positive income and consumption effects of aquaculture on households. The paper concludes that national policies for aquaculture development will need to concurrently address the food security and poverty questions more sharply than has been done at present, by providing institutional and infrastructure support for access to resources such as land and water and to markets by poor households.

**Islam *et al.*2002.** Conducted a research on rice-cum-fish farming in Mymensingh district to determine the relative profitability of rice production with and without fish cultivation. Gross cost of rice production with fish was Tk. 31702ha$^{-1}$ and without fish was Tk. 29121 ha$^{-1}$ in rice-cum-fish farming. Cash expenses of rice production with and without fish were Tk. 14357 and 15219 ha -1, respectively. Net return above cash expenses of rice production with and without fish was Tk. 35160 and 19776 ha -1, respectively. Net return above full cost was Tk. 18670 and 5011 ha -1, respectively. So, rice production with fish was more profitable than without fish in rice-cum-fish farming. The study showed that lack of institutional credit, higher priced of inputs, lack of marketing knowledge regarding fish and rice cultivation, insufficient water in dry season, attack of diseases and theft of fish are the major problems facing the

farmers. If these problems are immediately be solved, the yields of both rice and fish will possibly be increased tremendously.

The aforesaid review reveals that most of the study was undertaken exclusively on the profitability of fish cultivation in low lying paddy fields and in inland fisheries. Other researches were found on impacts of land shifting from rice to fruits cultivation. No studies were found on driving factors and land shifting impacts from rice to fish cultivation. So the present research was undertaken to fill up the knowledge gap in the field of shifting land from rice to fish.

# CHAPTER THREE
# METHODOLOGY

Methodology is an indispensable and integral part of any study. The reliability of a specific study finding depends to a great extent on the appropriate methods and methodology used in the study. Improper methodology leads to misleading result. So, an author had to follow a scientific and logical methodology for carrying out the study. The author has the responsibility in describing clearly what sorts of method and procedure is to be followed in selecting the study areas, the sources of data and the analyses as well as interpretations to arrive at a meaningful conclusion. This study was carried out by using a primary data collection from selected rice producers and fish cultivators in selected areas of Bangladesh for estimation. The methodological framework is presented in this chapter, which consists of four main sub-sections. The first section describes the selection of the study areas. Second section describes sampling procedure, sample size. Third section describes data collection procedure. Data analysis techniques are described in details in the fourth section.

## 3.1 Selection of the Study Areas

Selection of the study area is crucial for the acceptance of research findings. Increased fish cultivation, in recent years, in Cumilla district helps the researcher to select it as the study area. Data were collected from Chauddagram and Nangolkot upazilla under Cumilla district where fish cultivation has recently taken place of rice production.

## 3.2 Sampling Procedure and Sample Size

In this study multistage random sampling was used to select the samples. At first, two upazilas from Cumilla district were selected purposively. Then from each upazila a list of farmers who shifted their land from rice to fish cultivation was prepared. Finally 60 fish farmers taking 30 from each upazila was selected randomly. Among the 60 farmers, two farmers could not provide the cost and return information of fish cultivation. So I dropped those two farmers from the analysis and thus final sample stood at 58 for shifted farmers. For non-shifted farmers, a total of 50 farmers tacking 25 from each upazila were selected randomly. Out of these 50 farmers, 8 farmers informed that they have faced severe loss from rice cultivation during 2018. Finally,

those 8 farmers were dropped from the analysis. Therefore, total sample size was 100 for this study of which 58 fish farmers and 42 rice farmers.

### 3.3 Data Collection

Primary data refers to the first hand data gathered by the researcher. Sources of primary data are surveys, observations, questionnaires, and interviews etc. Individual interviews were conducted in a face-to-face situation with a structured and pre-tested interview schedule for collecting primary data. Interviews were conducted in respondent's house or at the farm site.

### 3.4 Period of Data Collection

Primary data were collected through structured interview schedule which were filled up by the researcher. Data were collected during September to October 2019.

### 3.5 Variables and Their Measurement Techniques

A research work usually contains at least two important variables viz. explanatory or independent variables and explained or dependent variables. There are several factors that influence the shifting decision of farmers but among them important thirteen components were studied to analyze the factors that affect the farmers shifting decision.

### 3.6 Data Processing and Analysis

In this study both descriptive and inferential method was used to analyze the data. Primary data were recorded into Microsoft excel and economic analysis was carried out to STATA for determining factor affecting fish cultivation. In this study, cost and return analysis were done on both variable and total cost basis.

### 3.7 Analytical Techniques

At first, the collected data were edited and summarized for analysis. Descriptive statistics like mean, standard deviation, percentage, ratio, etc. was used to achieve the objective. The profitability of rice and fish cultivation was estimated by using gross margin, net return, and benefit cost analysis. Binary probit regression was used to identify the factors affecting shifting land from rice to fish cultivation.

**Table 3.1 Description of the variables used in the model**

| Variable | Description |
|---|---|
| **Dependent Variable (y)** | A binary variable that takes a value of 1 if the farmer has shifted their land and 0 otherwise. |
| **Independent Variables** | |
| **Age ($x_1$)** | Farmers age in years. |
| **Primary Education ($x_2$)** | A dummy variable that takes a value of 1 if the farmer have primary level of education, and 0 otherwise. |
| **Secondary Education ($x_3$)** | A dummy variable that takes a value of 1 if the farmer have secondary or higher secondary education, and 0 otherwise. |
| **Spouse Education ($x_4$)** | Years of schooling of spouse. |
| **Earning Member ($x_5$)** | Number of earning member in the family. |
| **Occupation ($x_6$)** | A dummy variable that takes a value of 1 if the farmer's main occupation is agriculture, and 0 otherwise. |
| **Training ($x_7$)** | A dummy variable that takes a value of 1 if the farmer have training in fish cultivation, and 0 otherwise. |
| **Societal Membership ($x_8$)** | A dummy variable that takes a value of 1 if the farmer have any societal membership, and 0 otherwise. |
| **Contact with SAAO ($x_9$)** | A dummy variable that takes a value of 1 if the farmer have contact with local extension personnel (SAAO), and 0 otherwise. |
| **Farm Size ($x_{10}$)** | Total farm size in hectare. |
| **Distance from DAE office ($x_{11}$)** | Distance of DAE office from farmers home in km. |
| **Perception price of rice ($x_{12}$)** | A dummy variable that takes a value of 1 if the farmer perceived lower price of rice, and 0 otherwise. |
| **Access to credit ($x_{13}$)** | A dummy variable that takes a value of 1 if the farmer have access to formal credit, and 0 otherwise. |

### 3.7.1 Profitability analysis

Cost of variables inputs such as land preparation, labor, seed, fertilizer, irrigation, and insecticides were calculated. Land use cost was calculated on the basis of per year lease value of land. To calculate the relative profitability of shifting cultivation, at first, cost and returns of the cropping pattern of a season was estimated for non-shifted farmers. Finally, profit of the cropping pattern was deducted from the profit of fish cultivation.

**Gross Margin**

GM = TR – VC ,

Where,

GM = Gross Margin, TR = Total Revenue, VC = Variable Cost

**Net Income**

NI = TR – TC,

Where,

NI = Net Income, TR = Total Revenue, TC = Total Cost

For estimating net income total cost was subtracted from total revenue. Total cost includes variable cost plus fixed cost.

**Interest on Operating Capital**

Interest on operating capital was calculated by using the following formula (Miah, 1992):

Interest on Operating Capital (IOC) = Alit

Where,

Al = Total investment /2,

t = Total time period of investment

i= interest rate which was 10 percent per year.

### 3.7.2 Undiscounted Benefit Cost Ratio (BCR)

A benefit-cost ratio (BCR) is an indicator showing the relationship between the relative costs and benefits of a proposed project, expressed in monetary or qualitative terms. If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value to a firm and its investors.

BCR on TC = GR /TC

Where, GR = Gross return, TC = Total Cost

If BCR>1, then the return from farm is economically satisfactory;

If BCR<1, then the return from the farm is not economically satisfactory;

If BCR=1, then the farm is in break- even point.

### 3.7.3 Analysis of the Factors Affecting Land Shifting

To analyze the adoption process of a new technology there are few theories: diffusion theory, random utility theory, and rate of adoption theory, used over the period by different authors. In this study, the random utility theory was used as a framework of analysis of adoption of shifting cultivation. It is assumed that utility gain from fish cultivation is higher than the traditional crop cultivation practices and farmers will choose to adopt a new practice and continue it if the utility gain from adoption is higher compared to the older technology, given the socio-economic and technological characteristics.

The following empirical Probit model was used (Ashfaq, 2008, Christoph,2020):

$Y_s^* = Y_s - Y_{ns} > 0 = \beta_o + \beta_1$ age $+ \beta_2$ primary education$+ \beta_3$ secondary education $+ \beta_4$ spouse education$+ \beta_5$ earning member$+ \beta_6$ occupation$+ \beta_7$ training$+ \beta_8$ societal membership$+ \beta_9$ contact AEO$+ \beta_{10}$ farm size$+\beta_{11}$ distance AEO$+ \beta_{12}$ perception price $+ \beta_{13}$ credit access$+ u_i$,

Where, $u_i$= Error term and $u_i \sim N(0, 1)$, $_i = 1 \ldots n$

Y = 1 if Y* > 0, Otherwise 0

where, $Y_i^*$ is the latent variable representing the probability of farmers deciding to shift their land. $Y_s$ and $Y_{ns}$ represents shifted and not-shifted, respectively. Marginal effect was also estimated to interpret the results.

