AN ECONOMICS ANALYSIS OF POND FISH CULTURE IN SOME SELECTED AREAS OF SATKHIRA DISTRICT

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CERTIFICATE

This is to certify that the thesis entitled **"AN ECONOMICS ANALYSIS OF POND FISH CULTURE IN SOME SELECTED AREAS OF SATKHIRA DISTRICT"** submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka-1207, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (M.S.) in AGRICULTURAL STATISTICS** embodies the result of a piece of *bona fide* research work carried out by **MD. SHAMIM HOSSAIN,** Registration No. **12-05219** under my supervision and guidance. No part of this 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

Dhaka, Bangladesh

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DEDICATED TO

My Beloved Parents

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AN ECONOMIC ANALYSIS OF POND FISH CULTURE IN SOME SELECTED AREAS OF SATKHIRA DISTRICT

ABSTRACT

This study was designed to assess the costs, returns and profitability of pond fish farming. A total of 50 pond fish farmers were selected randomly from Chandanpur and Sonabaria union at KalaroaUpazila under Satkhira district. Both tabular and statistical analysis were done to perform the objectives of the study. It was estimated that per hectare gross cost of pond fish production was Tk.2136878.5 in which human labour, fingerlings, feed, fertilizer, insecticide, irrigation, mechanical cost, land use cost and cost on interest on operating capital items represented 1.15, 3.00, 88.00, 0.38, 0.25, 0.26, 0.51, 5.41 and 1.00 percent respectively.While gross return and net return were Tk. 3017973.4 and TK. 881094.9 per hectare respectively. The results of this study helped to know that pond fish production was profitable in the study areas. Cobb-Douglas production function was also applied to identify the specific effects of the factors on pond fish production. Out of seven variables, threevariables human labour,irrigation, fingerlings costare positive and significant impact on pond fish production. The study also helped to realize some problems faced by the fish farmers in producing pond fish. The results suggested that if the problems could be solved, all the selected farmers could earn a much higher profit than the existing level. Finally, as apolicy measures, it may be suggested that pond farmers should be provided with, fingerlings, credit, training and reasonable product price for sustainable development of the enterprise. Some recommendations were made to improve culture and management of pond fish farming.

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LIST OFABBREVIATIONS AND SYMBOLS

>	Greater than
<	Less than
%	Percentage
ANOVA	Analysis of variance
BAU	Bangladesh Agricultural University
BBS	Bangladesh Bureau of Statistics
BFTI	Bangladesh Foreign Trade Institute
cm	Centimeter
PCV	Percent Coefficient of Variation
DF	Degree of freedom
DoF	Department of Fisheries
et. al.	And others
e.g.	exempli gratia (L), for example
etc.	Etcetera
FAO	Food and Agricultural Organization
FRSS	First Response Survey System
GDP	Gross Domestic Product
gm	gram
i.e.	id est (L), that is
JSC	Junioor School Certificate
HSC	Higher Secondary School Certificate
Kg.	Kilogram
LIFDC	Low Income Food Deficit Country
LSD	Least Significant Difference
MT	Metric Ton
SAU	Sher-e-Bangla Agricultural University
SDG	Sustainable Development Goal
SSC	Secondary School Certificate
WHO	World Health Organization
USA	United States of America

CHAPTER 1

INTRODUCTION

The favorable geographic position of Bangladesh comes with a large number of aquatic species and provides plenty of resources to support fisheries potential. Fish is a popular complement to rice in the national diet, giving rise to the adage Maache-Bhate Bangali ("a Bengali is made of fish and rice"). There was a time when natural water bodies of the country were full of fishes and other fisheries items. But situation has changed now and the country's open water losing their resources. Although production from cultivable water bodies was increased to a great extent, still it is under the level of country requirement. The fisheries can broadly be classified into three categories: inland capture fisheries, inland aquaculture and marine fisheries, of which the inland aquaculture sector is contributing more than 55% of the total production. The fisheries sector plays a very important role in the national economy, contributing 3.69% to the Gross Domestic Product (GDP) of the country and 22.60% to the agricultural GDP (FRSS, 2016). Over the last 10 years (2004-2005 to 2013-2014 FY), the fisheries growth was fairly steady and at an average of 5.38% per year (FRSS, 2015). This sector experienced more or less consistent growth rate, ranging from 7.32% growth in 2009-2010 to 4.04% growth in 2013-2014 (Bangladesh Economic Review, 2014). More than 2% of Bangladeshi export value comes from the inland fisheries sector. Given proper government support, the fisheries sector has ample potential in creating various types of ancillary industries in rural areas that often have a high rate of economic return. These employment opportunities for poor rural citizens would also stem their migration to urban areas. Fish supplements about 60% of Bangladeshi people's daily animal protein intake. More than 17 million people including about 1.4 million women depend on fisheries sector for their livelihoods through fishing, farming, fish handling, and processing. A different surveys revealed that more than 80% of laborers engaged in the fish processing industries were women.

Bangladesh has one of the biggest and most active deltas, fed by three mighty rivers: the Padma, the Meghna and the Jamuna. This contributes to a high potential for fresh and brackish water capture and culture fisheries, in addition to the vast marine resources. Inland fisheries production has escalated over the years, but the productivity per hectare water area is not yet attained at its optimum. In recent years, the bulk of the production has been obtained from marine (16.78%) and freshwater (83.22%) wild capture fisheries.

1.1 Fish as a Human Food

Fish is a food of excellent nutritional value, providing high quality protein and a wide variety of vitamins and minerals, including vitamins A and D, phosphorus, magnesium, selenium, and iodine in marine fish. Its protein - like that of meat - is easily digestible and favorably complements dietary protein provided by cereals and legumes that are typically consumed in many developing countries.

Experts agree that, even in small quantities, fish can have a significant positive impact in improving the quality of dietary protein by complementing the essential amino acids that are often present in low quantities in vegetable-based diets. But recent research shows that fish is much more than just an alternative source of animal protein. Fish oils in fatty fish are the richest source of a type of fat that is vital to normal brain development in unborn babies and infants. Without adequate amounts of these fatty acids, normal brain development does not take place. Closely spaced pregnancies, often seen in developing countries, can lead to the depletion of the mother's supply of essential fatty acids, leaving younger siblings deprived of this vital nutrient at a crucial stage in their growth. In general, people in developing countries are much more dependent on fish as part of their daily diets than those living in the developed world.

1.2 Fish and Bangladesh

In the globe, fish provides the best protein food rich in essential macro and micro-nutrient, vitamins and minerals, Fish farming and fishing create working opportunity and income to millions of poor, and trade in fishery products play important role in poverty alleviation and economic growth of nations. The fisheries sector, in Bangladesh, plays a particularly crucial role among poor as a main or additional source of employment, livelihood and income. The sector is the second largest part-time and fulltime employer in rural areas. It provides a crucial source of income and food to Bangladesh, and is second only to agriculture in the overall economy of the country. Bangladesh produced 3.26 million tons of fish during 2011-12 from inland and marine water bodies and aquaculture contributed more than 50% of the total production. Fisheries accounts for 4.4% of Bangladesh GDP, 22.8% of agriculture sector and 2.5%

of total export earnings. It also contributes 60% of the animal protein intake in Bangladesh, and even higher in populations living in the coast.

1.3 Fisheries Sector: Prospects and Potentials

a. National Contribution

Fisheries sector contributed 3.57% to national GDP and 25.30% to the agricultural GDP and 1.5% to foreign exchange earnings by exporting fish and fish products in 2017-18. Fish provides 60% of national animal protein consumption. Fisheries sector also plays an important role in rural employment generation and poverty alleviation.

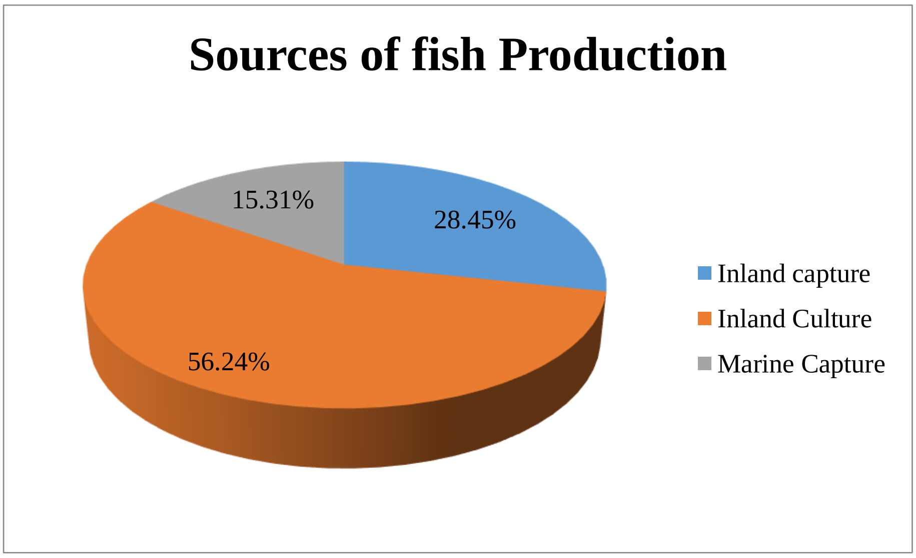
b. Source of Fish Production

There are three categories of major fisheries resources, these are-

i. Inland Capture (28.45%)

ii. Inland Culture (56.24%)

iii. Marine Capture (15.31%)



Source: DoF, 2019-2020

Figure 1.1: Sources of Fish Production

c. Inland Fisheries

Inland fisheries comprises of rivers, ponds, estuaries, beels flood plains, haor,baor brackish water etc. There are 260 fish and 24 prawn species in inland fresh water in the country. In early sixties inland fisheries contributed about 90% of total fish production of the country. Now only about 28.45% of total fish production comes from inland open water.

d. Marine Fisheries

The Bay of Bengal is situated in the South of Bangladesh. There is a total of 166,000 sq. km. water area including Exclusive Economic Zone (EEZ). Fishing is only confined within 200-meter depth. In the year 2017-18 total fish production from Marine source was 6.55 lac MT.

Recently Bangladesh has got the right to access 1.00 lac sq. kilometer water area in Bay of Bengal through International Tribunal for the Law of the Sea (ITLOS) by the visionary and pragmatic leadership of Honorable Prime Minister Sheikh Hasina. DoF has planned to assess the fisheries resources in the Bay of Bengal for maximum sustainable yield. A research vessel is under process of procurement to conduct appropriate stock assessment. Vessel Tracking Monitoring System will also be developed.

