A STUDY ON PANGUS CULTIVATION AT FARM LEVEL IN SOME SELECTED AREAS OF MYMENSINGH DISTRICT

MD. MEHEDI HASAN KADER

DEPARTMENT OF DEVELOPMENT AND POVERTY STUDIES
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
SHER-E-BANGLA NAGAR, DHAKA-1207

June, 2018

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A Thesis

By

Md. Mehedi Hasan Kader

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IN

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in partial fulfillment of the requirements for the degree
of

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Approved by

_____	_____
Dr. Mohammad Mizanul Haque Kazal	**Dr. Md. Sadique Rahman**
Professor	**Associate Professor**
Department of Development and Poverty Studies	**Department of Management and Finance**
SAU, Dhaka-1207	SAU, Dhaka-1207
Supervisor	**Co-supervisor**

_____
Dr. Ashoke Kumar Ghosh
Associate professor
Department of Development and Poverty Studies
SAU, Dhaka-1207
Chairman

Department of Development and Poverty Studies
Sher-e-Bangla Agricultural University
Dhaka-1207, Bangladesh

CERTIFICATE

This is to certify that the thesis entitled, ***"A Study on Pangus Cultivation in Some Selected Area of Mymensingh District"*** *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 Development and Poverty Studies****, embodies the result of a piece of bonafide research work carried out by Md. Mehedi Hasan Kader, Registration No. 11-04241 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: 27-06-2019
Place: Dhaka, Bangladesh

Dr. Mohammad Mizanul Haque Kazal
Professor
Department of Development and Poverty Studies
SAU, Dhaka-1207

DEDICATED

TO

MY BELOVEDPARENTS

A STUDY ON PANGUS CULTIVATION AT FARM LEVEL IN SOME SELECTED AREAS OF MYMENSINGH DISTRICT

ABSTRACT

Pangus is a fast-growing fish species that has great potential for production and export growth in Bangladesh. The study was conducted to determine the socio-economic profile,costand return and profitability analysis of pangus farming. The study area selected in Bhaluka and Trishal in Mymensingh district. A total of 92 farmers were selected on the basis of random sampling technique for data collection in 2018. To achieve the objectives of our study both descriptive and statistical analysis were done using Microsoft Excel. It was estimated that gross return and net return were Tk. 2470,560 and Tk. 340,825per year respectively.Benefit cost ratio was 1.16 which indicate potential profit from pangus cultivation from the study area. Cobb-Douglas production function was applied to identify the specific effect of the factors on production. Among the variables cost feed, cost of fertilizer and water treatment costwere positive coefficient and significant impact on return of the pangus production. The adjusted $R^2$was 0.61 which indicates that about 61%return from pangus culture was explained by variables included in this model and 39% variables excluded from this model. From returns to scale it shows that all the inputs specified the production increased by 1%, the gross return increase by 5%. From survey analysis the major problems mentioned by the cultivators were lack of money, lack of proper knowledge of farming, adulterate feed, insufficient scientific training, poor and inconsistent market price. It is suggested that government interventions, market facilities and quality of inputs should be improved to ensure profit from pangus production.

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The Author

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ACRONYMS AND ABBREVIATIONS

BBS: Bangladesh Bureau of Statistics

BFDC: Bangladesh Fisheries Development Corporation

DOF:Department of Fisheries

FAO: Food and Agriculture Organization

FD: Forest Department

FY: Fiscal Year

FRSS:Fisheries Resources Survey System

GAP: Good Aquaculture Practice

GDP: Gross Domestic Product

GI:Geographical Indicator

GO:Government Organization

Ha: Hectare

LGED:Local Government Engineering Department

NFP: National Fisheries Policy

NGO:Non-Government Organization

NOC: No Objection Certificate

MT: Metric Ton

KG: Kilogram

CHAPTER 1
INTRODUCTION

Bangladesh is considered one of the most suitable regions for fisheries in the world. Bangladesh, with its rich inland waters and river systems, has significant capture fishery and aquaculture potential. As an agricultural country Aquaculture has been emerging as one of the most prominent sector in Bangladesh. The farming of fish culture is the most common form of aquaculture. It involves raising fish commercially in tanks, fish ponds, or ocean enclosures, usually for food safety. Pangus (Pangasianodon hypophthalmus) cultivation has been emerging as an economically very important species to South-East Asian aquaculture. This species has become as an important aquaculture species in Indonesia, Malaysia, Cambodia, Bangladesh and China (FAO, 2010). There is great opportunity for further development of the pangus industry in Bangladesh and the export potentiality of this species is also very high.

1.1 Fisheries Sector in Bangladesh

Bangladesh is situated in the north eastern part of the South Asia and located between $20^0$34' and $26^0$38' North longitudes and $88^0$01' and $92^0$41' East latitudes. Bangladesh is situated in the tropical region and waters body flows all over the country. Fisheries sector plays a vital role in the national economy of Bangladesh which contribution 3.69% of the Gross Domestic Product (GDP) and 22.60% to the Agricultural GDP. According to FAO (Food and Agriculture Organization) Bangladesh ranks third in Inland Fisheries Production in 2018 (FAO, 2018) Bangladesh has achieved self-sufficiency in fish production. The target of fish production was 40.50 lakh MT in 2016-17, but it crossed the target by producing 41.34 lakh MT fish in Bangladesh (Yearbook of Fisheries Statistics of Bangladesh 2016-17). According to the data from the Yearbook of Fisheries Statistics (2015-16), the current CAGR for the fisheries sector is 5.28% over the last 10 years. According to industry estimates, fish production at present 4.22 million metric tons in 2019.The sector provides living and livelihood for more than 11% people of the country (Hossain, 2014). If the available resources are used sustainably with proper technological assistance, fish produced from aquaculture would efficiently meet the protein demand of growing population of the country.

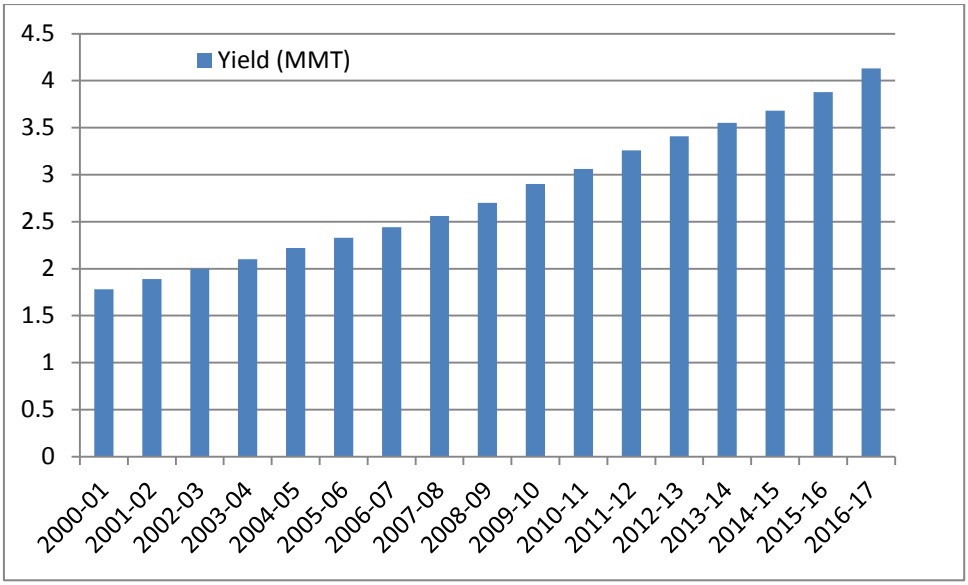

Figure 1.1: Yield of Inland and Marine Fisheries in Bangladesh from 2001 to 2017

Source: Statistical Yearbook (2016-17)

1.2 Economic Importance of Fisheries in Bangladesh

Pangus cultivation is a relatively new and fast-growing fish species that has great potential for production and export growth in Bangladesh. The pangus farming is very expensive as it is feed dependent culture system. More than 3% of Bangladeshi export value comes from the inland fisheries sector (Statistical Yearbook, 2017).

Table1.1 Sector-wise Annual Fish Production in Inland and Marine Fisheries, 2016-17 (BBS)

Sector of fisheries	Water Area (Ha)	Production (Metric Ton)	Percentage of production
Inland Open Water	3927142	1163606	28.14
Inland Closed Water	833752	2333352	56.44
Inland Fisheries Total	4760894	3496958	84.58

Source: Statistical Yearbook (2016-2017)

According to statistical Yearbook (2016-17), Bangladesh is one of the world's leading fish producing countries with a total production of 41.34 lakh MT in 2016-17, whereas inland open water (capture) contributes 28.14 percent (11.63 lakh MT) and inland closed water (culture) contributes 56.44 percent (23.33 lakh MT) to total production. So, 84.58 percent of total production comes from inland fisheries. The growth rates of inland capture and inland culture are 11.01 and 5.89 percent

respectively. On the other hand, Marine fisheries production is 6.37 lakh MT and its contribution to total fish production is 15.42 percent with growth rate 1.75 percent. Overall growth rate of total fish production in 2016-17 is 6.60 percent (BBS, 2017)
The overall growth performance from inland aquaculture shows a moderate increased trend. The fish production has increased more than five times (7.54 MT in 1983-84 to 41.34 lakh MT in 2016-17) over the last three decades. The fish production diversity of fisheries resources of inland open water fisheries of river, beel, flood plain and Kaptai lake in 2016-17 are 2.71 lakh MT, 0.98 lakh MT, 7.66 lakh MT and 0.09 lakh MT respectively and corresponding growth rates are 52.21, 2.79, 2.39 and 4.10 percent respectively. The respective contributions to total production are 6.57, 2.37, 18.52 and 0.24 percent. Fish production has been increased compare to previous (BBS, 2017).

The production of Sundarbans fishery has increased comparatively, its contribution is 0.44 percent to total production and consequently its growth rate is 7.21 percent. The fish production (aquaculture) in 2016-17 of pond, seasonal cultured water body, baor, shrimp farm, pen culture, cage culture (inland closed water body-culture) are 18.33 lakh MT, 2.16 lakh MT, 0.08 lakh MT, 2.46 lakh MT, 0.13 lakh MT, 0.02 lakh MT respectively. Subsequently, the corresponding contributions to total production are 44.31, 5.21, 0.19, 5.96, 0.32 and 0.06 percent respectively. The corresponding growth rates are 6.59, 3.80, 3.53, 2.76, 0.03 and 20.76 percent respectively. Crab production is 0.14 lakh MT which is included from last year in this yearbook (BBS, 2016-17).