# CHAPTER FOUR
# SOCIO-ECONOMIC PROFILE OF THE FARMERS

This chapter deals with the socio-economic characteristics of the sample farmers. Socio-economic characteristics of the farmers are important in influencing production planning and shifting decision. People differ from one to another in many respects. Behavior of an individual is largely determined by one's characteristics. There are numerous interrelated and constituent attributes that characterize an individual and profoundly influence development of his/her behavior and personality. It was, therefore, assumed that enterprise combination, consumption pattern, purchase pattern, and employment patterns of different farm household would be influenced by their various characteristics. In this study respondents' age, level of education, spouse education, family size, farm size, annual household income, experience of farmers, contact with DAE office and training exposure that might have great influence to the shifting decision of the farmers.

## 4.1 Age Distribution of the Rice Growers and Fish Farmers

The age of the rice growers varied from 22 to 85 years with an average of 51.33 and age of the fish farmers varied from 24 to 72 with an average of 43.76. Considering the recorded age, farmers were classified into three categories young (≤35 years), middle (36-50 years) and old (≥ 51 years) aged as classified by MoYS (2012). The distribution of the respondents in accordance of their age is presented in Table 4.1.

**Table 4.1 Age distribution**

| Age category | Rice grower (%) | Fish farmer (%) |
|---|---|---|
| ≤35 years | 12 | 26 |
| 36-50 years | 38 | 55 |
| ≥ 51 years | 50 | 19 |

Source: Field Survey, 2019.

Table 4.1 reveals that the old-aged rice growers comprised the highest proportion (50%) followed by young (12%) and middle (38%) aged category. Results also shows that the old-aged categories constitute 50 percent of the total rice farmers indicating the old-aged farmers were generally more involved in rice cultivation. The result seems that, rice farmers grow rice for the sake of tradition and they are traditionally risk-averse.

Middle-aged fish farmers comprised the highest proportion (55%) followed by young (26%) and old (19%) aged category. A result also shows that the young and middle-aged categories constitute 81 percent of the total fish farmers. The result seems that, the young and middle aged farmers were generally more involved in fish cultivation after the realization of the extra profit generating capacity of that practice. Almost same results were found by Khondokar *et al.* (2014).

### 4.2 Educational Status of the Respondents

The level of education of the rice farmers ranged from 0 to 18 years with an average of 6.24 years and the level of education of the fish farmers ranged from 0 to 18 years with an average of 10.79 years indicates that fish farmers are more educated than rice growers by 73%. Based on education years, the farmers were classified into four categories arbitrarily (Table 4.2 & 4.3). The Table 4.2 shows that the rice growers under primary education category constitute the highest proportion (33%) followed by secondary (31%) and above secondary (17%) education category. On the other hand, 19 percent of the respondents were found under the illiterate category. Therefore, the data reveals that the average year of schooling of the rice growers was lower than the national average of 6.8 (UNDP, 2019).

**Table 4.2 Distribution of the rice growers according to their level of education**

| Category | Basis of categorization (in year of schooling) | Observed range (years) | Rice farmers | | Average year of schooling |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Illiterate | 0 | 0-18 | 8 | 19 | 6.24 |
| Primary education | 1-5 | | 14 | 33 | |
| Secondary education | 6 - 10 | | 13 | 31 | |
| Above Secondary | >10 | | 7 | 17 | |
| Total | | | 42 | 100 | |

Source: Field Survey, 2019.

**Table 4.3 Distribution of the fish farmers according to their level of education**

| Category | Basis of categorization (in year of schooling) | Observed range (years) | Fish farmers | | Average year of schooling |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Illiterate | 0 | 0-18 | 2 | 3 | 10.79 |
| Primary education | 1-5 | | 7 | 12 | |
| Secondary education | 6 - 10 | | 22 | 38 | |
| Above Secondary | >10 | | 27 | 47 | |
| Total | | | 58 | 100 | |

Source: Field Survey, 2019.

The result shows that the fish growers under above secondary education category constitute the highest proportion (47%) followed by primary (12%) and secondary (38%) education category. On the other hand, the lowest 3 percent of the respondents were found under the illiterate category which is completely opposite from Khondokar *et al.* (2014) where illiterate categories of farmers were highest and the results also differs from Sarker *et al.* (2015) where secondary education categories were highest. Therefore, the data reveals that the average year of schooling of the fish farmers was higher than the national average of 6.8 (UNDP, 2019). Average education level of fish farmer is enough than that of rice farmers (Table 4.2 & 4.3). Majority of the rice growers were primarily educated whereas most of the fish farmers are highly educated.

### 4.3 Educational Status of the Respondent's Spouse

The level of education of the rice farmer's spouse ranged from 0 to 12 years with an average of 5.67 years and the level of education of the fish farmers ranged from 0 to 18 years with an average of 8.83 years indicates that fish farmer's spouses are more educated than rice grower's spouses by 56%. The distribution of farmer's spouses according to their level of education is presented in Table 4.4 and 4.5.

**Table 4.4 Educational status of the rice farmer's spouses**

| Category | Basis of categorization (in year of schooling) | Observed range (years) | Rice farmer's spouses | | Average year of schooling |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Illiterate | 0 | 0-12 | 11 | 26 | 5.67 |
| Primary education | 1-5 | | 12 | 29 | |
| Secondary education | 6 - 10 | | 16 | 38 | |
| Above Secondary | >10 | | 3 | 7 | |
| Total | | | 42 | 100 | |

Source: Field Survey, 2019.

The result shows that the spouse of rice growers under secondary education category constitute the highest proportion (38%) followed by primary (29%) and above secondary (7%) education category. On the other hand, 26 percent of the rice grower's spouses were found under the illiterate category. Therefore, the data reveals that average year of schooling of the rice grower's spouses was higher than the national average of 5.3 (UNDP, 2019).

**Table 4.5 Educational status of the fish farmer's spouses**

| Category | Basis of categorization (in year of schooling) | Observed range (years) | Fish farmer's spouses | | Average year of schooling |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Illiterate | 0 | 0-18 | 8 | 14 | 8.83 |
| Primary education | 1-5 | | 6 | 10 | |
| Secondary education | 6 - 10 | | 27 | 47 | |
| Above Secondary | >10 | | 17 | 29 | |
| Total | | | 58 | 100 | |

Source: Field Survey, 2019.

The result shows that the fish farmer's spouse under secondary education category constitute the highest proportion (47%) followed by primary (10%) and above secondary (29%) education category. 14 percent of the fish grower's spouses were found under the illiterate category. Therefore, the data reveals that average year of schooling of the fish grower's spouses was higher than the national average of 5.3 (UNDP, 2019).

### 4.4 Family Size of the Rice Growers and Fish Farmers

Family size of both rice growers and fish farmers ranged from 2 to 15 members with an average of 6.55 and 6.53 respectively, and STD 2.82 and 3.10 respectively. More or less same with the result was found by Khandoker *et al.* (2014). According to family size, the farmers were classified into three categories by adding and subtracting standard deviation with the average family size as 'small', 'medium' and 'large' family. The distribution of the farmers according to their family size is presented in Table 4.6 and 4.7.

**Table 4.6 Distribution of the rice farmers according to their family size**

| Category | Basis of categorization (in number) | Observed range (no.) | Rice farmers | | Average Family Size |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Small | ≤4 | 2-15 | 8 | 19 | 6.55 |
| Medium | 5-9 | | 30 | 71 | |
| Large | >9 | | 4 | 10 | |
| Total | | | 42 | 100 | |

Source: Field Survey, 2019.

**Table 4.7 Distribution of the fish farmers according to their family size**

| Category | Basis of categorization (in number*) | Observed range(no.) | Fish farmers | | Average Family Size |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Small | ≤3 | 2-15 | 6 | 10 | 6.53 |
| Medium | 4-9 | | 43 | 74 | |
| Large | >9 | | 9 | 16 | |
| Total | | | 58 | 100 | |

Source: Field Survey, 2019.

Result indicates that the medium size family constitute the highest proportion (74%) followed by the small (10%) and large (16%) sized family. The average family size of the study area for fish farmers was higher than the national average of 4.06 (BBS, 2016). The results revealed that the two farming groups are more or less same in family size distribution. Both farm group constituted highly by the medium family sized category.

### 4.5 Farm Size in the Study Area

The farm size of the rice growers ranged from 0.14 acre to 4 acre with an average of 1.09 acre. Based on their farm size, the farmers were classified into five categories following the categorization of DAE (1999) (Table 4.8 and 4.9).

**Table 4.8 Distribution of the rice growers according to their farm size**

| Category | Basis of categorization (acre) | Observed range (acre) | Rice farmers | | Average farm size |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Landless | < 0.50 | 0.14-4 | 13 | 31 | 1.09 |
| Small | 0.50-2.49 | | 26 | 62 | |
| Medium | 2.50-7.49 | | 3 | 7 | |
| Large | ≥ 7.50 | | 0 | 0 | |
| Total | | | 42 | 100 | |

Source: Field Survey, 2019

Results indicate that the small farm holder constituted the highest proportion (62%) and the least value (7%) were medium farmer. The second highest proportion (31%) was landless farm holder. The findings of the study reveal that majority (69%) of the rice growers were small to medium sized farm holder. The average farm size of the rice growers in the study area (1.09acre is equivalent to 0.44 hectare) was lower than that of national average (0.60 hectare) of Bangladesh (BBS, 2014).