Table 1.1 Last 5 Years Fish Production in Bangladesh

Year	**Source-wise production (MT)**			**Total**
	Inland open	Closed	Marine	
2017-2018	1216539	2405415	654687	4276614
2016-2017	1163606	2333352	637476	4134434
2015-2016	1048242	2203554	626528	3878324
2014-2015	1023991	2060408	599846	3684245
2013-2014	995805	1956925	595385	3548115

Source: DoF, 2019-2020

From the table 1.1 it is found that in 2017-18 the total fish production is 42.77 lac Metric Ton (MT). Average annual growth rate of fish production in last 3 years is 5.10%. The Production from closed water bodies is increasing very sharply due to dissemination of adaptive technologies and need-based extension services rendered by DoF.

1.4 Development Activities

a. Annual Development Program

In addition to the normal activities of the DoF several development projects are being implemented aiming at boosting up fish production and conservation of fisheries resources. In 2017-2018 a total of 18, investment projects 15 programs and 3 technical assistance Project has been in implementation. Technical assistance projects are being implemented. Through the development activities habitat restoration, conservation of natural resources, community based resource management, human resource development, and alternate income generating activities etc. is implementing in this sector.

b. Aquaculture Practices

i. Freshwater Aquaculture:
ii. Brackish Water Aquaculture
iii. Fish and shrimp Hatchery

c. Open Water Management

i. Hilsa Fishery Management
ii. Protection of Natural Breeding Ground Halda
iii. Fishers ID card
iv. Integrated Natural Resource Management
v. Fish Habitat Restoration

1.5 Export of Fish & Fish Products

There are100 fish processing plants in the country. Out of 100 plants European Commission has approved 76 plants. HACCP has already been introduced in fish processing establishments. Major importing countries are European countries, USA and Japan. About 98% of total fish products are exported to those countries. Remaining are exported to the countries in Southeast Asia and Middle East.

Table 1.2 Export of Fish and Fish Products

Year	Source-wise production		Other fish products		Total
	Quantity (MT)	Value (Crore Taka)	Quantity (MT)	Value(Crore Taka)	Value (Crore Taka)
20017-2018	36167.77	3527.07	32767.93	782.87	4309.94
2016-2017	39705.85	3682.26	28599.83	605.38	4287.64
2015-2016	40726	3598.67	34612	684.15	4282.82
2014-2015	44278	3937.60	39246	723	4660.60
2013-2014	47635	4118.80	29693	658.12	4776.92

Source: DoF, 2019-202

1.6 Fisheries as a Tool of Population Development

As an agro-based country, the contribution of fisheries to the national economy has always been essential and as the primary source of animal protein, employment opportunities, food security, foreign earnings and socio-economic development (FRSS, 2017). It contributes 3.61% to Bangladesh national GDP and around 24.41% to the agricultural GDP (DoF, 2017). Last ten years of average growth performance of this sector is almost 5.43%. Bangladesh has ranked 3rd in the world in inland fish production, 5th in aquaculture production and 11th in marine fish production in 2018 (FAO, 2018). Bangladesh is now self-sufficient in fish production and has started to get global recognition as one of the biggest fish producers among the countries (FRSS, 2017).

1.7 Justification

The fisheries sector is one of the most productive and dynamic industries which have a tremendous potentiality for future development in the agrarian economy of Bangladesh. Fish is the primary protein source in Bangladeshi diet contributing about 60% of total animal protein while per capita fish consumption in the country reaches 62.58 gm, which is higher than their daily protein demand (60 gm) as per the report of the (BBS, 2017). As an agro-based country, the contribution of fisheries to the national economy has always been essential and as the primary source of animal protein, employment opportunities, food security, foreign earnings and socio-economic development (FRSS, 2017). The entire fisheries sector supports the livelihoods of people more than 18 million in the country directly and indirectly (FRSS, 2017). About 1.4 million women depend on the fisheries sector for their livelihoods through fishing, farming, fish handling & process- sing (BFTI, 2016). This sector also has a high potential for the perspective of the economic development of the country. There is a close connection between agriculture growth and economic development (Mohsin et al., 2015).

1.8 Objectives

Present study was undertaken to accomplish the following specific objectives:

- To identify the socio-economic characteristics of pond fish farmers.
- To identify and estimate the major factors affecting costs, returns and profitability of pond fish farming.
- To identify the major problems and constraints facing the farmers in conducting pond fish farming.

1.9 Outline of the Study

This study consist of 5 distinct chapters. Chapters 1 deals with the introduction of the study. Chapter 2 deals with review of literature. Chapter 3 is concerned with the research methods of the study as well as the analytical techniques used in the study. Result and discussion is presented in chapter 4 and finally a summary of the study, conclusion and policy recommendations and limitations are included in chapter 5.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

The purpose of this chapter is to review the previous research works which are related to the present study. There are a lot of socio-economic studies of fisheries sector, because growth of fisheries sector in Bangladesh is increasing day by day. Different evaluation committees and research organizations in this country encourage all to do research work in this sector. Despite the fact that a large number of studies have been done on pond fish culture. It was found that a few limited numbers of workers conducted in Bangladesh which was particularly related to this research. However, in this chapter only the most common and relevant studies which have been conducted in the recent past are reviewed.

Ataur *et al.* (2020) conducted a survey entitled “Economic analysis of tilapia-carp polyculture in a selected area of Bangladesh”. The study was conducted to identify the socioeconomic characteristics, analyze the tilapia-carp polyculture system, profitability of tilapia-carp polyculture, and credit profile of the stratified randomly selected 50 sample farmers from Sherpur district in Bangladesh. The findings revealed that 36% of the respondents belonged to the age group of 25-29 years, 68% belong to medium family size (5 to 6 people). Average fingerlings released in the tilapia-carp polyculture were 24240 per hectare per year. Most of the fingerlings collected from private hatcheries. The annual per hectare production of tilapia and carp were 8028 kg and 11085 kg., respectively. Per hectare per year gross cost, gross margin, gross return and net return were Tk. 1093008 ($12897), Tk. 759447 ($8961), Tk. 1735455 ($20477) and Tk. 642447 ($7580), respectively. The BCR of tilapia-carp polyculture for cash cost was 1.78 and full cost was 1.59. About 20% of the respondents took loan from different sources and they received 84.51% of their applied amount and 84.73 % of the loan money used in productive purposes. Mortality of fingerlings, the high price of the ingredient, low price of fish, high interest rate and non-availability of good quality fingerlings at proper time were identified to be the major problems in conducting pond fish production.

Yeasmin *et al.* (2019) stated a survey on “Economic analysis of tilapia farming in some selected area of Dinajpur District”. The study was conducted to assess the cost and return from tilapia farming. Fifty homestead aquaculture ponds practicing monoculture and polyculture of tilapia (25 farmers from each category) were selected for this study. Data had been collected through face to face interview by using a structured questionnaire during April to September 2015 from the selected farmers of Dinajpur districts. The results from the survey revealed that both the tilapia monoculture and polyculture farming were profitable. However, the average total cost per hectare per production period was found higher (Tk. 332,712.08) in tilapia monoculture than tilapia culture with carps (Tk. 241,722.34). Moreover, the net margin was also found higher in tilapia monoculture with benefit cost ratio 1.51. Whereas, the benefit cost ratio in polyculture farming was 1.34.

Hossian *et al.* (2018) conducted a survey on the Culture Condition of Pangus (*Pangasius hypophthalmus*) at different farms in Trishal upazila. The study was conducted to investigate existing culture conditions of pangus (*Pangasius hypophthalmus*) at farms in Trishal Upazila under Mymensingh district during January to June, 2016. Data were collected with questionnaire by personal interviewing of the respondents. The study result showed that- the farmers of large category are about 60% where 47% farmers have leased pond. Most of the farmer use deep tube-well water as source, 87% farmers practice monoculture of pangus and monitored the health of fish in a regular basis. Only 13% farmer reported diseases occurred in their pond. Most of the pangus farmers used homemade or local farm made supplementary feeds for pangus culture. The study showed that development of better farming system, improving water management, stocking of quality fingerlings, health monitoring and use of prime and standard quality feed has resulted better pangus production in Trishal area.

Islam (2018) conducted a study with a view to finding out the carp's polyculture technique, pond management and cost analysis of Kaliganj upazila under Lalmonirhat District. The study was conducted for a period of six months (September 2017 to February 2018). It provides an overview on the guiding principles, aspects and tasks, and presents the applicable production techniques and patterns of carp polyculture. For further reading and more in-depth information on the suggested techniques and technologies. It is expected that this publication will help identify resources and contribute to the successful planning and realization of fish production by those fish pond owners and operators who need to strengthen and improve their knowledge on the subject.

Mondal *et al.* (2018) examined a study entitled “Present status, problems and prospect of fish farming at Gazipur Sadar upazila in Bangladesh” The study was conducted to reveal the present scenario, problems and the prospect of fish farming of Gazipur Sadar upazila Bangladesh. The primary data were collected through field survey, questionnaire interview and focus group discussion from the fish farmers of several villages and urban areas of the upazila. Secondary data were collected from the Department of Fisheries and aquaculture extension section. Gazipur Sadar upazila has 14462.42 ha potential fisheries resources of which floodplains, seasonal water bodies, and ponds comprise 71.01%, 13.04%, and 8.57%, respectively. The total fish production of the upazila in 2016-17 was 14492.7 MT, 27% of the Gazipur district. The highest fish production of 5436 MT and 4.39 MT/ha/year came from the pond sector. Among different pond culture systems, the semi-intensive system had the highest fish production output (2826 MT). Exotic carps were the highest produced fish in the ponds. However, in spite of comprising a huge proportion of seasonal floodplains the fish production from this sector was only 0.42 MT/ha/year in 2016-2017. This indicates the poor utilization of inland open water resources for fish production in the study area. The major areas were identified to improve the existing pond fish farming situation were access to low-interest loan, quality seed, and supply of advanced technologies, need-based training, and marketing facilities. Along with improving the pond fish farming, community-based fisheries management and some aquaculture initiatives on private own seasonal floodplains should be taken on a priority basis to improve open water management and to flourish inland fish production in the study area.

