PROFITABILITY AND RESOURCE USE EFFICIENCY OF SHRIMP AND PRAWN CULTURE IN SOUTHERN DISTRICTS OF BANGLADESH

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JUNE, 2019

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REGISTRATION NO. : 13-05380

A Thesis

Submitted to the Department of Agribusiness Management

Sher-e-Bangla Agricultural University, Dhaka

In partial fulfilment of the requirements

for the degree of

MASTER OF SCIENCE (MS)
IN
DEPARTMENT AND POVERTY STUDIES

SEMESTER: JANUARY- JUNE, 2019

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CERTIFICATE

This is to certify that the thesis entitled **" PROFITABILITY AND RESOURCE USE EFFICIENCY OF SHRIMP AND PRAWN CULTURE IN SOUTHERN DISTRICTS OF BANGLADESH"** submitted to the Department of Development and Poverty Studies, Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka in partial fulfillment of the requirements for the degree of **Master of Science (MS) in Development and Poverty Studies**, embodies the result of a piece of bona fide research work carried out by **TASMIA MAHMUDA CHOWDHURY, Registration No. 13-05380** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Dated: 1-12-2019
Dhaka, Bangladesh

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DEDICATED

TO

MY BELOVED

PARENTS

ACKNOWLEDGEMENT

Alhamdulillah, all praises are due to the almighty Allah for His gracious kindness and infinite mercy in all the endeavors which create that opportunity for the author to successfully complete the research work required for the partial fulfillment of the degree of Master of Science.

The author would like to express her heartfelt gratitude and sincere appreciation to her supervisor Professor Dr. Mohammad Mizanul Haque Kazal, Department of Development and Poverty Studies, Sher-e-Bangla Agricultural University, Dhaka, for his valuable guidance, advice, encouragement and support throughout the study. Likewise, grateful appreciation is conveyed to her co-supervisor Rezoyana Kabir Rasha, Assistant Professor, Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka, for her constant encouragement, constructive criticisms and valuable advice to complete the thesis.

The author expresses her sincere respect to Dr. Ashoke Kumar Ghosh, Associate Professor and Chairman, Department of Development and Poverty Studies, Sher-e-Bangla Agricultural University, Dhaka for providing valuable advice and sympathetic consideration regarding the research.

The author acknowledges the data support rendered by the UGC project which has helped her a lot throughout the research work.

The author is deeply indebted and grateful to her parents, sibling and husband who continuously prayed for her success and without their love, affection, inspiration and sacrifice this work would not have been completed.

June, 2019 *The Author*

ABSTRACT

Fisheries sector is playing an important role in the economy of Bangladesh from the ancient time. The overall objectives of the present study were to examine the socio-economic profile of shrimp and prawn producing farmers, to assess profitability and resource use efficiency of shrimp and prawn farming. Bagerhat and Khulna district were selected for the study based on intensive cultivation of shrimp and prawn. Simple random sampling technique had been used for collecting data from 200 sample farmers (both shrimp and prawn farming) by using structured interview schedule. After analyzing the data, per hectare gross return, net return, and gross margin of shrimp farming were found to be Tk. 525000.00, Tk. 83027.00 and Tk. 182503.00 respectively and prawn farming, Tk. 616250.00, Tk. 238784.00 and Tk. 324555.00 respectively. Total costs of shrimp and prawn production were calculated at Tk. 441973.00 and Tk. 377466.00 per hectare. Benefit Cost Ratio (BCR) was found to be 1.19 for shrimp farming and 1.63 for prawn farming. Thus, it was found that prawn farming was comparatively profitable in the study area. Production function analysis suggested that, among the variables included in the model, human labor, fingerling, and lime had a positive and significant effect on the gross production of shrimp farming, except feed and fertilizer had insignificant effect on the gross production of shrimp farming. In the case of prawn production, most of the variables had a positive and significant effect on the gross production of prawn production, except lime had a negative and insignificant effect and fingerling had an insignificant effect on the gross production of prawn farming. This study also identified some of the problems and barriers associated with shrimp and prawn farming. Problems faced by the respondents were ranked on the basis of corresponding percentages. The problems should be removed comprehensively through an integrated program for the overall development of shrimp (bagda) and prawn (galda) farming.

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LIST OF ACCRONYMS AND ABBREVIATIONS

%	Percentage
BBS	Bangladesh Bureau of Statistics
BCR	Benefit Cost Ratio
BER	Bangladesh Economic Review
DAE	Department of Agricultural Extension
DoF	Department of Fisheries
e.g.	Exempli Gratia (L), for example
et al.	And Others
etc.	Etcetera
FY	Financial Year
GDP	Gross Domestic Product
GM	Geometric Mean
GM	Gross Margin
GR	Gross Return
Ha	Hectare
i.e.	Id est (L), That is
J.	Journal
Kcal	Kilo Calorie (s)
Kg	Kilogram (s)
Kg/ha	Kg Per Hectare
MVP	Marginal Value of Product
MFC	Marginal Factor Cost
MT	Metric Ton
NGO	Non-government Organization
No.	Number
NR	Net Return
P	Probability
SAU	Sher-e-Bangla Agricultural University
Sq.	Square
TK.	Taka
TK./ha	Taka Per Hectare
TFC	Total Fixed Cost
TVC	Total Variable Cost
TC	Total Cost
USD	United States Dollar

CHAPTER I

INTRODUCTION

1.1 Background of the Study

Agriculture is the backbone of the economy of Bangladesh. Economic development is intricately linked with the performance of the agriculture sector. The country is densely populated with 168.07 million people encompassing an area of 147,570 sq. km (BER, 2018). In this country, about 64.96 percent of the people are living in rural areas (BBS, 2015). Agriculture provides employment about 40.62 percent of its labor forces (BER, 2018). Agriculture holds a key position in the contribution of Gross Domestic Product (GDP) in our country.

In the sectorial share of Gross Domestic Product at constant prices (Base year: 2005-06), the agriculture sector contributes 10.67 percent to the Gross Domestic Product (GDP) as a whole in FY 2017-18 (BER, 2018). The lower growth in agricultural productivity including the high growth of population and natural hazards poorly affects the living standards of the people of our country.

In an agro-based country like Bangladesh, the fisheries sector is one of the most important sub-sectors. It plays a vital role in the economic development of Bangladesh. In FY2017-18 fisheries sector contributes 3.56 percent (BER, 2018) to the GDP. The fisheries sector plays an outstanding role in earning foreign exchange, to increase the supply of animal protein by boosting fish production and socio-economic development of rural people by poverty reduction and employment generation. Shrimp farming, prawn farming and other related activities grant significantly to the national economy of Bangladesh. The main area of this contribution is employment generation and export earning by on and off-farm activities. The main cultured species named the tiger shrimp (locally known as Bagda), the scientific name is *Penaeus monodon*. The next most important cultured species for export is the fresh water prawn (locally called Galda), scientifically known as *macrobrachium rosenbergii*. Bangladesh has the potential to raise production, increase productivity, enhance processing facilities, and draw further land into shrimp and prawn cultivation.

Brackish water shrimp farming is recently one of the most important sectors of the national economy of Bangladesh. It is a highly valued product for international markets. Almost all shrimps are exported, basically to the USA, Japan and Europe. It

is mostly concentrated in southern Bangladesh mainly in Satkhira, Khulna, and Bagerhat districts. Thousands of farmers have converted their paddy fields to 'gher' for a profitable shrimp culture practice, in southern Bangladesh. The coastal region, especially the southwestern side (Satkhira, Khulna and Bagerhat) is one of the most favorable areas for shrimp cultivation for two major reasons: first, its fresh and saline water resources are rich in almost all seasons; second, the world's largest contiguous mangrove forest, the Sundarbans, provides a food source.

Bangladesh is considered as one of the most suitable countries in the world for the production of freshwater prawn (golda chingri) due to its climatic conditions. However, only golda chingri has aquaculture potential and is commercially cultured. A sub-tropical climate and a vast area of water bodies provide a great opportunity for the production of golda chingri. 24 species of freshwater prawns including 10 species of golda chingri are found in Bangladesh (Wikipedia, 2019). However, one and only golda chingri has major aquaculture potential and is commercially cultured.

There is a high demand for shrimp and prawn of Bangladesh in the world market. The increasing demand and steadily rising prices of shrimp and prawn encouraged its cultivation.

1.2 Importance of Fisheries Sector in the Economy of Bangladesh

Now-a-days the world is facing many challenges like - food crisis, population explosion, lack of shelter, employment, as well as the management of natural resources. Among all the natural resources, aquatic resources are considered a big source for meeting the protein deficits and play a vital role in the economic development of the world economy.

Fish is one of the most precious components of the agricultural sector in Bangladesh and its production contributes to the livelihoods as well as the employment of millions of people. The importance of the fisheries sector in our country on the growth and development of its economy cannot be overstated. The culture and consumption of fish therefore have great implications for national income and food security. The fisheries sector in a country like Bangladesh has been playing a very important role from the ancient time. Bangladeshi people are popularly mentioned as 'Mache Bhate Bangali' or 'fish and rice makes a Bengali'. But in the past, due to many reasons, special attention was not given to this sector.

The fisheries sector is profitable with a minimum level of investment and time. Now-a-days many fish farms and hatcheries were established with investment from the

government as well as the private sector. In Bangladesh, the fisheries sector is generally classified into two types. Such as- **Inland** (open-water fisheries) and **Marine** fisheries. The fisheries sector broadly divided into four sub-sectors, like - inland capture, inland culture, mariculture (artisanal fisheries) and marine industrial fisheries. Inland fisheries comprise of capture and culture (closed-water fisheries) based fisheries. The capture component is collected from rivers and estuaries, the Sundarban mangrove forest, beel, Kaptai Lake, flood-land etc. On the other hand, inland culture fisheries, include ponds and ditches, baors, and coastal shrimp and prawn farms. Bangladesh is one of the leading inland fisheries producer country and has a huge water resource all over the country.

Considering the scarcity of pasture land in this country fish is the next best alternative to substitute animal protein, which is very essential for the human body. Fishermen form one of the poorest segments of the population. Fisheries generate part-time employment for people by subsistence fishing, whose numbers peak in the flood seasons from June to October, and through related activities such as net manufacturing, processing, marketing, distribution, and other ancillary activities.

The total fish production in FY2016-17 stood at 41.34 lakh MT (BER, 2018), as well as total shrimp and prawn production in FY2016-17, was 2.47 lakh MT (BER, 2018). Inland aquaculture and inland open water fisheries are the two-sub-sectors in the context of making a major impact on the fish production and economic development of the people of Bangladesh, mainly the poor and marginal fishers.

1.3 Importance of Shrimp and Prawn in the Economy of Bangladesh

Bangladesh, with a large deltaic flood plain, has a long tradition of fishing and fish culture. In recent decades, for increased international demand, shrimp has become one of the most important export products. In our country, the shrimp industry is the second largest foreign currency earner after the garment industry. The weather and soil of Bangladesh is very suitable and favorable for shrimp and prawn farming and other fish farming business. Soil and water of coastal area of Bangladesh is very suitable for shrimp farming. The demand of shrimp around the world has increased. Many countries are interested in importing shrimp from Bangladesh. Shrimp and prawn minnow can be collected from the natural sources easily. It requires small investment for starting a shrimp/prawn farm. Farmer can make small sized shrimp/prawn farm by investing little capital. Other commercial carp fish can be cultivated with shrimp and prawn. The government has declared shrimp and prawn

cultivation a priority industry and particular support programmers (both technical and financial) have been designed.

Shrimp and prawn are popular food items consumed throughout the world, although once it was considered as a luxury food by many people. Developed nations such as the USA, Japan and the European countries are the major importers of shrimp products, whereas, developing nations, especially South-East countries, act as main shrimp and suppliers of the world.

Within the overall agro-based economy, freshwater prawn (*Macrobrachium rosenbergii*) farming is currently one of the most important sectors of the national economy in Bangladesh. During the last two decades, its development has attracted considerable attention for its export potential. Freshwater prawn farming offers diverse livelihood opportunities for a large number of rural poor. The freshwater prawn, locally known as golda, is a highly valued product in international markets. Almost all prawns are therefore exported, particularly to the USA, Japan and the Europe. Freshwater prawn farming is mostly focused in southwest Bangladesh mainly Khulna, Bagerhat and Satkhira districts. In southwest Bangladesh, thousands of farmers have converted their paddy fields to 'ghers' to accommodate a profitable prawn culture practice.

Quantity of shrimp and prawn to export and contribution of shrimp and prawn to export earnings in different years are given below (figure 1.1 and figure 1.2).