**Table 4.9 Distribution of the fish farmers according to their farm size**

| Category | Basis of categorization (acre) | Observed range(acre) | Fish farmers | | Average farm size |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Landless | < 0.50 | 0.32-53 | 4 | 7 | 5.62 |
| Small | 0.50-2.49 | | 25 | 43 | |
| Medium | 2.50-7.49 | | 18 | 31 | |
| Large | ≥ 7.50 | | 11 | 19 | |
| Total | | | 58 | 100 | |

Source: Field Survey, 2019

Results indicates that the small farm holder constituted the highest proportion (43%), medium farmer constituted the second highest proportion (31%) and another 19% of the fish farmers were large farm holder. the least value (7%) were landless . The result doesn't match with the findings of Khondokar *et al.* (2014) where highest categories belongs to the large farmer .The findings of the study reveal that majority (74%) of the fish farmers were small to medium sized farm holder. The average farm size of the fish farmers in the study area (5.62 acre is equivalent to 2.28 hectare) was notably higher than that of national average (0.60 hectare) of Bangladesh (BBS, 2014).

The result shows that landless and small farmers were higher in rice farming than fish cultivation by 24% and 19%, respectively. On the other hand, medium farmers were higher in the fish farming than rice farming by 24%. Large farmers were absent in the rice farming whereas 19% were present in fish farming. The average farm size of fish farmers was higher than that of rice farmers by 416%.

### 4.6 Distribution of the Farmers According to Their Occupational Status

The sample farmers have both primary and secondary occupation. The farmers of the study areas involved in various occupations such as agriculture, business, service and wage labor for their livelihood. Table 4.13 shows the distribution of the farmers according to their occupational status. Highest proportion (76%) of the rice farmer was engaged in agricultural activities. 17 percent was engaged in business, 5 percent were in labor selling and 2 percent were in service as their primary occupation. In case of subsidiary occupation of rice growers, 50% of farmers had no secondary occupation, 38% took agriculture as their secondary occupation. 2%, 5% and 5% took business, labor selling, and service as their secondary occupation, respectively. For fish farmers, 95% were engaged in agriculture, 3% in business and 2% in service as their primary occupation. 64% had no secondary occupation, while 26% were also engaged in business for their income. Only 10% were engaged in agriculture, labor selling and service activities for subsidiary income. The result is more or less similar to the findings of Khandoker *et al.* (2014).

**Table 4.10 Distribution of the farmers according to their occupational status**

| Parameters | Rice farmers | | Fish farmer | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| Primary Occupation: | | | | |
| i) Agriculture | 32 | 76 | 55 | 95 |
| ii) Business | 7 | 17 | 2 | 3 |
| iii) Labor Selling | 2 | 5 | 0 | 0 |
| iv) Service | 1 | 2 | 1 | 2 |
| Total | 42 | 100 | 58 | 100 |
| Secondary Occupation: | | | | |
| i) Agriculture | 16 | 38 | 3 | 5 |
| ii) Business | 1 | 2 | 15 | 26 |
| iii) Labor Selling | 2 | 5 | 2 | 3 |
| iv) Service | 2 | 5 | 1 | 2 |
| v) No secondary occupation | 21 | 50 | 37 | 64 |
| Total | 42 | 100 | 58 | 100 |

Source: Field Survey, 2019.

### 4.7 Annual Household Income of the Respondents

Annual household income of the respondents included all the incomes of the farmers and his/her family members from different income sources i.e. field crops, livestock rearing, business, services, foreign remittance and others. The annual household income of the rice growers ranged from 7.6 to 1287.05 thousand taka with an average of 332.76. Findings of the study shows that average monthly household income Tk. 27,730 of the rice growers were well above the national average of Tk. 15,988 (BBS, 2016). Besides, the annual household income of the fish growers ranged from 335 to 55,000 thousand taka with an average of 4100.19. Findings of the study shows that average monthly household income Tk. 341682.5 of the fish growers were well above the national average of Tk. 15,988 (BBS, 2016). On the basis of annual income, the farmers were classified into three categories arbitrarily as 'low (≤ Tk. 250,000)', 'medium (Tk.250000-Tk.350000)' and 'high (>Tk.350000)' annual income category (Sujon, 2018). The distribution of the respondent's according to their income is presented in Table 4.11 and 4.12.

**Table 4.11 Distribution of the rice farmers according to their annual household income**

| Category | Basis of categorization ('000' Tk) | Observed range ('000' Tk) | Rice farmers | | Average annual household income |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Low income | ≤ 250 | 7.6-1287.05 | 23 | 55 | 332.76 |
| Medium income | 250-350 | | 6 | 14 | |
| High income | >350 | | 13 | 31 | |
| Total | | | 42 | 100 | |

Source: Field Survey, 2019.

Result shows that the rice growers having low annual income constitute the highest proportion (55%), while 14% of the farmers have medium and 31% have high annual household income.

There have no fish farmers with low annual income. High income constitute the highest proportion (97%), while only 3% of the fish farmers have medium annual household income (Table 4.12). Rice farmers are poorer than fish farmers. High annual income of fish farmers influenced them to take risk to go beyond the traditional rice farming, ultimately helps them to shifting cultivation (Table 4.11 & 4.12).

**Table 4.12 Distribution of the fish farmers according to their annual household income**

| Category | Basis of categorization ('000' Tk) | Observed range ('000' Tk) | Fish farmers | | Average annual household income |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Low income | ≤ 250 | 335-55000 | 0 | 0 | 4100.19 |
| Medium income | 250-350 | | 2 | 3 | |
| High income | >350 | | 56 | 97 | |
| Total | | | 58 | 100 | |

Source: Field Survey, 2019.

### 4.8 Experience of the Respondents

Farming experience of the rice farmers ranged from 2 to 70 years with an average of 24.26 years and STD 15.28. Experience of the fish farmers ranged from 2 to 40 years with an average of 12.76 years and STD 8.91. Based on the experience, the respondents were classified into three categories by adding and subtracting standard deviation with the average experience as 'low', 'medium' and 'high' experience. The distribution of the farmers according to their experience of farming is given in Table 4.13 and 4.14.The results of Table 4.13 reveal that the majority (62%) of the farmers were medium experienced, whereas only 14% in low experience category and 24% in high experience category.

**Table 4.13 Distribution of the rice farmer based on their farming experience**

| Category | Basis of categorization (years) | Observed range (years) | Rice farmers | | Average year of experience |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Low experience | ≤9 | 2-70 | 6 | 14 | 24.26 |
| Medium experience | 10-39 | | 26 | 62 | |
| High experience | >39 | | 10 | 24 | |
| Total | | | 42 | 100 | |

Source: Field Survey, 2019.

**Table 4.14 Distribution of the fish farmer based on their farming experience**

| Category | Basis of categorization (years*) | Observed range (years) | Fish farmers | | Average year of experience |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Low experience | ≤4 | 2-40 | 5 | 8.62 | 12.76 |
| Medium experience | 5-22 | | 45 | 77.59 | |
| High experience | >22 | | 8 | 13.79 | |
| Total | | | 58 | 100 | |

Source: Field Survey, 2019.

The results reveal that the majority (77.59%) of the farmers were medium experienced, whereas only 8.62% in low experience category and 13.79% in high experience category.

### 4.9 Contact with Agricultural Extension Office and Societal Membership of the Respondents

Study shows that only 26% rice growers have communication with the extension office and 74% never communicated with the extension officers. Almost same situation for the fish farmers where only 40% have communication and 60% have no communication with the extension personnel.

The result also shows that only 26% rice farmers and 34% fish farmers have societal membership and most of the farmers of both category have no societal membership.

### 4.10 Training Experience of the Respondents

Training experience of the farmers was measured on the basis of total number of days the respondents attended in different training programs in their entire life. Training experience of the rice growers ranged from 0 to 90 days with an average of 3.55 days; and for the fish farmers the range was 0 to 120 days with an average of 13 days. Based on the training experience, the farmers were classified into four categories arbitrarily as 'no training', 'low (≤3 days)', 'medium (4-10 days)' and 'high (≥ 10 days)' training experience. The distribution of the farmers according to their training experience is presented in Table 4.15 and 4.16.

The Table 4.15 shows that 78 percent of rice growers have no training experience. Low, medium and high training experience categories constituted 5%, 12% and 5% respectively.

**Table 4.15 Distribution of the rice growers based on their training**

| Category | Basis of categorization (days) | Observed range(days) | Rice farmers | | Average training period |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| No training experience | 0 | 0-90 | 33 | 78 | 3.55 |
| Low training experience | ≤ 3 | | 2 | 5 | |
| Medium training experience | 4-10 | | 5 | 12 | |
| High training experience | ≥ 10 | | 2 | 5 | |
| Total | | | 42 | 100 | |

Source: Field Survey, 2019

Only 45% of the fish farmers had training experience, a majority (19%) of it constituted by low training experience for only one to three days. Another 10% of the farmers had training experience for 4-10 days and 16% had high exposureto training. Besides, 55% hadn't the opportunity to take part in any training program regarding fish cultivation (Table 4.16).

The results showed that highest proportion of both farmers category have no training but average training of the fish farmers are higher than that of rice farmers by 266% (Table 4.15 & 4.16).

**Table 4.16 Distribution of the fish growers based on their training**

| Category | Basis of categorization (days) | Observed range (days) | Fish farmers | | Average training period |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| No training experience | 0 | 0-120 | 32 | 55 | 13 |
| Low training experience | ≤ 3 | | 11 | 19 | |
| Medium training experience | 4-10 | | 6 | 10 | |
| High training experience | ≥ 10 | | 9 | 16 | |
| Total | | | 58 | 100 | |

Source: Field Survey, 2019

### 4.11 Conclusion

The socio-demographic profile of the rice growers indicates the prevalence of old aged rice farmers with medium sized family. In case of fish farmers, it indicates that the farmers belongs to medium aged group with medium sized family. Most of the rice farmers have primary education in contrast with the fish farmer where higher education constitutes the majority. Both rice farmers and fish farmers have small farm size in majority with agriculture as their main occupation. Maximum rice farmers have low annual income which is exactly opposite to the fish farmers having 97% high income famers. Majority of both farm growers have medium experience with no training. High proportion of both rice and fish farmers have no contact with the extension offices. But higher education and high income with medium training experience helps farmer to shift their farming practices from rice to fish cultivation.