The aquaculture production became more than double (9.19 lakh MT in 2005-06 to 23.33 lakh MT in 2016-17) during the last ten years. The overall growth performance from inland aquaculture shows a moderate, reasonable and admirable increasing trend. In 1983-84, the contribution of inland capture and culture fisheries to total fish production were 62.59 percent and 15.53 percent respectively; whereas in 2016-17, inland capture fisheries contributes only 28.14 percent and inland culture fisheries contributes 56.44 percent to total fish production. Total marine fisheries production is 6.37 lakh MT (Industrial is 1.08 lakh and Artisanal is 5.29 lakh MT) and its growth rate is 1.75 percent (BBS, 2017)

Table 1.2: Species/Group-wise Annual Fish Production in Inland and Marine Fisheries 2016-17 [Unit: Metric Ton]

Sl. No.	Species/Group	Inland Fisheries	Marine Fisheries	Total	Percentage (%)
1	Major Carp	811588	0	811588	19.63
2	Other Carp	100730	0	100730	2.44
3	Exotic Carp	409801	0	409801	9.91
4	**Pangus (Cat Fish)**	510097	0	510097	12.34
5	Other Cat Fish	66646	0	66646	1.61
6	Snake Head	72991	0	72991	1.77
7	Live Fish	127120	0	127120	3.07
7	Silver carp	380019	0	380019	9.01
8	Tilapia	370017	0	370017	8.95
9	Other Inland fish	598923	0	598923	14.49
10	Hilsha/Illish (Tenualosa ilisha)	217469	278948	496417	12.01
11	Shrimp/Prawn	197155	49619	246774	5 .97
12	Crab	14421	0	14421	0.35
13	Sardine (Sardinellafimbriata)	0	48704	48704	1.18
14	Bombay duck (Harpondonnhe)	0	69230	69230	1.67
15	Samlon(Polydactylusindicu)	0	775	775	0.02
16	Pomfret (Rup/ Hail/ Foli Chanda)	0	10686	10686	0.26
17	Jew Fish (Poa, Lambu, Kaladatina etc.)	0	33768	33768	0.82
18	Sea Cat Fish (Tachysurus spp.)	0	8424	8424	0.20
19	Shark/ Skate / Ray	0	4495	4495	0.11
20	Other Marine Fish	0	132827	132827	3.21
Total	Metric Ton	3496958	637476	4134434	100.00
	%	84.58	15.42	100.00	

Source: BBS (2016-17)

Note: 1. Major carp –Rui, Catla, Mrigal

2. Other Carp - Kalibaus, Bata, Ghania

3. Exotic Carp - Silver Carp, Grass Carp, Common Carp, Mirror Carp, Big Head Carp, Black Carp

4. Other Cat Fish - Boal, Air, Silon, Rita

5. Snake Head - Shol, Gazar, Taki

6. Live Fish - Koi, Singhi, Magur

7. Prawn - Galda and Other Inland Chingri

8. Shrimp - Bagda and Other Coastal/ Marine Chingri

9. Other Fish (Inland and Marine) - Includes all other fishes except those mentioned above

1.3 Fisheries Sub-sectors

- Inland Open Water (Capture)

Inland Fisheries	Inland Closed Water (Culture)
1. River and Estuary 2. Sundarbans 3. Beel 4. Kaptai 5. Floodplain	6. Pond 7. Seasonal cultured water body 8. Baor 9. Shrimp/Prawn Farm 10. Crab 11. Pen Culture 12. Cage Culture

Marine Fisheries

- Industrial
- Artisanal

1.4 Food Security

The 36 countries are home 90 percent of the world's malnourished children. Haiti (1976 calories /per person/per day) is the highest rate of malnutrition country. Rates of malnutrition in Bangladesh are among the highest compare the malnourished countries. A survey report from the NGO called 'Save the Children' represents that about six million children estimated to be chronically undernourished. Fish contribute a significant amount of animal protein to the diets of people in Bangladesh, about 63% of which comes from aquatic animals especially from fishes. Aquaculture has shown tremendous growth in the last two decades, exhibiting by about 10% average annual growth in production ((Murshed E- Jahan, Ahmed, & Belton, 2010).

Malnutrition and starvation are the two serious problems being faced by millions of rural poor in most of the developing countries. Fish contain about 16–20% protein compared to about 12% in egg, 3.5% in milk and 6–8% in rice and wheat. Moreover, it is wholesome, tasty, highly nutritive and an excellent source of essential minerals, vitamins and essential amino acids. At present about 31% of the total animal protein supply in the Asian region is in the form of fish protein (FAO, 2016).

According to the FAO (Nutritin Value of Pangaisius, 2016)

- The feed Conversion Ratio (FCR) of Pangasius that are fed commercial pellets is around 1.7-19:1. Pangasius feeding is divided into two stages. The first

tends to use feed with high amounts of protein and minerals so the fish gain maximum length.

- In the second stage, the carbohydrate concentration of homemade feed is usually increased to fatten the fish, make them heavier and thus result in higher production.

Table 1.3 Nutritional Value Per 100 grams of Pangus Fish (Everyday-Fish, 2017)

Nutritional value per 100 grams	
Energy	92 kcal
Protein	15 g
Fat	3.5 g
Cholesterol	80 mg

Fig 1.2 Pangus Fish (Source: Marine Food Supplies, 2017)

Pangus can be a potential source of protein and balanced diet. Pangasius is a healthy choice for families and particularly for people who pay special attention to a healthy diet. Some characteristics are-

- a source of Omega 3, rich in protein and average in fat
- low in saturated fat
- zero carbohydrates, low cholesterol, zero sodium
- A source of high quality of protein equivalent to meat. 60% of the calories are from protein and 40% of the calories are from fat.
- Very Delicious and socially acceptance of Pangus fish
- Affordable and easy accessibility

1.5 Employment Generation

Fisheries and aquaculture provide livelihoods to around 820 million people worldwide. (FAO, 2018) Fish worker communities are most of the time isolated in

rural areas with little access to market information and infrastructure facilities. Fisheries sector also plays an important role in rural employment generation and poverty alleviation. 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). More than 11 percent of the total population of Bangladesh is engaged with this sector in full time and part time basis for their livelihoods (DOF, 2017).

1.6 Low-Cost Cultivation in the Pond

As a developing country about 31.5% people are living below the poverty line and suffers from extreme hunger and malnutrition (Asian Development Bank Report, 2016). Pangus can be cultivated in the pond with proper maintenance. In Bangladesh ponds are very available all over the country which reduces the implementation cost.

1.7 Socio-Economic Profile of Our Country

The fisheries sector plays a very important role in the national economic, contributing 3.69% to the Gross Domestic Product (GDP) of the country and 22.60% to the agricultural GDP (FRSS, 2016). 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. Economic and social advancement of the country is highly depending on the agricultural sectors and plays a vital role in the socioeconomic condition of the village people, carry out the animal protein demand, creating new employment opportunity in agriculture sector.

About 2.7 million people are directly employed in this sector and another 17.80 million people indirectly earn their livelihood indirectly involving activities related to fisheries (DoF, 2015). The socio-economic profile includes-

- Primary occupation of fish farmers
- Age structure of fish farmers
- Educational status of fish farmers
- Drinking water sources
- Sanitation facilities
- Housing condition of fish farmers

- Family member
- Family type

1.8 Importance of Pangus Cultivation and Farmers Betterment through Pangus Cultivation:

Development of aquaculture has generated considerable employment opportunities in Bangladesh through the production and marketing of fish and associated activities. Around 400,000 ha of freshwater ponds/ditches and more than 900,000 households are involved in aquaculture. Conditions are highly favorable for the rapid expansion of aquaculture as the quantity of seed produced has risen rapidly in recent years (Muir, 2003). Bangladesh is considered one of the most suitable countries in the world for small-scale freshwater rural aquaculture, because of its favorable resources and agro climatic conditions. Over the last three decades, there has been a steady increase in inland freshwater aquaculture production. In Bangladesh, total fish production was estimated at 2.2 million tons in 2005 of which 882,091 tons (40%) were from inland freshwater aquaculture, 859,269 tons (39%) from inland capture fisheries, and 474,597 tons (21%) from marine fisheries (DOF, 2006). The main production systems for freshwater aquaculture in Bangladesh are extensive and semi-intensive pond poly-culture of carps which accounts for 80% of the total freshwater aquaculture production (Ahmed, 2005). The remaining 20% are mainly from pangus, tilapia, small indigenous species (SIS) of fish and rice-fish farming (Muir, 2003).

1.9 Key Research Questions

a. What are the characteristics of the pangus cultivators?
b. What is the socio-economic status of pangus cultivators?
c. How much cost arises in the time of pangus cultivation?
d. How much gross margin received during pangus cultivation?
e. What is the profit margin of pangus cultivation in the study area?
f. What is the extent of constraints faced by the cultivators during pangus cultivation?
g. Which problems suffered them mostly in the time of marketing?
h. What was the extent of impact of pangus cultivation on cultivator's livelihood?

1.10 Objectives:

a. To delineate the socio-economic profile of pangus cultivators in the study area;
b. To identify the profit margin of pangus cultivation in the study area;
c. To estimate determinants of pangus cultivation on sample farm;
d. To find out constraint faced during the cultivation of pangus in the study area.

1.11 Rationale of the Study

Although pangus cultivation has been emerged as a promising sector of income generation as well as protein and nutritional sources in Bangladesh, research works related to profitability and resource use efficiency of pangus cultivation are very rare. Therefore, an attempt was taken to delineate the socio-economic profile of pangus cultivators, to estimate the profitability of pangus cultivation, to identify the factors responsible for increasing pangus cultivation and to investigate the standard of living of the farmers who cultivate pangus in two upazila namely; Trishal and Bhaluka under Mymensingh district.

The outcomes of this research will be helpful to the agricultural sector, planners, policy makers and extension workers for better understanding the current scenario of pangus cultivation and for taking strategies to accelerate regional development programs specifically in rural agricultural sector. From this study a new prospect of agricultural sector can be opened to the new farmers through pangus cultivation. This study will also be helpful to the academicians and researchers for further conceptualization who will work related to fisheries (cultivation of fish) sector in Bangladesh. A number of steps can be taken by the government for increasing pangus production in large level. These steps included increasing total water area for aquaculture, augmenting open water capture fishery, ensuring access of the poor and genuine fishers to fish cultivation.

1.12 Challenges of Fisheries Sector

According to the Statistical Analysis of Bangladesh Government there are challenges in fisheries sectors. A recent study in one of the counties aimed at finding out the

opportunities in the fish value chain listed five main challenges, namely, low production/productivity, limited supply of fingerlings, limited value addition, limited quality. The main analysis were- The major current and future challenges of this fast growing sector includes-gradual resource depletion (inland open water),deteriorating brood stock of potential species; increasing water-logging, blocking migratory routes of indigenous fish species, disturbing biodiversity and creating social conflicts; scarcity of good quality seeds and production inputs; - scarcity of good quality and virus-free shrimp post larvae ,obstructing the migratory routes due to increased silt deposit on the river channels; stock assessment of marine fishery resources; fishers access to public water bodies; expansion of good aquaculture practices for ensuring food safety, Climate change impacts on fisheries and aquaculture; alternative livelihoods support to fishers during banned fishing seasons and sanctuary maintenance.

CHAPTER 2
REVIEW OF LITERATURE

The purpose of this chapter is to review the previous research works which are related to the present study. A large number of research works have been done in the fisheries sector, but studies exclusively on pangus fish production are scare because it is relatively a new development in the fisheries sector of Bangladesh. The most relevant studies, which have been conducted in the recent past related to the research; are discussed below.

Asif and Habib (2018) the study was conducted to know the livelihood status of fish farmers and socio-economic condition in the Jhikargacha upazila, Jessore, Bangladesh. Data were collected from 50 fish farmers through primary data. The study indicated that 38% of the farmers were in age structure of 50-60 years, 44 farmers (88%) were Muslims and others Hindu (12%). About 82% farmers had a primary occupation of agriculture and others were involved in business (8%), service (4%) and politics (4%). It was found that, 66% farmers had joint family and others lived in separated family (34%). Majority (44 farmers) respondents had concrete house and rest of (6 farmers) had semi-concrete house. All the respondents used to drink tube well water for drinking and other household works. Out of 50 fish farmers, 4% had no education (illiterate), 36% had primary education, 42% secondary level (Up to X), 10% S.S.C., 4% H.S.C. and 4% bachelor level of education. In the study area, 32% of the farmers had ponds of 34-66 dec, 28% had pond of 15-33 dec, 14% had ponds of up to 100 dec, 22% had ponds of 101-330 dec and 4% had ponds of 330-above dec. It was found that, 62% farmers had training on fish farming and rest 38% farmers had no training on fish farming. Among 50 farmers 64% farmers were found used to invest their own credit and rest 36% farmers took loan from bank, NGO, money lender and broker agency. Most of the farmers were interested to stock rui, catla and mrigal and other species. In the study area, cow dung was used by 50 (100%) of farmers, 47 farmers used urea, 40 farmers used TSP and 34 farmers used MoP. It was found that, 40% farmers produced fish between 1001 kg – 2000 kg/year and 17 (34%) farmers produced 3001 kg-above/year. The highest income was 3, 30,

75,000Tk/Year and the lowest income from a pond was 20000 Tk/Year. In the study area, every farmer had at least one mobile phone.