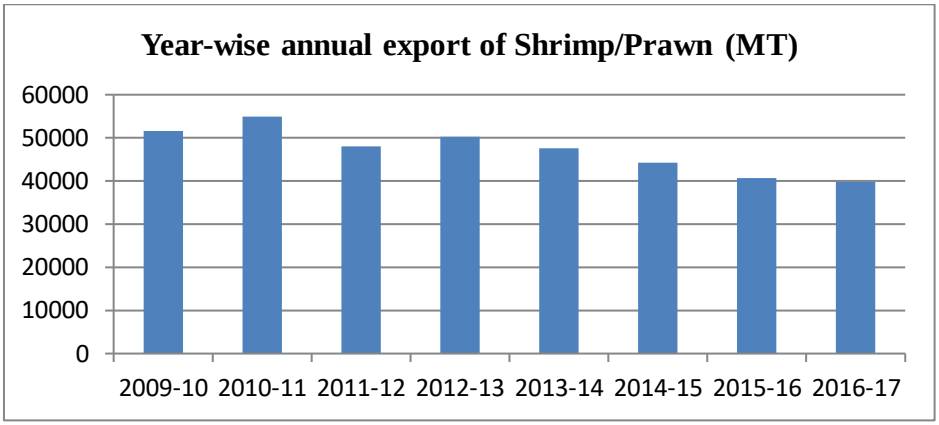

Figure 1.1: Quantity of Shrimp and Prawn to Export in Different Years (MT), 2009-2010 to 2016-2017 [Source: FSY (2016-17)]

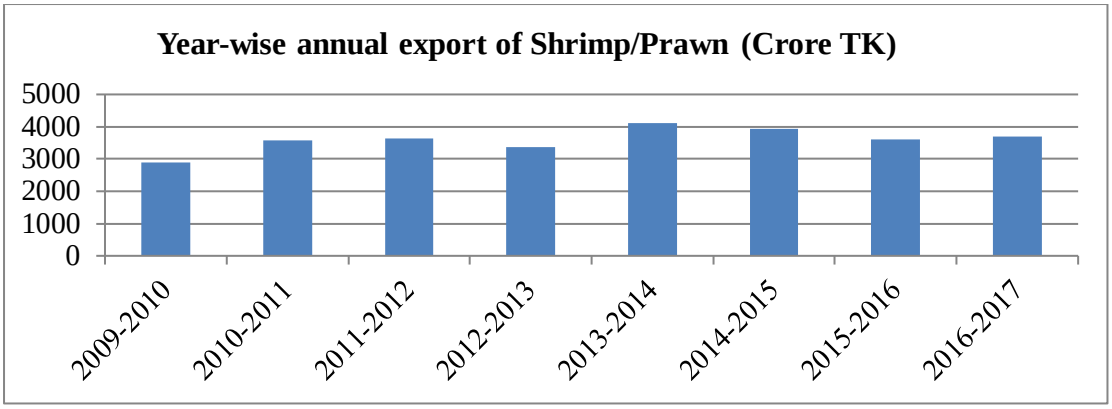

Figure 1.2: Contribution of Shrimp and Prawn to Export Earnings in Different Years (Crore TK), 2009-2010 to 2016-2017 [Source: FSY (2016 -17)]

In 2016-17 the total foreign earnings from shrimp and prawn export were Tk. 3682.26 crore by exporting 39705.85 MT shrimp and prawn (Figure 1.1, Figure 1.2).

The following table (1.1) shows the annual production of shrimp/prawn farm in the 2015-16 in different divisions of Bangladesh including- Dhaka, Khulna, Barisal, Rangpur, Rajshahi, Chittagong and Sylhet division.

1.4 Justification of the Study

Shrimp and prawn farming plays a major role in changing our farmer's living standards and achieves self-sufficiency in income. It is mainly based in the southern region of Bangladesh. This region is very important for fisheries production and most of the people are related to shrimp and prawn farming. Shrimp and prawn farming should receive attention in order to earn huge amount of foreign currency for the growing population of Bangladesh. Presently government and non-government organizations are outspreading scientific method of shrimp and prawn production. The management practices and input use are likely to be influenced by socio-economic factors such as farmer's age, education, occupation, resource base and access to information. For increasing the production of shrimp and prawn farming to the maximum possible level, it was necessary to identify the factors behind the production variations so that policy interventions might be made consequently.

Table 1.1: Annual Production of Shrimp/Prawn Farm in (2015-16)

Division	Area (Ha)				Shrimp/ Prawn Production (MT)				Crab Production (MT)	Fish Production (MT)	Total Production (MT)
	Bagda	Galda	Crab	Total	Bagda	Galda	Other shrimp/ prawn	Total shrimp/ prawn			
Dhaka	0.00	1346.09	0.00	1346.09	0.00	854.09	5.60	859.69	0.00	831.41	1691.10
Khulna	158690.18	63103.91	18728.32	240522.41	57927.50	42315.20	7415.79	107658.49	11067.11	101413.02	220138.62
Barisal	984.70	3628.82	38.56	4652.08	311.70	2296.01	277.00	2884.71	77.62	1450.20	4412.53
Rangpur	0.00	15.31	0.00	15.31	0.00	5.80	0.00	5.80	0.00	6.29	12.09
Rajshahi	0.00	15.83	0.00	15.83	0.00	6.98	1.58	8.56	0.00	20.40	28.96
Chittagong	47088.33	629.68	640.57	48358.58	9978.06	1095.29	3196.60	14269.95	2015.37	10375.43	26660.75
Sylhet	0.02	6.07	0.00	6.09	0.00	2.85	0.00	2.85	0.00	2.01	4.86
Total	206763	68746	19408	294917	68217	46189	11293	125699	13160	114099	252958
percent	70.11	23.31	6.58	100	26.97	18.26	4.46	49.69	5.20	45.11	100

Source: FYS, (2015-16)

This study will generate baseline information on socio-economic characteristics of shrimp and prawn farmers, level of input use and its quantity, cost and returns, factors affecting the productivity of shrimp and prawn farms, resource use efficiency, problems and suggestions associated with shrimp and prawn farming. The present study was conducted in Bagerhat and Khulna under the Khulna division. This study was expected to add some valuable information to the current body of knowledge regarding shrimp and prawn farming particularly with respect to the study area. This study also provides appropriate suggestions and policy recommendations that might help the development agencies and policymakers of our country to improve the livelihood of coastal and rural people.

1.5 Objective of the Study

The specific objectives of the study are as follows:

a) To assess the socio-economic status of shrimp and prawn culture fish farmers;
b) To investigate comparative profitability and resource use efficiency of shrimp and prawn culture;
c) To identify the factors behind the yield variation of shrimp and prawn farming; and
d) To find the constraints and recommend for policy implications.

1.6 Organization of the Paper

The write up in the present thesis has been divided into eight chapters, which are organized in the following sequence. Chapter one gives the introduction and objective of the study. Chapter two gives a brief review of literature in the study area. The methodology of the relevant study is discussed in Chapter three. Chapter four contains the socio-economic status of the shrimp and prawn producing farmers. Chapter five represents the costs and returns of shrimp and prawn farming. Chapter six describes the factors affecting the returns of shrimp and prawn farming. Chapter seven highlights the problems and suggestions of shrimp and prawn farming. Finally, Chapter eight deals with the summary, conclusion and policy recommendations to increase shrimp and prawn production.

CHAPTER II

REVIEW OF LITERATURE

Review of literature in any research is essential because it provides a scope for reviewing the stock of knowledge and information relevant to the proposed research. It represents the relevant literature for understanding the method and cause-effect relationship of past and present research work on shrimp and prawn farming. This would help in identifying the problem correctly and in selecting the most appropriate method of analysis. There exist a large number of studies related to shrimp and prawn farming. However, review of literature was not only limited in Bangladesh but also was extended to other countries for having a broader view.

2.1 Shrimp and Prawn Related Studies

Ahmed (2005) stated that 'The role of women in freshwater prawn farming in southwest Bangladesh'. In his study he found that the rural women of our country were discriminated in all sphere of life. They did not have their own right to make a decision in terms of their income generating activities. The rapid development of the freshwater prawn industry provided employment opportunities for women. A project funded by the UK Department for International Development, 200 women who were directly or indirectly involved with prawn production were interviewed in 2003. The women were involved in various terms of prawn farming. Such as- prawn feeding, gher construction, gher supervision and management, prawn harvesting and post-harvest handling. The main barrier was the household work responsibilities, particularly for Muslim women, as they were facing religious confinements. The study showed that, active participation of women was miscalculated. Prawn farming was enhancing the socio-economic condition of women although there were many constraints.

Reddy (2006) conducted a study on 'Resource use efficiency of shrimp farming in India'. This study was directed for analyzing resource use efficiency as well as resource productivity of shrimp farming for the long-term sustainability. The large farmers were followed by the medium farmers emerged as the technologically advanced group, who accurately adopted scientific culture management practices. In this study, the revival segment of shrimp culture from the recent obstacle was observed. The resources which efficiently utilized by the farmers were-lime, organic manures and pond area. Nevertheless, the input materials, such as-feeds, stocking

material, and fuel and electricity were overused. The suggestion was, need-based training programs as well as protests should be conducted among farmers for encouraging them to follow the commended package of practices.

Ahmed *et al.* (2008) conducted a study on 'Freshwater prawn farming in Bangladesh: history, present status and future prospects'. In Bangladesh, freshwater prawn farming is currently one of the most essential sectors of the national economy'. It is creating various livelihood opportunities for the rural people. This paper presented an overview of freshwater prawn farming in Bangladesh. Freshwater prawn farming is mainly perfect for small-scale units, though to exploit markets, producer groups and marketing organizations are important. Prawns required definite care during harvesting, processing and marketing. A range of public and private sector investments were needed to realize the significance for growth and expanding economic output from this sector. In Bangladesh, the issues of environmental sustainability of prawn cultivation, though clearly not as negative as those of marine shrimp culture, are nevertheless poorly understood. Thus research would be required as quantitative as well as qualitative environmental impacts for sustainable prawn farming.

Ahmed *et al.* (2008) stated that 'An economic analysis of freshwater prawn, *Macrobrachium rosenbergi*, farming in Mymensingh, Bangladesh'. It deals with the production system, cost structure as well as profitability of freshwater prawn farming in Mymensingh district. In this study, the cost and return of extensive and semi-intensive prawn farming system are compared. According to the study, the annual net return per hectare of prawn farm averaged $US874.91, $US609.39 in extensive farming and $US1140.37 in semi-intensive farming. Here the rate of income from extensive farming and semi-intensive farming ware found 36% and 42% respectively. The BCR of extensive and semi-intensive farming system were found 1.57 and 1.73 respectively. For ensuring the prawn farmers, in particular extensive farmers, can shift to the semi-intensive farming system, the government along with national banks should provide sufficient access to interest-free credit or credit at a lower interest rate.

Uddin (2008) conducted a study on 'Safety standards in shrimp export from Bangladesh to the world's market'. This showed us various actions of different investors in the value chain from the production level to export market conformity with the food safety standards. The result exposed that shrimp farming found to be very much profitable and the work environment should be improved. Some

international organizations are working by means of third party certification agency. Nevertheless, it was recommended for ensuring traceability from the farm level to shipment level as well. It is also suggested for recovering the illegally occupied government land and distribute those to the real shrimp farmers and processor to enhance its production level and export volume.

Bhattacharya (2009) conducted a study on, 'Economics of shrimp farming: A comparative study of traditional vs. scientific shrimp farming in West Bengal'. It was attempting to do so through analyzing the economic viability of alternative shrimp farming process from a long term perspective in the term of household level shrimp farming in West Bengal. The marginal level scientific shrimp farmers who cultured in less than one acre of land were in an unpleasant position for the profitability of traditional shrimp farmers. Availability of quality shrimp seed and feed were limited in West Bengal. Scientific shrimp farming was not good for the shrimp farmers for very small pieces of land. The sensitivity analysis was indicating that, the scientific shrimp farming would not profitable for the farmers for facing argumentative situation of shrimp price decline in the international shrimp market and rise in the cost of production of shrimp. The concerned authority should give enough importance on traditional shrimp farming by increasing better farm management practice.

Yasmin *et al.* (2010) conducted a study on 'Economics of fresh water prawn farming in Southwest Region of Bangladesh'. This study was aimed to assess the profitability of freshwater prawn farming in gher systems in southwest Bangladesh. Four Upazilas such as-Bagerhat Sadar, Fakirhat, Mollahat and Chitalmari were selected from Bagerhat district. Primary data were collected from 100 gher owners, who were selected randomly. After the financial analyses, results indicate that investment in all the selected golda farming projects are profitable. Here, total cost of FPF was calculated Tk. 80,301.00 per hectare, average gross return per hectare per year stood at Tk. 216,400.00 and the gross margin per hectare per year was Tk. 205,278.00. The net return per hectare per year was calculated Tk. 136,099.00. As farmers in the study areas were facing different kinds of problems, it was concluded that the freshwater prawn farming is sustainable as well as did not have any harmful effect on environment. Lastly, based on the findings of the study, some recommendations were made for the better development of freshwater prawn farming in Bangladesh.

Lestariadi *et al.* (2012) conducted a study on 'Efficiency of resource use in small-scale white shrimp (*Penaeus Vannamei*) production in Lamongan Regency, East Java

Province, Indonesia'. This study carried out to regulate the recourse used efficiency in white shrimp (Penaeus Vannamei) production in Lamongan Regency, East Java Province, Indonesia. The simple random sampling method used to select 125 small-scale white shrimp farmers from the six-study areas in Lamongan Regency. The production function of white shrimp was estimated using Ordinary Least Square (OLS) method. The results indicated that Double Log production function had the best fit for explaining the relationship between inputs used as well as output. The coefficient of multiple determination (R^2=0.846) indicated that, the 84.6 percent of variation in output of white shrimp was explained by the explanatory variables in the model. Findings presented that labor, fertilizer, feed and stocking density are significant determinants of production inputs. Besides this, the estimates of the ratio of the value of marginal product (VMP) to marginal factor cost (MFC) exposed that the non-optimal combination of inputs among the white shrimp farmers, that the aquaculture farms resources were inefficiently utilized for labor, feed and stocking density by 1.94, 1.93 and 171.4 respectively, whereas fertilizer showed otherwise by 0.11 or over-utilized.

Alauddin and Hamid (2014) under look 'Shrimp culture in Bangladesh with emphasis on social and economic aspects'. He found that, the impact of shrimp farming has economic, social as well as environmental dimensions. For the growth and development of shrimp aquaculture some factors, such as - ecological, economic, institutional, social and cultural factors played a significant role. It was argued that the sustainable development of shrimp industry could be attained by cumulative effects included in integrated shrimp-rice farming system. It suggested two research strategies. They were- (1) a robust approach to the complicated and interconnecting issues of integrated shrimp–rice farming, which developed indicators to measure the sustainability of shrimp farming and could be used by shrimp producers at farm level; and (2) an approach that offered policy planning to respond effectively for changing different variables that determine as well as affect shrimp farming.

Ahmed *et al.* (2015) studied that "Coastal to inland: Expansion of prawn farming for adaptation to climate change in Bangladesh." This paper was conducted that the practice of prawn (Macrobrachium rosenbergii) farming is widespread in coastal Bangladesh due to favorable biophysical resources. However, export-oriented prawn farming is particularly vulnerable to climate change in coastal Bangladesh. This study identified different climatic variables, including salinity, coastal flooding, cyclone,

sea-level rise, water temperature, drought, and rainfall have profound effects on prawn farming in the Bagerhat area of southwest Bangladesh. Considering extreme vulnerability to the effects of climate change on prawn production, one of the adaptation strategies is to translocate prawn culture from coastal to inland (i.e., Bagerhat–Gopalganj) that appear less vulnerable to climate change. Although the prospects for prawn–carp polyculture and integrated prawn–fish–rice farming are positive in Gopalganj, a number of challenges were identified for the expansion of prawn culture. So it was suggested that institutional support would help to adopt prawn production.