# CHAPTER FIVE

# PROFITABILITY OF RICE CULTIVATION AND FISH FARMING

The main purpose of this chapter is to assess the costs, returns and profitability of rice farming and fish cultivation. Profitability is a major criterion to make decision for producing any crop at farm level. It can be measured based on net return, gross margin and ratio of return to total cost. The costs of all items were calculated to identify the total cost of production. The returns from the crops have been estimated based on the value of main products and by-products. In this chapter, in terms of rice and fish farming, per hectare yield, gross return, gross margin, net return and undiscounted benefit-cost ratio are discussed. Therefore, a financial return of farm production was calculated from the standpoint of farmers. All the returns were accounted for the study period. A brief account showing how the individual costs and returns were estimated in the present study is presented below. For analytical advantages, the cost items were classified under the following heads:

## 5.1 Cost and Return from Rice Cultivation

For calculating the costs and returns of rice production, the costs items were classified in to two groups: (1) variable cost; and (2) fixed cost. Variable cost included the cost of all variable factors like hired human labor, tillage, seed, fertilizer, irrigation water, pesticides, interest on operating capital . On the other hand, fixed cost was calculated for family labor and land use value.

### 5.1.1 Variable cost

#### 5.1.1.1 Cost of hired labor

Human labor was considered the most important and largely used input in rice production. It shared a large portion of total cost of rice production. Human labor is required for various activities and management such as land preparation, weeding, fertilizing, using insecticides and herbicides, harvesting etc. There were two sources of human labor in the study area, one was family supplied labor and another one was hired labor. The valuation of hired labor was done as the nominal cash wages paid to the farmers.

Rice growers usually grow rice in three seasons i.e. Kharif-1(Aus), Kharif-2(Amon) and Robi(Boro). The estimated cost of hired labor in the study area was Tk.22,000, Tk.19,500 and Tk.20,500 per hectare for Aus, Amon and Boro, respectively with Tk. 500 per man-days.

#### 5.1.1.2 Cost of tillage

For rice production the per hectare tillage cost was Tk. 6560.61, Tk.5829.3 and Tk.6071.6 for Aus, Amon and Boro season, respectively.

#### 5.1.1.3 Cost of seeds

The cost of seed is the single most important cost item for rice production. The total amount of seed requirement per hectare for producing rice were 70 kg/ha with an average price of Tk.48.75 for Aus rice; 52 kg/ha with an average price of Tk. 80 for Amon; and 51 kg/ha with an average price of Tk. 95 for Boro rice, respectively. Total cost of seeds were Tk. 3412.5, Tk.4160 and Tk.4845 respectively for Aus, Amon and Boro rice production.

#### 5.1.1.4 Cost of fertilizers

It was found that farmers used different kinds of fertilizer in rice production. Such as Urea, MoP, TSP and Gypsum and Zinc. Per hectare cost of these fertilizer estimated separately for details understanding.

a) **Cost of Urea:** Cost of urea for Aus, Amon and Boro rice production was Tk.4030, Tk.4026 and Tk.4410, respectively.
b) **Cost of TSP:**Cost of TSP for Aus, Amon and Boro rice production was Tk.3530, Tk.3308 and Tk.3502.5, respectively.
c) **Cost of MoP:** Cost of MoP for Aus, Amon and Boro rice production was Tk.1214, Tk.1067 and Tk.1109.85, respectively.
d) **Cost of Gypsum:** Cost of Gypsum for Aus, Amon and Boro rice production was Tk.90.91, Tk.89.1 and Tk.89.1, respectively.
e) **Cost of Zinc:** Cost of Zinc for Aus, Amon and Boro rice production was Tk.63.03, Tk.106.4 and Tk.162.24, respectively.

#### 5.1.1.5 Cost of weeding

In the study area, per hectare cost of weeding was Tk.3415, Tk.1807 and Tk.1912 for Aus, Amon and Boro rice production, respectively.

#### 5.1.1.6 Cost of pesticides

In the study area, farmers applied pesticides to protect the farm production from the attack of pests and diseases. Cost of insecticides amounted to Tk.674.2, Tk.488.7 and Tk.521 per hectare forAus, Amon and Boro rice production, respectively.

#### 5.1.1.7 Cost of irrigation

Irrigation is a crucial factors of production in case of Boro rice. But for the production of Aus and Amon it has a very negligible impact on production. The estimated cost of irrigation in the study area was Tk.60.61, Tk.250.4 and Tk.15759 per hectare forAus, Amon and Boro rice production, respectively.

#### 5.1.1.8 Cost of Interest on Operating Capital

Interest on operating capital was estimated by taking into account of all the operating costs incurred during the production period of rice. IOC was Tk.1259.31, Tk. 1113.65 and Tk. 1432.87 per hectare for Aus, Amon and Boro, respectively.

### 5.1.2 Fixed costs

#### 5.1.2.1 Cost of family labor

The estimated cost of family labor in the study area was Tk.1000, Tk.2000 and Tk.2500 per hectare for Aus, Amon and Boro, respectively with Tk. 500 per man-days.

#### 5.1.2.2 Cost of land use value

The value of land was calculated on the basis of lease value of the particular land. The estimated cost of land use value in the study area was Tk.29508, Tk.24187 and Tk.24590 per hectare for Aus, Amon and Boro, respectively.

### 5.1.3 Total costs of rice production

#### 5.1.3.1 Cost of Aus rice production

Total cost of Aus rice production was Tk.76818.17 per hectare constituted by total variable cost of Tk. 46310.17contributing 60.29% of total cost and by total fixed cost of Tk.30508 holding 39.71% of share in total cost. Hired labor cost was highest contributor in total variable cost with 28.64% share in total cost. Tillage cost share in

the total cost was estimated to 8.54%, and fertilizer cost share was 11.63%. It was notable that, in Aus rice production the irrigation cost has a negligible share in total cost holding only 0.07% share. Land use value cost contributed highest in total fixed cost and 38.41% of total cost (Table 5.1).

#### 5.1.3.2 Cost of Amon rice production

Total cost of Amon rice production was Tk.67933.55 per hectare constituted by total variable cost of Tk. 41745.55contributing 61.45% of total cost and by total fixed cost of Tk. 26187 holding 38.55% of share in total cost. Hired labor cost was highest contributor of total variable cost with 28.70% share in total cost. Tillage cost share in the total cost was estimated to 8.58%, and fertilizer cost share was 12.65%. It was notable that, in Amon rice production the irrigation cost has a negligible share in total cost holding only 0.36% share. Land use value cost contributed highest in total fixed cost and 35.60% of total cost (Table 5.2).

#### 5.1.3.3 Cost of Boro rice production

Total cost of Boro rice production was Tk.87405.16 per hectare constituted by total variable cost of Tk. 60315.16 contributing 69.01% of total cost and by total fixed cost of Tk. 27090 holding 30.99% of share in total cost. Hired labor cost was highest contributor in total variable cost with 23.45% share in total cost. Tillage cost share in the total cost was estimated to 6.95%, and fertilizer cost share was 10.61%. It was notable that, in Boro rice production the irrigation cost has a significant share in total cost holding 18.03% share. Land use value cost contributed highest in total fixed cost and 28.13% of total cost (Table 5.3) .Table 5.4 shows the cumulative cost of rice production.

**Table 5.1 Per hectare cost of Aus rice production**

| Cost Items | Unit | Quantity | Price per unit (Tk.) | Total Amount (Tk.) | Share in TC (%) |
|---|---|---|---|---|---|
| A.Variable cost<br>1.Hired labor | Man-days | 44 | 500 | 22000 | 28.64 |
| 2. Tillage cost | - | - | - | 6560.61 | 8.54 |
| 3. Seed | (kg/ha) | 70 | 48.75 | 3412.5 | 4.44 |
| 4. Fertilizer<br>i. Urea | (kg/ha) | 201.5 | 20 | 4030 | 5.25 |
| ii. TSP | (kg/ha) | 141.2 | 25 | 3530 | 4.60 |
| iii. MoP | (kg/ha) | 80.93 | 15 | 1214 | 1.58 |
| iv. Gypsum | (kg/ha) | 9.091 | 10 | 90.91 | 0.12 |
| v. Zinc | (kg/ha) | 1.21 | 52 | 63.03 | 0.08 |
| Fertilizer's total cost | | | | 8927.94 | 11.63 |
| 5. Weeding | - | - | - | 3415 | 4.45 |
| 6. Irrigation | - | - | - | 60.61 | 0.07 |
| 7. Pesticides | - | - | - | 674.2 | 0.88 |
| 8. IOC | - | - | - | 1259.31 | 1.64 |
| Total VC | - | - | - | 46310.17 | 60.29 |
| B. Fixed cost<br>1.Family labor | Man-days | 2 | 500 | 1000 | 1.3 |
| 2.Land use value | - | - | - | 29508 | 38.41 |
| Total FC | - | - | - | 30508 | 39.71 |
| Total cost(VC+FC) | - | - | - | 76818.17 | 100 |

Source: Author's estimation based on field Survey, 2019.