Zaman et al. (2017) the study mainly based on existing condition and assessment of sustainability of Pangasius (Pangasius hypophthalmus) farming in Bangladesh. The study area was Jhikargacha upazila in Jessore district. The study was carried out through questionnaire interview with randomly selected 80 farmers. In the study areas, a good number of farmers 90% made various comments on the advantages of pangus culture. In the research area it was found that 96% farmers cultured pangus with other fish (poly culture), whereas only (4%) farmers cultured only pangus (monoculture). It was found that 15% farmers learned the pangus culture technology themselves through learning by doing. About 48% gained experience from friend and neighbors, 16% farmers acquired experience from NGO and remaining 21% obtained experience from GO's (DoF, BFRI etc.). The highest percentage (48%) of farmers learned the farming of pangus from friend and neighbors and then from GO's (DoF, BFRI etc.). The study area, all of the farmers maintain stocking density for pangus culture with other species. The farmers mainly stocked pangus with some other fish species like Tilapia, Silver carp, Grass carp, common carp, Bata, Mrigal, Rui and Catla. It was found that maximum stocking density were pangus and tilapia. Farmers can improve their social and economic status through pangus farming. Institutional credit facility for pangus farmers was found to be very limited. Only 20% pangus farmers were found to have access to institutional credit. Two banks, the Bangladesh Krishi Bank (BKB) and Grameen Bank was found as the major sources of institutional credit for pangus farmers in the studied areas. Though it is a great potential but it is currently facing a number of problems such as, lack of capital, proper technological knowledge, lack of regular supply of quality fingerlings, improper proportion of protein and supply of adulterate feed, high price of feed, inbreeding, marketing and management problems.

Khan et al. (2017) in this paperthe risk factors were estimated using Just–Pope stochastic production function. Production variability exists from farm to farm and location to location, which indicates that production risk may be obstacle in pangus farming. Research on production risk is considered a great importance, especially for small-scale farming systems in developing countries, where farmers are more

vulnerable to risk. This study investigates the production risk of pangus farming in selected areas of Bangladesh. A Just–Pope stochastic production function was chosen to estimate the mean and risk functions. The test result shows that significant production risk exists in pangus farming, and that the risk differs between small and large farms

.

Faruk and Rahman (2017) Tilapia (Oreochromisniloticus) and pangasius (Pangasianodon hypophthalmus) are currently very important and popular species for aquaculture in Bangladesh. The study was carried out to investigate diseases of the two species under farming condition with special emphasis on risk factors. Also taken into consideration into analysis and health management strategies. Data were collected through questionnaire survey and focus group discussion and public meeting with farmers. Altogether 50 farmers were interviewed of which 25 were tilapia farmers and 25 were pangus farmers in Trishal upazila of Mymensingh district. The most prevalent clinical signs of diseased fish included anal protrusion and red spot on body surface in case of pangus while pop and red eye and gas problems were common in both pangasius and tilapia.

Ramadhan et al. (2016) in the recent years of 2015 Pangasius fillet industry in Indonesia that has grown which will face the ASEAN regional competitiveness. The research was carried out with regard to internal and external factors to determine the future strategies. This study was conducted to generate alternative competitiveness strategies of Pangasius fillet through descriptive analysis, SWOT and AHP method.

Ali et al. (2016) the present study was conducted for evaluating status of polyculture of Pangasius hypophthalmus with carp. In this study Weekly field survey was carried out between July 2012 and December 2012 to collect the necessary information and data collection. Focus group discussion is also important part of this study. Chi square test was applied to find any significant difference between number of male and female members in the respondent's household. Data were analyzed at 95% confidence limit using SPSS. The cost benefit ratio (CBR) analysis was carried out using the following formula – CRB=Total cost/total benefit (total benefit=total income –total cost). The average CBR was found1:1:15 (cost: benefit) indicating profitability of pangus culture with carps. From the results several problems were

identified. High mortality rate of stocked fish seeds was the most common problem identified in the study area, reported by 22.50% farmers.

Ibrahim et al. (2014) this study was conducted to determine the amount of the fish consumption in Malaysia; the quantity of heavy metal residues (arsenic, cadmium, mercury and plumbum) in the fish and the level of the risk exposure. The result showed that 60.3% of the respondents consumed the fish. The level of heavy metal risk exposures were calculated as very low.

Kumar and Ramulu (2013) this paper mainly identify the diseases of pond aquaculture. In this research it was found that Pangasius hypophthalmus infected with red disease in culture ponds of West Godavari and Krishna districts of Andhra Pradesh, India.

Njagi et al. (2013) the purpose of this study was to investigate factors affecting profitability of fish farming under Economic Stimulus Programme in Tigania East District of Meru County, Kenya. The descriptive analysis showed that a large proportion (68%) of the fish farmer had formal (tertiary) education and financed their fish production through personal savings. Equally evident from the result is that an average total cost of 394,380 was incurred per annum by fish farmers. The multiple regression result revealed that fish output was significantly determined by pond size, labour used, cost of feeds, cost of lime and cost of fingerlings. The coefficient of determination, R2 value of 0.462 indicates that 46.2% of the variation in the value of fish output was explained by pond size, quantity of labour used, cost of feed, cost of lime and cost of fingerlings The degree of responsiveness of the value of fish output to changes in the independent variables shows that a percent increase in the values of pond size, labour, feeds, fertilizer, lime, fixed input and fingerlings will lead to 0.029%, 0.057%, 0.005%,0.534%,0.007% , 0.79% and 0.001% in the value of fish produced respectively.

Sheheli et al. (2013) the study was conducted to investigate the existing status and practices of fish farming. Most of the farmers (89%) made profit from fish production. The impact analysis of fish farming on livelihood of fish farmers shows that overall 64% fish farmers have increased overall livelihood from fish farming during the last four years (2010- 2013). Access to micro-credit, provide good quality

input such as fry, feed, vaccines, etc., market facilities, supply of improve technologies, and provide training all lead to increased fish production.

Asamoah and Nunoo (2012) in this study Cobb-douglas Model was taken as analytical tool. The Cobb-Douglas production function, which relates production output to several independent input variables, Aquaculture exhibited increasing returns to scale over the period of the study. It means an increase in inputs will more than proportionately increase the output.

Ahmed (2011) the study suggests poly-culture rather than mono culture of production. The study provide evidence that integrated rice-fish farming can play an important role in increasing food production. Integrated farming system is better than rice monoculture in terms of resource utilization, diversity, productivity, and both the quality and quantity of the food produced. The Cobb-Douglas production function model also suggests that higher yields can be achieved by increasing inputs. Integrated rice-fish farming also provides various socioeconomic and environmental benefits analyzed from cobb-Douglas model.

Zannah (2011) the study was based on some participatory rural appraisal (PRA) technique tools such as personal interview, focus group discussion (FGD) and key informant interview with fish farmers in the area of Mymensingh. Data analysis revealed that the average pond size was 0.83 ha with a range from 2.5 ha to 15 ha. Overall, 80% of the fish farmers practiced polyculture while only 20% farmers practiced monoculture.

Phung et al. (2009) in this study a field experiment was conducted in the wet season 2007 using three doses of solid wastes. Rice yields were more or less the same in all treatments, suggesting that the fishpond waste replaced 1/3 to 2/3 of the fertilizer normally applied.

Faruk (2008) the research was carried out to examine the status of disease and health management practices in Pangasius hypophthalmus in Mymensingh District, Bangladesh.a financial loss of farmers due to fish disease was the main concern of the thesis. The most manifested symptoms of disease was reported by the fish farmers were red spot, followed by anal protrusion, tail and fin rot, pop eye, dropsy and gill

rot. Other symptoms like cotton wool type lesion, ulceration and white spot were also reported but with lower concern. The present study provided valuable information on disease and health management in P. hypophthalmus in Bangladesh based on primary data, mainly field data. Approximately 3.6% of farmers ‘faced loss of yearly income from fish production.

Chandra and Alam (2004) the study was conducted to determine the cost, return and relative profitability of pond fish production of Mymensingh and Jessore districts It was found that per hectare per year gross cost of pond fish production in Mymensingh and Jessore were Tk 333457.75 and Tk 54327.74, while gross return were Tk 434131.16 and Tk. 96640.00 and net return were Tk 100673.41 and Tk. 42312.26, respectively. Cobb- Doglus Model was taken for data analysis. Cobb-Douglas production function was applied to realize the specific effect of the factors on pond fish production. Among six variables included in the function by which three variables had positive impact on return from pond fish production, in Mymensingh district but five variables had positive impact on return from pond fish production in Jessore district.

Saha et al. (2004) the study was conducted to estimate the cost, return and relative profitability of pond fish production of Mymensingh and Jessore districts. A total of 75 ponds were selected (Trishal and Gou.ripur) of Mymensingh districts and Jessore district. The findings of this study stated that the pond fish production in Jessore district was more profitable than that of Mymensingh district. Cobb-Douglas production function was applied to realize the specific effect of the factors on pond fish production.

Cremer et al. (2003) in this study area two-stage feeding trial was conducted near Haikou, Hainan Province, to calculate fry to market growth performance of pangasius catfish using the ASA 80:20 pond production model and ASA soymeal-based feeds. Pangasius catfish grew from 190 g to an average weight of 880 g in 78 days.

The above review indicates that a limited number of studies on pangus fish farming was conducted in the areas under present study. The present study of pangus attempt to determine the profitability of pangus fish farming. Thus the findings of this

research are likely to provide useful information which will help farmers and researcher in many ways.

CHAPTER 3
METHODOLOGY

3.1 Introduction

A micro-level study based on primary data was designed to achieve the objectives of this study. In this study both descriptive and statistical analysis were done for analysis. All the data were collected from especially field survey. The methodology of the study is mainly about the sampling procedure, collection of data, Process of data and analytical framework to the objectives of this study.

3.2 Selection of Study Area:

The study was conducted in a major pangus (Pangasius hypophthalmus) cultivating district of Bangladesh, namely Mymensing district. Trishal and Bhaluka upazila of this district were selected purposively for administering questionnaire survey because the area has great potential to pangus cultivation. In Mymensing district there are many ponds and farmers are interested in fish farming specially pangus farming as it is a fast growing fish. The study area was selected because the area was suitable for pangus Culture, the availability of data collected be ensured. There were some reasons for selecting Trishal and Bhaluka upazillas in Mymensing. They are-

- One of the low land districts in Bangladesh causing abundance of ponds and water bodies,
- Some successful pangus fish farmers which was our one of the main concern.
- Fish farming is popular in that region
- Finally, the expectation of available data collection was high.

3.3 Socio-Economic Profile Analysis

To identify the socio-economic profile of the study area was one of our main objectives. To fulfill our objectives some parameters were taken for this procedure.

3.3.1 Population of the Study Area

All the farmers who cultivate pangus in Trishal and Bhaluka upazila of district constitute the population of the study. For this purpose, an up-to-date list of the pangus cultivators were prepared with the help of the village elites and fisheries officers. Based on population of farmers and fish farmers sample size was determined for this study.

3.3.2 Sampling Technique and Sample Size

A multistage stratified random sampling technique was followed to select sample respondents for the study. At first stage, Mymensing district was selected purposively considering its higher density of pangas cultivation. In the second stage, two upazilas of the district were selected accordingly. Finally, 50 farmer's bhaluka and 42 farmers Trishal were selected randomly from each upazila amassing a total of 92 cultivator from the study area for interviewing. Population stratification was necessitated for common heterogeneity among agricultural household populations.

3.3.3 Sampling Design and Distributing of Sample Farmers

Sample size was determined based on the fish farmers of the selected area. In the study area the fish cultivators. Total 92 sample of farmers were taken for this purpose.50 pangus farmers in Bhaluka upazila and 42 pangus farmers in Trishal upazilla.

Table-2.1: Population of the study area

Name of the district	Name of the upazila	Sample size
Mymensingh	Trisal	42
	Bhaluka	50
Total		92

Source: Field Survey, 2018

3.4 Method of Data Collection and Period of Study

The study was mainly based on primary data collected during April to December of the month of 2018. Field level interviewers were collected data under my close supervision. Household survey was done mainly for data collection method. The survey was conducted to collect data using pre-tested interview schedule. Detailed information necessitated for the study were collected as per input costs, market price, yields etc.