Gammanpila, M. (2015) studied the 'Economic viability of small scale shrimp (*Penaeus monodon*) farming in the northwestern province of Sri Lanka'. Shrimp export is the second most valuable export of fish as well as fishery products of Sri Lanka and it was 8% during 2013. The present study represents the profitability and risks in semi intensive small scale shrimp aquaculture practices in the northwestern province of Sri Lanka. For profitability analysis of the operation over 10 years, data and information were collected from small scale shrimp aquaculture farms in the Puttalam district, Sri Lanka, during April to August, 2014. Economic analysis exposed that the variable cost per unit production and break-even production for the black-tiger shrimp by semi-intensive culture system is 4.4 US$/kg and 2,500 kg respectively. In this study, assuming the minimum acceptable rate of return (MARR) is 15%, the NPV value at the end of 10 years was found 33,003 US$ for the total capital invested and 34,993 US$ for the equity. The internal Rate of Return (IRR) for the total capital investment is 41% and 74% for the equity. After ending of the ten years, sum of total and net cash flow is 95,176 US$ and 84,093 US$ respectively. Pay-back period for the capital investment is three years and it was two years for the equity The profitability was highly sensitive to changes in sales price was indicated by the sensitivity analysis. When the sales price value falls by 20% or more, the IRR value becomes 13% which is not profitable. The sales price has frequency of 28% of receiving negative (-) NPV, followed by sales quantity (6%) as well as variable cost (5%). The study result indicates that investment is highly profitable while shrimp farming is most sensitive to changes in sales price.

Hoque (2015) studied on 'Shrimp cultivation: influencing factors for locational choice and its compatibility with international and national policies'. In his research the selected study area were- Ghatbogh union of Rupsha upazila and Raghunathpur

union of Dumuria upazila. From 1995 to 2010, the cultivated area of shrimp farming increased from 3,455 acre to 6,812 acre in Ghatbogh union and 4,574.72 acre to 5,266.25 acre in Raghunathour union. Brackish-water shrimp production in Ghatbogh and Raghunathpur union was the source of higher income than rice cultivation. The study provided evidences of increase of salinity level over the shrimp farm neighboring areas. To consider certain difficulties from the point of view ecological, environmental and socioeconomic, some specific recommendations have been made for the future development of shrimp farming and consequent improvement of coastal zone.

Sivaraman *et al.* (2015) studied on 'Technical efficiency of shrimp farming in Andhra Pradesh: estimation and implications'. He found that shrimp farming is a key subsector of Indian aquaculture which has seen outstanding growth in the past decades and has an incredible potential in future. The study analyzed the technical efficiency of the shrimp farmers of East Godavari district of Andhra Pradesh using the Stochastic Production Frontier Function with the technical inefficiency effects. The estimates mean technical efficiency of the farmers was 93.06 % which means the farmers operate at 6.94 % below the production frontier production. Age, education, experience of the farmers and their membership status in farmers associations and societies were found to have a significant effect on the technical efficiency. The variation in the technical efficiency also approves the differences in the extent of adoption of the shrimp farming technology among the farmers. Proper technical training opportunities could facilitate the farmers to adopt improved technologies to increase their farm productivity.

Banu and Christianus (2016) carried out a study on 'Giant freshwater prawn Macrobrachium rosenbergii farming: a review on its current status and prospective in Malaysia'. The present study showed that, the giant freshwater prawn *Macrobrachium rosenbergii* is an essential targeted species in Malaysia. The aquaculture production of *M. rosenbergii* increased from 318 tonnes in 2012 to 457 tonnes in 2013 but the total freshwater aquaculture production decreased in the year 2013, comparing with the previous year. In recent time, the production of giant freshwater fries raised from the three government as well as 21 private hatcheries in 2012 to the four government and 19 private hatcheries in 2013. Giant Freshwater prawn farming plays a very important role in Malaysian economy, which is contributing to increased food production with earning valuable foreign exchange as well as diversifying the economy and enhanced

employment opportunities. Besides several problems, prawn farming practice has offered opportunity for increasing incomes for farmers and allied groups. Public as well as private sector investments and involvements are needed for realizing the potential for development and expanding economic output from this sector. This study concluded that, freshwater prawn farming in Malaysia has an encouraging scenario for increasing demand and to prospects of an upgraded organization of the productive chain.

Begum *et al.* (2016) examined 'Determinants of technical efficiency of freshwater prawn farming in southwestern Bangladesh'. This paper estimates a translog stochastic production function for examining the determinants of technical efficiency of freshwater prawn farming in Bangladesh. Primary data has been collected by using random sampling from 90 farmers of three villages in southwestern Bangladesh. She found that prawn farming displayed much variability in technical efficiency ranging from 9.50% to 99.94% with mean technical efficiency of 65%, which suggested a substantial 35% of potential output can be recovered by removing inefficiency. For a land scarce country like Bangladesh this gain could help increase income and ensure better livelihood for the farmers. Based on the translog production function specification, farmers could be made scale efficient by providing more input to produce more output. The results suggested that farmers' education and non-farm income significantly improve efficiency while farmers' training, farm distance from the water canal and involvement in fish farm associations reduces efficiency. Hence, the study proposed strategies such as less involvement in farming-related associations and raising the effective training facilities of the farmers as beneficial adjustments to reduce inefficiency. Moreover, the key policy implication of the analysis is that investment in primary education would greatly improve technical efficiency.

Islam and Tabeta (2016) conducted a study on 'Impacts of shrimp farming on local environments and livelihoods in Bangladesh'. The study was conducted in two coastal sub-districts in the southwestern part of Bangladesh. One of these was named Rampal sub-district which is dominated by saline water shrimp farming and another one named Dumuria sub-district is dominated by agriculture as well as freshwater prawn farming. The aim of the study is to illustrate the impact of shrimp and prawn-rice farming on agriculture, livestock and livelihoods of local marginal farmers who are the mainstream of the society. The results disclosed the effects of salinity intrusion for shrimp farming significantly reduced the crops and livestock production, and finished

many livelihood options of the local people in Rampal sub-district over last three decades. Alternatively in same time period crops production in Dumuria sub-district has been significantly increased and prawn-rice farming system creates adaptable employment opportunities of the local people.

Mahalder *et al.* (2018) studied on 'The sustainable livelihoods approach of freshwater prawn production in South-western Bangladesh'. This study was conducted in two villages of Dumuria upazila namely Ghona Mader Danga and Ramkrishnapur in Khulna district. 181 sample farmers were selected from the two villages. After analyzing the data, per hectare average yield of prawn, average cost of gher operation and average net return was found 319 kg, Tk. 76,015 and Tk. 93,152 respectively. Here we found that the farmers who have their own land were obtained higher net returns than the leaseholders. . In the study area, freshwater prawn brings economic as well as social benefits for the sample farmers. However, our country could undoubtedly have earned a huge amount of foreign exchange by exporting prawn if more areas could be brought under prawn cultivation.

Shawon *et al.* (2018) conducted a study on 'Financial profitability of small scale shrimp farming in a coastal area of Bangladesh'. The present study showed that, aquaculture specifically shrimp farming has a significant contribution to the economy of Bangladesh. This study estimates the socio-economic status as well as financial profitability of small scale shrimp farming in selected areas of the Khulna district. One hundred (100) shrimp farmers were selected or the study and data were collected by direct interview method. Here, financial profitability was analyzed from a different view point. The study disclosed that, about 35 percent of farmers lie in primary working age group. Most of the farmers completed their primary education whereas a few of them were illiterate. 65 percent of farmer's family size was medium and 40 percent of farmer's main occupation was shrimp farming. This study also revealed that the gross profit margin was high here, i.e. 59 percent, which indicated that farmers did well in managing their farm as well as farmers has more to cover for operating, financing and other cost. Break-even price for the small scale shrimp was Tk. 311 per kg whereas break-even production was found 155 kg per acre. Benefit cost ratio (BCR) and net profit margin were found more than one and positive respectively, which indicated that small scale shrimp farming was commercially profitable. The research concludes that there is sufficient scope and possibility for

supporting and emerging the small scale shrimp farming in the coastal area of Bangladesh.

Rahman-Al-Mamun *et al.* (2019) studied that "Impact of progressive shrimp farming on farmer's livelihood in the southwestern region of Bangladesh." The study was carried out on 30 shrimp farmers of Shyamnagar upazilla in Satkhira district, situated in the southwestern coastal region of Bangladesh. The research was conducted to evaluate the livelihood analysis of the farmers based on progressive shrimp farming. It is showed that the majority of the respondents (56.67%) were dependent on shrimp farming and others involved in some subsidiary occupations like business, agriculture, service, etc. the farmer realized that shrimp culture was better than agriculture because maximum profit could be obtained by shrimp farming in minimum time and minimum cost although there were high risks in the culture system. They supported shrimp farming more because of higher availability of post-larval shrimp, lower feed cost, year round culture system, opportunity for self-employment etc. The annual incomes of major shrimp farmers (56.67%) were 50,000-2,00,000 BDT, 23.33% were 2,01,000-5,00,000 BDT and rest 20% were 5,01,000-20,00,000 BDT, respectively. Livelihoods of all farmers in the study area had improved by practicing extensive shrimp farming. Most of them uplifted their living status by ensuring some housing (50%), drinking (90%), electricity (73.33%), sanitary (56.67%), medical (100%) and banking (73.33%) facilities. In addition, majorities of them also increased their expenses on children's education (80%), health management (56.67%), and purchasing entertainment equipment (63.33%). In contrast, the expenses on buying cattle or other animals decreased (56.67%) showing their livelihood mainly depends on shrimp farming.

Rasha (2019) conducted a study on 'Productivity and resource use efficiency of bagda shrimp farming in some selected areas of Bagerhat district in Bangladesh'. A simple random sampling method is used here for collecting sample from 105 sample farmers through interview schedule. After analysis of the data, per hectare gross return, net return, and gross margin were found to be Tk. 364222.00, Tk. 215931.00 & Tk. 260095.00 respectively. Total costs of shrimp production were calculated at Tk. 148291.00 per hectare. Benefit Cost Ratio (BCR) was found to be 2.46 for shrimp farming. Thus it can be told that shrimp farming was highly profitable. If modern inputs and production technology can be made available to farmers in the right time, yield and production will be increased which can help farmers to increase their

income and improve their living standards. This study also identified some of the problems and constraints related to shrimp farming.

2.2 Concluding Remarks

The above review and discussion shows that most of the studies dealt with profitability and productivity of shrimp and prawn. Some studies also determine the productivity as well as resource use efficiency. Some studies are related to technical efficiency of shrimp and prawn farming. The review of the literature was helpful to re-construct the methodological aspects for overcoming the limitations of previous studies. From these studies the researcher felt the need of conducting the comparative profitability of shrimp and prawn culture and analyzing the resource use efficiency of shrimp and prawn culture in southern region of Bangladesh within the recent development context, which will help the policymakers for understanding the current situation and take initiatives to increase shrimp and prawn production and improving the livelihood of coastal people in Bangladesh. In contrast, the researcher believed that the findings of this study would provide useful recent updated information, which would help the policymakers as well as researchers for more inquiries.

CHAPTER III

METHODOLOGY

This chapter deals with the methodology of the study. It deserves careful consideration in any systematic study. Scientific research depends on a proper methodology used in the research. Appropriate methodology is the prerequisite of good research. The primary data was collected depends upon nature as well as aim of the study and its objectives. This chapter covers a detailed sequential steps of research work for instance, selection of study areas, selection of the samples and sampling techniques, sources of data, processing of data and analytical techniques etc.

3.1 Selection of the Study Area

For this study, two districts named Bagerhat and Khulna under Khulna division was selected as a shrimp and prawn cultivation area. Data were collected from Bagerhat Sadar, Rampal, Dumuria and Paikgacha upazilla for shrimp production and Rampal, Dumuria and Paikgacha upazilla for prawn production. Data collection was suitable from this region for the following reasons-

a) Availability of traditional gher farming, shrimp and prawn farmers,
b) Easy of access and good communication facilities in these areas and
c) Researcher's belief about getting healthy co-operation from the selected farmers and so on.

Figure 3.1: A Map of Khulna District Showing the Study Area

The location of Dumuria is at 22.8083°N 89.4250°E. It has 46,251 households and a total area of 454.23 km². As well as the location of Paikgachha is at 22.5889°N 89.3361°E. It has 41,194 households and a total area of 411.19 km².