Hasan *et al.* (2016) examined a study on “Comparison of Production Performance and Economics of Different Carp Polyculture Systems”. The study was conducted to evaluate the comparison of production performance and economics of different carp polyculture systems in Gangni Upazila under Meherpur district from July to November 2015. Primary data collection and secondary information were used to assess the performances in aquaculture activities. From the survey, it was found that 14 (35.0 %) of the farmers applied supplementary/homemade feed prepared with rice bran and mustard oil cake, 17 (43.0 %) farmers used commercial feed and 9(22.0 %) farmers were depended on natural feed. Average fish production of the farmers was 6274 kg per ha per year. The calculated highest fish production 7,904 kg per ha per year and net income was BDT 2,42,060 per ha per year respectively in carp-tilapia polyculture system. The lowest fish production was 5,187 kg ha-1 yr-1 and net income was BDT 1, 66,478 came in carp-koi polyculture system. From the result of present study, it is clear that fish production and financial benefit in carp-tilapia polyculture were higher than others. The present findings reveal that carp-tilapia polyculture system is more suitable and profitable culture system than other polyculture systems existing in Gangni upazila of Meherpur district.

Masum (2013) conducted a study to identify the farmer's knowledge and practice on pond fish farming. The major purpose of this research study was to determine farmers' knowledge and practice of pond fish culture and also to explore the relationships between 10 characteristics of the pond farmers and their knowledge and practice of pond fish culture. The study was conducted in 4 villages of Kaijuri union of Faridpur district. The populations of pond farmers in these villages were 253, from where 101 samples were drawn by using random sampling technique. An interview schedule was used for data collection. The majority 44.6 percent of the pond farmers' possessed medium knowledge, 25.7 percent of the pond owners possessed high knowledge and only 16.8 percent of the pond owners had low knowledge and 12.9 percent of the farmers possessed very high knowledge. About 61.4 percent of the pond farmers had medium practice, while 27.7 percent farmers had low practice and only 10.9 percent farmers had high practice. Age, pond size, commercialization and training exposure of the pond farmers had positive significant relationship with farmers' knowledge on pond fish farming, while problem faced had negative relationship. In case of farmers' practice pond size, commercialization and training exposure had positive significant relationship and problem faced had negative relationship. The pond owners faced such major problems as: proper marketing facilities, poor communication system, natural calamities, and shortage of pond water in dry season, insufficient credit and low price of pond fish in pick period.

Rahman *et al.* (2015) conducted a survey to examine the cost, returns, profitability of pond fish farm, requirements, adequacy, sources and utilization patterns of credit and problems associated with pond fish farming in Madhupur Upazila of Tangail district. A total of 60 farmers with small traditional types of ponds were randomly selected for this study. Both description and econometric analysis were used. Human labour was the most important and one of the largest inputs used for pond fish production. The average per acre human labour cost, fingerlings cost, feed cost, chemical fertilizers cost, manure cost, and lime cost were Tk. 9345, Tk. 18506, Tk.10476, Tk.3759, Tk. 329, and Tk.1605, respectively. Pond rental value was calculated at Tk. 11537 per acre for one year which shared 26.42 percent of total costs of pond fish production. Gross return was Tk. 70928 per acre. Gross margin and net return of the pond fish farm were Tk.38118 and Tk. 24081 per acre respectively. The BCR was 1.514. Out of 60 farmers, only 11 farmers received loans from different sources and 86.67 percent of applied amount received. About 83 percent of the loan used for operating expenditure of farming and rest 17 percent loan used for non-farm expenditure. There were some problems in fish farming, such as insufficient water, high feed cost etc. Government needs to provide subsidized feed, technical supports and credit facilities for the small scale fish farmers.

Alam (2005) conducted a study to measure the productivity, profitability and efficiency of producing fish in Bangladesh. Two regions, Satkhira and Jashore were selected purposively. From each of the selected regions 60 farmers and 30 retailers were randomly selected for the study. Farmer of Satkhira region produced significantly higher output (21942.41 kg) per hectare than those of Jashore region (12735.5 kg). Net returns (full cost basis) per hectare for producing fish in Satkhira and Jashore regions were tk. 245219.12 and tk. 187014.90 respectively. The benefit cost ratios (full cost basis) showed that production of fish was profitable for both regions with BCR being 1.49 and 1.27 in Satkhira and Jashore region respectively.

Ahmed (2003) conducted a study mainly to assess the different practices and to determine the relative profitability of fish production in Mymensingh district. He observed that average stoking density of carp fingerlings to e 9537-10445 ha per year. Average fish production cost was estimated Tk. 23210 to Tk. 24790 per hectare while the net return was fond to be Tk. 59119 to Tk. 56484 per hectare per year. He stated that carp polyculture was profitable.

Faruque (2003) carried out of study titled “A comparative economic analysis of carp and pangus culture in some selected area of Satkhira district” and found that average per hectare total cost of carp culture for all farms was Tk. 95908 while gross income and net return per hectare were Tk. 281215 and Tk. 185307 respectively. On the other hand, corresponding figures for pangus culture were Tk. 668722 Tk. 1021300 and Tk. 352578 respectively. It was observed that pangus culture was highly profitable and its net return was about times higher than that of carp culture.

Roy (2003) conducted a study mainly to understand the dynamics on pond fishery and to determine the costs and returns of pond fish culture and explore the backward and forward linkages of pond fish culture in two upazillas of Mymensingh district. The study showed that the pond fish and hatchery production was highly profitable business.

Biswas (2001) conducted a study on "An economic analysis of pond fish culture of BRAC in some selected areas of Mymensingh district". This study revealed that per hectare per year total cost of pond fish production was Tk. 59814 where artificial feed cost was largest cost and it contributed 30.44% of total cost. Net return was observed as Tk. 855110 for all location.

2.2 Research Gap

The above mentioned review and discussion are certainly relevant to the objectives and methodologies of the present study. Most of the studies dealt with the profitability and productivity of pond fish culture. Some studies are related with technical efficiency of carp culture farming. It was very useful to reconstruct the methodological issues to overcome the limitations of previous studies. From the study the economic analysis and profitability of pond fish culture in Satkhira district of Bangladesh with the recent development context will help the policy makers to understand the current situation and take decision for pond culture. In the contrast, the findings of the study would provide recent updated information of Satkhira District which would help the policy makers as well as researcher for further study.

CHAPTER 3

METHODOLOGY OF THE STUDY

3.1 Introduction

In scientific research appropriate methodology is very important aspect. Without using proper methodology one does not get ethical results. According to the nature of research, availability of times and fund, the survey method was selected because it is less expensive and required less time above all this method is very simple and easy. But some short comings are also here. In this method, the main short coming is that the investigation has to depend on the memory of the respondents. The method of collecting data has undertaken depending on the nature, aims and objectives of the study. There are various types of methods of collecting inevitable data and information. The current study was based on field survey where primary data were taken from the respondents. To perform the current study the following steps were followed.

3.2 Selection of the Study Area

Selection of the study is an important step for pond fish culture study. To collect information for pond for pond fish culture study the area is selected to serve the purpose to set the study. Two villages from Satkhira district under Kalaroa upazilla namely Hizaldi and Sultanpur were randomly selected for the study. The selection of the village area were for the following reasons-

i. Small scale pond fish farmers was heavy concentration
ii. Identical characteristics like topography, soil and climate condition are same in these village for producing pond fish culture
iii. Commercial and semi-commercial fish farming's were available in these area
iv. Expectation of high co-operation from the farmers
v. Good communication facilities with the farmer

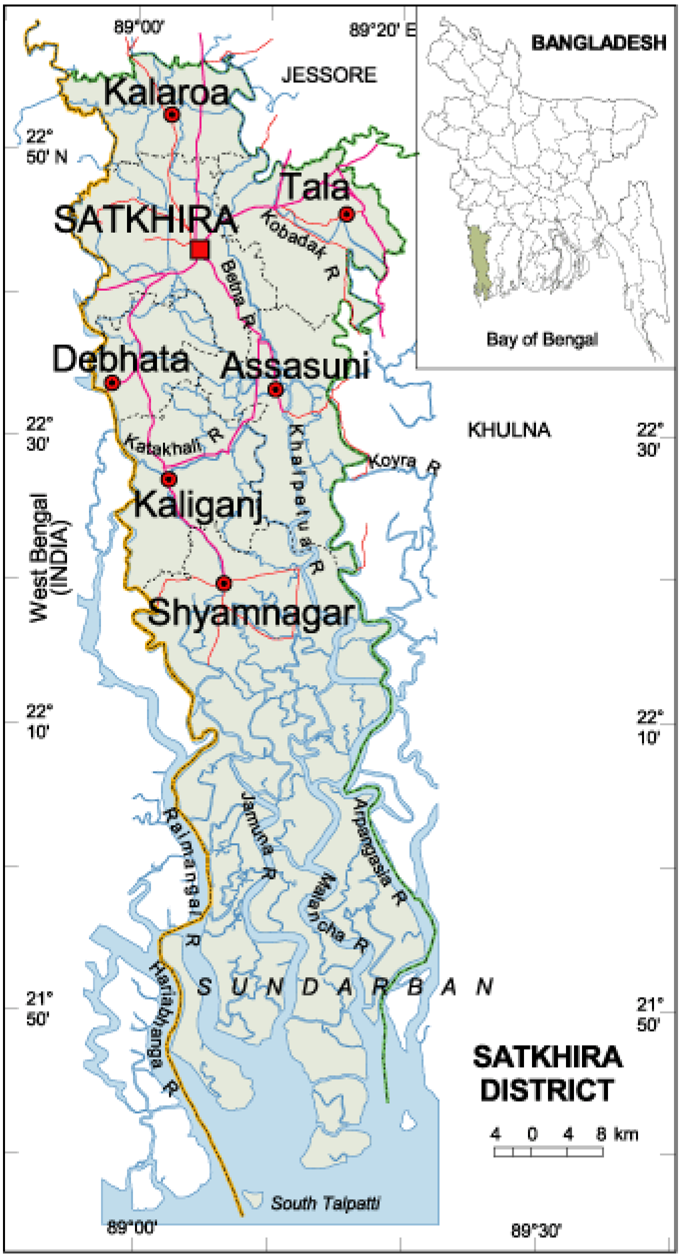


Figure 3.1 A Map of Satkhira District Showing the Study Area

3.3 Preparation of the Interview Schedule

The survey schedule was conducted by keeping in view the targets of the study which was to collect the expected primary data from the pond fish farmers. At first, draft schedule was prepared and pretested with a few farmers and draft schedule was improved, rearranged and modified in the light of the practical examinations. A final interview schedule was developed after pre-testing and necessary adjustment.