**Table 5.2 Per hectare cost of Amon rice production**

| Cost Items | Unit | Quantity | Unit Price (Tk.) | Total Amount (Tk.) | Share in TC (%) |
|---|---|---|---|---|---|
| A.Variable cost<br>1.Hired labor | Man-days | 39 | 500 | 19500 | 28.70 |
| 2. Tillage cost | - | - | - | 5829.3 | 8.58 |
| 3. Seed | (kg/ha) | 52 | 80 | 4160 | 6.12 |
| 4. Fertilizer<br>i. Urea | (kg/ha) | 201.3 | 20 | 4026 | 5.92 |
| ii. TSP | (kg/ha) | 132.32 | 25 | 3308 | 4.87 |
| iii. MoP | (kg/ha) | 71.13 | 15 | 1067 | 1.57 |
| iv. Gypsum | (kg/ha) | 8.91 | 10 | 89.1 | 0.13 |
| v. Zinc | (kg/ha) | 2.046 | 52 | 106.4 | 0.16 |
| Fertilizer's total cost | | | | 8596.5 | 12.65 |
| 5. Weeding | - | - | - | 1807 | 2.66 |
| 6. Irrigation | - | - | - | 250.4 | 0.36 |
| 7. Pesticides | - | - | - | 488.7 | 0.72 |
| 8. IOC | - | - | - | 1113.65 | 1.64 |
| Total VC | - | - | - | 41745.55 | 61.45 |
| B. Fixed cost<br>1.Family labor | Man-days | 4 | 500 | 2000 | 2.95 |
| 2.Land use value | - | - | - | 24187 | 35.60 |
| Total FC | - | - | - | 26187 | 38.55 |
| Total cost(VC+FC) | - | - | - | 67933.55 | 100 |

Source: Author's estimation based on field Survey, 2019.

**Table 5.3 Per hectare cost of Boro rice production**

| Cost Items | Unit | Quantity | Unit Price (Tk.) | Total Amount (Tk.) | Share in TC (%) |
|---|---|---|---|---|---|
| A.Variable cost<br>1.Hired labor | Man-days | 41 | 500 | 20500 | 23.45 |
| 2. Tillage cost | - | - | - | 6071.6 | 6.95 |
| 3. Seed | (kg/ha) | 51 | 95 | 4845 | 5.54 |
| 4. Fertilizer<br>i. Urea | (kg/ha) | 220.5 | 20 | 4410 | 5.05 |
| ii. TSP | (kg/ha) | 140.1 | 25 | 3502.5 | 4.00 |
| iii. MoP | (kg/ha) | 73.99 | 15 | 1109.85 | 1.27 |
| iv. Gypsum | (kg/ha) | 8.91 | 10 | 89.1 | 0.10 |
| v. Zinc | (kg/ha) | 3.12 | 52 | 162.24 | 0.19 |
| Fertilizer's total cost | | | | 9273.69 | 10.61 |
| 5. Weeding | - | - | - | 1912 | 2.19 |
| 6. Irrigation | - | - | - | 15759 | 18.03 |
| 7. Pesticides | - | - | - | 521 | 0.60 |
| 8. IOC | - | - | - | 1432.87 | 1.64 |
| Total VC | - | - | - | 60315.16 | 69.01 |
| B. Fixed cost<br>1.Family labor | Man-days | 5 | 500 | 2500 | 2.86 |
| 2.Land use value | - | - | - | 24590 | 28.13 |
| Total FC | - | - | - | 27090 | 30.99 |
| Total cost(VC+FC) | - | - | - | 87405.16 | 100 |

Source: Author's estimation based on field Survey, 2019.

**Table 5.4 Cumulative cost of Aus, Amon and Boro rice production per hectare**

| **Cost Items** | **Aus** | **Amon** | **Boro** | **Total Cost** |
|---|---|---|---|---|
| Total VC | 46310.17 | 41745.55 | 60315.16 | 148370.88 |
| Total FC | 30508 | 26187 | 27090 | 83785 |
| **Total cost(VC+FC)** | **76818.17** | **67933.55** | **87405.16** | **232156.88** |

Source: Author's estimation based on field Survey, 2019.

### 5.2 Gross Return of Rice Production

Gross returns for rice production are calculated by considering both per hectare products and by products. Products price can be obtained by multiplying per hectare total quantity with unit price. Table 5.5 and 5.6 shows the gross returns and profitability from Aus, Amon and Boro rice production.

**Table 5.5 Gross returns from Aus, Amon and Boro rice production per hectare .**

| **Item** | **Aus** | | **Amon** | | **Boro** | | **Gross return** |
|---|---|---|---|---|---|---|---|
| | Quantity Kg/ha | Return @ Tk.16.25 | Quantity Kg/ha | Return @Tk.17.5 | Quantity Kg/ha | Return @ Tk.15 | |
| Main product | 2909 | 47273 | 3395 | 59407.6 | 5038 | 75573.5 | **216531.8** |
| By products | - | 12000 | - | 10897 | - | 11381 | |
| Total | - | 59272.7 | - | 70304.3 | - | 86954.8 | |

Source: Author's estimation based on field Survey, 2019.

Results shows that the gross return for three season of rice production in the study area was Tk.216531.8 considering the value of total products and by products.

### 5.3 Cost and Return of Fish Cultivation in the Study Area.

For fish production, it is estimated that in the study area the total cost was Tk.1206185.4 per hectare (Table 5.6). Details cost estimation provided below:

#### 5.3.1 Variable cost

Variable cost requirement was higher than the fixed cost for fish production in the study area. Total variable cost was Tk. 952315.4 with the contribution of 78.95% to the total cost.

##### 5.3.1.1 Cost of hired labor

The estimated cost of hired labor in the study area was Tk.92449 per hectare for fish cultivation with Tk. 329 per man-days. Hired labor cost constituted 7.66% of total fish production cost.

##### 5.3.1.2 Pond repairing cost

For fish production the per hectare pond repairing cost was Tk. 36444 in the study area which is 3.02% of total cost.

##### 5.3.1.3 Cost of fingerlings

The cost of fingerlings was Tk.98619 per hectare with Tk.3 per fingerlings. It has the contribution to total cost 8.18%.

##### 5.3.1.4 Cost of feed

Feed cost is the most important contributor in the fish production. In the study area it required 10840 kg feed per hectare with per unit cost of Tk.50. Feed cost was Tk.542000 holding the highest share (44.94%) of total cost.

##### 5.3.1.5 Cost of fertilizers

It was found that farmers used mainly urea and TSP in fish production. Cost of this fertilizer estimated separately for details understanding.

i) **Cost of Urea:** Farmers used 3 kg urea per hectare with Tk.20 per kg. Cost of urea was Tk.60 having only 0.005% share of total cost.

ii) **Cost of TSP:** Farmers used 108 kg TSP per hectare with Tk.25 per kg. Cost of TSP was Tk.2700 having only 0.224% share of total cost.Total fertilizer cost for fish production was Tk.2760 per hectare having 0.229% of share in total cost.

#### 5.3.1.6 Cost of salt

Farmers used 166 kg salt per hectare with Tk.10 per kg. Cost of salt was Tk.1660 having only 0.14% share of total cost.

#### 5.3.1.7 Cost of lime

Farmers used 502 kg lime per hectare with Tk.14 per kg. Cost of lime was Tk.7028 holding 0.58% share of total cost.

#### 5.3.1.8 Cost of medicine

Farmers used medicine to protect the fish from the attack of pests and diseases. Cost of medicine amounted to Tk.85871 per hectare with 7.12% share of total cost.

#### 5.3.1.9 Cost of irrigation

Irrigation is a crucial factor of production in case of fish cultivation. Cost of irrigation was Tk.28047 per hectare having 2.33% share in total cost.

#### 5.3.1.10 Cost of Interest on Operating Capital

IOC was Tk.57437.4 per hectare for fish cultivation having 4.76% share of total cost and holding 2nd highest position in the estimation of total fixed cost.

### 5.3.2 Fixed costs

Total fixed cost was Tk. 253870 with the contribution of 21.05% to the total cost.

#### 5.3.2.1 Cost of family labor

The estimated cost of family labor in the study area was Tk.28952 per hectare with Tk. 329 per man-days contributing 2.40% in total cost.

#### 5.3.2.2 Cost of land use value

The value of land was calculated on the basis of lease value of the particular land. The estimated cost of land use value in the study area was Tk.204741 per hectare having 16.97% in total cost and highest cost contributor in fixed cost.

#### 5.3.2.3 Cost of net and fencing

The estimated cost of net and fencing in the study area was Tk.20177 per hectare with 1.67% share of total cost.

**Table 5.6 Per hectare cost of fish cultivation**

| Cost Items | Unit | Quantity | Unit Price (Tk.) | Total Amount (Tk.) | Share in TC (%) |
|---|---|---|---|---|---|
| A.Variable cost<br>1.Hired labor | Man-days | 281 | 329 | 92449 | 7.66 |
| 2. Pond repairing | - | - | - | 36444 | 3.02 |
| 3. Fingerlings | (no./ha) | 32873 | 3 | 98619 | 8.18 |
| 4. Feed | (kg/ha) | 10840 | 50 | 542000 | 44.94 |
| 5. Fertilizer<br>i. Urea | (kg/ha) | 3 | 20 | 60 | .005 |
| ii. TSP | (kg/ha) | 108 | 25 | 2700 | 0.224 |
| Fertilizer's total cost | | | | 2760 | 0.229 |
| 6. Salt | (kg/ha) | 166 | 10 | 1660 | 0.14 |
| 7. Lime | (kg/ha) | 502 | 14 | 7028 | 0.58 |
| 8. Medicine | - | - | - | 85871 | 7.12 |
| 9. Irrigation | - | - | - | 28047 | 2.33 |
| 10. IOC | - | - | - | 57437.4 | 4.76 |
| Total VC | - | - | - | 952315.4 | 78.95 |
| B. Fixed cost<br>1.Family labor | Man-days | 88 | 329 | 28952 | 2.40 |
| 2.Land use value | - | - | - | 204741 | 16.97 |
| 3. Net & fencing | - | - | - | 20177 | 1.67 |
| Total FC | - | - | - | 253870 | 21.05 |
| Total cost(VC+FC) | - | - | - | 1206185.4 | 100 |

Source: Author's estimation based on field Survey, 2019.