- Primary data collection
- Secondary data Collection

3.4.1 Primary Data Collection

Primary data was collected through questionnaire survey and household survey. An extensive questionnaire was prepared for data collection method. In questionnaire socio economic data as well as cost and returns of pangus production were collected for the study. For questionnaire survey different methods were taken that includes-

- ❖ Household survey
- ❖ Seminars and meeting
- ❖ From Government offices.

3.4.2 Secondary Data Collection

Secondary data were mainly collected from Zilla office, Upazilla Agriculture Extension offices of the selected area. Data from the fish farmers were also collected for this study. For Data analysis Microsoft Excel software was used for this study.

3.5 Socio-Economic Profile of the Study Area

A combination of participatory, qualitative and quantitative methods was used for data collection. From the data socio economic profile can be stated. For the analysis some criteria to be considered.

- Percentage of fish farmers and pangus fish farmers
- Educational status of fish farmers
- Number of fish cultivator members.
- Potential ware body for pangus cultivation
- Drinking water sources
- Sanitation facilities
- Technology use
- Family members

3.6 Analytical Techniques

3.6.1 Tabular Technique

Collected data were edited, summarized, tabulated and analyzed to fulfil the purposes of the study. Descriptive statistics like averages, percentages and ratios were used in presenting the results in a tabular form.

The profitability of pangus cultivation were examined on the basis of gross return (GR), gross margin (GM), net return (NR) and benefit cost ratio (BCR) analysis.

Besides, the imputed value of family labour were taken into account in the time of total cost approximation. Per year lease value of land were considered for determining the land use cost. Benefit Cost Ratio (BCR) will be calculated with the following formulas (Chauhan, 2014; Davies, 1996; Gittinger, 1982 and Sujan et al., 2017):

3.6.2 Profitability Analysis

Profitability of pangus will be analyzed to compare the return received by the cultivators. The following algebraic equation will be used to assess the costs and returns from different crops (Khandokeret al., 2017 and Sujanet al., 2017):

Equations for cost analysis are as follows-

$$\text{Variable Cost} = VC_{ij} = \sum_{t=1}^{n} X_i P_j$$

$TVC_{ij} = VC_{ij} + IOC_{ij}$

$TC_{ij} = TVC_{ij} + TFC_{ij}$

Where, TC_{ij} = Total cost (Tk/ha)

TVC_{ij}= Total variable cost (Tk/ha)

TFC_{ij} = Total fixed cost (Tk/ha)

VC_{ij}= Variable cost (Tk/ha)

IOC_{ij}= Interest of operating capital (Tk/ha)

X_{ij} = Quantity of inputs (kg)

P_{ij} = Price of inputs (Tk/kg)

i = Number of pangus cultivators (1.2.3…….n)

Equations for profitability analysis-

Gross return, $GR_{ij} = Y_{ij}P_{ij}$

Net return = $GR_{ij} - TC_{ij}$

Gross margin = $GR_{ij} - VC_{ij}$

Where, GRij = Gross return (Tk/ha)

P_{ij} = Price (Tk/ha) of panus fish

Y_{ij} = Quantity (kg/ha) produced

Benefit Cost Ratio (BCR) The benefit cost ratio (BCR) of an investment is the ratio of the undiscounted value of all cash inflows to the undiscounted value of all cash

outflows during the life of the project. It can be estimated using the following formula:

$$BCR = \sum_{i=1}^{n} \frac{B_i}{C_i}$$

Where, B_i = Total benefit (Tk/ha)

C_i = Total cost (Tk/ha)

i = Number of output (t =1, 2, 3 …….n)

3.7 Cobb-Douglas Production Function

While discussing the production theory of the firm, economists C. W. Cobb and P. H. Douglas used a special form of production function, which is known as the Cobb-Douglas Production Function. Cobb-Douglas (C-D) production function is of the form.

$Q = AL^{\alpha}K^{\beta}$

Where,

L = quantity used of labour

K = quantity used of capital

Q = quantity of output produced

A, α, β = positive constants.

Actually, the parameter A is the efficiency parameter. It serves as an indicator of the state of technology. The higher the value of A, the higher would be the level of output that can be produced by any particular combination of the inputs.

Also α and β are the distribution parameters. They have to do with the relative factor shares in the product. Here it is assumed that the firm uses two inputs, labor (L) and capital (K) and produces only one product (Q).

Functional Analysis

To explore the effect of variable inputs, Cobb-Douglas production function model was estimated as

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

The function was liberalized by turning into the double log or ln linear form-

$\ln Y=\ln a+b_1\ln X_1+ b_2\ln X_2+ b_3\ln X_3+ b_4\ln X_4+ b_5\ln X_5+U$

Here,

U=error term

a=intercept

b=co-efficient of the relevant variables

Y=Gross return from Pangus production per hactre (Tk/ha)

X_1= Lime cost (Tk/ha)

X_2=Fingerlings cost (Tk/ha)

$X_{3=}$ Fertilizer cost (Tk/ha)

$X_{4=}$ Labour cost (Tk/ha)

$X_{5=}$ Land cost (Tk/ha)

$X_{6=}$ Feed cost (Tk/ha)

$X_{7=}$ Water treatment cost (Tk/ha)

Returns to Scale: Returns to scale (RTS) reflect the degree to which a proportional change in all inputs cause change in the outputs. Constant (RTS) occurs when a proportional increase in all inputs results in the same proportional increase in output. Increasing (RTS) occurs when a proportional increase in all inputs results in a more than proportional increase in output, while decreasing (RTS) exists when a proportional increase in all inputs result in a less than proportional increase in output.

Returns to scale is defined as the change in output as factor inputs change in the same proportion. A production function explains the functional relationship between inputs (or factors of production) and the final physical output. Let us begin with a simple form a production function first Q = f(L, K). Empirical analysis of production investigates Returns to Scale estimating the total elasticity of production.

E=b1+b2

Here,

e=total elasticity

b1=partial production elasticity

When the elasticity is 1, it refers to constant returns to scale, when it is greater than 1, it indicates increasing returns to scale and when less than 1 ,decreasing returns to scale.

CHAPTER 4
DESCRIPTION OF THE STUDY AREA

4.1 Introduction

In this study two upazilas were selected as the areas have great potential for pangus cultivation. The selected areas were Bhaluka and Trishal upazilas in Mymensing District. The study was carried out from July-2018 to January-2019 in upazila at Mymensingh district in Bangladesh

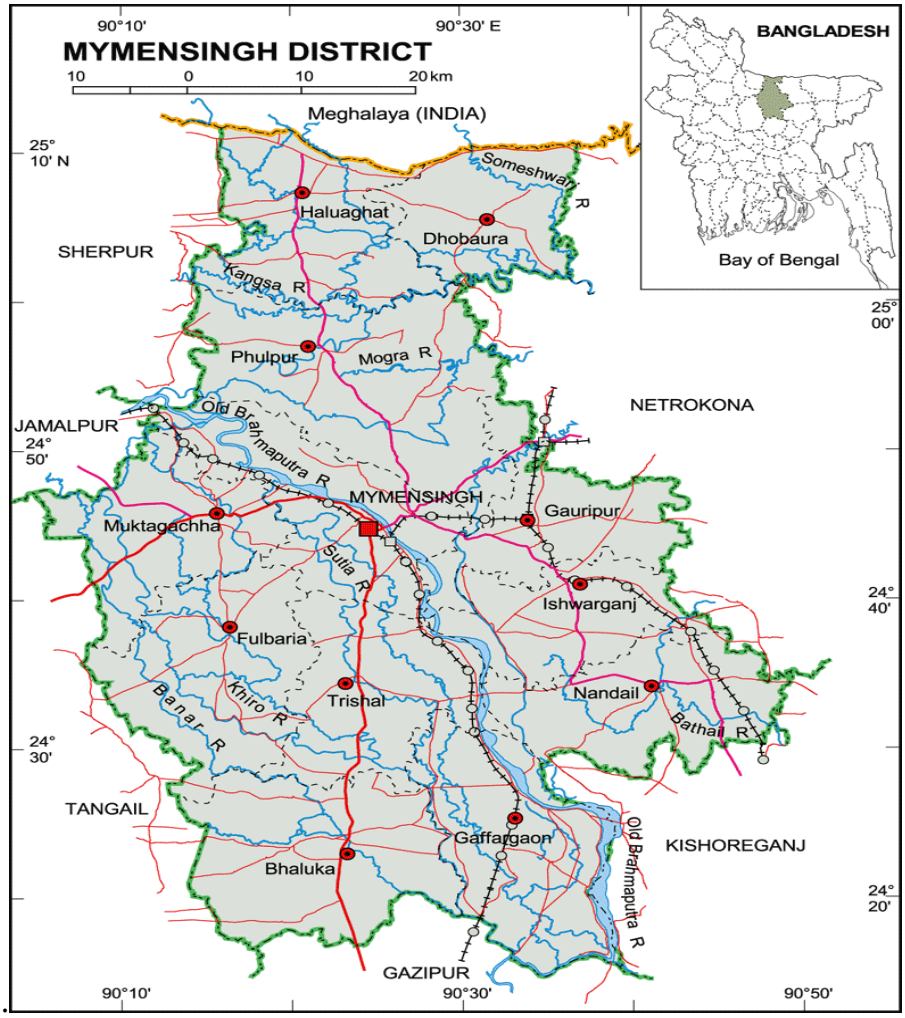

Fig 3.1: Map of Mymensing District (LGED, 2017)

4.2 Bhaluka Upazilla

4.2.1 Location

Bhaluka is an Upazila of the Mymensingh District in Mymensingh division of the Bangladesh. Bhaluka is the 1st Model Thana of Bangladesh. Its co-ordinates are 24°22.5′N 90°22.7E and total area is 444.05 km^2 (171.45 sq mi) (Banglapedia, 2017).

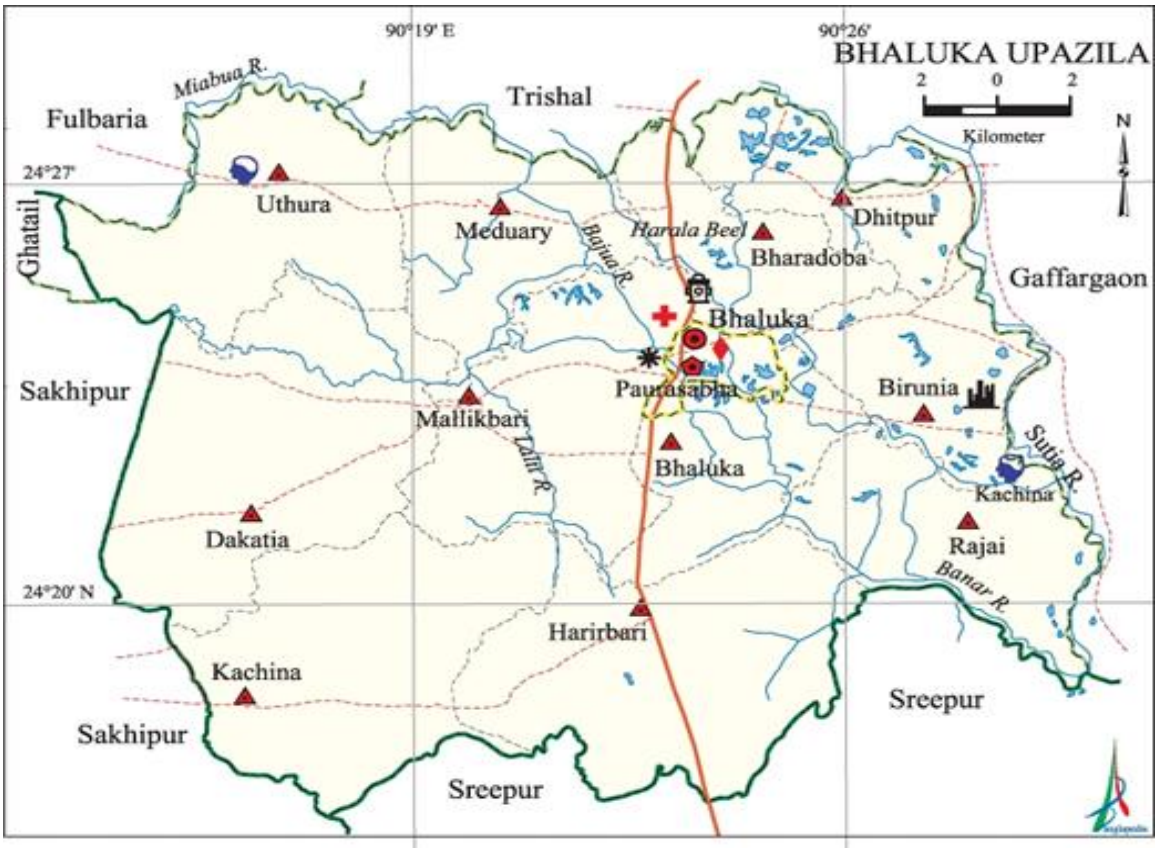

Fig 3.2: Map of Bhaluka Upazilla (LGED, 2017)

4.2.2 Demographic Information

According to the 2011 Bangladesh census, Bhaluka had a population of 430,320. Males constituted 50.46% of the population and females 49.54%. Muslims formed 95.45% of the population, Hindus 4.04%, Christians 0.34% and others 0.17%. Bhaluka had a literacy rate of 49.12% for the population 7 years and above. According to the 2011 Bangladesh census, Bhaluka had a population of 430,320. Males constituted 50.46% of the population and females 49.54%. Muslims formed 95.45% of the population, Hindus 4.04%, Christians 0.34% and others 0.17%. Bhaluka had a literacy rate of 49.12% for the population 7 years and above. (Bangladesh Census, 2011).