After all necessary reconciliation a final schedule was progressed in logical sequence of the following aspects of the information:

i. Socio demographic profile of pond fish farmers.
ii. Production practices and inputs use cost and returns.
iii. Factors intensity and returns.
iv. Expenses including labor supplies, stocking fingerlings etc.
v. Artificial feeding and fertilizer.
vi. Problems and constraints of pond fish farming and other related issues.

3.4 Sampling Techniques

The collection of required information for a research study from each and every elements of population become costly and time consuming. So the determination of sample size was one of the crucial issues for the study. A reasonable size was of sample to attain the objectives of the study was recommended. A sample of representative farms is therefore taken in such a way that the information meets the purpose of the study. As the population is not so large and considering the limited time, efforts and fund a sample of 50 were randomly selected.

Plate 1: Commercial Fish Culture Pond

3.5 Period of Data Collection

The data and information were collected in respect of operation and activities included pond fish farming. First-hand information were collected from the study areas during February-March, 2020.

3.6 Categories of Farm Household Selection

Three categories of farmers were selected for this study:

i. Small farmers: Holding less than 1 hectare (below 2.47 acres)
ii. Medium farmers: Holding area between 1 hectare to 3 hectare (2.47 to 7.49 acres)
iii. Large farmers: Holding area above 3 hectare (above 7.49 acres)

For pond fish farming, 47 small farmers 2 medium farmers and 1 large farmers from Kalaroa upazilla under Satkhira district were selected randomly. The sample design and distribution of sample farmers are shown in table 3.1

Table 3.1 Sampling Design and Distribution of Sample Farmers

Categories of farmers	Pond fish farmers
Small farmers	47
Medium farmers	2
Large farmers	1
All farmers	50

Sources: Field survey, 2020

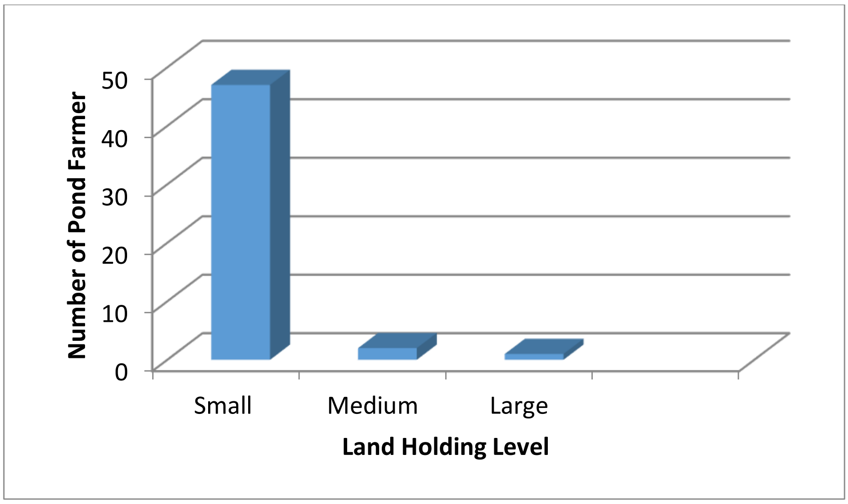


Figure 3.2: Number of Fish Farmer Based on Land Holding Area

3.7 Collection of Data

The collection data and related information was taken by the researcher through direct interview from the targeted fish farmers. It is not an easy task to collect precise and authentic data from the field. The researcher's intelligence is an important factor in this case. As most of the cases the farmers did not keep any written record of their fish farming, so researcher had to depend on the memory of the respondents. The researcher applied all necessary efforts to confirm the collection of reasonably authentic information from the field.

Plate 2: Feeding of Fish in Commercial Fish Culture Pond

The selected farmers were interviewed personally when the respondents were not so much busy with their farming business. During the interview, at first each farmers given a brief discussion about the nature and purpose of the study. Then question were asked systematically in a very simple and easy manner with explanation when it was felt necessary and the answer was were recorded on the schedules. After completion of each interview the schedule were checked and verified to be ensure that the reply of the respondent was perfectly recorded. In case of any inconsistency of data the respondent were again interviewed for authentic answers. In order to lessen errors, data were taken in local units.

3.8 Processing, Tabulation and Analysis of data

The primary data which was collected from the study area were digest and survey carefully the before actual catalog was done. The processed data was transferred to a M.S. Excel sheet. After performing the pre-tabulation function, real tabulation work was started. A list of catalog were assembled on the basis of the aims and targets of the study. Finally, tabulated data were examined and condensed by using average, percentage and ratio to obtain the results.

3.9 Analytical Techniques

Mainly two types of techniques were used in this study:

i. Tabular analysis and
ii. Functional analysis

Tabular analysis

Most of the data are presented in a tabular form. This structure of data is simple in computation, widely used and easy to understand. Some statistical calculations like average, percentage and ratios were estimated as these were simple to understand and easy to estimation. This analysis also includes socio-demographic characteristics of sample farmers, production practices and input use, costs and return of pond fish culture.

Per hectare profitability of pond fish production from the view point of individual farmers was estimated in terms of gross return, gross margin, net return and benefit cost ratio (undiscounted).

Gross return

Gross return was calculated by multiplying the total volume of output of an enterprise by the average price in the harvesting seasons (Dillon and Hardaker, 1993). To estimate GR, following equation was used.

$GR_i = \sum_{i=1}^{n} Qi\ Pi$

Where,

GR_i= Gross return from i^{th} product (Tk/ha);

Q_i= Quantity of the i^{th} product (kg/ha);

P_i= Average price of the i^{th} product (Tk/kg);

i= 1, 2,3,…………,n.

Gross margin

Gross margin has given a calculation of the difference between total return and variable costs.

That is,

GM = TR-VC

Where,

GM = Gross margin

TR = Total return

VC = Variable cost

Net return

Net return analysis considered fixed costs, cost of land rent, interest on operating capital etc. Net return was estimated by deducting all cost (variable and fixed) from gross return. To determine the net return of pond fish culture the following equation was used in the study:

$\Pi = P_y Y - \sum_{i=1}^{n} PxiXi - TFC$

Where,

Π= Net return (Tk/kg);

P_y= per unit price of the product (Tk/kg)

Y= Quantity of the production per hectare (kg)

P_{xi}= per unit price of i^{th} inputs per hectare (kg)

X_i= Quantity of the i^{th} inputs per hectare (kg)

TFC= Total fixed cost (Tk)

i=1, 2, 3,…………, n.(number of inputs)

Cost and return analysis were done based on both variable and total cost basis in the study. A simple tabular analysis was calculated to get the objectives of the study. To assess the profitability of the pond fish production the following profit equation was developed:

$$\Pi = \text{Gross return} - (\text{Variable cost} + \text{Fixed cost})$$

Here, π= Profit per hectare

Gross return = Total production ×per unit price

Variable cost include:

i. Cost of human labour
ii. Cost of fertilizer
iii. Cost of fingerlings
iv. Cost of feed
v. Cost of irrigation
vi. Cost of insecticide
vii. Cost of mechanical power

Fixed cost includes:

i. Land use cost, and
ii. Interest on operating capital.

Benefit Cost Ratio (BCR)

The BCR (Benefit Cost Ratio) is a relative measure, which is used to compare benefit per unit of cost. The BCR is calculated as a ratio of gross returns and gross costs. The formula for calculation BCR (undiscounted) is given below:

$$\text{Benefit cost ratio} = \frac{Gross\ benefit}{Gross\ cost}$$

Functional analysis

Functional analysis was implemented to identify the individual effect of input use and other related factors of pond fish culture with the help of Cobb-Douglas production function model. The model was used in the following form:

$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} e^{n}$

Cobb-Douglas production function can be estimated in the alternative form by using OLS (Ordinary Least Square) method, in a log linear form.

$\text{Ln } Y = \ln a + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + b_5 \ln x_5 + b_6 \ln x + b_7 \ln x_7 + U_i$

Where,

Y= Gross return, Tk/ha

X_1= Human labour cost, Tk/ha

X_2= Fingerlings cost, Tk/ha

X_3= Feed cost, Tk/ha

X_4= Fertilizer cost, Tk/ha

X_5= Insectiside cost, Tk/ha

X_6= Mechanical cost, Tk/ha

X_7=Irrigation cost, Tk/ha

ln= Natural logarithm

U_i= Disturbance term

a= intercept

b_i= Co-efficient of the relevant variables

CHAPTER 4

RESULT AND DISCUSSION

4.1 Socio-Economic Characteristics

4.1.1 Introduction

Production pattern and technology use are affected by socioeconomic characteristics of fish farmers. To provide a more accurate picture of pond fish culture, to know the socioeconomic characteristics of a fish farmers is very much essential. In this chapter, an attempt was taken to identify the socioeconomic characteristics, family size, educational level, occupational status, land utilization pattern and indebtedness of selected sample farmers of the study area.

4.1.2 Age Distribution of Pond Area

In this study the pond fish farmers were classified into three categories according to their age groups. Such as 20-40 year, 41-60 year and above 60 years. Table 4.1 is presented as the age classification of sample pond fish farmers. About 68 percent fish farmers belonged to the age group of 20-40 out of total pond owners. Out of the total pond owners 30 percent of fish owners were age of 41-60 year. About 2 percent of fish pond farmers fell into the age group of above 60.This information implies that more than half of the sample farmers were in active age of 20-40 years, indicating that they provided more physical efforts for pond fish culturing.

Table 4.1.1 Age Distribution of Sample Farmers

Age groups (years)	No	Percent (%)
20-40	34	68
41-60	15	30
Above 60	1	2
Total	50	100

Sources: Field survey 2020

4.1.3 Family Size of the Sample Farmers

A family size has been defined as the total number of persons of either sex living together and having meals from the same kitchen under the administration of a single head of the family. The farm family includes husband, wife, sons, unmarried daughters, parents, brothers, etc.