### 5.4 Gross Return of Fish Production per Hectare

Total production of cultured fish in the study area was 13085 kg per hectare with an average price of Tk.145 per kg. Gross return of fish cultivation was Tk.1897325.

## 5.5 Relative Profitability of Fish Production and Rice Production in the Study Area

Gross return for fish cultivation was Tk. 1680793.2 higher than rice farming where total cost of fish cultivation was Tk. 974028.5 higher than the total cost of rice farming.

**Table 5.7 Relative profitability of fish production and rice production per hectare**

| Sl. No. | Items | Fish production (Tk.) | Rice production(Tk.) |
|---|---|---|---|
| 01. | Gross Return | 1897325 | 216531.8 |
| 02. | Total variable cost | 952315.4 | 148370.88 |
| 03. | Total cost | 1206185.4 | 232156.88 |
| 04. | Gross margin | 945009.6 | 68160.92 |
| 05. | Net return | 691139.6 | -15625.08 |
| 06. | Undiscounted BCR | 1.57 | 0.93 |

Source: Author's estimation based on field Survey, 2019.

The result shows that fish cultivation is a highly capital intensive venture, but more profitable than rice cultivation in the study area. So, shifting cultivation helps farmers with higher income than traditional rice farming. Thus, farmers should shift their farm for fish cultivation.

# CHAPTER SIX
# FACTORS AFFECTING SHIFTING CULTIVATION

To assess the factors that affect shifting land to fish cultivation 'Empirical Probit Model' was employed in the study area. Findings of the research are being discussed in this chapter.

## 6.1 Factors Affecting Shifting Cultivation

To run the Probit model, both continuous and dummy variable used as independent variable. Sometimes, the variables chosen for analysis may correlate with one another by some extent. For the reliability of the research findings, it is crucial to avoid correlation between the independent variables. In this study VIF test was used to detect the multicollinearity. Test results indicates that VIF values are well below 10 (1.13-2.87) which is lower than the cut off value of 10 (Appendix-II)

**Estimated Values of the Probit Model Analysis**

i) LR Chi-square and Pseudo R-square value was used to measure the goodness of fit.

ii) P-values were tested for significance level at 1 percent, 5 percent and 10 percent levels of significance.

iii) Marginal effects were estimated for the result estimation.

iv) VIF was estimated for testing of multicollinearity.

The estimated values and co-efficient of land shifting have been presented in Table 6.1 and marginal effect have been presented in Table 6.2.

**Table 6.1 Estimated values and co-efficient of Probit regression**

| Explanatory Variable | Coefficient | Standard Error | z statistic | P-value |
|---|---|---|---|---|
| Intercept | -3.36 | 1.58 | -2.13 | 0.033 |
| Age ($x_1$) | -0.015 | 0.017 | -0.84 | 0.399 |
| Primary education ($x_2$) | 0.802 | 0.776 | 1.03 | 0.301 |
| Secondary education ($x_3$) | 0.923 | 0.693 | 1.33 | 0.182 |
| Spouse education ($x_4$) | 0.067 | 0.061 | 1.09 | 0.275 |
| Earning member ($x_5$) | 0.084 | 0.217 | 0.39 | 0.697 |
| Occupation ($x_6$) | 0.974** | 0.463 | 2.10 | 0.036 |
| Training ($x_7$) | 1.012** | 0.512 | 1.98 | 0.048 |
| Societal membership ($x_8$) | -0.052 | 0.573 | -0.09 | 0.928 |
| Contact with SAAO ($x_9$) | 0.095 | 0.582 | 0.16 | 0.873 |
| Farm size ($x_{10}$) | 0.831** | 0.395 | 2.10 | 0.035 |
| Distance to DAEO ($x_{11}$) | -0.023 | 0.137 | -0.17 | 0.864 |
| Perception price of rice ($x_{12}$) | 2.266*** | 0.476 | 4.76 | 0.000 |
| Access to formal credit ($x_{13}$) | -0.221 | 0.456 | -0.48 | 0.629 |
| LR chi-squared | 79.35 | | | |
| Pseudo $R^2$ | 0.58 | | | |

Source: Author's estimation based on field Survey, 2019.

Note: *** and ** indicate significant at 1% and 5% level, respectively.

**Table 6.2 Marginal effects after Probit regression**

| Variable | dy/dx | Standard error | z statistic | P-value |
|---|---|---|---|---|
| Age ($x_1$) | -0.003 | 0.005 | -0.79 | 0.431 |
| Primary education ($x_2$)* | 0.16 | 0.129 | 1.22 | 0.221 |
| Secondary education ($x_3$)* | 0.26 | 0.233 | 1.14 | 0.255 |
| Spouse education ($x_4$) | 0.02 | 0.015 | 1.13 | 0.258 |
| Earning member ($x_5$) | 0.02 | 0.053 | 0.39 | 0.693 |
| Occupation($x_6$)* | 0.29 | 0.164 | 1.77 | 0.077 |
| Training($x_7$)** | 0.22 | 0.120 | 1.83 | 0.067 |
| Societal membership ($x_8$)* | -0.01 | 0.146 | -0.09 | 0.929 |
| Contact with SAAO ($x_9$)* | 0.02 | 0.144 | 0.16 | 0.872 |
| Farm size($x_{10}$) | 0.21 | 0.048 | 4.27 | 0.000 |
| Distance to DAEO ($x_{11}$) | -0.006 | 0.048 | -0.17 | 0.865 |
| Perception price of rice($x_{12}$)* | 0.61 | 0.151 | 4.05 | 0.000 |
| Access to formal credit ($x_{13}$)* | -0.057 | 0.125 | -0.45 | 0.650 |

Source: Author's estimation based on field Survey, 2019.

Note: i) '*'dy/dx is for discrete change of dummy variable from 0 to 1.

ii)'**' Training refers the training of fish farmers regarding fish cultivation

## 6.2 Interpretation of the Variable Based on Marginal Effect

### Occupation($x_4$)

Farmers with agriculture as main occupation are 29% more likely to shift their land into fish cultivation compared to those farmers who are not in agriculture.

### Training($x_7$)

Farmers having training related to fish cultivation are 22% more likely to shift in fish farming compared to those farmers having no training in fish cultivation.

### Farm Size($x_{10}$)

Marginal effect analysis suggested that 1 unit increase in farm size would increase the probability by 21% to shift cultivation from rice to fish.

### Perception Price of Rice($x_{12}$)

Farmer's perception played a vital role in shifting decision. Farmers who perceived lower price of rice are 61% more likely to shift their land into fish cultivation.

## 6.3 Concluding Remarks

Among the factors occupation, training, farm size and perception price of rice were found as the most influential factors for farmer's land shifting. The finding may indicates that current extension approach can be modified by targeting larger farmers. More training and awareness building programs may be arranged frequently.

# CHAPTER SEVEN

# LAND SHIFTING CHANGES ON LIVELIHOOD OF FARMERS

Fish cultivation has created tremendous change on many of the respondent farmers in the study areas. Fish cultivation brought them positive impacts to some extent on household income, food intake, and livelihood improvement.

## 7.1 Change in Livelihood

In this study probable seven livelihood changing factors were used.

**Table 7.1 Land shifting change on expenditure of the respondents in the study area.**

| Sl. No. | Category of expenditure | Change in livelihood (%) | | | Rank |
|---|---|---|---|---|---|
| | | Increase | Constant | Decrease | |
| 1. | Food | 95 | 5 | 0 | 1st |
| 2. | Drinking water | 47 | 53 | 0 | 5th |
| 3. | Sanitation | 45 | 55 | 0 | 6th |
| 4. | Education | 59 | 0 | 41 | 7th |
| 5. | Health | 90 | 2 | 8 | 4th |
| 6. | Clothing | 90 | 8 | 2 | 3rd |
| 7. | Electricity | 93 | 7 | 0 | 2nd |

Source: Field Survey, 2019

### Expenditure on food

The table indicates that fish farmer's expenditure increased by 95% holding 1st rank in consumption factors.

### Expenditure on drinking water

Drinking water expenditure increased by 47% and 53% constant change in expenditure on drinking water.

### Expenditure on sanitation

Sanitation expenditure increased by 45% and 55% constant change in expenditure on sanitation.

### Expenditure on education

Expenditure on education increased by 59% and 41% decreased change in expenditure on education.

**Expenditure on health**

Health expenditure holding 4th rank with 90% increased, 2% constant and 8% decreased change in livelihood of the respective farm household.

**Expenditure on clothing**

Clothing expenditure holding 3rd rank with 90% increased, 8% constant and 2% decreased change on livelihood of the respective farm household.

**Expenditure on electricity**

Expenditure on electricity of shifted farmers was in 2nd position with 93% increased and 7% constant change on livelihood.

### 7.2 Changes in Total Income of the Farmers in the Study Area

Farming income has a significant contribution on total income of a farm household (Table 7.2). Average annual income of rice farmers was Tk. 332760.43 having Tk. 100547.62 and Tk. 232212.81 from agricultural and non-agricultural sources, respectively. Income of rice farmers from rice farming was Tk. 74188.10 contributing 22.29% to the total income of the respective farm household. Fish farmer's average annual income was Tk. 4100187.93 with agricultural income of Tk. 3830515.52 and non-agricultural income of Tk. 269672.41. Fish farming income was Tk. 3764956.90 with 91.82% contribution to the farmer's total income (Table 7.2).