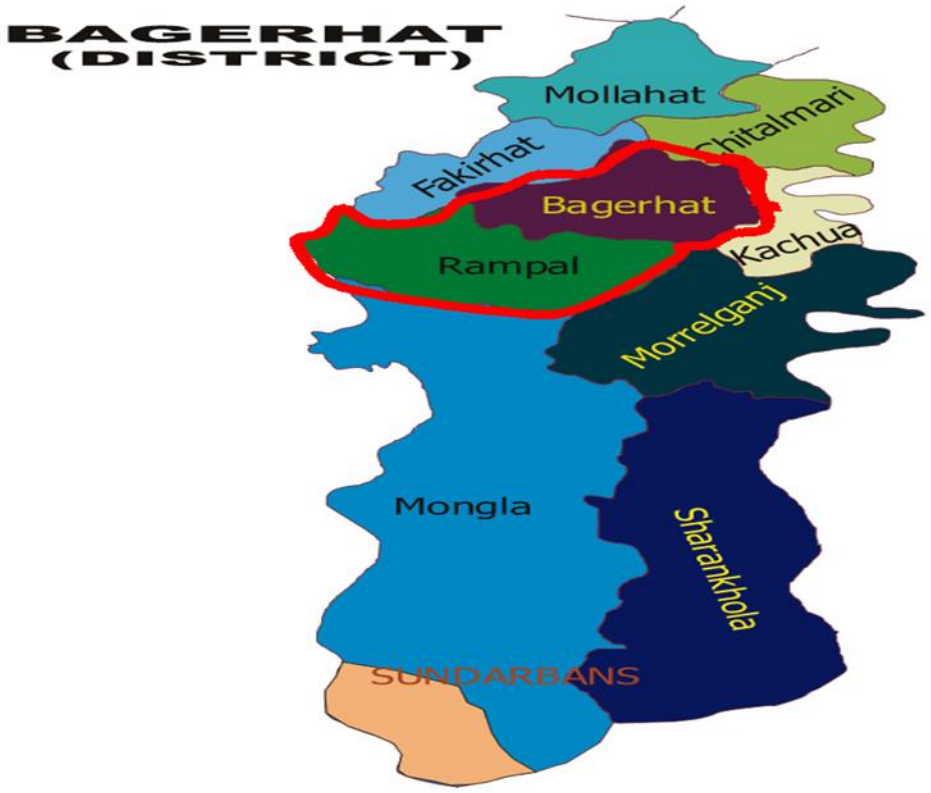

Figure 3.2: A Map of Bagherhat District Showing the Study Area

The total area of Bagerhat Sadar is 272.73 km² and has 45,527 households. This upazila is bounded by Fakirhat and Chitalmari upazilas on the north, Morrelganj upazila on the south, Kachua upazila on the east, Rampal and Fakirhat upazila on the west. The location of Rampal is at 22.5667°N 89.6639°E. It has 33119 households and total area of 335.46 km².

3.2 Selection of the Samples and Sampling Technique

Total 200 samples (100 samples for each district constituting 50 from shrimp farming and 50 from prawn farming) were taken for the study. Simple random sampling technique was for data collection from the respondent. The list of shrimp and prawn farmers was prepared by a preliminary short survey with the help of Department of Fisheries (DoF) and Department of Agricultural Extension (DAE) personnel. Total samples of 200 shrimp and prawn farmers were selected from the selected areas.

3.3 Preparation of the Survey Schedule

Preparation of the survey schedule is one of the most important part in this study. A complete survey schedule was prepared to collect necessary information from the selected respondent in such a way that all appropriate information needed for shrimp and prawn farming could be easily found within the shortest possible time. The interview schedule was pretested for the judgment of their suitability. The final survey questionnaire was prepared on the basis of the results of the pre-test survey.

3.4 Sources of Data and Collection of Data

Data required for the present study were collected from primary and secondary sources. Primary data was collected from the selected respondents and secondary data were collected from various published sources. The primary data collection period was December 2018 to February 2019 in the study area. After collecting, data were correctly edited and analyzed. Secondary sources of data were collected from Bangladesh Bureau of Statistics (BBS), Department of Fisheries (DoF), Bangladesh Economic Review (BER), journals, newspapers, articles, internet etc. For minimizing errors, data were collected in local units. After that the data were converted into appropriate standard unit.

3.5 Editing and Tabulation of Data

After collecting primary data, the filled schedules were edited for analysis. These data were verified for eliminating possible errors as well as inconsistencies. All the collected data were summarized and examined carefully. For data entry and data analysis, the Microsoft Excel programs and SPSS programs were used. It might be observed here that information was collected in local units at the initial stage and after checking the collected data, it was converted into standard units. After that, a few relevant tables were prepared according to necessity of analysis to meet the objectives of the study.

3.6 Analytical Techniques: Both descriptive and statistical analysis will be used for the analysis of the data.

3.6.1 Descriptive Analysis: Tabular and graphical analysis was generally used for finding the socio-economic status of the respondents. The tabular technique of analysis was used for determining the cost, returns and profitability of shrimp and prawn farm enterprises. It is simple in calculation, widely used and easy to understand. It was used to get the simple measures- like average, percentage and ratio.

Tabular technique presented production practices and input use, cost and returns of shrimp and prawn farming.

3.6.2 Profitability Analysis

Cost and return analysis is the most common method to determine and compare the profitability of different farm households. In the present study, the profitability of shrimp and prawn farming was calculated by the following way-

3.6.2.1 Calculation of Gross Return

Gross return (per hectare) was calculated by multiplying the total amount of product and by-product by their respective per unit prices.

Gross Return= Quantity of the product * Average price of the product + Value of by-product.

3.6.2.2 Calculation of Gross Margin

Gross margin can be defined as the difference between gross return and variable costs. Gross margin was calculated on the basis of TVC (total variable cost). Per hectare gross margin was obtained by deducting variable costs from gross return. That is,

Gross margin = Gross return – Variable cost.

3.6.2.3 Calculation of Net Return

Net return or profit was calculated by subtracting the total production cost from the total return or gross return. That is,

Net return = Total return – Total production cost.

3.6.2.4 Undiscounted Benefit Cost Ratio (BCR)

Average return to each taka spent on production is an important criterion to measure the profitability. Undiscounted BCR was estimated by the ratio of total return to total cost per hectare.

$$\text{BCR}= \frac{\text{Total Return}}{\text{Total Cost}}$$

3.7 Functional Analysis

The input-output relationship in shrimp and prawn cultivation was analyzed with the help of Cobb-Douglas production function approach. To determine the contribution of the most important variables in the production process of shrimp and prawn cultivation, the following specification of the model will be used.

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}e^{u_i}$$

The Cobb-Douglas production function was transformed into following logarithmic form so that it could be solved through ordinary least squares (OLS) method.

$$lnY = lna + b_1 lnX_1 + b_2 lnX_2 + b_3 lnX_3 + b_4 lnX_4 + b_5 lnX_5 + U_i$$

Where, Y= Gross production from year round shrimp/prawn (Kg. /ha);

X_1= Quantity of human labor (Man-days. /ha);

X_2= Quantity of fertilizer (Kg. /ha);

X_3= Quantity of lime (Kg. /ha);

X_4= Quantity of fingerling (No. /ha);

X_5= Quantity of feed (Kg. /ha);

a= Intercept;

b_1…..b_5= Coefficient of the respective variable;

Ui= Error Term;

i= 1, 2,…..5.

3.8 Measurement of Resource Use Efficiency

For testing the efficiency, the ratio of Marginal Value Product (MVP) to the Marginal Factor Cost (MFC) for each input were computed and tested for its equality to 1. i.e., MVP/MFC = 1.

The marginal productivity of a particular resource represents the additional to gross returns in value term caused by an additional one unit of that resource, while other inputs are remained constant. When the marginal physical product (MPP) is multiplied by the product price per unit, the MVP is obtained. The most reliable, perhaps the most useful estimate of MVP is obtained by taking resources (Xi) as well as gross return (Y) at their geometric means.

In this study the MPP and the corresponding values of MVP were obtained as follows:

$MPP_{xi} * P_{yi} = MFC$,

Where, $MPP_{xi} * P_{yi} = MVP$,

But, MPP = bi*(Y/Xi)

So, MVP = bi* (Y/Xi) P_{yi}

Where, b_i = regression coefficient per resource,

Y = Mean output,

X_i = Mean value of inputs,

P_{yi} = price of output and

MFC = price per unit of input.

Thus, when resource-use efficiency (RUE) =1, resources are used at an optimum level, When RUE <1, resources are over utilized, when RUE >1, resources are underutilized.

3.9 Problem Faced in Collecting Data

During the period of data collection, the researcher faced the following problems-

a. Most of the farmers felt disturbed to answer questions as they thought that the researcher might use the information against them. To earn the confidence of the farmers, huge time was spent.
b. The farmers do not keep records of their activities and daily expenses. For that reason, the author had to depend upon their memory.
c. The farmers were usually busy with their filed works. So, the researcher sometimes also had to pay extra time for visiting the farmer.

CHAPTER IV

SOCIO-ECONOMIC STATUS OF SHRIMP AND PRAWN FARMERS

4.1 Introduction

This chapter deals with the socio-economic characteristics of the shrimp and prawn farmers. Socioeconomic characteristics of the respondents are very much important in influencing production planning. In our society people are different from one another. Behavior of an individual is representing the characteristics of the person. There are various interrelated and essential attributes that characterize an individual as well as influence the development of the behavior and personality of the person. Basic characteristics of the farmers were family size and composition, age distribution, occupation (main and subsidiary), level of education, land ownership pattern, culture technique etc. A brief discussion of these aspects is given below.

4.2 Age Distribution with Family Size, Earning Member and Farming Experience of the Sample Farmers

Age of farmer is an important component of the production and in the better management of the farming system. Some researchers think that older farmers are more experienced as well as more efficient in using resources. Other researchers comment that younger farmers are eager to adopt new and upgraded technology than older.

Table 4.1 Age Distribution, Family Size, Earning Member and Farming Experience of the Respondents

Attributes	Shrimp Farming		Prawn Farming	
Age category	**No.**	**Percentage**	**No.**	**Percentage**
Less than 30	17	17	16	16
31 to 45	43	43	44	44
Above 45	40	40	40	40
Total	100	100	100	100
Average family size	4.20		4.30	
Average male member	2.16		2.25	
Average female member	2.04		2.05	
Average earning member	1.34		1.48	
Average farming experience	12.98		13.39	

Source: Field survey, 2019

In the present study, all the farmers of the study area were classified into different age groups as presented in Table 4.1. By the evidence from the table that most of the farmers were middle aged in the study area. The shrimp and prawn producing farmers were classified into three age groups: less than 30 years, 31-45 years and above 45.

In shrimp farming, out of the total sample farmers, 17 percent belonged to the age group of less than 30 years and in prawn farming, 16 percent belonged to the age group of less than 30 years out of total sample farmers. In shrimp farming, 43 percent belonged to the age group of 31-45 years and in prawn farming, 44 percent belonged to this age group. In shrimp farming, 40 percent fell into the age group of above 45 and in prawn farming, the percentage was also 40 in this age group. The average family sizes of the shrimp and prawn producing farmers were found to be 4.20 and 4.30 respectively. This finding implies that majority of the sample farmers were in the age group of 31-45 years indicating that they provided more physical efforts for working in both shrimp and prawn farm. This age group is supposed to have enough strength and risk bearing ability. Here, the average male member, average female member, average earning member and average farming experience were- 2.16, 2.04, 1.34 and 12.98 respectively found in shrimp farming. On the other hand, average male member, average female member, average earning member and average farming experience were- 2.25, 2.05, 1.48 and 13.39 respectively found in prawn farming.

4.3 Age Distribution and Gender of the Sample Farmers

The sex category was divided into two groups here, such as- male and female. The relationship between age and sex of the study area is presenting in table 4.2. The table is given below-

Table 4.2: Age Distribution and Gender of the Respondents

		Shrimp Farming			**Prawn Farming**		
		Sex			**Sex**		
		Male	**Female**	**Total**	**Male**	**Female**	**Total**
Age	Less than 30	13	4	17	12	4	16
	31 to 45	35	8	43	31	13	44
	Above 45	38	2	40	39	1	40
	Total	86	14	100	82	18	100

Source: Field survey, 2019

In shrimp farming, out of the total sample farmers, 17 percent belonged to the age group of less than 30 years. Here the percentage of males and females were 13 percent and 4 percent respectively. Now, 43 percent belonged to the age group of 31-45 years. The percentage of male and female were 35 percent and 8 percent respectively. Once

more 40 percent fell into the age group of above 45. Male and female percentages were 38 percent and 2 percent respectively.

Again in prawn farming, out of the total sample farmers, 16 percent belonged to the age group of less than 30 years. Here the percentage of males and females were 12 percent and 4 percent respectively. Now, 44 percent belonged to the age group of 31-45 years. The percentage of male and female were 31 percent and 13 percent respectively. Once more 40 percent fell into the age group of above 45. Here male and female percentages were 39 percent and 1 percent respectively.

4.4 Educational Status of the Respondents

Education is generally regarded as a basic need of the social improvement of a community. It plays a vital role to reduce poverty and inequality, improving health etc. Education enhances working efficiency. Better education of farmers helps to increase skill and productivity.

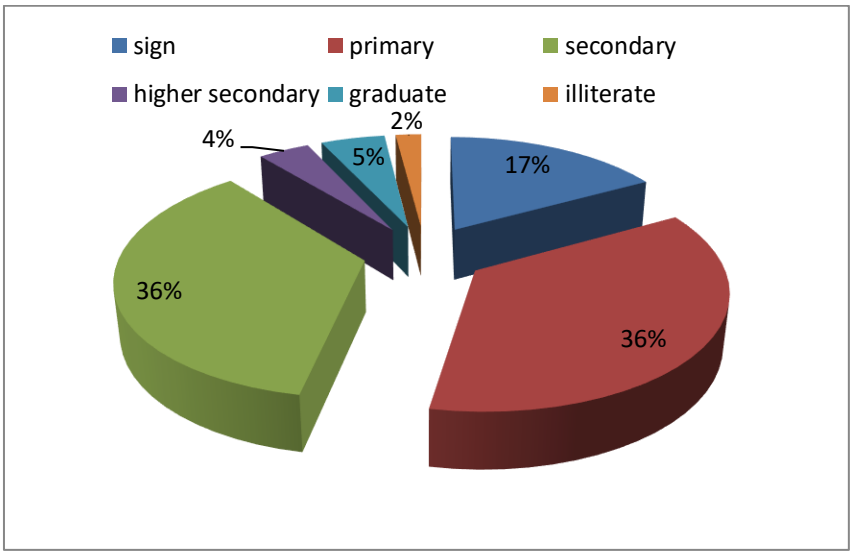

Figure 4.1: Educational Status of Shrimp Farmers

Source: Field survey, 2019

It is evident from figure 4.1 that out of 100 shrimp farmers, 17 percent farmers had the ability to sign their name, 36 percent farmers had completed primary level education, 36 percent farmers had completed secondary level education, 4 percent farmers had completed their higher secondary level education, 5 percent farmers had completed their graduation and last of all only 2 percent farmers were illiterate.