Table 4.1.2 Average Family Size of the Sample Farmers According to Sex

Sex	Pond fish producers	
	No	%
Male	2.83	52.61
Female	2.55	47.39
Total	5.38	100

Sources: Field survey 2020

4.1.4 Level of Education Distribution of Respondents According to Literacy

The literacy level is generally considered as an index of social advancement of the community. From the literacy point of view, fish farmers were classified into five groups, i.e., illiterate, primary level, secondary level, higher secondary level and graduate level. As this is the age of science, various types of fish culture is based on scientific method so every pond fish farmer will have some educational background to have some knowledge on improved fish culture technique.

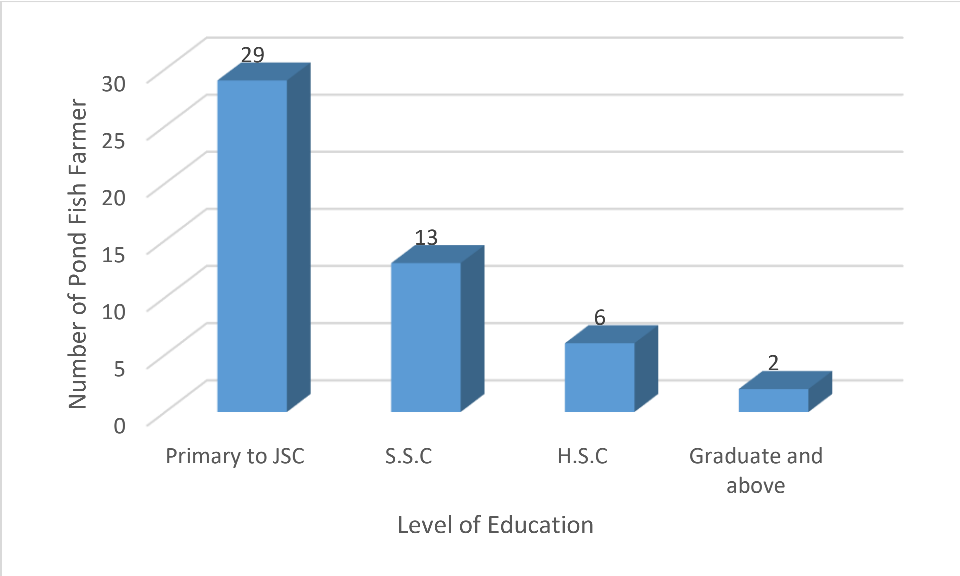


Figure: 4.1 Educational Status of Sample Respondents

4.1.5 Educational Status of Family Members

The level of education of pond fish farmer's family members is shown in the table 4.4. The table revealed that about 7 percent of the family members were illiterate, 47 percent a major part of the family members completed only Junior School Certificate, among them 25 percent completed Secondary School Certificate, Higher Secondary School Certificate completing members were only 16 percent and only 5 percent family members completed graduation level.

Table 4.1.3 Educational Status of Family Members

Level of education	**No. of family members**	**%**
Illiterate	17	7
Primary to JSC	107	47
S.S.C	58	25
H.S.C	36	16
Graduate and above	12	5
Total	230	100

Sources: Field survey 2020

4.1.6 Occupation of the Pond Fish Farmers

Occupation is the important aspect among the socioeconomic characteristics of the respondents. The pond fish possessors were involved in various types of livelihood.

The main occupation of farm family considered in the present study was the occupation from which most of the income was earned. The occupations of fish pond owners are presented in Table 4.5.

Table 4.1.4 Distribution of Sample Pond Fish Farmers by Types of Occupations

Occupations	No.	Percent (%)
	Main	
Agriculture	7	14
Fish farming	39	78
Business	3	6
Service	1	2
All groups	50	100
	Subsidiary	
Agriculture	35	70
Fish farming	11	22
Business	4	8
Service	-	
All groups	50	100

Sources: Field survey, 2020

4.1.7 Land Holding and Utilization Pattern

In this present survey, total land holding was defined as the sum total of all types of cultivable land possessed by the individual owners of fish farms and having legal rights on it. Therefore, the respective farm size in the survey area was measured by using the following formula.

Farm Size = Homestead (including garden) area + Pond + Own land + Rented in + Mortgaged in – (Rented out + Mortgage out).

Table 4.1.5 Average Land Distribution of Sample Farmers

Utilization of land	Pond fish farmers	
	Area in ha	**%**
Homestead area	.40	11
Own cultivable land	1.20	31
Lease in	1.10	29
Lease out	1.00	27
Mortgage in	.07	2
Total	1.77	100

Sources: Field survey, 2020

Distribution of Sample Ponds According to Size

Pond size may vary in different locations on the basis of physical and socioeconomic conditions. A suitable pond size is required to minimize the production cost and maximize the production. The Figure 4.2 shows the distribution of areas the majority of pond sizes were in 0.2 to 0.3 hectare.

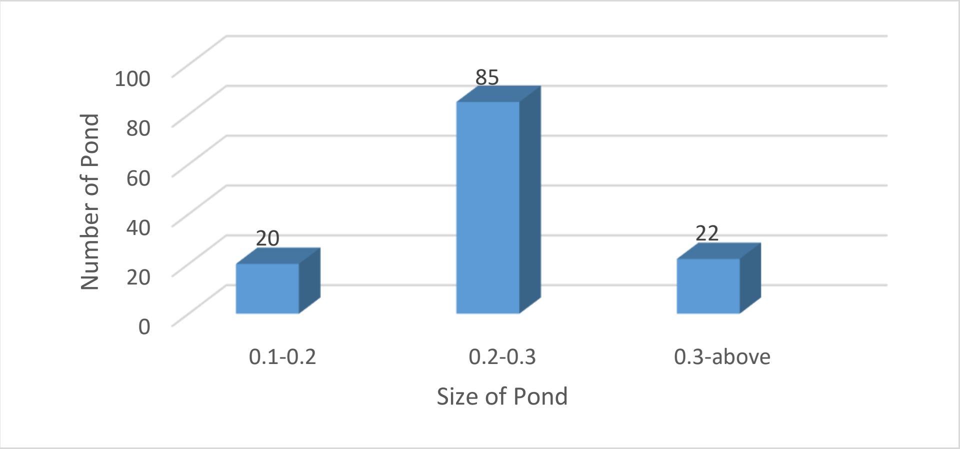


Figure 4.2 Distribution of Sample Ponds According to Size

Indebtedness of producers

From the survey, it is found that most of the fish farmers borrowed money from banks. Table 4.8 indicates the indebtedness of fish farmers on the basis of borrowed amount. Money borrowed from different sources was divided into five categories such as Tk. 5000 to Tk. 15000, Tk. 15001 to Tk. 25000, Tk. 25001 to Tk. 35000, Tk. 35001 to Tk. 50000 and above Tk. 50000.

Table 4.1.6 Indebtedness of Sample Farmers According to Amount of Borrowing

Amount borrowed	No	Percent (%)
15001-25000	2	4
25001-35000	8	16
35001-50000	11	22
50001-above	18	36
Not indebted	11	22
Total	50	100

Sources: Field survey, 2020

4.2 Estimation of Costs for Using Inputs in Pond Fish Farming

Introduction

Pond fish farmers in the survey area did not keep any written records of costs and returns of fish culture. However, it is assumed that they possess a sharp memory and can estimate everything in concentration with their farm business. The aim of this chapter is to determine costs, returns and profitability of fish production. All these costs and returns were estimated for duration of one year of the fish farms.

Estimation of costs and returns

Cost and returns were calculated from farmer's point of view. Costs were calculated for all the family supplied and purchased inputs used in producing pond fish. The market prices of inputs and output were used. The cost of pond fish production included the costs of human labor and material input (feed, fertilizer, manure and fingerlings), land use cost and cost on operating capital. The items have been described below:

Cost of fingerlings

Per unit price of fingerlings depends on their sizes s well as the concerned fish species. The stocking rate of fingerlings varies with the fertility of pond. Pond fish farmers in the study area used purchased fingerlings and the cost was calculated on the basis of farm-gate price. The selected species of fingerlings were Rui, Catla, Mrigal, karfu, Silver carp, Grass carp, Mirror carp, Shrimp, Chetol, Tilapia, Pangus, Kalabous and Sharpunti used for fish culture. The average unit price of fingerlings was 2.14 Tk. /piece. The purchasing cost of fingerlings per ha for pond fish production was Tk. 63217.

Table 4.2.1 Per Hectare Cost of Fingerlings for Fish Production

Cost item	Quantity of fingerlings	Price/piece	Total cost
Fingerlings	29540.7	2.14	63217

Sources: Field survey, 2020

Cost of human labour

Human labour was required in different operations and managements, such as reconstruction, feed application, fertilizer application, compost making and its application, application of cow dung, Stocking of fingerlings, making feeding ring, weeding and fish harvesting and marketing. Both family and hired labour were used in the pond fish culture. Family labour included the farm operator himself/ herself and other members of his family i.e., brothers and children etc. Labour was measured in terms of man-day which usually consisted of 8 hours. For women and children, man equivalent hours were estimated. This was computed by converting all women and children hours into man-equivalent hours assuming 1 adult male =1.5 women =2 children. The average human labour cost per ha was Tk. 23576.

Table 4.2.2 Distribution of Human Labour Cost per Hectare per Year by Operations

Cost items	Total labor (man-days)	Cost (Tk.)	% of total cost
Cleaning and pond preparation	51	10200	43
Feed and fertilizer application	26	5200	22
Security	3	600	3
Chemical Application	6	1200	5
Fish harvesting and marketing	32	6376	27
Total	118	23576	100

Sources: Field survey, 2020

From the Table 4.2.1 it can be said that total cost of human labour for pond fish production was Tk. 23576 per hectare per year in which cleaning and pond preparation, feed and fertilizer application, security, chemical application, fish harvesting and marketing represented 43, 22, 3, 5 and 27 percent of the costs, respectively. That indicates most of the labour costs were included in cleaning and pond preparation, fish harvesting and marketing and feed and fertilizer application.