**Table 7.2 Farming income contribution on total income**

| Income source | Rice farmers income (Tk.) | Contribution | Fish farmers income (Tk.) | Contribution |
|---|---|---|---|---|
| Agriculture | 100547.62 | | 3830515.52 | |
| Non-Agricultural income | 232212.81 | **22.29%** | 269672.41 | **91.82%** |
| Total income | 332760.43 | | 4100187.93 | |
| Farming Income | 74188.10 | | 3764956.90 | |

Source: Field survey, 2019.

### 7.3 Concluding Remarks

Income from fish cultivation had its' positive impact on every possible livelihood sector of farm household. More than 93% farmers obtained increased income. The amount of food intake was also increased for most of the responded households (94.83%). Expenditure on water and sanitation also increased for the farmers about 46.55% and 44.83% respectively. Expenditure on electricity was increased for 93.1% households. Clothing expenditure also increased for 89.66% .Most importantly, education and health expenditure of fish farmers increased for 58.62% and 89.66% respondents, respectively. For the rice farmers, only 22.09 percent income generated from rice farming to the farm household income. But for the fish farmers, 91.82 percent income generated from fish farming.

# CHAPTER EIGHT
# CONSTRAINTS FOR LAND SHIFTING

In this chapter researcher discussed about the problems faced by fish farmers and opted to generate some solutions based on the farm level survey. Open ended questions regarding the constraints of fish farmers were asked to the respondents. The respondents were free to mention all the problems they faced during fish cultivation.

## 8.1 The Constraints of Shifting Cultivation

There is no doubt about that the fish cultivation is a profitable venture but the farmers were encountered by some problem during their farming practices. All the problems were mentioned by the farmers.

**Table 8.1 Constraints faced by fish farmers**

| Problems | Percentage | Rank |
|---|---|---|
| 1.Lack of capital | 74 | 1st |
| 2.High feed price | 74 | 1st |
| 3.Disease proneness of fish | 16 | 2nd |
| 4.Lack of labor availability | 13.8 | 3rd |
| 5.Lack of market information | 5 | 4th |
| 6.Lack of technical know-how | 5 | 4th |

Source: Field Survey, 2019

Table depicted that high proportion (74%) of respondents faced severe problem of capital scarcity and high feed price in fish cultivation. Disease proneness of fish also may cause threats to fish farmers.

## 8.2 Concluding Remarks

Some inevitable constraints like shortage of capital, high input price, lack of information, lack of labor availabilities were encountered by the farmers. To overcome the problems and further improvement, different suggestions were proposed by the farmers. Among them feed price reduction, provision of subsidy, increasing the fish price were recommended by most of the respondents.

# CHAPTER NINE
# SUMMARY AND CONCLUSION

This chapter presents the summary of findings, conclusions and recommendations of the study. The summary of the study shows the findings in brief. By conclusion, the main points of the report can be identified quickly. Recommendation draws the attention of the respective authority to implement some strategy for improving the situation of the shifted farmers.

## 9.1 Summary

Cumilla zilla was ranked third in 2018 for cultured fish production in Bangladesh. Chauddagram and Nangolkot upazila from Cumilla district were selected as the study area of this research to delineate the socio-economic profile of the rice farmers and fish farmers to estimate the profitability to explore the impacts of that practices on the farmer's livelihood and to identify the reasons and problems encountered by the farmers.

Besides extensive study on all the secondary sources, 100 farmers, 42 rice growers and 58 fish farmers were randomly selected for conducting field level survey to collect primary data. A structured interview schedule was developed based on the background information, expert's appraisal and pre-test questionnaire.

Data obtained by administering interviews with the respondents were coded appropriately and entered into a database system using Microsoft Excel. Finally, obtained dataset were analyzed using MS Excel and STATA 14 statistical software. Descriptive statistics (percentage, mean, range, standard deviation etc.) were used to describe the socio-economic variables and Probit model was used to identify the factors that affects in shifting decision of farmers.

The socio-economic profile of the rice farmers reveals that the highest (50%) proportion were old-aged followed by middle (38%) and young aged category (12%) and for the fish farmers, it reveals that middle-aged fish farmers comprised the highest proportion (55%) followed by young (26%) and old (19%) aged category .

Among the rice growers under primary education category constitute the highest proportion (33%) followed by secondary (31%) and above secondary (17%) education category. On the other hand, 19 percent of the respondents were found under the

illiterate category. The spouse of rice growers under secondary education category constitute the highest proportion (38%) followed by primary (29%) and above secondary (7%) education category. On the other hand, 26 percent of the rice grower's spouses were found under the illiterate category.

The fish growers under above secondary education category constitute the highest proportion (47%) followed by primary (12%) and secondary (38%) education category. On the other hand, the lowest 3 percent of the respondents were found under the illiterate category. the fish farmer's spouse under secondary education category constitute the highest proportion (47%) followed by primary (10%) and above secondary (29%) education category. 14 percent of the fish grower's spouses were found under the illiterate category.

The medium size family constituted the highest proportion (71%) followed by the small (19%) and large (10%) sized family for the rice growers and for fish farmers, the medium size family constituted the highest proportion (74%) followed by the small (10%) and large (16%) sized family.

In rice farming the small farm holder constituted the highest proportion (62%) and the least value (7%) were medium farmer. The second highest proportion (31%) was landless farm holder and no farmers were in large farm holder category. The findings of the study reveal that majority (69%) of the rice growers were small to medium sized farm holder. In fish cultivation the small farm holder constituted the highest proportion (43%), medium farmer constituted the second highest proportion (31%), another 19% of the fish farmers were large farm holder and the least value (7%) were landless.

Highest proportion (76%) of the rice farmer was engaged in agricultural activities. 17 percent was engaged in business, 5 percent were in labor selling and 2 percent were in service as their primary occupation. In case of subsidiary occupation of rice growers, 50% of farmers had no secondary occupation, 38% took agriculture as their secondary occupation. 2%, 5% and 5% took business, labor selling, and service as their secondary occupation, respectively. For fish farmers, 95% were engaged in agriculture, 3% in business and 2% in service as their primary occupation. 64% had no secondary occupation, while 26% were also engaged in business for their income.

Only 10% were engaged in agriculture, labor selling and service activities for subsidiary income.

The rice growers having low annual income constitute the highest proportion (55%), while 14% of the farmers have medium and 31% have high annual household income. For the fish farmers, high income constitutes the highest proportion (97%), while only 3% of the fish farmers have medium annual household income.

Majority (62%) of the rice farmers were medium experienced, whereas only 14% in low experience category and 24% in high experience category. Majority (77.59%) of the fish farmers were medium experienced, whereas only 8.62% in low experience category and 13.79% in high experience category.

Only 26% rice growers have communication with the extension office and 74% never communicated with the extension officers. Almost same situation for the fish farmers where only 40% have communication and 60% have no communication with the extension personnel.

Twenty-six percent of rice farmers and thirty-four percent of fish farmers have societal membership and most of the farmers of both categories have no societal membership. 78 percent of rice growers have no training experience. Low, medium and high training experience categories constituted 5%, 12% and 5% respectively. Only 45% of the fish farmers had training experience, a majority (19%) of it constituted by low training experience for only one to three days. Another 10% of the farmers had training experience for 4-10 days and 16% had high exposure to training. Besides, 55% hadn't the opportunity to take part in any training program regarding fish cultivation.

Profitability analysis of the study shows that different inputs were used for rice and fish farming. Total cost of Aus rice production was Tk.76818.17 per hectare constituted by total variable cost of Tk. 46310.17contributing 60.29% of total cost and by total fixed cost of Tk.30508 holding 39.71% of share in total cost. Hired labor cost was highest contributor in total variable cost with 28.64% share in total cost. Tillage cost share in the total cost was estimated to 8.54%, and fertilizer cost share was 11.63%. It was notable that, in Aus rice production the irrigation cost has a negligible share in total cost holding only 0.07% share. Land use value cost contributed highest in total fixed cost and 38.41% of total cost.

Total cost of Amon rice production was Tk.67933.55 per hectare constituted by total variable cost of Tk. 41745.55contributing 61.45% of total cost and by total fixed cost of Tk. 26187 holding 38.55% of share in total cost. Hired labor cost was highest contributor of total variable cost with 28.70% share in total cost. Tillage cost share in the total cost was estimated to 8.58%, and fertilizer cost share was 12.65%. It was notable that, in Amon rice production the irrigation cost has a negligible share in total cost holding only 0.36% share. Land use value cost contributed highest in total fixed cost and 35.60% of total cost.

Total cost of Boro rice production was Tk.87405.16 per hectare constituted by total variable cost of Tk. 60315.16contributing 69.01% of total cost and by total fixed cost of Tk. 27090 holding 30.99% of share in total cost. Hired labor cost was highest contributor in total variable cost with 23.45% share in total cost. Tillage cost share in the total cost was estimated to 6.95%, and fertilizer cost share was 10.61%. It was notable that, in Boro rice production the irrigation cost has a significant share in total cost holding 18.03% share. Land use value cost contributed highest in total fixed cost and 28.13% of total cost. Gross return and gross margin of rice cultivation was Tk. 216531.8 and Tk. 68160.92 per hectare, respectively. The net return from the farming was Tk. -15625.08 per hectare. The undiscounted benefit cost ratio was 0.93 on total cost basis.

For fish cultivation, the cost of fingerlings was Tk.98619 per hectare. It has the contribution to total cost 8.18%. Feed cost was Tk.542000 holding the highest share (44.94%) of total cost. The cost of land use value in the study area was Tk.204741 per hectare having 16.98% in total cost. Gross return and gross margin of fish cultivation was Tk. 1897325 and Tk. 945009.6 per hectare, respectively. The net return from the farming was Tk. 691139.6 per hectare. The undiscounted benefit cost ratio was 1.57 on total cost basis. Fish cultivation was more profitable than rice cultivation in the study area.