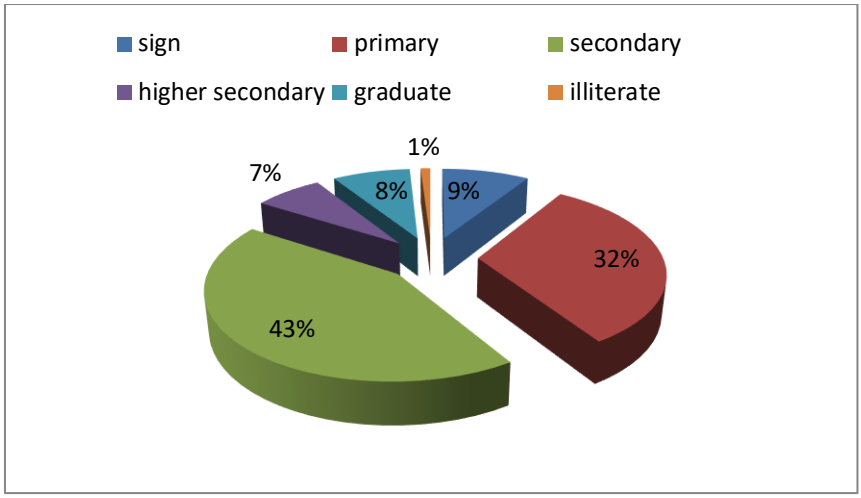

Figure 4.2: Educational Status of Prawn Farmers

Source: Field survey, 2019

In the case of 100 prawn farmers, 9 percent of farmers had the ability to sign their name, 32 percent farmers had completed primary level education, 43 percent farmers had completed secondary level education, 7 percent farmers had completed their higher secondary level education, 8 percent farmers had completed their graduation and last of all only 1 percent farmers were illiterate. These are presenting in figure 4.2.

4.5 Occupational Status of the Shrimp and Prawn Farmers

The work in which a man was engaged more or less the whole year was considered as the occupation of the person. In the present study, the selected farmers were engaged with various types of occupation in the course of shrimp and prawn farming. It was observed that, as a key source of income, shrimp farming was the main occupation for shrimp farmers and prawn farming was the main occupation for prawn farmers. Some of them were engaged in other activities. Main occupational status of the shrimp and prawn farmers are shown in the following figure 4.3 and 4.4 respectively.

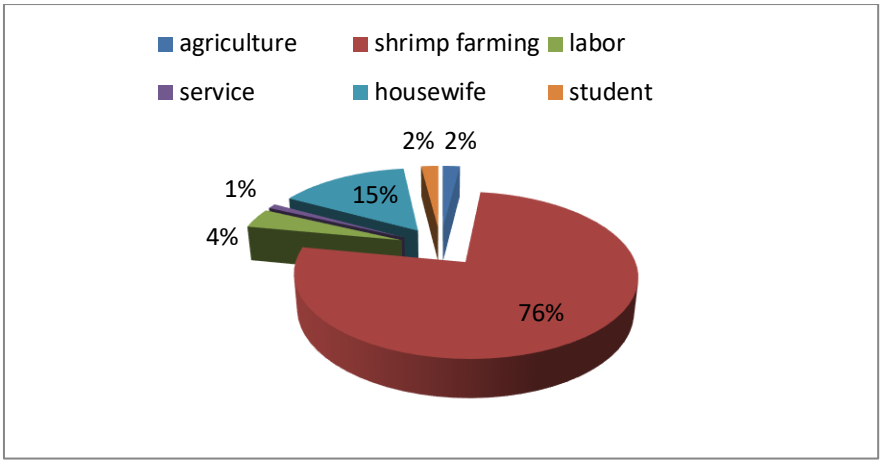

Figure 4.3: Main Occupation of the Shrimp Farmers

Source: Field survey, 2019

It is evident from the figure 4.3 that 76 percent of farmers were involved in shrimp farming as the main occupation. Besides this, 2 percent were doing agricultural activities, 4 percent were labor, 15 percent were housewife, 2 percent were the student and 1 percent was doing service.

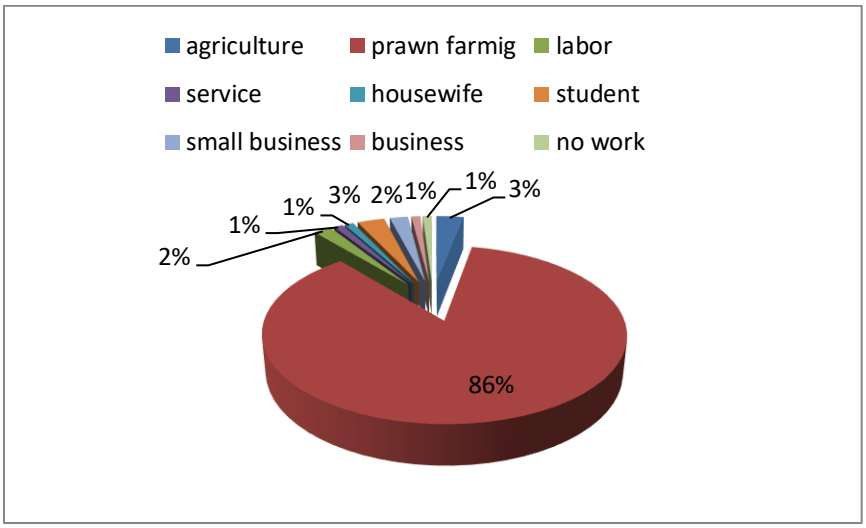

Figure 4.4: Main Occupation of the Prawn Farmers

Source: Field survey, 2019

By the evidence of figure 4.4, 86 percent of farmers were involved in prawn farming as the main occupation. Besides this, 3 percent were doing agricultural activities, 2 percent were labor, 1 percent was housewife, 3 percent were student, 1 percent was doing service, 2 percent were doing small business and 1 percent was doing business. Subsidiary occupational status of the shrimp and prawn farmers are shown in the following figure 4.5 and 4.6 respectively.

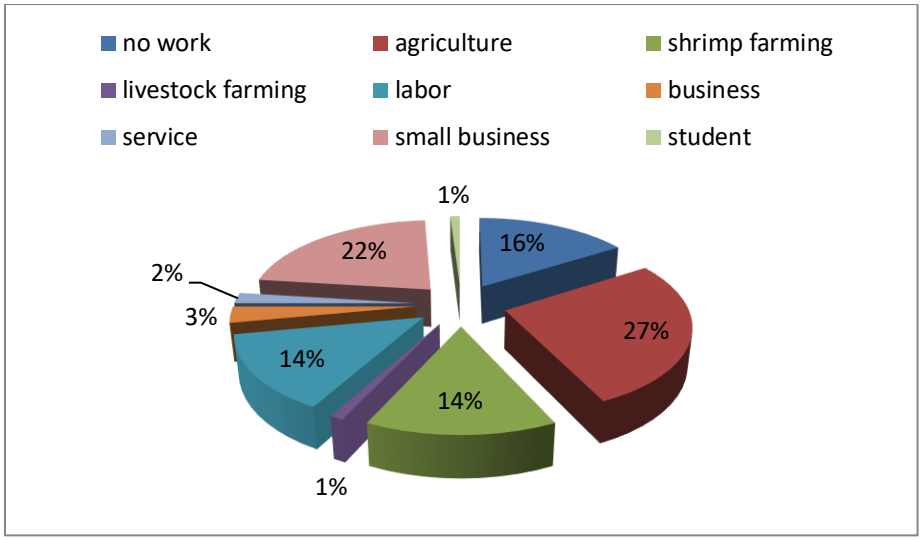

Figure 4.5: Subsidiary Occupation of the Shrimp Farmers

Source: Field survey, 2019

It is evident from the figure 4.5 that 14 percent of farmers were involved labor activities in shrimp farming as a subsidiary occupation. Besides this, 27 percent were doing agricultural activities, 14 percent were labor, 22 percent were doing small business, 1 percent was student, 2 percent were doing service, 3 percent were doing business, 1 percent was doing livestock farming and 16 percent had no subsidiary occupation.

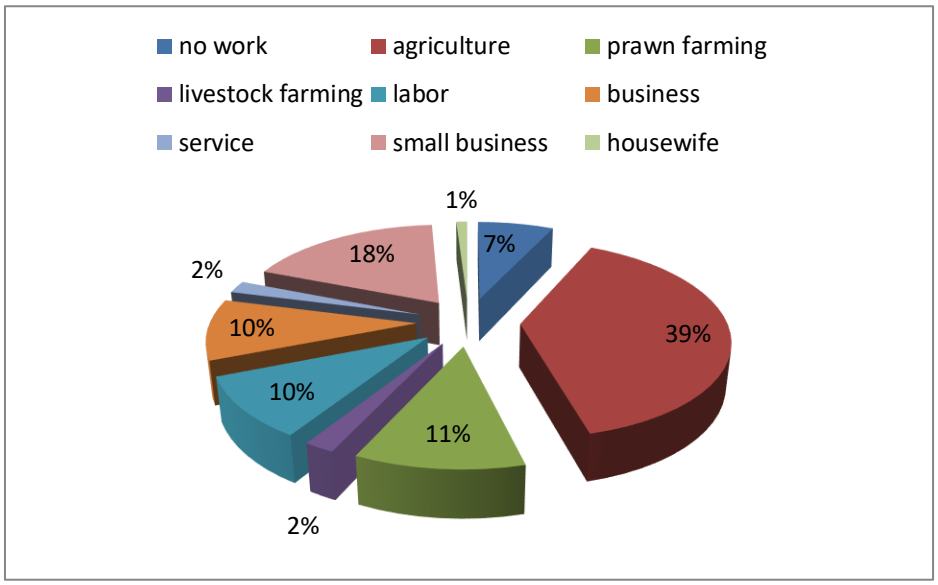

Figure 4.6: Subsidiary Occupation of the Prawn Farmers

Source: Field survey, 2019

By the evidence of figure 4.6.11 percent of farmers were involved in prawn farming as a subsidiary occupation. Besides this, 39 percent were doing agricultural activities, 10 percent were labor, 18 percent were doing small business, 1 percent was

housewife, 2 percent were doing service, 10 percent were doing business, 2 percent were doing livestock farming and 7 percent had no subsidiary occupation.

4.6 Ownership Pattern of Selected Sample Farmers

In Bangladesh, most of the agricultural lands are divided and sub-divided into small plots mainly for law of inheritance. The ownership patterns of the shrimp and prawn producing farmers were classified into three categories: single, joint and leased.

In shrimp farming about 58 percent shrimp farmers were single owner, 4 percent were belonged to joint ownership and those of 38 percent had leased ownership.

In prawn farming about 70 percent prawn farmers were single owner, 2 percent were belonged to joint ownership and those of 28 percent had leased ownership (Table-4.3).

Table 4.3 Ownership Pattern of the Shrimp and Prawn Producing Farmers

Ownership pattern	Shrimp Farming		Prawn Farming	
	No.	Percent (%)	No.	Percent (%)
Single	58	58	70	70
Joint	4	4	2	2
Lease	38	38	28	28
Total	100	100	100	100

Source: Field survey, 2019

4.7 Culture Technique of Selected Sample Farmers

This plays an important role for the better production of shrimp and prawn farming. The culture technique of the shrimp and prawn producing farmers were classified into three categories: extensive, semi-intensive and intensive.

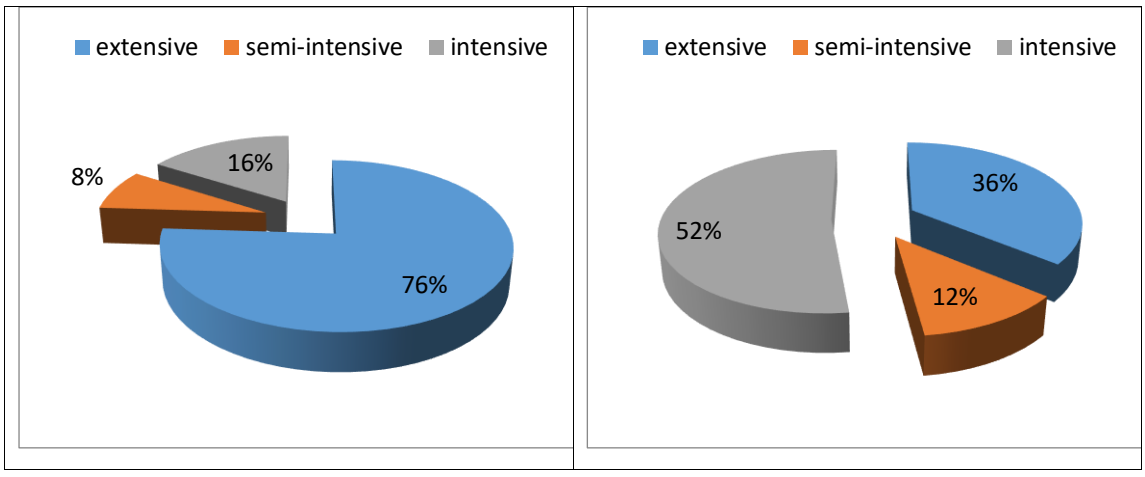

Figure 4.7: Culture Technique of Shrimp and Prawn Farmers

Source: Field survey, 2019

In shrimp farming about 76 percent of shrimp farmers were following extensive culture, 8 percent were following semi-intensive culture and those of 16 percent were following intensive culture (Figure: 4.7).

In prawn farming about 36 percent of prawn farmers were following extensive culture, 12 percent were following semi-intensive culture and those 52 percent were following intensive culture (Figure: 4.7).

4.8 Training Facilities of Sample Farmers

Training facilities can enhance the production capacity and efficiency of the shrimp and prawn farmers. The present situation of training facilities in the study area are given below.