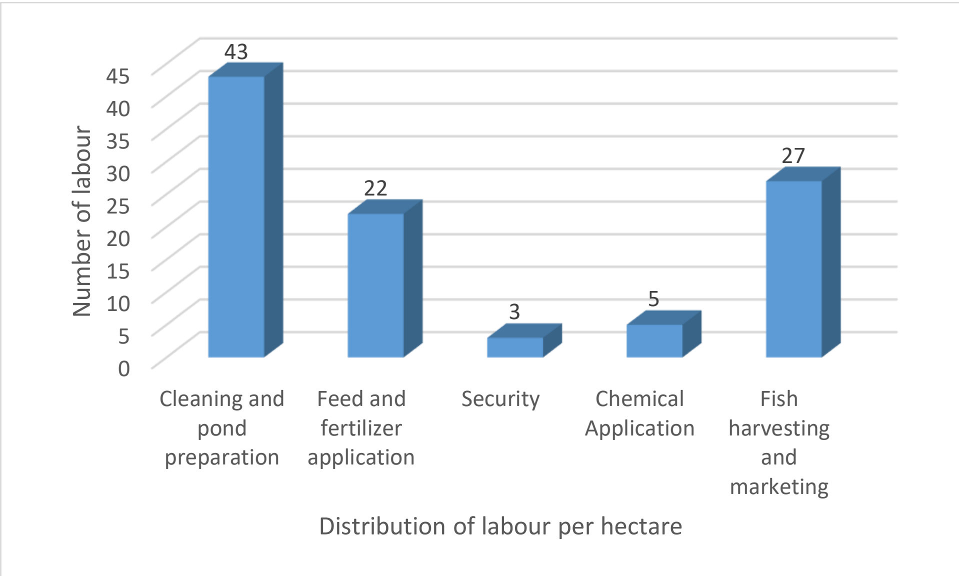


Figure 4.3: Cost of Labour on Different Items

Cost of feed

It was found that almost all the farmers applied supplementary feed such as both rice-bran and oil-cake. It varied according to the intensity of cultivation. Farmers normally do not use pellet feed because it is costly and not available. In the study area, farmers applied rice bran 37595 kg per ha and oil cake 2045 kg per acre. Rice bran costs Tk. 1766967 per ha and oil-cake costs Tk. 112475 per ha. The average feed cost per acre was Tk.1879442

Cost of fertilizer

Fertilizer was generally used in the fishpond to create condition, which facilitates an increase in production of good quality natural fish feed, thereby increasing fish production. Farmers used three kinds of chemical fertilizers namely, Urea, Triple super phosphate (TSP) and Manure in the study area. The cost of fertilizer was charged at the prevailing market rate in the study area during pond fish culture season. Farmers applied Urea 371 kg per ha and TSP 169 kg per ha. Urea and TSP costs were Tk. 5194 and Tk. 3383 per ha, respectively. The average fertilizer cost per ha was Tk.8577.6. Manure was important for fish production. It was observed that, farmers used cow-dung in fish ponds as manure in the study area. Cow-dung was home supplied and purchased. The cost of cow-dung was calculated Tk.0.50/kg. It observed that farmers used 657 kg manure per ha per year. So, the average cost of manure per ha was Tk. 329. Lime application was an important factor for pond fish pond production. Lime was used mainly to neutralize acidity in the soil and water of pond. Lime assists in release of nutrient from the soil and promotes the bacterial breakdown of water material including green manure. The average quantity of lime used by fish farmers was 247 kg/ha per year. Average cost incurred for lime was Tk.4199.

Cost of insecticide

In this survey it is found that fish farmers in the study area used only cow dung as a manure for cultivating fish. Average cost incurred for cow dung was Tk. 1215.

Mechanical cost

In the survey it is found that shallow tube well was used for irrigation in the water bodies during the dry season. Shallow tube well was also used for safety of ponds. Average cost of watering and mechanical cost of fish ponds was amounted Tk. 10092.

Cost of irrigation

Irrigation is another variables that was used in dry season. In the survey area it was found that average cost of irrigation was Tk. 6010 per hectare per year.

Other costs

The average other cost of pond fish cultivation was amounted Tk. 3500 per hectare per year.

Table 4.2.3 Per Acre Material Inputs Costs for Fish Farmers

Items of cost	Quantity	Price/Kg	Total cost	% of total cost
Rice bran	37595	47	1766967	93
Oil cake	2045	55	112475	6
Urea	371	14	5194	.26
TSP	169	20	3380	.17
Insecticide	-	-	1215	.06
Irrigation	-	-	6010	.30
Lime	247	17	4199	.21
Total			**1899440**	**100**

Sources: Field survey, 2020

Land use cost

Lease value of pond was consisted as land use cost. It was calculated at the rate of prevailing cash rental value of per ha pond land in the study area. Pond rental value was calculated at Tk. 120012 per ha for one year which shared 5.41 percent of total costs of pond fish production. This was treated as fixed cost in this study.

Cost on operating capital (IOC)

Interest on operating capital was calculated by taking into account the costs incurred on all field operations but excluding those items for those interest was already been calculated. On an average, the cost was estimated at Tk. 17035. It constituted 1 percent of gross costs (Table 4.2.3)

Table 4.2.4 Average Gross Cost of Producing Pond Fish

Cost items	Cost (Tk./ha)	%(percent)
Variables cost		
Human labour	23576	1.15
Fingerlings	63217	3
Feed	1879442	88
Fertilizer	8577	0.38
Insecticide	5414	0.25
Irrigation	6010	0.26
Mechanical	10092	0.51
Other cost	3503	0.02
Fixed cost		
Land	120012	5.41
Interest on operating cost	17035	1
Total	2136878	100

Sources: Field survey, 2020

4.2.1 Gross Cost of Pond Fish Production

Gross cost is the total cost calculated by sum of total variable cost and total fixed costs. Variable cost involves human labour cost, fingerlings cost, feed cost, mechanical cost, irrigation cost, fertilizer cost and cost of insecticide. Fixed cost involves land use cost and cost of interest on operating capital. Per hectare per year cost of pond fish production was estimated on the basis of gross costs. From the Table 4.2.4 indicates that total cost was Tk. 2136878 per hectare in which human labour, fingerlings, feed, fertilizer, insecticide, irrigation, mechanical cost, land use cost and cost on interest on operating capital items represented 1.15, 3, 88, 0.38, 0.25, 0.26, 0.51, 5.41 and 1 percent respectively. From this figure it is observed that feed cost shared a major part of the total cost.

Table 4.2.5 Average Return from Pond Fish Production per Hectare per Year

Yield	Quantity(kg)	Price/kg	Value (Tk.)	% (percentage)
Gift and consumption	225	106.7	24007	1
Sale	28060	106.7	2993966	99
Total	28285	-	3017973	100

Sources: Field survey, 2020

Gross return

Gross return was the value of fish produced in money terms. This was calculated by multiplying the total amount of production by their respective market prices. Gross return from pond fish production was estimated at Tk. 3017973 (Table 4.2.4)

Gross margin

Producers generally want to gain maximum return over variable cost of production. Gross margin was the difference between the gross return and total variable cost. The gross margin of pond fish production was estimated at Tk. 1018142 from (Table 4.2.5)

Net return

Per acre net returns from pond fish production was calculated by deducting gross costs from gross returns. It can be noted from (Table 4.2.5) that per acre net return was Tk.881095.

Table 4.2.6 Per Hectare Costs and Economic Returns of Producing Pond Fish

Particulars	Cost and Economic Returns (Tk./ha)
Yield(Y) kg.	28285
Gross return(GR) Tk.	3017973
Total variable cost (TVC) Tk.	1999831
Total fixed cost (TFC) Tk.	137047
Total cost/ Gross cost, TC=(TVC+TFC) Tk.	2136878
Gross margin GM= (GR-TVC) Tk.	1018142
Net return, NR=(GR-TC) Tk.	881095
Return over per taka investment (NR/TC)	.412
BCR(GR/TC)	1.412

Sources: Field survey, 2020

Return over per taka investment

Net return per taka invested was the ratio between net return and total cost. Table 5.5 shows that net return per taka investment in pond fish farming was 0.412. It means that by spending Tk.100 net return of Tk. 41 was obtained.

Benefit cost ratio (BCR)

Benefit cost ratio for pond fish culture was determined as ratio of gross return to gross cost. Table 4.2.6 reveals that benefit cost ratio (undiscounted) of pond fish farming was 1.412 indicating that production of pond fish was profitable. The finding justifies that benefit cost ratio was higher than one, Suggesting that there was a potential for pond development in study area. Requirements, adequacy, sources and utilization patterns of credit. The farmers of Satkhira district are not so solvent. Although they do not want to take loan easily, they somehow try to manage continue farming without taking loan.

4.3 Factors Affecting Costs, Returns and Profitability

4.3.1 Introduction

The focus of the recent chapter is to relate main factors affecting costs and returns of pond fish production in the form of tabular and functional analysis. Cobb-Douglas production function was applied to determine the effects of resources used on gross returns of pond fish production.

4.3.2 Factors Affecting Gross Returns

In this survey, there were many factors engaged in producing pond fish namely fingerlings, feed, fertilizer, manure, lime and human labour. The effects of these factors on gross costs and gross returns have been analyzed in this section. The above mentioned factors were considered as a priori explanatory variables which were responsible for pond fish production.

4.3.3 Discussion of the Result from the Model

The parameter calculates of the production function for pond fish production are presented in Table 4.3.1

Principal characteristics of the model are given below:

i. F-values were used to measure the goodness of fit for different types of inputs
ii. The co-efficient of multiple determination testified that the total variations of output expressed by the independent variables encircled in the model.
iii. Co-efficient having sufficient degrees of freedom was tested for significance level at 1 percent and 10 percent levels.
iv. Steps of production were estimated by returns to scale which was the total of all the elasticities of various inputs.

By using the co-efficient we can find the following production function:

$$\ln Y=4.7146+0.1916x_1+0.1054x_2+0.0126x_3+0.0596x_4+0.0060x_5+0.4111x_6-0.0055x_7$$

4.3.4 Interpretation of Results

The result of the economic analysis are demonstrated in terms of the calculated co-efficient and related statistics.

Human labour cost (x_1)

From the analysis it was found that the regression co-efficient of human labour was positive in case of pond fish culture and significant at 1 percent level which showed that one percent increase in cost of this input, keeping other factors constant, would increase the gross return of pond fish production by 0.192 percent.