Among thirteen inputs used in Probit analysis for identifying the factors that affects land shifting decision of farmers, four of them were significant. Occupation, training, farm size and perception price of rices hold the marginal effects co-efficient of 0.29, 0.22, 0.21 and 0.61 respectively. LR chi-squared value was 79.35 and Pseudo $R^2$ value was 0.58.

More than 93% farmers obtained increased income from land shifting. The amount of food intake was also increased for most of the responded households (94.83%). Expenditure on water and sanitation also increased for the farmers about 46.55% and 44.83% respectively. Expenditure on electricity was increased for 93.1% households. Clothing expenditure also increased for 89.66%. Most importantly, education and health expenditure of fish farmers increased for 58.62% and 89.66% respondents, respectively. Rice farming contributed to rice farmer's total income by 22.29% where fish farming contributed to farm household total income by 91.82%.

Constraints faced by the fish farmers were explored by offering open ended questions regarding the constraints of fish farming and suggestions for improvements. Among the different constraints mentioned by the farmers, high proportion (74%) of respondents faced severe problem of capital scarcity and high feed price in fish cultivation.

### 9.2 Conclusion

The socio-economic profile of the rice growers indicates the prevalence of old aged farmers with medium sized family; most of the fish farmers constituted by the medium aged group with medium sized family. Having primary level educational status most of them were smallholder rice growers whereas fish farmers were small farm holder along with high educational status. The rice growers having low annual income constitute the highest proportion. For the fish farmers, high income constitute the highest proportion. Highest proportion of the rice growers have low income from their farming. Majority of the fish farmers have high income from their farm production. Majority of the rice and fish farmers were medium experienced category. Only Twenty-six percent rice growers and forty percent of fish farmer had communication with the extension offices. Twenty-six percent rice farmers and thirty-four percent fish farmers had societal membership and most of the farmers of both category had no societal membership. Seventy-eight percent of rice growers had no training experience. Only forty-five percent of the fish farmers had training experience, a majority of it constituted by low training experience for only one to three days.

Rice farming is highly labor intensive, where a large portion of cost incurred for labor. Fixed cost for rice production included cost of family labor, land use cost and

interest on operating capital. BCR for rice cultivation was not satisfactory. Fish cultivation was not a labor intensive venture but capital. Highest portion of the resources were required to spend for fingerling collection and feeding. Land use cost, interest on operating capital, family labor cost and cost of net and fence constitute fixed cost in fish cultivation. BCR of the fish farm indicated that the farmers obtained a satisfactory net return from their investment.

Most of the fish farmers obtained increased income. The amount of food intake was also increased for most of the responded households. Expenditure on water and sanitation also increased for the farmers. Expenditure on electricity was increased for fish farmer's households. Clothing expenditure also increased along with the expenditure on health and education.

Among the different constraints mentioned by the farmers, high proportion (74%) of respondents faced severe problem of capital scarcity and high feed price in fish cultivation.

### 9.3 Scope for Further Study

On the basis of experience, observation and conclusions drawn from the findings of the study some recommendations have been prescribed to the concerned authorities, planners and executioners. These recommendations are-

- Lack of proper education and market access of non-shifted farmers (rice farmers) negatively affected their net return. They also deprived of fair market price for their marketable surplus. If proper information could be provided to the farmers, rice cultivation would be a profitable venture.
- Fish farmers of the study area were deprived of training facilities regarding use of technology in fish cultivation. Fish productivity can be risen to some extent if proper training can be provided to the farmers. Respective authority like Department of Fisheries may arrange frequent field days, demonstration and training programs to impart fish cultivation knowledge of the farmers. More extension service should be provided by the respective authority.
- A significant portion of the fish farmers mentioned the unavailability of capital. Majority of the fish farmers urged for supplying loan with a lower interest rate. Government may take this initiative to facilitate the establishment of this fish cultivation.

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**Appendix-I: Research questionnaire**

Department of Agricultural Economics

Sher-e-Bangla Agricultural University

An Interview Schedule on

**Impact of shifting land under rice to fish cultivation in some selected areas of Bangladesh**

**Contact Number:** **Serial No.:** **Village:**

**Post Office:** **Union/Pourashova** **Upazilla:**

**1. General information of the Respondent.**

| | |
|---|---|
| **Name of the Respondent:** | |
| **Gender:** Male/Female | **Age:** |
| **Education:** | |
| **Marital status:** Unmarried= 1, Married = 2, Widow = 3, Divorced = 4 | |
| **Family Size:** Male- Female- Children- Old (60)- Earning members: | |
| **Main occupation:** | **Secondary occupation:** |

Farming experience: Years

Spouse education: Years

Training on agriculture: Yes/ No

If Yes: Days

Distance from Agriculture Extension Office: KM

Have any contact with extension office: Yes/ No

Have any societal membership: Yes/No

**2. Land Ownership pattern.**

| Types of land | Area (acres) |
|---|---|
| a. Own Cultivated Land | |
| b. Rented In | |
| c. Rented Out | |
| d. Mortgaged In | |
| e. Mortgaged Out | |
| f. Fellow Land | |
| No. of ponds | |
| **Total land** | |

**3. Annual Income**

| Sector of Income | Source of income | Annual income |
|---|---|---|
| Agriculture | 1. Fisheries | |
| | 2.Rice | |
| | 3. Wheat | |
| | 4.Livestock | |
| | 5.Others farm | |
| | 6. Fruits | |
| | 7.Vegetables | |
| | 8.Homestead | |
| | 9.Forest | |
| | 10.others | |
| Total income from agriculture | | |
| Non-Agriculture | 1.Service | |
| | 2.Business | |
| | 3. Remittance/Pension | |
| | 4. Others (selling labour, rickshaw pulling etc.) | |
| Total annual Income from non-agricultural sector | | |

**4. Overall livelihood status of the households:**

| Questions on livelihood status | Increase | Decrease | Constant |
|---|---|---|---|
| Uses of sanitary toilet | | | |
| Uses of tube well water | | | |
| Uses of electricity | | | |
| Purchasing new clothes during festivals | | | |
| Expenses on health | | | |
| Expenses on education | | | |
| Expenses on food items | | | |
| Expenses on non-food items | | | |

**5. Materials /inputs cost of production**

| Inputs | Fish cultivation | | Cropping Pattern | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Kharif-1 | | Kharif-2 | | Rabi | | Total | |
| | Own | Hired | Own | Hired | Own | Hired | Own | Hired | Own | Hired |
| Fingerlings/ seed | | | | | | | | | | |
| Man power | | | | | | | | | | |
| Feed | | | | | | | | | | |
| Land preparation/ tillage | | | | | | | | | | |
| Fertilizer | | | | | | | | | | |
| a. Urea | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| b. TSP | | | | | | | | | | |
| c. MoP | | | | | | | | | | |
| d. Gypsum | | | | | | | | | | |
| e. Zinc | | | | | | | | | | |
| Liming | | | | | | | | | | |
| Salting | | | | | | | | | | |
| Medicine | | | | | | | | | | |
| Weeding | | | | | | | | | | |
| Pesticides | | | | | | | | | | |
| Lease value of land | | | | | | | | | | |
| Irrigation | | | | | | | | | | |
| Net & fencing | | | | | | | | | | |
| Total | | | | | | | | | | |

**6. Total Production**

| Items | Fish | | Cropping Pattern | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Price | Kharif-1 | | Kharif-2 | | Rabi | | Total | |
| | | | Quantity | Price | Quantity | Price | Quantity | Price | Quantity | Price |
| Main product | | | | | | | | | | |
| By product | | | | | | | | | | |
| Total | | | | | | | | | | |

**7. Sources of capital:**

| Source | Interest rate | Source | Interest rate |
|---|---|---|---|
| Own fund = 1 | Nil | NGO = 5 | |
| Bank loan = 2 | | Friends and relatives = 6 | |
| Money lenders = 3 | | Other (Specify) = 7 | |
| Traders (Aratdar) = 4 | | | |

a) Do you get loan from Bank for your agricultural activities/production? Yes=1, No =0

b) If no, why: Lending institution is far (distance) = 1, Lack of guarantees/collateral = 2, Non-cooperation from the financial institutions = 3, Others (specify) = 4

**8. Problems of shifting cultivation faced by farmers:**

| Problems | Rank |
|---|---|
| Lack of quality juvenile | |
| Lack of capital | |
| Lack of technical knowledge and market information | |
| Lack of labor availability | |
| Higher price of inputs | |
| Storage problems | |
| perishability | |
| Rivalry | |
| Price instability | |
| Disease proneness of fish | |
| Lack of desire quality | |

Code: Problems: high=1, moderate=2, low=3

10. Suggestions for shifting land under rice to fish cultivation:

1.

2.

3.

Thank you for your kind co-operation

Date…….. Signature of theinterviewer

**Appendix-II: Variance Inflation Factor (VIF)**

| Variable | VIF |
|---|---|
| Age($x_1$) | 1.33 |
| Primary education($x_2$) | 2.42 |
| Secondary education($x_3$) | 2.87 |
| Spouse education($x_4$) | 1.53 |
| Earning member($x_5$) | 1.34 |
| Occupation($x_6$) | 1.13 |
| Training($x_7$) | 1.33 |
| Societal membership($x_8$) | 1.65 |
| Contact with AEO($x_9$) | 1.88 |
| Farm size($x_{10}$) | 1.28 |
| Distance to AEO($x_{11}$) | 1.46 |
| Perception price of rice($x_{12}$) | 1.24 |
| Access to credit($x_{13}$) | 1.20 |
| Mean VIF | 1.59 |