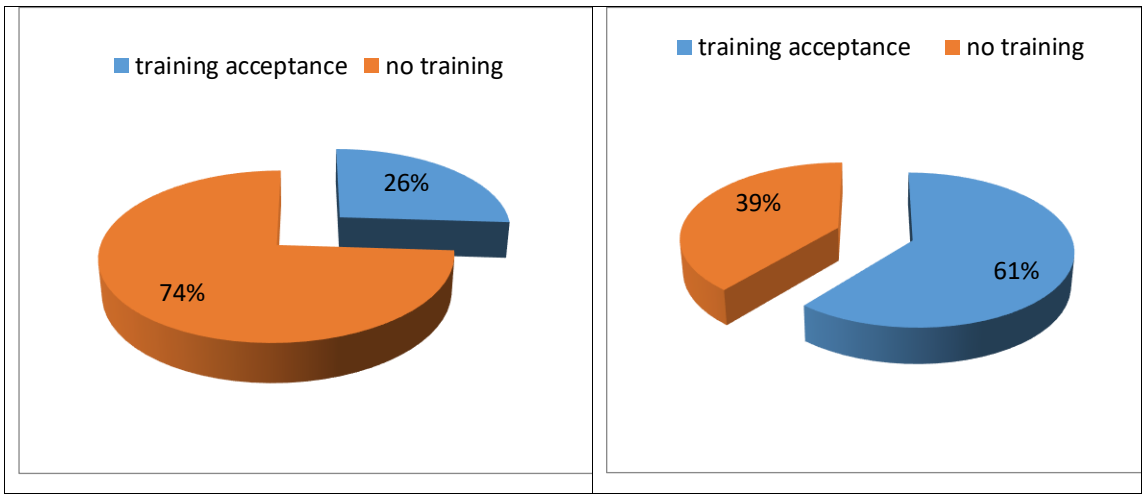

Figure 4.8: Training Facilities of Shrimp and Prawn Farmers

Source: Field survey, 2019

Here we can see that, 26 percent of shrimp farmers had training facilities while 74 percent of them had not (Figure: 4.8).

In prawn farming, 61 percent of farmers had training facilities while 39 percent of them had not (Figure: 4.8).

Name of the training institutions are given below (Table-4.4) in which the sample farmers took their training.

Table 4.4: Name of the Institutions

Institution	Shrimp Farming		Prawn Farming	
	No.	Percent (%)	No.	Percent (%)
No training	74	74	39	39
Fisheries office (govt.)	16	16	48	48
NGO	4	4	10	10
NATP project	2	2	1	1
Others	4	4	2	2
Total	100	100	100	100

Source: Field survey, 2019

In shrimp farming, farmers were given 16 percent training from the Fisheries office (govt.), 4 percent from NGO, 2 percent from NATP projects and 4 percent from other sources. 74 percent of farmers had no training facilities here.

In prawn farming, farmers were given 48 percent training from the Fisheries office (govt.), 10 percent from NGO, 1 percent from NATP projects and 2 percent from other sources. 39 percent of farmers had no training facilities here.

4.9 Involvement with Social Organizations in Shrimp and Prawn Farming

No man can live alone in society. All need support from others. In this perspective, men are involving different kinds of social organizations.

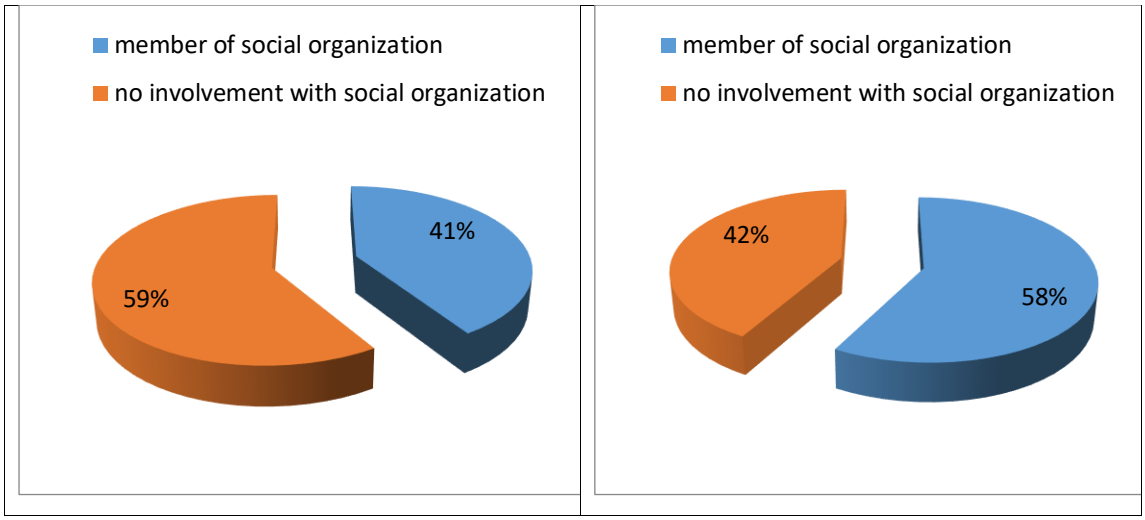

Figure 4.9: Involvement with Social Organizations of Shrimp and Prawn Farmers

Source: Field survey, 2019

In shrimp farming, 41 percent of shrimp farmers had involvement with social organizations and 59 percent of them had not (Figure: 4.9).

In prawn farming, 58 percent of prawn farmers had involvement with social organizations and 42 percent of them had not (Figure: 4.9).

Name of the social organizations are given below (Table-4.5) in which the sample farmers were involved.

Table 4.5: Name of the Social Organizations

Name of social organization	Shrimp Farming		Prawn Farming	
	No.	Percent (%)	No.	Percent (%)
Agriculture cooperative society	4	4	8	8
NGO	23	23	20	20
Fish farmer welfare association	3	3	3	3
Others	11	11	27	27
No member of any organization	59	59	42	42
Total	100	100	100	100

Source: Field survey, 2019

In shrimp farming, 23 percent of farmers were involved with NGO, 4 percent were with Agriculture cooperative society, 3 percent with Fish farmer welfare association and 11 percent with other organizations. 59 percent of farmers had no involvement with any social organizations here.

In prawn farming, 20 percent of farmers were involved with NGO, 8 percent were with Agriculture cooperative society, 3 percent with Fish farmer welfare association and 27 percent with other organizations. 42 percent of farmers had no involvement with any social organizations here.

4.10 Size of Land Holdings of the Sample Farmers

In the present study, the size of land holdings of the shrimp and prawn producing farmers are classified into different categories. Size of land holdings includes own land, homestead area, pond owned, pond leased, leased in, leased out, mortgage in and mortgage out as reported by the selected farmers.

In shrimp farming, the evidence from the table 4.6 represents that, 33.41 percent, 4.90 percent, 17.25 percent, 18.67 percent, 0.40 percent, 3.06 percent, 14.96 percent and 7.35 percent areas were own land, homestead area, pond owned, pond leased, leased in, leased out, mortgage in and mortgage out respectively hold by the sample farmers on an average.

Table 4.6 Size of Land Holdings of the Sample Farmers

Types of Land	Shrimp Farming		Prawn Farming	
	Average Area (decimal)	Percent (%) of Area	Average Area (decimal)	Percent (%) of Area
Own land	83.40	33.41	117.56	36.53
Homestead	12.24	4.90	13.98	4.34
Pond owned	43.05	17.25	25.53	7.93
Pond leased	46.60	18.67	9.71	3.02
Leased in	0.99	0.40	16.02	4.98
Leased out	7.65	3.06	83.82	26.05
Mortgage in	37.35	14.96	48.92	15.20
Mortgage out	18.35	7.35	6.26	1.95
Total	249.63	100	321.8	100

Source: Field survey, 2019

In prawn farming, the table 4.6 shows that, 36.53 percent, 4.34 percent, 7.93 percent, 3.02 percent, 4.98 percent, 26.05 percent, 15.20 percent and 1.95 percent areas were own land, homestead area, pond owned, pond leased, leased in, leased out, mortgage in and mortgage out respectively hold by the sample farmers on an average.

4.11 Credit Facilities of the Respondent

Available amount of funding is an important factor for any kind of farming. The sources of credit facilities for the shrimp and prawn producing farmers include Banks, NGOs, relatives and also their own funding.

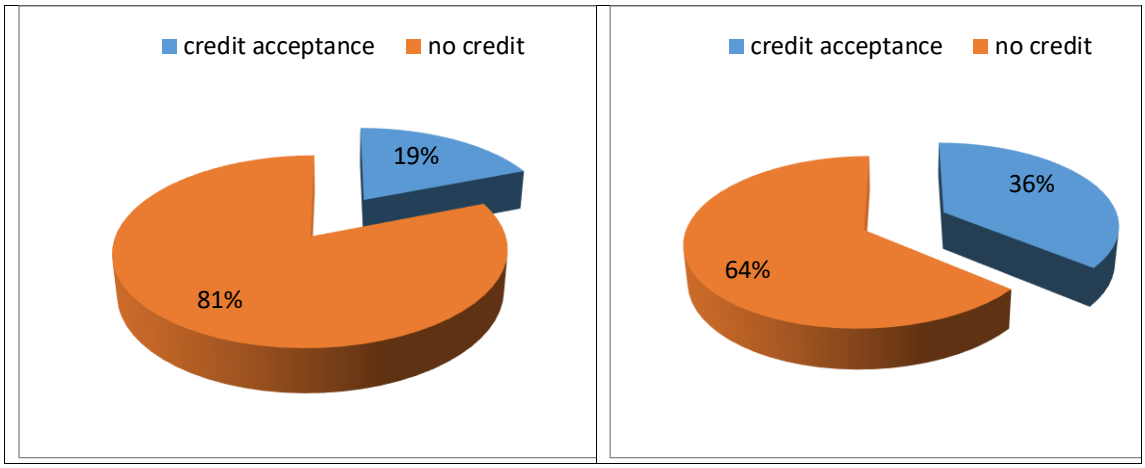

Figure 4.10: Credit Facilities of Shrimp and Prawn Farmers

Source: Field survey, 2019

In shrimp farming, about 19 percent of farmers were taken credit for their production and 81 percent of farmers were not taken any credit facilities (Figure: 4.10).

In prawn farming, about 36 percent of farmers were taken credit for their production and 64 percent of farmers were not taken any credit facilities (Figure: 4.10).

4.12 Income Distribution of the Respondents

The yearly income of shrimp and prawn farmers differs from one another. In the present study, the income of sample farmers were categorized as follows: crop cultivation, livestock rearing, foreign remittance, business, service, income from shrimp/ prawn farming and others.

In case of shrimp farming, table- 4.7 shows that, 53 percent, 15 percent, 11 percent, 6 percent, 6 percent, 5 percent and 4 percent income came from- shrimp farming, livestock rearing, crop cultivation, business, others, service and foreign remittance respectively.

Table 4.7: Annual Income of the Respondents

Source of income	Shrimp Farming		Prawn Farming	
	Average income	Percent (%) of income	Average income	Percent (%) of income
Crop cultivation	23155	11	32560	14
Livestock rearing	31575	15	34886	15
Foreign remittance	8420	4	2326	1
Business	12630	6	20932	9
Service	10525	5	11629	5
Income from shrimp/ prawn farming	111565	53	127916	55
Others	12630	6	2326	1
Total	210500	100	232575	100

Source: Field survey, 2019

In case of prawn farming, table- 4.7 tells that, 55 percent, 9 percent, 15 percent, 14 percent, 5 percent, 1 percent and 1 percent income came from- prawn farming, business, livestock rearing, crop cultivation, service, foreign remittance and others respectively.

4.13 Expenditure of the Respondents

The yearly expenditure of shrimp and prawn farmers also differs from one another. In the present study, the expenditure of shrimp and prawn farmers were categorized as follows: cloth, house repair, medical purpose, food, festival and others.

Table 4.8: Annual Expenditure of the Respondents

Expenditure	Shrimp Farming		Prawn Farming	
	Average Expenditure	Percent (%) of expenditure	Average Expenditure	Percent (%) of expenditure
Cloth	9375	10.05	9448	8.56
House repair	5842	6.29	6817	6.17
Medical purpose	6354	6.84	6107	5.53
Food	62823	67.69	79000	71.53
Festive	7378	7.94	8400.075	7.61
Others	1108.46	1.19	672.75	0.60
Total	92880.46	100	110444.83	100

Source: Field survey, 2019

In shrimp farming, table 4.8 shows that, shrimp producing farmer's expenditure were 67.79 percent, 10.05 percent, 6.29 percent, 6.84 percent, 7.94 percent and 1.19 percent from food, cloth, house repair, medical purpose, festival and others respectively.

In prawn farming, table 4.8 represents that, prawn producing farmer's expenditure were 71.53 percent, 8.56 percent, 6.17 percent, 5.53 percent, 7.61 percent and 0.60 percent from food, cloth, house repair, medical purpose, festival and others respectively.

4.14 Concluding Remarks

This chapter considered the socio-economic attributes of the sample farmers of shrimp and prawn farming. The findings of analysis clearly indicate the socio-economic characteristics from each other in respect of age distribution, education, occupation, farm size, culture technique, ownership pattern, training, income, expenditure etc. By the analysis of this study, the socio-economic status of the shrimp and prawn farmers were overall similar.

CHAPTER V

PROFITABILITY ANALYSIS OF SHRIMP AND PRAWN FARMING

5.1 Introduction

For every production process, cost plays an important role to make a right decision for the farmers. This chapter generally deals with the estimation and analysis of costs of shrimp and prawn production. The costs were classified into two groups. Such as- variable costs and fixed costs.

In this chapter, in terms of shrimp and prawn farming per hectare yield, gross return, gross margin, net return and undiscounted benefit-cost ratio (BCR) are discussed. All the returns were accounted for the study period. A brief account showing how the individual costs and returns were estimated in the present study is represented below. For analysis, the cost items were classified under the following heads:

i. Human labor cost
ii. Fertilizer cost;
iii. Lime cost;
iv. Fingerling cost;
v. Feed cost;
vi. Land use cost;
vii. Others cost(pond maintenance, netting, guard shed and equipments) and
viii. Interest on operating capital (IOC).

5.2 Variable Costs

5.2.1 Human Labor Cost

Human labor is one of the most important variable inputs in the production process. Human labor is required for various activities of the selected farms such as- farm preparation, weeding, sorting, grading, harvesting, etc.