Table 4.3.1 Estimated Values of Co-efficient and Related Statistic of Cobb-Douglas Production Function Model

Explanatory variables	Co-efficient	Standard error	t Value	P-value
Intercept	4.715	0.372	12.673	9.1E-16
Labour	0.192***	0.0601	3.187	0.00275
Fingerlings	0.105**	0.0516	2.0435	0.0475
Feed	0.013	0.0158	0.7956	0.431
Fertilizer	0.0596	0.0613	0.9712	0.337
Insecticide	0.006	0.0200	0.3012	0.765
Mechanical power	0.411***	0.0638	6.4458	1E-07
Irrigation	-0.006	0.0175	-0.3123	0.756
R^2	0.96			
F	143.94			
Return to scale($\sum b_i$)	0.78			

Note: *** P<0.01, **P<0.05 and *P<0.1

Fingerlings cost (x_2)

The regression co-efficient of fingerlings (x_2) was positive in pond fish culture and it was found from the table that it is significant at 10 percent level of significant which testified that other things remaining the same, 1% increase in cost of fingerlings would increase the gross return by 0.105 percent.

Feed cost (x_3)

The Co-efficient of feed cost (x_3) in pond fish culture was positive but it was not statistically significant, which testify that other things remaining the same, one percent increase feed in pond fish culture would lead to an increase in the gross return by 0.013 percent.

Fertilizer cost (x_4)

The regression Co-efficient of Fertilizer cost (x_4) was positive and it was statistically significant in pond fish production which indicates that one percent increase of fertilizer cost keeping other things constant would increase the gross return by 0.0596 percent.

Insecticide cost (x_5)

The production co-efficient of Insecticide cost (x_5) was positive but it was not statistically significant which implies that keeping other things remaining the same one percent increase in cost of insecticide would lead to increase the gross returns by 0.006 percent.

Mechanical cost (x_6)

The regression co-efficient of Mechanical Cost (x_6) was positive in pond fish production and it was found from the analysis that it is significant at 1 percent level that implies other thigs remaining constant one percent increase in cost of mechanical power would increase gross return by 0.411 percent.

Irrigation cost (x_7)

The co-efficient of Irrigation Cost (x_7) was negative and not statistically significant indicates that other things keeping constant one percent increase in cost of irrigation would lead to decrease the gross return by 0.006 percent.

Value of R^2

The co-efficient of multiple determination, R^2 was 0.96 which implied that about 96 percent of return from pond fish production was explained by explanatory variables, that were involved in the model and it was also implied that excluded variables accounted for 4 percent of the variation in pond fish farming.

F-value

The F-value of the model is 143.94 which was highly significant indicating that all the included variables were important for expressing the variation in pond fish production. Therefore, the inclusion of independent variables was reasonable.

Returns to scale

The economic analysis evaluates the return to scale directly. Return to scale are the summation of calculated co-efficient (input co-efficient) of accepted explanatory variables ($\sum b_i$). The sum total of all the production co-efficient (production elasticities) of the equation was 0.78. This implies that the production function displayed decreasing return to scale.

4.4 Problems and Constraints in Pond Fish Production

4.4.1 Introduction

The motive of this chapter is to know and analyze the major problems and constraints associated in pond fish production. The problems and constraints faced by the fish farmers were recognized according to opinions given by them.

4.4.2 Problems Faced by the Producers

Farmers of Bangladesh have been cultivating pond fish for a long period of time but production of pond fish is yet to achieve the target consistent with adequate availability of fish to people. Knowledge has shown that the farmers do not get the required quantity of fish seeds, quality of fish seeds, feed and fertilizers, chemicals, technical support and lastly the expected price of their products. It has also shown that the farmers are not enough capable to invest the required fund in their farming due to lower capital base. For the sake of easy understanding these problems can be grouped into four categories.

i. Economic problems
ii. Technical problems
iii. Social problems
iv. Marketing problems

Economic problems

It was identified that pond fish farmers faced some economic problems during the production of pond fish culture. The major economic problems faced by the farmers were:

(i) **Lack of credit facilities:** The pond fish farmers did not get required amount of credit that was one of the most limiting factor in producing pond fish. In the study area about 43.67 percent of the pond fish producer faced problems in obtaining bank loan. The procedures of bank loan system was very complicated and sometimes it was not available in proper time.

(ii) **Lack of operating capital:** To maintain variables cost such as fingerlings, feed, labour, insecticide, fertilizers etc. cash money was very much important. In the survey area about 43 percent of fish farmers said that they did not have sufficient amount of money for buying their required inputs (Table 4.4.1).

(iii) **High price of inputs:** Some pond fish farmers complained that they did not get inputs such as fingerlings, feed, fertilizers, insecticides etc. in aright time at a fair price that was a problem to expanding their enterprises. Table 4.4.1 express that about 43 percent of producers said that they had to purchase these inputs at a higher price than the normal market price from the local traders.

(iv) **Low price of fish:** The study indicate in case of fish marketing that most of the farmer had to sell their product to the middlemen at a lower price. It can be known from the table that about 63 percent farmers complained that they did not get reasonable prices of their products.

(v) **Loss of fish during flood:** During rainy season, over flooding was another major problem in the survey area. Sometimes the study area submerged by rain water which caused huge amount of fish losses. In the survey, about 9 percent farmers reported that the pond had over flooded in the rainy season.

Table 4.4.1 Major Problems Faced by the Fish Farmers in Pond Fish Production

Problems and constraints	Pond fish production (N=50)	
	No. of respondent producer	% (percent)
A. Economic problems		
Lack of credit facilities	38	76
Lack of operating capital:	34	68
High price of inputs	23	46
Low price of fish:	40	80
Loss of fish during flood	3	6
B. Technical Problems		
Lack of Scientific knowledge and method	22	44
Lack of extension services	12	24
Insufficient water in dry season	11	22
C. Social problems		
Theft	45	90
Sometimes poisoning to the pond water:	3	6
Social Interference by village leaders	9	18
Political instability	23	46
D. Marketing problems		
Transportation problems	10	20
Price instability	45	90
Market is limit	28	56

Sources: Field survey, 2020

Technical Problems

Technical problems were associated with production techniques. Technical problems linked with scientific knowledge and method, lack of extension service, insufficient water in dry season, non-availability of fish seeds, attack of fish parasites and diseases etc.

(i) **Lack of scientific knowledge and method:** Lack of scientific knowledge and method was one of the major problems which caused hamper better fish culture. In the study area it was found that the producers were not aware of the latest scientific knowledge of farming. About 55 percent of fish farmers encountered this problem (Table 4.4.1).

(ii) **Lack of extension services:** Some fish farmers reported that they did not get any technical suggestion from extension workers and Upazilla Fisheries Officers (UFO). About 33 percent pond fish farmers expressed about inadequate cooperation of concerned organizations (Table 4.4.1).

(iii) **Insufficient water in dry season:** According to the producers, insufficient water during dry season was another problem for producing pond fish. It can be revealed that about 25 percent pond fish farmers were faced this types of problems.

Social problems

Some pond fish farmers complained about some social problems faced during pond fish cultivation. Theft of fish from the pond, poisoning the pond water due to enmity and jealousy, social interference by village leader and political instability. These are discussed in the following:

(i) **Theft:** Some producers said that theft of fish from the pond is one of the most serious problem in fish cultivation. In the survey area, about 33 percent producers reported that their products were stolen (Table 4.4.1).

(ii) **Sometimes poisoning to the pond water:** Some producer said that sometimes fish were killed by enemies or rival peoples through poisoning to the pond. It was hazardous than any other problems because poisoning damaged all the products. About 8 percent of the producer reported this types of problems (Table 4.4.1).

(iii) **Social interference by village leaders:** Fish farming is profitable business in village areas. The rich and villages leaders and influential persons do this types of business. They take lease pond from the poor farmers of the village. If the pond owners do not agree to give their pond the leader compel to give the pond without providing proper value of the pond and that is why poor becomes poor day by day. Sometimes it causes collision between two groups and many peoples loss their lives every year. About 13 percent producers reported this types of problems.

(iv) **Political instability:** Sociopolitical instability such as hartal, strike, procession and clash among rival groups of peoples is another major problems of pond fish farming. It was about 20 percent pond farmers expressed that this problems hampered the smooth transportation system.

Marketing problems

The fish marketing is mostly traditional, complex and less competitive. The fish marketing system faces various problems including heavy losses and waste and poor quality of fish. Due to the lack of public sector fish marketing organization the fishermen or pond fish farmer are compelled to hand over their harvest to the commission agents at a price determined by the latter. Majorities of low-income people who do not have strong purchasing power were the major buyers of low cost fish species. Bargain is the common methods practice of settings fish prices in retail markets between retailers and the consumers. It is rarely practiced in wholesale markets. When the fishermen, fish farmers or the beparis sell fish to wholesalers or retailers, the price is usually set through auction by an aratdar.

There are no separate quality control measures for domestic marketing of fish in Bangladesh. The quality or grade of fish, namely freshness of large fish is roughly assessed by looking at the reddish hue of gills, sinking of eyes, general appearance of fish pressing fingers in different parts of the fish body and sometimes by smelling. There are also a lack of knowledge on the part of the fishermen, pond fish farmers and other intermediaries, fish traders, with respect to proper handling, preservation, transporting, and marketing of fish causing spoilage of fish and rendering a considerable quantity of fish unsuitable for consumption.

4.4.3 Solutions to the Problems as Suggested by the Fish Farmers

Fish farmers provided some suggestion to continue their fish cultivation smoothly. Such were:

Easy procedure for obtaining bank loan, availability of fish seeds and inputs at proper time at proper rate, social, moral and scientific education and training, low rate of interest, fixed price of major inputs and implementation of government rules. By developing modern marketing facilities at fish assembly centers, and retail fish markets, increasing cold storage facilities, refrigerated transport vehicles, and adequate supply of ice, increasing competition and providing stability to wholesale and retail markets etc. both the primary producer and consumer interest might be protected.

Table 4.4.2 Solution to the Problems as Suggested by the Fish Farmers

Suggestions	Pond Fish Producer (n=50)	
	Respondent producers	% (percent)
To maintain easy procedure in obtaining loan	27	54
To ensure the availability of fish seeds at proper time	43	86
To improve marketing facility	41	82
To make available of inputs at right time	36	72
To serve credit facilities at a lower rate of interest	13	26
To provide social, moral and scientific knowledge and training	17	34
To fix the major inputs price	32	64
To execute govt. rules	24	48
To ensure the availability of water in dry season	9	18

Sources: Field survey, 2020

Table 4.4.2 displayed that 54 percent fish farmers suggested formulating easy procedure in obtaining loan, 86 percent of the producers suggested to provide availability of fish seed at right time. The table also expressed that 82 percent of the producers suggested developing the marketing facilities and 34 percent of the fish farmers advised to provide social, moral and scientific knowledge and training.