4.2.3 Educational Institution

Educational institutions: college 5, secondary school 42, primary school 127, community school 24, satellite school 7, technical school 1, madrasa 38 (BBS, 2011).

4.2.4 Income Source

Main sources of income Agriculture 69.72%, non-agricultural laborer 3.14%, industry 0.54%, commerce 9.48%, transport and communication 2.61%, service 5.91%, construction 1.04%, religious service '0.17%, rent and remittance 5.99% and others 1.40% (BBS, 2017).

4.2.5 Ownership of Agricultural land

Ownership of agricultural land Landowner 71.69%, landless 28.31%; agricultural landowner: urban' 59.59% and rural 73.01% (BBS, 2011).

4.2.6 Fish Cultivation

Fisheries, dairies and poultries: Fishery 25, poultry 35, hatchery 2. (BBS-2011).

4.2.7 Communication Facilities

Communication facilities Pucca road 125 km, semi-pucca road 17 km, mud road 805 km; railway 25 km; waterway 14 nautical miles.

4.3 Trishal Upazilla

4.3.1 Location

Trishal is an Upazila of the Mymensingh district in Mymensingh Division which coordinates is 24°34.5′N 90°23.5E. The area of Trishal is 338.98 km^2 (130.88 sq mi).

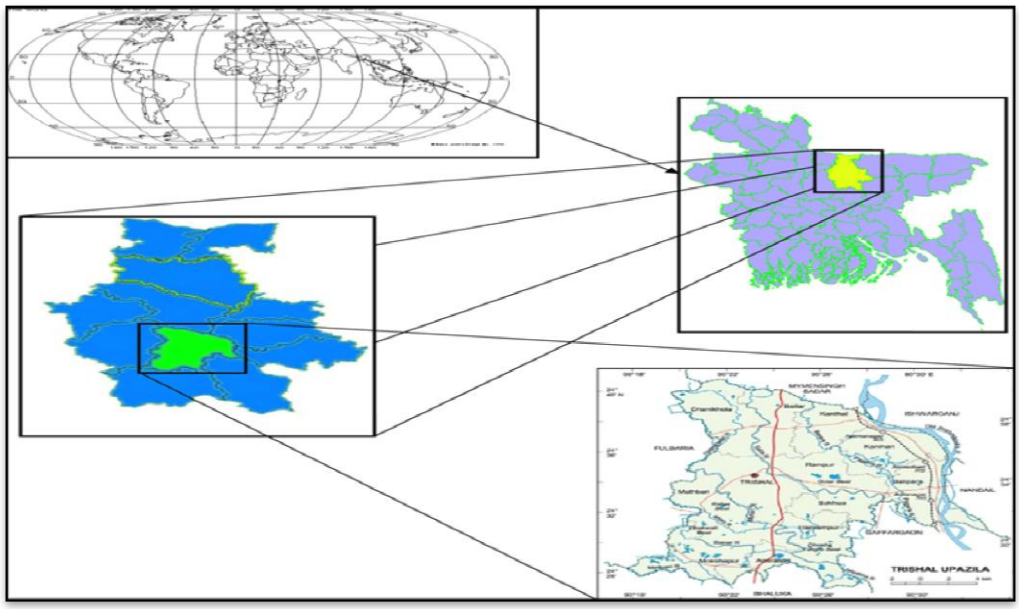

Fig 3.3; Location of Trishal Upazilla (LGED, 2017)

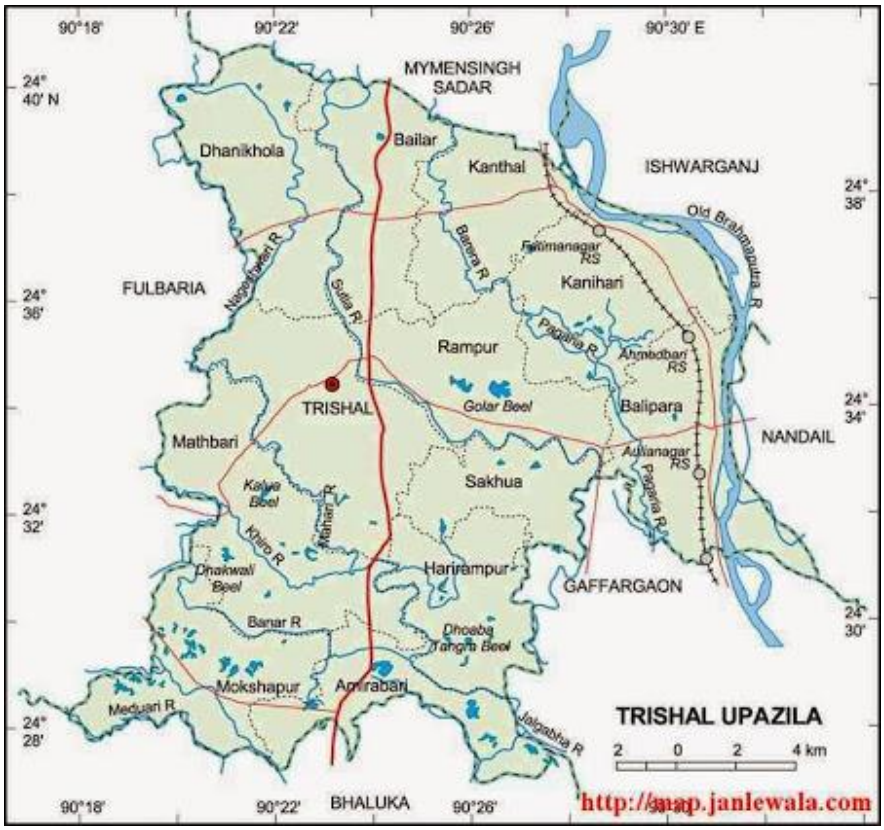

Fig 3.4 Location of Trishal Upazilla (LGED, 2017**)**

4.3.2 Demographic Information

According to the (BBS, 2011) Trishal had a population of 419,308. Males constituted 49.76% of the population and females 50.24%. Muslims formed 97.23% of the population, Hindus 2.70%, Christians 0.02% and others 0.05%. Trishal had a literacy rate of 40.02% for the population 7 years and above (Bangladesh Census, 2011).

4.3.3 Income Source

Main sources of income Agriculture 62.69%, non-agricultural laborer 3.58%, industry 0.52%, commerce 12.65%, transport and communication 3.79%, service 5.45%, construction 1.08%, religious service 0.27%, rent and remittance 0.57% and others 9.40%.

4.3.4 Ownership of Agricultural Land

Ownership of agricultural land Landowner 53.64%, landless 46.36%; agricultural landowner: urban 70.03% and rural 29.97%.

4.3.5 Fish Cultivation

Fisheries, dairies and poultries Fishery 9, dairy 14, poultry 85.

4.3.6 Communication Facilities

Communication facilities Pucca road 125 km, semi-pucca road 17 km, mud road 805 km; railway 25 km; waterway 14 nautical miles.

4.4 Comparative **Analysis**

In order to increase fish production, the Department of Fisheries (DoF) and some Non-Government Organizations (NGOs) are encouraging people to increase fish production not only in rivers but also in the surrounding water areas (pond, haor, baor, bee] etc.) of fish farmers.

Table 3.1: Water Body of Trishal and Bhaluka

Upazilla	Main water body
Trisal	Old Brahmaputra
Bhaluka	Sutia, Lalti, Bajua, Miabua, Salda; Harala Beel is also notable.

A comparative Socio-economic analysis was done based on the secondary information. From this information we found that Bhaluka has more Potential than Trishal. In the present situation Trishal is lack behind in agricultural activities, poultry fisheries and fish cultivation.

Table 3.2: Comparative Socio-economic Analysis

Features	Bhaluka (%)	Trishal (%)
Agriculture (%)	69.72%	62.69%
Non-agricultural laborers (%)	3.14%	3.58%
Agricultural land owner (%)	71.69%	53.64%,
Landless (%)	28.31%	46.36%
Poultries Fishery(number)	25%	9%
Average literacy (%)	41.10%	40.2%;

Source- Bangladesh Population Census 2001, Bangladesh Bureau of Statistics (BBS); Cultural Survey Report of Bhaluka and Trishal Upazila 2007.

4.5 Drinking Water Sources

In Bhaluka Sources of drinking water were informed Tube-well 88.66%, tap 0.57%, pond 0.69% and others 10.08%. In Trishal Sources of drinking water were informed Tube-well 93.70%, tap 0.43%, pond 0.67% and others 5.20%. In Both areas the drinking water facilities were satisfactory.

4.6 Sanitation Facilities

In Bhaluka upazilla the Sanitation system is 27.74% (rural 27.13% and urban 33.39%) of dwelling households of the upazila use sanitary latrines and 37.43% (urban 36.54% and rural 45.59%) of dwelling households use non-sanitary latrines; 34.43% of households do not have latrine facilities(Bangladesh Population Census 2001, Bangladesh Bureau of Statistics; Cultural survey report of BhalukaUpazila2007.In Trishal Sanitation 22.97% (rural 20.18% and urban 46.05%) of dwelling households of the upazila use sanitary latrines and 44.79% (rural 46.36% and urban 31.74%) of dwelling households use non-sanitary latrines; 32.24% of households do not have latrine facilities(Bangladesh Population Census 2001, Bangladesh Bureau of Statistics; Cultural survey report of Trishal Upazila 2007).

CHAPTER 5
SOCIO-ECONOMIC CHARACTERISTICS OF PANGUS FARMERS

Introduction

Socio-demographic characteristics are the reflection of individual's positive or negative qualities. To get a more complete picture of pangus fish culture, it is essential to know the socio -economic characteristics of the farmers. In this chapter, an attempt was made to identify the socioeconomic characteristics of the sample farmers like age of the farmers, occupational structure, level of education, family size, land holding and distribution of land income level etc.

5.1 Socio-Economic Profile: Socio-economic characteristics are very important which reflects the individual's characteristics and physical situation. The relations between socio-demographic, socio-economic status and activities of daily living are very complex

5.1.2 Primary Occupation of Fish Farmers

Pangus is a profitable source of income. From our study it is found that overall 82% farmer are engaged in fish cultivation as their major income source. Only a few percentage of people had other jobs as extra source of income. From my analysis I found that 2% people main income source was agriculture, 3% people in small business, 2% student and only 9% farmers have shops as an income source.