In this study, human labor was calculated in man-days. The labor of women and children was converted into man-equivalent day to present a ratio of 2 children day = 1.5 women days = 1 man equivalent day (Miah, 1987). One man-day was considered to be 8 hours of work. To avoid complexity, average rate has been taken into account. The wage rate of labor varies with respect to different seasons.

In the study area the computed average rate was Tk. 500 per man-days for shrimp farming. Use of human labor and its relevant cost incurred were shown in table 5.1.

The per hectare labor cost for shrimp was Tk. 30000 which constituted 8.76 percent of total variable cost.

The per hectare labor cost for prawn was Tk. 39000 which constituted 13.37 percent of total variable cost.

5.2.2 Cost of Fertilizer

Fertilizer is another essential input for shrimp and prawn farming. Shrimp and prawn farmers applied two kinds of fertilizer such as Urea and TSP. By using these fertilizers, it influence the growth of shrimp and prawn. The cost of fertilizer was estimated by using the usual market rate which was actually paid by the farmers. These fertilizers prices were assumed to be same in all categories of farms. The average price of fertilizer (Urea and TSP) was Tk. 42 per kg in the study area. The estimated cost of fertilizer is shown in table 5.1. It was showed that, shrimp farmers incurred cost of Tk. 8484 for fertilizer which constituted 2.48 percent of total variable cost.

Now the average price of fertilizer (Urea and TSP) was Tk. 38 per kg in the study area. It was observed that prawn farmers incurred cost of Tk. 8436 for fertilizer which constituted 2.89 percent of total variable cost (Table 5.1).

5.2.3 Cost of Lime

Lime is a vital element to the shrimp and prawn farmers which creates healthy and productive environment for shrimp and prawn in the shrimp and prawn farm. It was used to neutralize the acidity level in the soil and pond water and it prevents diseases of shrimp and prawn. Cost of lime was charged at the price actually paid by the farmers. The average price of lime was estimated to be Tk. 20 per kg in the study period of shrimp farming. There is a required dose for lime application, but the shrimp farmers used 130 kg/ha in the study area for shrimp production. Average per hectare costs of lime was calculated at Tk. 2600 which constituted 0.76 percent of total variable cost (Table 5.1).

During the study period of prawn farming, the average price of lime was estimated to be Tk. 19 per kg. . Beyond the required dose of lime application, the prawn farmers in the study area used 190 kg/ha for prawn production. Average per hectare costs of lime was calculated at Tk. 3610 which constituted 1.24 percent of total variable cost (Table 5.1).

5.2.4 Cost of Fingerling

Fingerling is a major input of shrimp and prawn farming in the study area. There was a variation in the per unit price of fingerling from place to place as well as time to time. But cost was calculated on the basis of actual price paid by the farmers. The average price of shrimp fingerling was Tk. 2.00 per piece. The per hectare average costs of fingerling were estimated at Tk. 240354 which constituted 70.18 percent of total variable cost (Table 5.1).

Here, the average price of prawn fingerling was Tk. 3.00 per piece. The per hectare average costs of fingerling were estimated at Tk. 197043 which constituted 67.55 percent of total variable cost (Table 5.1).

5.2.5 Cost of Feed

For increasing shrimp and prawn production supply of artificial supplementary feed is the most important element, which can complement nutritional deficiency. In the study area shrimp and prawn farmers used different types of supplementary feed for shrimp and prawn growth. Cost of feeds was estimated at the prevailing market price. For shrimp farming, the average cost of ready feed was calculated at Tk. 50 per kg during the study period. Per hectare average costs of feed were calculated at Tk. 44750 which constituted 13.07 percent of total variable cost (Table 5.1).

For prawn farming, the average cost of ready feed was calculated at Tk. 46 per kg during the study period. Per hectare average costs of feed were calculated at Tk. 29716 which constituted 10.19 percent of total variable cost (Table 5.1).

5.2.6 Interest on Operating Capital (IOC)

Interest on operating capital (IOC) was determined on the basis of the opportunity cost principle. This cost was incurred throughout the total production period; hence, at the rate of 10 percent per annum interest on operating capital for six months was computed for shrimp and prawn production. Interest on operating capital was calculated by using the following standard formula (Miah, 1992).

Interest on Operating Capital (IOC) = Alit

Where,

Al= Total investment /2,

t = Total time period of a cycle

i = interest rate which was 10% per year during the study period.

In shrimp farming, the interest on operating capital was estimated at Tk. 16309 which constituted 4.75 percent of total variable cost (Table 5.1).

In prawn farming, the interest on operating capital was estimated at Tk. 13890 which constituted 4.76 percent of total variable cost (Table 5.1).

Table 5.1 Per Hectare Variable Costs of Shrimp and Prawn Farming

		Shrimp				Prawn			
Variable cost item	**Units**	**Quantity (Unit/ha)**	**Price (Tk./Unit)**	**Cost(Tk.)**	**% of TVC**	**Quantity (Unit/ha)**	**Price (Tk./Unit)**	**Cost (Tk.)**	**% of TVC**
Human labor	Man-days	60	500	30000	8.76	65	600	39000	13.37
Fertilizer	Kg	202	42	8484	2.48	222	38	8436	2.89
Lime	Kg	130	20	2600	0.76	190	19	3610	1.24
Fingerling	No.	120177	2	240354	70.18	65681	3	197043	67.55
Feed	Kg	895	50	44750	13.07	646	46	29716	10.19
IOC				16309	4.75			13890	4.76
TVC				342497	100			291695	100

Source: Field survey, 2019

5.2.7 Total Variable Cost

In the study area, the total variable costs varied from year to year. It was shown that the total per hectare variable cost for shrimp farming was Tk. 342497 which comprised of 77.49 percent of total cost. And the total per hectare variable cost for prawn farming was Tk. 291695 which comprised of 77.28 percent of total cost (Table5.3).

5.3 Fixed Costs

5.3.1 Land Use Cost

The farmers used the land as per the conditions of leasing arrangement. The term leasing cost explains the cost which was needed for shrimp and prawn farmers to take land lease which would be used for shrimp and prawn production for a particular period of time. Leasing cost varies from place to place depending on the location, soil fertility, topography of the soil and distance from the water sources, etc. Land use cost for shrimp and prawn farming was estimated at the prevailing rental value per hectare in the study area. The rental value of shrimp farming of per hectare land was estimated at Tk. 68067 which occupied 68.43 percent of total fixed cost. And the rental value of prawn farming of per hectare land was estimated at Tk. 47676 which occupied 55.59 percent of total fixed cost (Table 5.2).

5.3.2 Others Cost (Pond Maintenance, Netting, Guard Shed and Equipment)

Guard shed was constructed to protect shrimp and prawns from thieves and dacoits. The per hectare average pond maintenance, netting, guard shed and equipment cost were calculated at Tk. 31409 for shrimp farming which shared 31.57 percent of total

fixed cost and Tk. 38095 for prawn farming which shared 44.41 percent of total fixed cost (Table 5.2).

Table 5.2 Per Hectare Fixed Costs of Shrimp and Prawn Farming

Fixed cost items	Shrimp		Prawn	
	Cost(Tk./ha)	% of TFC	Cost(Tk./ha)	% of TFC
Land use cost	68,067	68.43	47,676	55.59
Others cost(pond maintenance, netting, guard shed and equipment)	31409	31.57	38095	44.41
TFC	99476	100	85771	100

Source: Field survey, 2019

5.3.3 Total Fixed Cost

In the study area, it was estimated that per hectare total fixed cost for the year round shrimp farming was Tk. 99476 which comprised of 22.51 percent of total cost and prawn farming was Tk. 85771 which comprised of 22.72 percent of total cost (Table 5.3).

5.4 Total Cost

The total costs were calculated by the addition of total variable cost and total fixed cost. In the study area, per hectare total cost of shrimp farming was calculated at Tk. 441973 and prawn farming was calculated at Tk. 377466 (Table 5.3).

Table 5.3 Per Hectare Total Cost of Shrimp and Prawn Farming

Cost items	Shrimp		Prawn	
	Cost(Tk./ha)	%of total cost	Cost(Tk./ha)	%of total cost
a. TVC	342497	77.49	291695	77.28
b. TFC	99476	22.51	85771	22.72
Total cost (a+b)	441973	100	377466	100

Source: Field survey, 2019

5.5 Returns of Shrimp and Prawn Farming

5.5.1 Gross Return

Gross returns per hectare were calculated by multiplying the total amount of production by their respective market prices. In the study area, per hectare average yield of shrimp was 750 kg and its monetary value was Tk. 525000 and per hectare average yield of prawn was 850 kg and its monetary value was Tk. 616250(Table 5.4). Shrimp and prawn have a different grading system. Most shrimp and prawn are graded on the basis of size (weight). Here the grading was done on the basis of number of pieces forming one kg as reported by the farmer. For calculation, three types of grading system were followed in this study.

- A-grade: 10-15 numbers of shrimp/prawn is required to make 1kg weight.
- B-grade: 20-29 numbers of shrimp/prawn is required to make 1kg weight.
- C-grade: 30^{+} numbers of shrimp/prawn is required to make 1 kg weight.

5.5.2 Net Return

In general sense, net return is termed as entrepreneur's income. For evaluate the profitability of shrimp and prawn production, net return is an important aspect. Net return is the difference between gross return and total costs. In this study, per hectare net return for shrimp production was estimated at Tk.83027and prawn production was estimated at Tk.238784 (Table 5.5).

5.5.3 Gross Margin

Farmers usually want to gain the maximum level of return over variable cost of production. Because the estimation of fixed cost of production is difficult to determine. For that reason the gross margin analysis has been taken into account to calculate the relative profitability of shrimp and prawn farming. The gross margin of shrimp and prawn farming were estimated at Tk. 182503 and Tk. 324555 respectively (Table 5.5).

Table 5.4 Per Hectare Return of Shrimp and Prawn Farming

Items	Yield(kg/ha)	Price(Tk./kg)	Gross return	% of gross income
Average Gross production from shrimp	750	700	525000	100
Average Gross production from prawn	850	725	616250	100

Source: Field survey, 2019

Table 5.5 Gross Margin and Benefit Cost Ratio (Undiscounted) of Shrimp and Prawn Farming

SI. No.	Items	Shrimp	Prawn
		Amount(Tk./ha)	Amount(Tk./ha)
A.	GR	525000	616250
B.	TVC	342497	291695
C.	TFC	99476	85771
D.	TC=TVC+ TFC	441973	377466
E.	NR (GR-TC)	83027	238784
F.	GM (GR-TVC)	182503	324555
G.	BCR= GR/TC	1.19	1.63

Source: Field survey, 2019

5.5.4 Benefit Cost Ratio (Undiscounted)

Benefit cost ratio (BCR) was calculated by dividing gross return by total cost. It denotes return per taka invested. It is helpful for analyzing financial efficiency of a farm. It was evident from the study that, the benefit cost ratio (BCR) of shrimp farming was accounted for 1.19. Which implies that Tk. 1.19 would be earned by investing Tk. 1.00 for shrimp production (Table 5.5).

Here we get the benefit cost ratio (BCR) of prawn farming was accounted for 1.63 implying that Tk. 1.63 would be earned by investing Tk. 1.00 for prawn production (Table 5.5).

5.6 Concluding Remarks

It was evident from the results of the study that, BCR of prawn farming (1.63) is higher than shrimp farming (1.19) in the study area. Prawn farming provides higher returns to the farmers of the selected areas. Because in the study area, both the yield (kg/ha) and price (Tk./kg) of prawn was higher than the shrimp and variable as well as fixed both cost were higher in shrimp production than prawn production . Both shrimp and prawn cultivation is gaining popularity gradually in the country for the high yield potentiality and high demand in the international market. Sample farmers showed their opinion that higher production and income encouraged them to continue prawn production in the study area.

CHAPTER VI

FACTORS AFFECTING DETERMINANTS OF SHRIMP AND PRAWN FARMING

6.1 Introduction

An attempt has been made in this chapter for identifying and measuring the effects of the main variables on shrimp and prawn production. Cobb-Douglas production function was chosen for estimating the contribution of key variables on the production process of shrimp and prawn farming. The estimated values of the model are presenting in Table 6.1.

6.2 Functional Analysis for Measuring Production Efficiency

Production function is a mathematical function identifying the maximum output that can be produced with given inputs for a given level of technology. The objectives of the study should keep in mind and considering the effect of explanatory variables on output of shrimp and prawn farming. Five explanatory variables were chosen to estimate the quantitative effect of inputs on output.

In the present study, management factor was not included in the model. Because specification and measurement level of management factor is nearly impossible (where a farm operator plays the role of a labor and manager). Other explanatory variables like water quality, time, etc., which might have affected the production of shrimp and prawn farming, were deducted from the model on the basis of some initial estimation. A brief description is presented here about the explanatory variables included in the model.

6.3 Estimated Values of the Production Function Analysis

i. F-value was used in the model for measuring the goodness of fit for different types of inputs.
ii. The coefficient of multiple determinations (R^2) means the total variations of output explained by the explanatory variables included in the model.
iii. Coefficients having sufficient degrees of freedom were tested for significance level at 1 percent, 5 percent and 10 percent levels of significance.
iv. Stage of production was estimated by returns to scale which was the summation of all the production elasticity of various inputs.

The estimated coefficients and related measurements of the Cobb-Douglas production function for shrimp and prawn production are shown in Table 6.1.