It is expected that an improvement of all these aspects will provide adequate incentives for pond fish farming.

CHAPTER 5

SUMMARY AND CONCLUSION

5.1 Summary and Conclusion of the Study

Fisheries are an extensive economic activity in Bangladesh. Fish constitutes a common item of the diet of the population and a major source of protein supply. The bulk of the fish catches comes from inland fishery resources of which ponds constitute an important source. In most of the ponds, fish culture is practiced mostly by traditional ways. The government of Bangladesh is disbursing a considerable amount of credit each year for development of pond fish culture through proper management. The cereal crops can satisfy hunger temporarily, but can hardly fulfill the nutritional requirements which are most essential for human body. But the present level of animal protein production in Bangladesh fails to satisfy the demand of increasing population. This article gives an overview of the fisheries sector and its challenges and opportunities in Bangladesh. It is evident that the performance of fisheries sector is crucial from a national macroeconomic and food and nutrition security perspective. Therefore it proposes that a more efficient and sustainable management of the aquatic resources will contribute greatly to health and economy of the country. Policy makers must spare no effort to ensure the functioning of this sector in full swing by enhancing investment and research infrastructure, more strict environmental policies, and introducing better storage and marketing facilities. More importantly, the situation of fishers must be taken into account and special task force should be built to assess their vulnerability and strategies to tackle them. In order to meet the soaring demand for food for the burgeoning population, there is a need for increased rice and fish production in Bangladesh.

The present survey was designed in order to evaluating the profitability of pond fish production by analyzing costs and returns. The findings of the study reveal that the major portion of the fish farmer were in the active age groups. . About 68 percent fish farmers belonged to the age group of 20-40 out of total pond owners. Out of the total pond owners 30 percent of fish owners were age of 41-60 year. About 2 percent of fish pond farmers fell into the age group of above 60.This information implies that more than half of the sample farmers were in active age of 20-40 years, indicating that they provided more physical efforts for pond fish culturing.

Gross cost is the total cost calculated by sum of total variable cost and total fixed costs. Variable cost involves human labour cost, fingerlings cost, feed cost, mechanical cost, irrigation cost, fertilizer cost and cost of insecticide. Fixed cost involves land use cost and cost of interest on operating capital. Per hectare per year cost of pond fish production was estimated on the basis of gross costs. From the Table 5.3 indicates that total cost was Tk. 2136878 per hectare in which human labour, fingerlings, feed, fertilizer, insecticide, irrigation, mechanical cost, land use cost and cost on interest on operating capital items represented 1.15, 3, 88, 0.38, 0.25, 0.26, 0.51, 5.41 and 1 percent respectively.

Gross return was the value of fish produced in money terms. This was calculated by multiplying the total amount of production by their respective market prices. Gross return from pond fish production was estimated at Tk. 3017973. The gross margin of pond fish production was estimated at Tk. 1018142. Per acre net returns from pond fish production was calculated by deducting gross costs from gross returns. It can be noted that per acre net return was Tk.881095. The benefit cost ratio (undiscounted) of pond fish farming was 1.412.

Cobb-Douglas production function was applied to determine the effects of resources used on gross returns of pond fish production. In this survey, there were many factors engaged in producing pond fish namely fingerlings, feed, fertilizer, insecticide, irrigation and human labour. The co-efficient of multiple determination, R^2 was 0.96 which implied that about 96 percent of return from pond fish production was explained by explanatory variables, that were involved in the model and it was also implied that excluded variables accounted for 4 percent of the variation in pond fish farming. The F-value of the model is 143.94 which was highly significant indicating that all the included variables were important for expressing the variation in pond fish production. Therefore, the inclusion of independent variables was reasonable.

5.2 Recommendations

On the basis of the result of the survey the following recommendations may be forwarded which are likely to be helpful for policy formulation:

(i) From the survey 29 pond fish farmers said that they did not get loan easily and shortest possible time. Easy procedures of bank loan and other institutional credit should be made available to the producers

(ii) Among 50 survey data 43 of pond fish farmers told that they did not find any training program for fish culture. So, Knowledge sharing and skill development program should be arranged by the concerned authorities.

(iii) This research indicate that among 50 pond fish farmer 40 are not aware of scientific knowledge of fish farming. So, application of scientific methods in fish farming should be ensured.

(iv) Among the survey it was found that 92 percent of the pond fish farmer was not satisfied with the prices of fish, fingerlings, and inputs should be strictly ensured.

(v) The area should be saved from submerged and inundation.

5.3 Limitations

The present survey provides some important information for producers, extension workers and decision makers in case of pond fish culture. Almost all the research works have some limitations in terms of time, money and personnel. The survey is not out of the limitations. Some of the limitations that is identified may be expressed as follows;

(i) The survey data were collected from a small area taking a small number of samples. The result is inadequate to represent the overall scenery of pond fish culture in Bangladesh

(ii) It is very difficult to collect data that the researcher had to depend on the memory of the fish farmer. Sometimes the producer did not keep any written document as result the data collection was only from the memory of the producers. To reduce this problem several connection with producers was made by the researcher to ensure correct data from the field.

(iii) Exact calculation of family labour is very difficult task because the fish farmer often could not identified the definite number of family labour properly.

(iv) Most of the case it was found that the respondents initially hesitated to answer the questions since they thought that it will be interfere with their interest. In some cases, respondent became afraid of imposition or tax increase or land acquisition by the government.

In spite of the above limitations some of the findings of the study may be helpful to the decision makers, fish farmers, GO and NGO officials. It may also provide information as a guide line for further research.

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APPENDICES

Appendix 1. Questionnaire of the study

An Interview Schedule on

An Economic analysis of pond fish culture in some selected areas of Satkhira District

Sample No…………..

1. Farmers Identification

a) Name………………………………………. b) Village…………….........

c) Upzilla……………………………………..

2. Farmers Socio-Economic Characteristics

2.1. General Information

Sl. No	Relation with H .H	Sex	Age	Education	Marital status	Occupation	
						Main	Subsidiary

N.B. Sex= (Male=1, Female=2)

Marital status= (Married=1, Unmarried=2)

Education (year of schooling) = (write name=1, PSC=2, JSC=3, SSC=4, HSC =5, Graduate=6, Masters=7.

Occupation= No work=0, Fish cultivation =1, Agriculture=2, Poultry rearing=3, Livestock's=4, Labor=5 Student=6, Business=7, Housewife=8, Others=9.

3. Land Holding and Tenancy

Area in Bigha (1 bigha= 0.33 decimal)

Category	Own cultivated land	Leased in	Leased-out	Rented in	Rented out	Mortgage in	Mortgage out	Total operated land (2+3+5+7-4-6-8)
	2	3	4	5	6	7	8	9
Pond area								
Homestead								

4. a) Variety of Fish Seed and Sources

	Sources		
Variety	Private Hatchery	Public Hatchery	Own Nursery
Rui			
Catla			
Mrigal			
Silver carp			
Grass crap			
Common carp			
Bata			
Calbaus			
Tilapia			
Pangas			

b) Variety of Feed Cost per Year

Variety	Quantity per bigha	Cost per unit	Total cost
Rice bran			
Oil cake			
Artifical feed			
Others			

5. **Information about Annual Family Source of Income:**

a) **Agricultural Sources**

Agriculture	Total amount	Present value (Tk)	Family consumption		Amount of remainder (tk)
			Amount (kg)	Value (tk)	
Farm income					
Rice (mound)					
Fisheries: i. Capture					
ii. Cultivation					
Livestock: Milk					
No of Animal: a. Cow					
b. Goat/Sheep					
Poultry					
Other					

b). Non-Agricultural Sources

SL No.	Income sources	Amount of income (in TK.)/yearly
1.	Business	
2.	Services	
3.	Foreign Remittance	
4.	labor	
6.	Auto driver	
7.	Others income source	
Total		

6. Farmer Expenditure

(Please mention you monthly expenditure in following source)

SL.No.	Items	Monthly Expenditure(Taka)	Yearly Expenditure(Taka)
1.	Food		
2.	Energy(Petrol, Gas, Electricity)		
3.	Health Care		
4.	Education		
5.	Clothing		
6.	Transportation		
7.	Festivals & social Economics		
8.	House Rent		
9.	Cell phone expense		
10.	Entertainments		
11.	Others		

7. Cost and Return

a. Human Labor Requirement (man/day)

(Please mention of your Human Labor requirement)

Name of items	Pond fish culture			
	No. of labor		Taka/ labor	Total (Tk)
	own	Hired		
Execavation or re-excavation				
Applying CaO				
Preparation of pond				
Irrigation				
Fingerlings				
Feeding				
Harvesting				
Stoking				
Freezing and transporting				
Night guard				
Total				

b). Cost of Mechanical Powers Used

(Please mention your cost of mechanical powers used)

Name of Practices	Pond fish				
	Name of machine	No of machine	Rent (taka/Unite)	Cultivated Area(Decimal)	total (taka)

c. Materials Inputs Used

(Please mention about material input used)

Inputs	Unit Price (Tk/unit)	fish	
		Amount(kg/Unite)	Total Taka
Fingerlings			
CaO			
Fertilizer			
a. Urea			
b. TSP			
c. MP			
Artificial feeding			
Land use cost			
Cost of fish feed			
Insecticides			
Irrigation			
Others			
Total			

8. Amount of Fish Production and Disposal/Return

(Please mention about fish production and disposal)

Fish Variety	**Total production (kg)**	**Unite price(TK/kg)**	**Total taka**	**Other production (kg)**	**Unite price (TK/kg)**	**Total Taka**	**Grand Total taka**
1	2	3	4(2*3)	5	6	7(5*6)	4+7

9. Please Mention the Problems Faced by You in Fish Culture
a)……………………………………………………………………………..
b)……………………………………………………………………………..
c)……………………………………………………………………………..
d)……………………………………………………………………………..
e)……………………………………………………………………………..

10. What are Your Suggestions to Overcome the above Problems?
a)……………………………………………………………………………
b)…………………………………………………………………………..
c)…………………………………………………………………………..
d)…………………………………………………………………………..
e)…………………………………………………………………………..

Thank you for kind co-operation

Date……………………………..

Signature of the interviewer