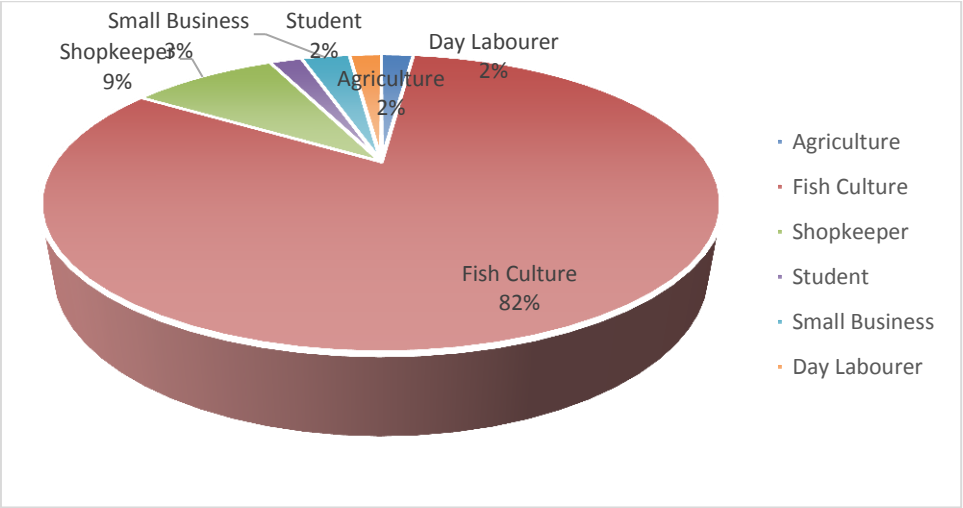

Fig 5.1: Major Occupation of Study Area

(Source: Field Survey Data, 2018)

As I chose two study area, the area based scenario was a little bit different but insignificant result was found. Both Trishal and Bhaluka, the percentage of people involved in fish culture were 76% and 86%. More peole were involved in fish culture in Bhaluka rather than Trishal.

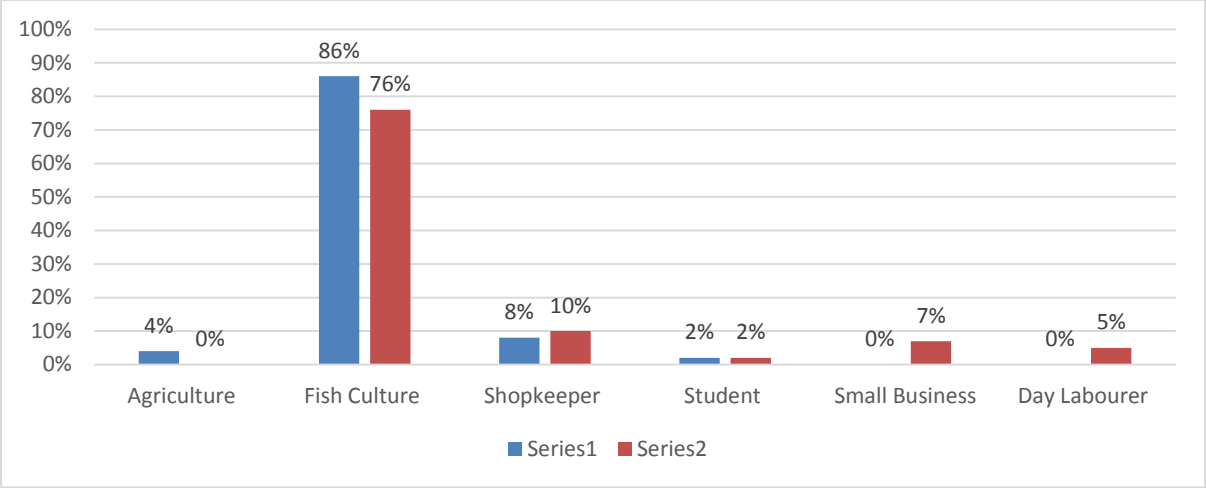

Fig 5.3: Major Occupation of Bhaluka and Trishal Upazilla;

(Source: Field Survey Data, 2018)

A comparison was done between the two study area Bhaluka and Trishal Upazila. Almost all the categories there is not much difference between two areas but in Fish cultivation. The difference was 10% which is significant. From the field data the overall scenario was given in the following table-

Table 5.1: Comparative Analysis of Bhaulka and Trishal Upazila Field Survey Occupation

Category	Bhaluka		Trishal		Total	
	Number	percentage	Number	percentage	Number	percentage
Agriculture	2	4%	0	0%	2	**2%**
Fish culture	43	86%	32	76%	75	**82%**
Shopkeper	4	8%	4	10%	8	**9%**
Student	1	2%	1	2%	2	**2%**
Small business	0	0%	3	7%	3	**3%**
Day laborer	0	0%	2	5%	2	**2%**

Source: Field Survey, 2018

5.1.3 Age Structure of Fish Farmers

From this analysis, it was found that fishermen, belonged to the age groups of 21 to 31 years (18%), 31 to 40 years (39%),41 to 50 years (28%) and the others were 51 to above (15%).

Table 5.2 Age structure of fish farmers

Age Group	Number	Percentage
20-30	16	18%
31-40	36	39%
41-50	26	28%
51-above	14	15%
Total	92	100%

Source: Field Survey, 2018

5.1.4 Educational Status of Fish Farmers

From the above table, it is found that has the highest percentage of literacy rate with 50% in secondary education and 1% people were illiterate. The literacy rate was not up to the mark among the fish farmers. Only 23% farmers are degree or hons pass and a good knowledge of fish farming.

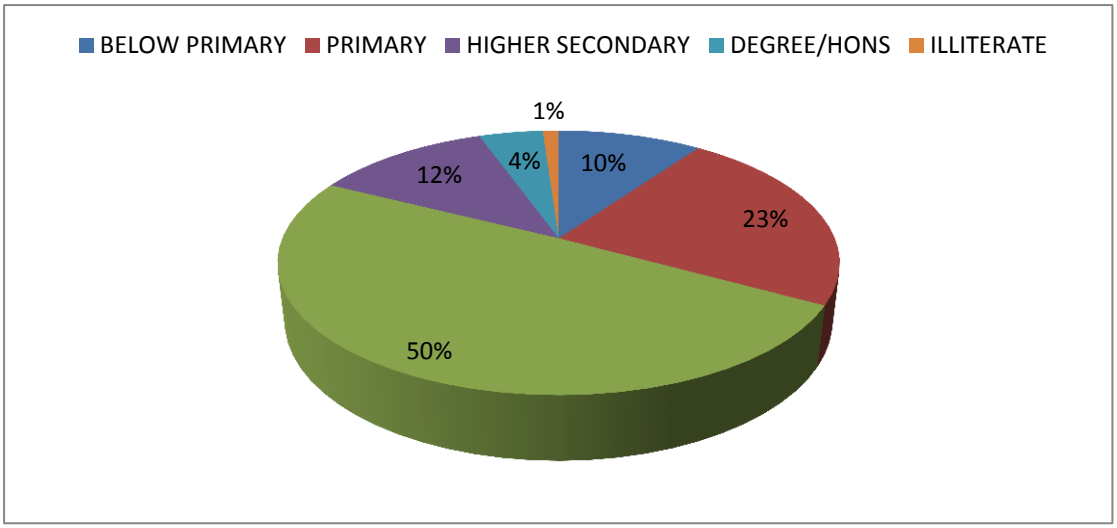

Fig 5.5: Educational Structure of study Area

5.1.5 Population Size

For study purpose 92 samples were takes for analysis. From this data it was found that male people (53%) are larger number than female (47%) people.

Table 5.3: Population Size of the Study Area

Gender	Number	Percentage
Total Male	207	53%
Total Female	182	47%
Total	391	100%

Source:Field Survey, 2018

5.1.7 Use of Technology

Technology is also an application of science which is used to expand the production of fisheries. Intensive means advance technology and modern way of cultivation. Intensive refers large cultivation with low inputs. Using proper technology is a main tool for increasing the production of pangus. But the result was satisfactory as the 98%adpoted technology which of them 34% adopted extensive technology, 33% semi intensive and 31% intensive and only 2% people were not aware of such technology.

Table 5.6: Use of Technology

Use of Technology	Number	Percentage
Extensive	31	34%
Semi-intensive	30	33%
Intensive	29	31%
None	2	2%
Total	92	100

Source: Field Survey, 2018

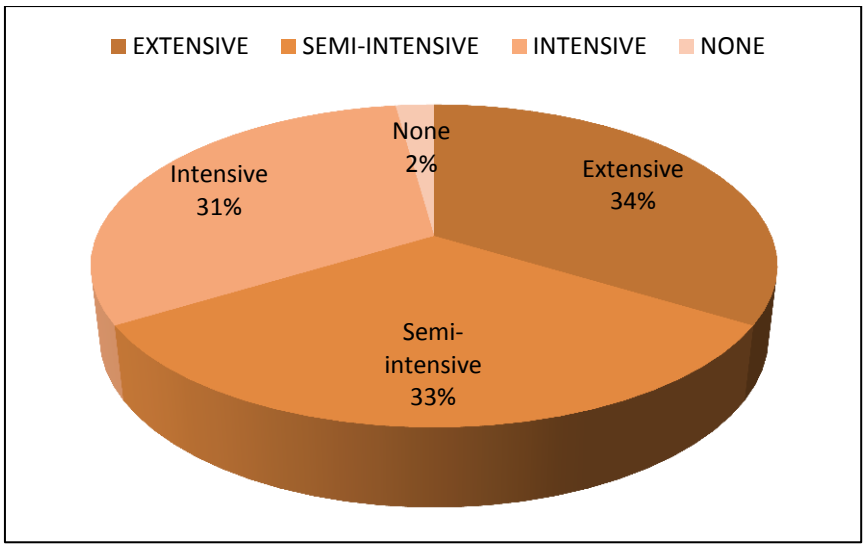

Fig 5.7: Use of Technology

5.1.8 Availability of Training

Many government and non-government organization are available train people for pangus culture as it is one of the most profitable business in Bangladesh. People get information and necessary training very easily .100% people got there from various organizations. But NGO plays a vital role in this and 65% people trained through NGO sector. In this case only 1% farmers trained by research organization which is the lowest. As NGO gives proper training and user friendly scheme and easy access, farmers got attracted to them rather than government organization though the government provides low cost training.

Table 5.5: Availability of Training

Organization	Number	Percentage
Research organization	1	1%
Zilla fisheries office	17	19%
NGO	57	62%
Upazilla fisheries office	5	5%
NATP Project	9	10%
Youth Development Office	3	3%
Others	0	0%

Source: Field Survey, 2018

5.2 Resource Use Efficiency Analysis

Production depends on the utilization of resources. Resource use efficiency accelerate the production to a very profitable situation. For fish cultivation resources include proper land use, use of water resources, use of technology etc.

5.2.1 Land Use Efficiency

Land-use is one of the main resources of fish culture. From the field survey data, it was found that 37% farmers cultivate in their own land. Because if risk factor farmers were willing to rent their land for different purposes rather than fish cultivation. From field survey maximum amount of people, 43% people rent their lands to others. Only 4% people mortgage land from other farmers and mahajons which is the lowest percentages.

Table 5.6: Land Use Efficiency

Land type	Per (Ha)	Percentages
Cultivation in own land	1052	37%
Rented-in	129	5%
Rented-out	1202	43%
Mortgage-in	102	4%
Mortgage -out	321	11%

Source: Field Survey, 2018

5.2.2 Number of Cage Using for Cultivation

Cage is important for fish cultivation. The average number of cage cultivation in the following

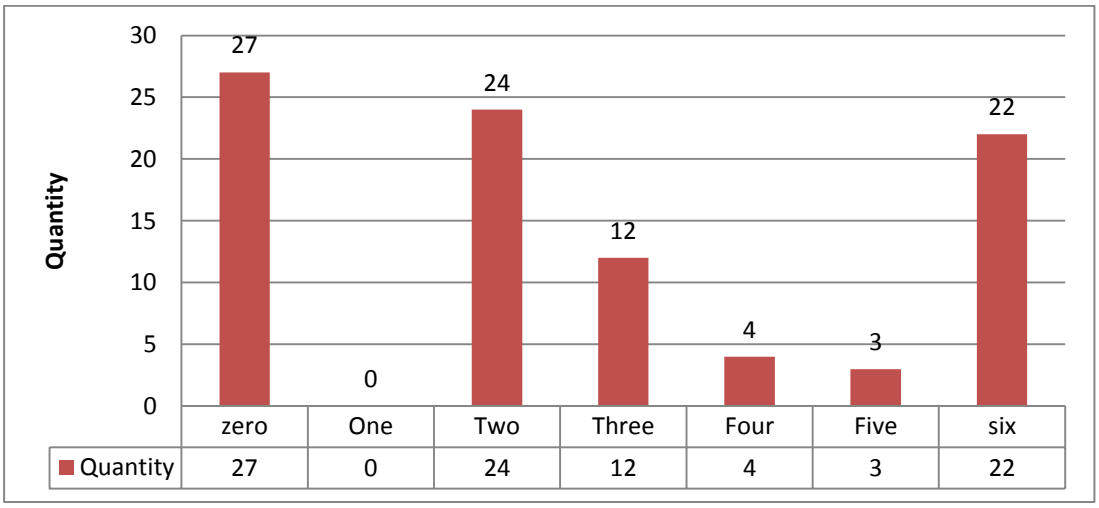

Fig 5.9 Number of Cage Using Cultivation

Quality Fingerlings

From this study, it is found that only 8% farmers use low quality of fingerlings and 92% fish cultivators use high quality fingerlings.

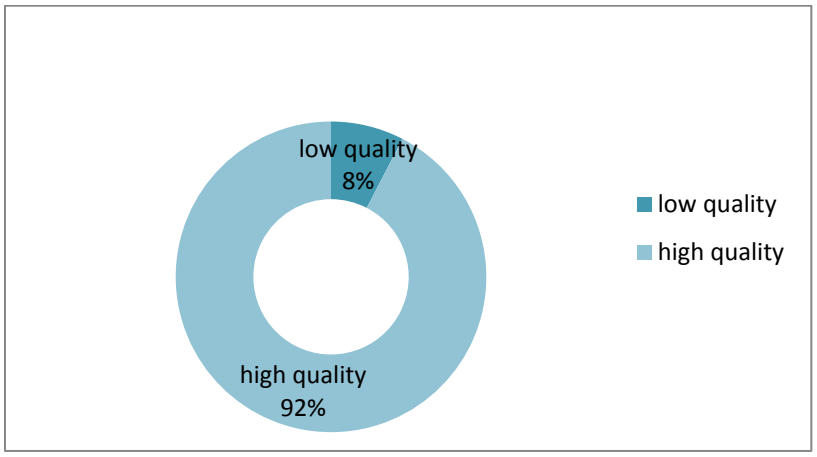

Fig 5.9: Quality of Fingerlings

CHAPTER 06
PROFITABILITY OF PANGUS FISH FARMING

6.1 Introduction

Profit margin depends on the type of farming and the production of species. To identify the profit margin of pangus cultivation in the study area was one of the main objectives of this study. For estimating profit-cost analysis we need to determine cost and returns of pangus fish production. Production cost plays a vital role in many ways like decision making, marketing strategies etc. Pangus farmers did not mention any written records and the survey was done through their sharp memory and experiences. The main purpose of this study was to determine the cost of total Pangus cultivation.

6.2 Estimation of Total Costs and Returns

Cost and returns calculated from field survey and farmers point of view. As the record were not accurate, so the cost of our analysis also not so much accurate. Cost was calculated from all the possible inputs used in pangus cultivation.

6.2.1 Cost of Lime

Lime is essential for pangus culture. Liming fish ponds is not always necessary for productivity. Lime stone reduces the acidity of pond bottom soils, makes nutrients more available, and increases the alkalinity and hardness of water which increase productivity. Lime is very cheap in our country and need not to use more because of good condition of our existing ponds. The average total cost of lime of fish farmers was Tk 9300 per year.

6.2.2 Cost of Fingerlings

The cost of fingerlings depends on the quality and type of pangus. The cost depends availability of proper time of pangus. The average cost of fingerlings was 4 TK/piece. The average cost of fingerlings per hectare per year for pangus production was Tk. 138488.

6.2.3 Pond Repair Cost

Pond repair was one of the most element of pangus fish cultivation. Ponds repair and prepared required for high production of pangus fish. The average cost of pond repair per hectare per year Tk was 19960.

6.2.4 Cost of Fertilizer

Different types of fertilizers were used in this purpose. Urea, TSP (Tripple Super Phosphate) and others types of fertilizer used. The price of fertilizer in the study area was urea 18Tk /kg and average cost of fertilizer per hectare per year was tk 18928.

6.2.5 Labour Cost

Human labour is an important factor in fish farming. Human labor has been measured in man-day. In our study area in fish farming all the members of the family engaged in the fish culture. From fish harvesting and marketing of pangus fish, human labour is so much crucial in various types of operation and management. The average amount of human labour required to per hectare per year total cost Tk 87540.

6.2.6 Land Cost

The leasing cost of water body varies from one place to another due to productive capacity of individual water bodied as well as owing to their location. Pond rental value was calculated Tk 126200 per hectare for one year which shared 5.92 percent of total cost of pangus fish production. This was treated as fixed cost in this study.

6.2.7 Cost of Feed

Now-a-days a variety of feeds are used for aquaculture in Bangladesh including supplementary feed, farm-made feeds and manufactured feeds. Extensive farmers mainly use supplementary feed. The average price range of supplementary feed was estimated to be Tk 62.63 per kg. Homemade Feed is usually made by rice bran, wheat bran, oil cake and occasionally incorporating soybean meal and fish meal. Maintaining feed quality remains challenging. In many cases, poor feed quality results in low fish production and causing loss .In our findings it as found that the major amount of cost responsible feed cost .The price of pangus feed in the study area was Tk 62.63 and average cost of feed per hectare per year was Tk 1592948.

6.2.8 Cost of Water Treatment

Water quality depends on the productivity of fish production. Fish cannot live in contaminated water. Maintaining good water quality is the most important aspect of fish keeping. Poor water quality often means that the dissolved oxygen level is very low. The average cost per hectare per year Tk 11203. Spend for water treatment as water quality was good in the selected study area.

Table 6.1 Total Cost of Producing of Pangus Fish Per Year

Cost items	Cost(Tk/ha)	Percentage (%)
Labor cost	87540	4.11
Guard salary	25057	1.17
Fingerlings	138488	6.50
Lime	9300	0.43
Feed	1592948	74.79
Pond repair	19960	0.93
Water treatment	11203	0.52
Interest	10341	0.48
Salt	4875	0.22
Electric bills	7625	0.35
Fertilizer	18928	0.88
Others	77270	3.62
Land cost (Fixed Cost)	126200	5.92
Total Cost	**2129735**	**100**

Source: Field Survey, 2018

6.2.9 Cost of Interest

Interest on operating cost calculated directly from the survey data from the farmers. In this study the interest was found the average cost per hectare per year Tk 10341 in the pangus fish cultivation.

6.2.10 Cost of Salt

Salt application is important factor for pangus fish production to reduce the red colour spot disease of pangus fish production. Average price of salt in the study area was 25 Tk/Kg. Average cost of salt per hectare per year was Tk 4875.

6.2.11 Cost of Electric Bills

Electricity is very essential for ensuring irrigation water. Average cost of electricity of pangus fish producer Tk 7625 per hectare.

6.2.12 Guard Salary

Average cost of guard salary Tk 25057 per hectare per year paid to consignment pangus fish production to the study area.

6.2.13 Cost of Others

Average cost of others Tk 77270 per hectare per year was required for panus fish cultivation selected study area.

6.3 Gross Cost of Pangus Fish Production

Gross cost was calculated by the summation of total consumption and total sale. Variable cost includes human labour, cost of fingerlings, pond repair, water treatment, feed of pangus, lime, salt, equipment fertilizers etc. variable cost changes due to different season, different criteria and provision of government. Fixed cost includes land cost and interest of operating capital .it is observed that the feed cost shared the major amount of gross cost (74.79%) as proper feed was of the main element of cultivation.

Table 6 .2 Average Returns from Pangus Cultivation

Items	Quanitity(kg)	Price(Tk/Kg)	Value(Tk)	%
Consumption	810	80	64800	2.62
Sale	30072	80	2405760	97.38
Total	30882		2470,560	100

Source: Field Survey, 2018

From table 6.2 it was found that only 2.62% of pangus fish was consumed and 97.38% fish were used only for sale and business purpose. From the cost and return,

benefit cost ratio was easily measured through this data. BCR measures whether the production is profitable or not.

Gross Return (GR)

Gross Return (GR) is the value of total return of product.GR was calculated by multiplying the total amount of product by the respective market price of pangus of that time. Gross Return was estimated Tk 2470,560 per hectare per year gross return (Table-6.3)

Total Variable Cost (TVC)

Variable cost includes fingerlings cost, guard cost, lime cost, salt, fertilizers, electric bills, pond repair, water treatment, electric bills, netting etc. The total variable cost was Tk 2003535 per hectare per year (Table-6.3)

Total Fixed Cost (TFC)

Total fixed cost includes land cost and interest cost. The total fixed cost calculated Tk 126200 per hectare per year total fixed cost (Table -6.3)

Total Cost (TC)

Total cost is the summation of total variable cost and total fixed cost.

TC = (TVC+TFC)

From this study the total cost was Tk 2129735 per hectare per year, which was essential to calculate the Benefit Cost Ratio (BCR)

Net Return (NR)

Net Return was calculated by Deducting Gross cost from Gross returns. From this calculation NR was measured Tk 340,825 per hectare per year net return was estimated (Table-6.3)

Table 6.3 Cost and Returns for Pangus Producing

Particulars	Unit	Cost and returns(TK/ha)
Yield	Kg	30882
Gross Return(GR)	Tk	2470,560
Total Variable Cost(TVC)	Tk	2003535
Total fixed Cost (TFC)	Tk	126200
Total cost TC= (TVC+TFC)	Tk	2129735
Gross Margin GM= (GR-TVC)	Tk	467,025
Net Return NR= (GR-TC)	Tk	340,825
Return over per taka investment(NR/TC)		0.16
BCR(GR/TC)		**1.16**

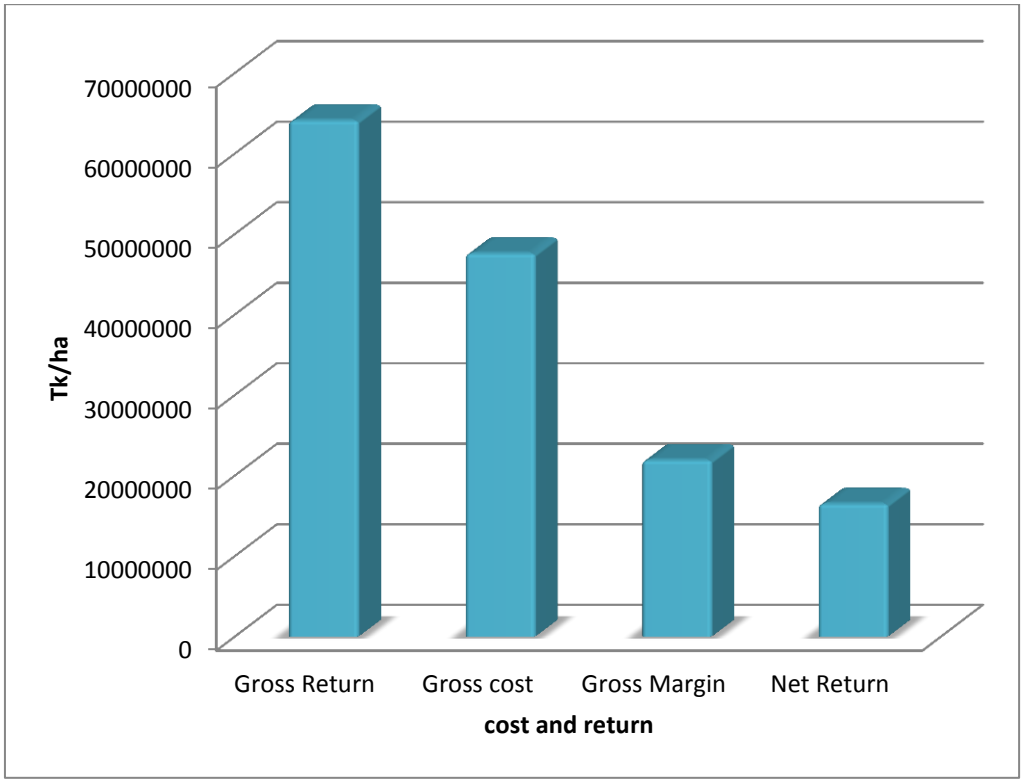

Fig 6.1 Bar Diagram of Cost and Returns

Return Over Per Taka Investment

Return over per taka investment is the ratio between net return and total cost. Return over per Tk. investment was calculated diving the net return by total cost (NR/TC). Return over per Tk. investment was 0.16 (Table-6.3)

Benefit Cost Ratio (BCR)

BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. The higher the BCR the better the investment. General rule of thumb is that if the benefit is higher than the cost the project is a good investment. In this study the ratio was 1.16 indicates that pungas production was profitable in our study area. This BCR indicates more potential of pangus cultivation.

CHAPTER 7
DETERMINANTS OF PANGUS CULTIVATION

7.1 Introduction

The main objective of this chapter was to analyze the factors that affecting cost return and profitability. Cobb-Douglas Production Model was applied for this study. This model was highly recommended for profitability analysis.

7.2 Factors Affecting Gross Return

Pangus fish production is the outcome of using various input of production process. In this study the main factors that affect mostly were fingerlings, lime, land cost, pond repair, feed cost used and water treatment cost.

7.3 Interpretation of Results

The estimated co-efficient and related statistics of the Cobb-Douglas Model production Function were analyzed in table-7.1**.**

Cost of Lime ($X_{1)}$

The regression coefficient of lime cost (X_1) in pangus fish production was positive (0.01) and it reveals that 1 percent increase in the cost of lime, keeping others factors constant, would increase gross return of fish production by 0.01. This coefficient was not statistically significant.

Cost of Fingerlings (X_2)

The Regression coefficient of fingerlings cost(X_2) in pangus fish production was positive (0.09) and it reveals that 1 percent increase in the cost of fingerlings, keeping others factors constant, would increase gross return of fish production by 0.09 percent. This coefficient was not statistically significant.

Fertilizer Cost (X_3)

The production coefficient of fertilizer cost(X_3) was 0.96 with positive sign and significant at 1 percent level of significance. Keeping other things constant, 1 percent increase in fertilizer lead to an increase in gross return by 0.96 percent

Labour Cost (X_4)

The regression coefficient of labour cost (X_4) in pangus fish production was positive (0.06) and it reveals that 1 percent increase in the cost of labour cost, keeping others factors constant, would increase gross return of fish production by 0.06 percent. This coefficient was not statistically significant.

Land Cost (X_5)

The Regression coefficient of land cost was negative (-0.06) for pangus fish production and indicate that the over use of this input. An increase of 1percent of money spent on land cost, keeping others factors constant, would result in a decrease of gross return by 0.06 percent (Table 7.1). The possible cause of this negative sing might be the irrational use of land cost for different activities in producing pangus fish. Farmers can have better per hectare return of pangus fish by reducing this inputs, although this was not statistically significant.

Cost of Feed (X_6)

The Regression coefficient of feed cost (X_6) was 8.58 with positive sign and significant at 5 percent level of significance, keeping other things constant, 5 percent increase in feed cost lead to an increase in gross return by 8.58 percent.

Water Treatment (X_7)

The coefficient of water treatment cost (X_7) was negative (-3.64) and significant at 1 percent level indicating 1 percent increase in the cost of water treatment keeping others factors constant would decrease gross return of pangus fish production by 3.64 percent. The possible cause of this negative sign might be the irrational use of water treatment cost for different activities in producing pangus fish. Farmers can have better per hectare return by reducing this input.

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Table 7.1 Estimated Co-Efficient and Related Statistics of Cobb-Douglas Production Function Model

Variables	Co-efficient	Standard Error	t value	P value
Intercept	12.92	12.82	-1.00	0.31
Lime (X_1)	0.01	0.19	0.05	0.95
Fingerlings (X_2)	0.09	0.09	0.98	0.32
Fertilizer (X_3)	0.96***	0.35	2.72	0.00
Labour cost (X_4)	0.06	0.04	1.65	0.10
Land cost (X_5)	-0.06	0.15	-0.38	0.70
Feed cost (X_6)	8.58**	3.85	2.22	0.02
Water treatment ($X_{7)}$	-3.64***	1.05	-3.46	0.00
Multiple R	0.81			
R^2	0.65			
Adjusted R^2	0.61			
F	4.22			
Returns to scale	6			

Note: *** Significant at 1%level; ** Significant at 5%level

Value of R^2 and Adjusted R^2

The coefficient of multiple determinations, R^2 was 0.65 which indicates that about 65% return from Pangus culture was explained by variables included this model indicates that excluded variables accounted 35% of the variation in pangus fish farming.

The adjusted R^2 was 0.61 which indicates that about 61% return from Pangus culture was explained by variables included this model and 39% variables excluded from this model. The value of adjusted R^2 Is the corrected co-efficient by the explanatory variables.

F-value

F value of this equation is 4.22 which is highly significant indicating that all the included explanatory variables were important for the Pangus cultivation.

Results of the Model

- F-values were used to measure the goodness of fit for different types of inputs.
- The p-value for each term tests the null hypothesis that the coefficient is equal to zero (no effect). A low p-value (< 0.05) indicates that you can reject the null hypothesis. In other words, a predictor that has a low p-value is likely to be a meaningful addition to your model because changes in the predictor's value are related to changes in the response variable.
- Regression coefficients represent the mean change in the response variable for one unit of change

CHAPTER 8
PROBLEMS AND CONSTRAINTS IN PANGUS FISH PRODUCTION

Introduction:

The objectives of this chapter is to identify and analyze the major problems and constraints faced by the producers were identified according to opinions given them.

Lack of Proper Skill and Education

The country is burden with large population and most of the populations are illiterate and unskilled. Most of the farmers did not keep record of profit and loss and the cost of each inputs. In Descriptive statistics 23% fish farmers educated up to primary level and 50% farmers up to secondary level. Mainly uneducated and unskilled people are in agricultural business, with proper education can make this sector very prominent.

Adequate Training

People are not aware of proper training and education about pangus cultivation provided by the government and NGOs.

Government Interventions

The Government fisheries sector should be more efficient to supply high quality fingerlings and food and fertilizer among fish farmers. Fisheries Extension office should be more efficient and active to maximize the production.

Provision of Poly-Culture.

Provision of poly-culture should be introduced to maximize the profit. Mixed use cultivation is not introduced properly among the farmers.

Market Instability

Inconsistent pangus fish price, there is no fixed price of pangus throughout the year. Fish cultivators sometimes face loss and stop fish cultivation.

In-Affordable Feed

Price of fish-food is very high which is not affordable for fish cultivators. In this study the maximum 74.79 % cost was in purchasing the fish feed.

Provision of Small and Soft-Loan

There is no easy small loan scheme for fish farmers, many people have not enough money to cultivate. Many farmers have to stop fish farming because of not having money.

Use of Technology

From this study majority of the fish farmers use extensive (34%) and obsolete technology. Use of proper technology should be introduced properly.

Proper Monitoring

The major areas were identified to improve the existing pond fish farming situation were access to low interest loan, quality seed, 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 flourish inland fish production in the study area.. But the seed quality of fish is now a major threat for aquaculture expansion.

Solutions to the Problems:

Producers put forward some suggestion, the prominent of which were easy procedure for obtaining bank loan, availability of fish seeds and inputs in proper, social, moral and scientific education and training improved marketing facilities; low rate of interest; fixed price of major inputs and implementation of government rules.

CHAPTER 9
SUMMARY CONCLUSION AND RECOMMENDATION

9.1 Introduction

This chapter present the summary, policy recommendation and conclusion of the study considering salient features of different chapter.

9.2 Summary

Agriculture sector in Bangladesh consists of four sub-sectors and among them fisheries sub-sector is the most important in terms of GDP contribute, export earnings, employment opportunities and nation's animal protein intake. This country has a long tradition in Agriculture and most of the people depend on fish a principal source of animal protein. The demand for fish is increasing day by day but at home and the world market .The Government of Bangladesh has expressed the determination to become self-sufficient in food production .In order to achieve the objectives of self-sufficiency in food top most priority has been placed on the campaign of massive production of crops and fisheries .In fact, cereal crops can satisfy hunger temporarily, but can hardly fulfill the nutritional requirement which are most essential for human body. The present level of animal protein production in Bangladesh fails to satisfy the demand of increasing population. For increasing the production of fish, it is obvious that number of fish must be increased. The present study is designed with a view evaluating the profitability of pangus fish production by analyzing costs and returns. The main objectives of the present study were as follow:

a. To delineate the socio-economic profile of pangus cultivators in the study area;
b. To identify the profit margin of pangus cultivation in the study area.
c. To estimate determinants of pangus cultivation on sample farm.
d. To find out constraint faced during the cultivation of pangus in the study area.

As the fishery sector plays a vital role in the socioeconomic development, it has a great opportunity for employment generation, poverty alleviation and earning foreign exchange for Bangladesh. From this study it is found that Pangus cultivation has great potential in our country after evaluating the data analysis .In Descriptive statistics 23% fish farmers educated up to primary level and 50% farmers up to secondary

level. In adapting technology only 31% used intensive technology, 33% semi-intensive and 34% extensive. Training is not adequate 65% pangus farmers get training from NGOs, Government intervention should be included in training purpose. It can be more profitable business as we can see from the analysis that the profit cost ratio is positive and the result was 1.16 benefit cost ratio indicates the existing scenario was profitable for pangus cultivation. Cobb-Douglas production function was applied to identify the specific effect of the factors on production. Among the variables feed cost, fertilizer cost, water treatment cost positive coefficient and significant impact on return of the pangus production. The adjusted R^2 was 0.61 which indicates that about 61%return from Pangus culture was explained by variables included this model and 39% variables excluded from this model. F value of this equation is 4.22 which is highly significant indicating that all the included explanatory variables were important for the Pangus cultivation.

From returns to scale it shows that all the inputs specified the production increased by 1%, the gross return increase by 5%.

9.3 Conclusion

The overall findings of the research suggest that pangus fish production is a profitable enterprise. It is faced, however, with some problems, if the constraints could be removed and pangus producers are given incentives, these scientific pangus production could help in income and employment generation and poverty alleviation in the country. It may be concluded that large-scale pangus production may contribute to overall economic development.

9.4 Recommendations

The following recommendation may be advanced which are likely to be useful for policy formulation

1. Government interventions for Training program should be updated for fish farmers with the collaboration of DoF and other NGOs.
2. Reasonable and low cost price of feed, fingerling and other inputs should be ensured and proper distribution of these inputs should be strengthened.
3. Bank loan and other institutional credit should be made affordable on easy terms and conditions to the fish farm owners and fish farmers.

4. Marketing facilities and inequalities should be improved to get market stability of their product throughout the year.
5. Availability of inputs should be made at proper time.
6. Continuous monitoring and evaluation should be ensured to avoid adulterate fish inputs and feed which shorten the pangus fish production.
7. The area should be protected from inundation.

9.5: **Limitations**

Almost all the research works have limitations in terms of time, money and personnel. The study is not an exception to them. Some of the specific limitation of this study may be observed as follows:

i. Most of the farmers did not keep record of their fish farming business. The farmers, therefore, had to furnish information mainly from their memory. To overcome this problem, several visits were made by the researcher herself to ensure the collection of reasonably accurate data from the field.
ii. Necessary data were collected from a limited area covering a small number of samples. Results obtained form an observation of 92 sample producers may be inadequate to represent the actual situation.

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