Table 6.1 Estimated Values of Coefficients and Related Statistics of Cobb-Douglas Production Function

	Shrimp Farming				Prawn Farming			
Explanatory variables	**Coefficient**	**Standard Error**	**t value**	**P value**	**Coefficient**	**Standard Error**	**t value**	**P value**
Intercept	-0.499^{NS}	1.219	-0.41	0.683	0.801^{NS}	1.219	0.66	0.513
Human labor (X_1)	0.577***	0.129	4.48	0.000	0.578**	0.284	2.04	0.045
Fertilizer (X_2)	0.061NS	0.184	0.33	0.741	0.231*	0.140	1.65	0.100
Lime (X_3)	0.229**	0.099	2.29	0.023	-0.042^{NS}	0.123	-0.34	0.736
Fingerling (X_4)	0.300**	0.124	2.42	0.017	0.001^{NS}	0.185	0.01	0.992
Feed (X_5)	0.038^{NS}	0.092	0.41	0.681	0.482**	0.204	2.37	0.020
R^2	0.53				0.58			
Adjusted R^2	0.52				0.57			
Returns to scale	1.21				1.23			
F- value	18.24***				16.17***			

Source: Field survey, 2019

Note: *** Significant at 1 percent level, ** Significant at 5 percent level;

* Significant at 10 percent level; and NS: Not Significant

6.4 Interpretations of Results

Quantity of human labor: The estimated coefficients of human labor were 0.577 and significant at 1 percent level for shrimp farming. It implies that a 1 percent increase in the quantity of human labor, keeping other factors constant, would increase gross production by 0.577 percent (Table 6.1).

The estimated coefficients of human labor were 0.578 and significant at 5 percent level for prawn farming. It implies that a 1 percent increase in the quantity of human labor, keeping other factors constant, would increase gross production by 0.578 percent (Table 6.1)

Quantity of fertilizer: The fertilizer used for shrimp farming included the category of Urea and TSP. The regression coefficient of the quantity of fertilizer was 0.061 which is insignificant for shrimp farming. It implies the 1 percent increase in the quantity of fertilizer, keeping other factors constant, would decrease gross production by 0.061 percent (Table 6.1).

The fertilizer used for prawn farming included the category of Urea and TSP. The regression coefficient of the quantity of fertilizer was 0.231 and significant at the 10 percent level for prawn farming. It implies the 1 percent increase in the quantity of fertilizer, keeping other factors constant, would increase gross production by 0.231 percent (Table 6.1).

Quantity of lime: The regression coefficient of the quantity of lime was 0.229 and significant at 5 percent level for shrimp farming. It implies the 1 percent increase in the quantity of lime, keeping other factors constant, would increase gross production by 0.229 percent (Table 6.1).

The regression coefficient of the quantity of lime (-0.042) was negative and insignificant for prawn farming. It implies the 1 percent increase in the quantity of lime, keeping other factors constant, would decrease gross production by 0.042 percent (Table 6.1).

Number of fingerling: The regression coefficient of the number of fingerlings was 0.300 and significant at 5 percent level for shrimp farming. It indicates that 1 percent increase in the number of fingerlings, remaining other factors constant, would increase gross production by 0.300 percent (Table 6.1).

The regression coefficient of the number of fingerling 0.001 was insignificant at for prawn farming. It indicates that 1 percent increase in the number of fingerlings, remaining other factors constant, would decrease gross production by 0.001 percent (Table 6.1).

Quantity of feed: Estimated coefficient of the quantity of feed was 0.038 and insignificant for shrimp farming. It implies that 1 percent increase in the quantity of feed, remaining other factors constant, would decrease gross production by 0.038 percent (Table 6.1).

The estimated coefficient of the quantity of feed 0.482 was and significant at 5 percent level for prawn farming. It implies that 1 percent increase in the quantity of feed, remaining other factors constant, would increase gross production by 0.482 percent (Table 6.1).

6.5 Coefficient of Multiple Determinations (R^2)

The values of the coefficient of multiple determination (R^2) of shrimp farming was found to be 0.53 which implied that about 53 percent of the total variation in the gross production could be explained by the included explanatory variables of the model. So we can say the goodness of fit of this regression model is better since R^2 indicates the goodness of fit of the regression model (Table 6.1).

The values of the coefficient of multiple determination (R^2) of prawn farming was found to be 0.58 which implied that about 58 percent of the total variation in the gross production could be explained by the included explanatory variables of the model. So we can say the goodness of fit of this regression model is better since R^2 indicates the goodness of fit of the regression model (Table 6.1).

6.6 Adjusted R^2

Here the term adjusted indicates adjusted for the degrees of freedom. The adjusted R^2 for shrimp farming was found to be 0.52 which indicated that about 52 percent of the variations of the output were explained by the explanatory variables included in the model (Table 6.1). The adjusted R^2 for prawn farming was found to be 0.57 which indicated that about 57 percent of the variations of the output were explained by the explanatory variables included in the model (Table 6.1).

6.7 Returns to Scale in Shrimp and Prawn Production

The summation of all the production coefficients of shrimp farming is equal to 1.21. This means that production function for shrimp farming shows increasing returns to scale. This means that, if all the variables specified in the model were increased by 1 percent, gross production would also be increased by 1.21 percent (Table 6.1).

The summation of all the production coefficients of prawn farming is equal to 1.23. This means that production function for prawn farming exhibits increasing returns to scale. This means that, if all the variables specified in the model were increased by 1 percent, gross production would also be increased by 1.23 percent (Table 6.1).

6.8 F-Value

The F-statistic was computed to signify the overall goodness of fit of any fitted model. The F-value for the shrimp farming was estimated at 18.24 which were significant at 1 percent level. It means that the explanatory variables included in the model were important for explaining the variation in gross production of shrimp production (Table 6.1).

The F-value for the prawn farming was estimated at 16.17 which were significant at 1 percent level. It means that the explanatory variables included in the model were important for explaining the variation in gross production of shrimp production (Table 6.1).

6.9 Resource Use Efficiency in Shrimp and Prawn Production

For identifying the status of resource use efficiency, it was considered that a ratio equal to unity showed the optimum use of that factor, a ratio more than unity indicated that the yield could be increased by the use of more resources. A value of less than unity showed the unprofitable level of resource use, which should be decreased to minimize the losses because farmers over used this variable. The negative value of MVP means the indiscriminate and inefficient use of resources.

The ratio of MVP and MFC of human labor (26.87) for shrimp production was positive and more than one, which indicated that in the study area human labor was

under used (Table 6.2). So, farmers should increase the use of human labor to attain efficiency considerably.

The ratio of MVP and MFC of human labor (27.31) for prawn production was positive and more than one, which indicated that in the study area human labor was under used (Table 6.2). So, farmers should increase the use of human labor to attain efficiency considerably.

Table 6.2 showed that the ratio of MVP and MFC of fertilizer (2.62) for shrimp farming was positive and more than one, which indicated that in the study area fertilizer for shrimp growth was under used. So, farmers should increase the use of fertilizer to attain efficiency level.

Table 6.2 showed that the ratio of MVP and MFC of fertilizer (15.10) for prawn farming was positive and more than one, which indicated that in the study area fertilizer for prawn growth was under used. So, farmers should increase the use of fertilizer to attain efficiency level.

The ratio of MVP and MFC of lime was (3.51) for shrimp farming was positive and more than one, which indicated that in the study area use of lime for shrimp production was under used (Table 6.2). So, farmers should increase the use of lime for shrimp production to attain efficiency considerably.

The ratio of MVP and MFC of lime was found to be (-6.16) for prawn farming was negative and less than one, which indicated that in the study area use of lime for prawn production was over used (Table 6.2). So, farmers should decrease the use of lime for prawn production to attain efficiency considerably.

Table 6.2 revealed that the ratios of MVP and MFC of fingerling used for shrimp production was positive and more than one (1.23), which indicated that fingerling was underutilized. So, farmers should increase the use of fingerling to attain efficiency in shrimp production.

Table 6.2 revealed that the ratio of MVP and MFC of fingerling used for prawn production was negative and less than one 0.01, which indicated that fingerling was over utilized. So, farmers should decrease the use of fingerling to attain efficiency in prawn production.

It was evident from the table 6.2 that the ratio of MVP and MFC of feed (0.07) for shrimp farming was positive and less than one, which indicated that in the study area use of feed for shrimp farming was over used. So, farmers should decrease the use of feed to attain efficiency in shrimp production.

It was evident from the table 6.2 that the ratio of MVP and MFC of feed 8.55 for prawn farming was positive and more than one, which indicated that in the study area use of feed for prawn farming was under used. So, farmers should increase the use of feed to attain efficiency in prawn production.

6.10 Concluding Remarks

It is evident from the Cobb-Douglas production function model that, the included main variables had significant and positive effect on shrimp production except insignificant effect of fertilizer and feed. Resource use efficiency indicated that all of the resources were under used for shrimp production except overutilization of feed. Again in case of prawn farming, by the evident from the Cobb-Douglas production function model that, the included key variables had significant and positive effect on prawn production except insignificant effect of lime and fingerling. Resource use efficiency indicated that all of the resources were under used for prawn production except overutilization of lime and fingerling.

Table 6.2 Estimated Resource Use Efficiency in Shrimp and Prawn Production

	Shrimp Farming					Prawn Farming				
Variables	**GM**	**MVP**	**MFC**	**MVP/MFC**	**Comment**	**GM**	**MVP**	**MFC**	**MVP/MFC**	**Comment**
Human labor	12.86	13436.94	500	26.87	Under-utilized	15.07	16385.5	600	27.31	Under-utilized
Fertilizer	165.44	110.19	42	2.62	Under-utilized	171.96	573.87	38	15.10	Under-utilized
Lime	97.74	70.15	20	3.51	Under-utilized	151.94	-116.95	19	-6.16	Over-utilized
Fingerling	88112.10	2.45	2	1.23	Under-utilized	46651	0.015	3	0.01	Over-utilized
Feed	3185.09	3.54	50	0.07	Over-utilized	524.24	393.09	46	8.55	Under-utilized

Source: Field survey, 2019

CHAPTER VII

PROBLEMS AND SUGGESTIONS OF SHRIMP AND PRAWN FARMING

7.1 Introduction

In Bangladesh, fishery as a source of livelihood for thousands of fishermen. But the fishermen community is backward in socially, economically and educationally. In the present study, an attempt had been made to specify, identify and analyze the main problems and suggestions in running the business of shrimp and prawn farming. Here, the problems and suggestions were ranked on the basis of their percentages. These problems and suggestions are presented and discussed below.

7.2 Shrimp and Prawn Farming Problems

Shortage of High Quality Fingerling: About 48 percent of farmers reported that shortage of high quality fingerling was one of the most important and major problems for shrimp farming. But in present situation it is not a major problem for the farmers. Because government along with many private organizations supply high quality fingerling which are required for the shrimp farming.

Attack of Viral Diseases: This was another problem by which shrimp and prawn farmers were suffered a lot. It was reported by 45 percent of shrimp farmers along with 39 percent of prawn farmers reported that shrimp and prawn were attacked by viral disease in the study area. Shrimp and prawn which were infected by viral infection should be removed from the fresh ones. Otherwise the percentage of infection could be raised.

Lack of training Facility: Lack of training facility was the vital problem faced by the farmers in conducting shrimp and prawn farming in the study area. About 29 percent of shrimp farmers as well as 25 percent of prawn farmers reported that there were inadequate training facilities for their improvement.

Lack of Water Supply in Dry Season: About 21 percent of shrimp producing farmers reported that, the insufficiency of water in dry season hampered shrimp production. The government can solve this problem by keeping the diesel price at a minimum level so that farmers can supply sufficient water in the canal in dry season.

Attack of Disease Infestation: About 17 percent of shrimp producing farmers reported that attack of shrimp disease hampered the shrimp production. Besides this 39 percent of prawn farmers also faced this as a vital problem. To overcome this problem, scientific use of chemicals should be established and arrangement of

artificial irrigation should be given in dry season. Extension workers, UFO may take initiatives to ensure scientific approach for overcoming this problem.

Lower Production: It was announced by 15 percent of the shrimp producing farmers and 9 percent of prawn producing farmers that, the production of shrimp and prawn were lowered day by day. Desirable environment, specific temperature, production technology etc. should be maintained here for the better production of shrimp.

High Price of Feed: It is very shocking that about 10 percent of shrimp producing farmer announced that the price of shrimp feed was very much higher. Now-a-days shrimp farmers are getting subsidy in this purpose by our government which creates a positive change in shrimp farming.

Flooding in Rainy Season: For flooding during the heavy rains, the shrimp farms became flooded and fish escape from one field to another. About 10 percent of shrimp producing farmers and 15 percent of prawn producing farmer reported the problem in the study area. This problem can be solved by making embankment, proper canal and suitable drainage system.

Table7.1 Major Problems Faced by the Shrimp and Prawn Farmers

Shrimp Farming				Prawn Farming			
Problem	**No. of respondent**	**Percent (%)**	**Rank**	**Problem**	**No. of respondent**	**Percent (%)**	**Rank**
Shortage of high quality fingerlings	48	48	1st	Low price of output	39	39	1st
Attack of shrimp viral diseases	45	45	2nd	Attack of disease infestation	39	39	1st
Lack of training facilities	29	29	3rd	Attack of prawn viral diseases	37	37	2nd
Lack of water supply in dry season	21	21	4th	Lack of training facilities	25	25	3rd
Attack of disease infestation	17	17	5th	Fish poisoning by enemy	20	20	4th
Lower production	15	15	6th	Theft of prawn from farm	17	17	5th
High price of feed	10	10	7th	Flooding in rainy season	15	15	6th
Flooding in rainy season	10	10	7th	Oxygen deficiency	11	11	7th
Low price of output	8	8	8th	Lower production	10	10	8th
High soil temperature	4	4	9th	Crisis of fresh water	8	8	9th
Lack of drainage facilities	4	4	9th	Lack of transportation facilities	8	8	9th

Note: one shrimp and prawn farmer reported more than one problems, so addition of percentage will not necessarily equal to 100.

Low Price of Output: Low price of output was reflected as another important problem and reported by 8 percent of shrimp farmers. It was the main problem of prawn farmers in the study area. About 39 percent prawn farmers complained about the problem. Most of the farmers complained that they had to sell their products at local market at low price for the transportation problem. Measures should be taken by the government to resolve the price issue.

High Soil Temperature: About 4 percent of shrimp producing farmers complained that they were suffering from this problem. If this is going to be continued then it can create threat for the shrimp farmers.

Lack of Drainage Facilities: About 4 percent of farmers reported that this problem hampered their total production. To overcome this problem community based management should be developed.

Fish Poisoning by Enemy: About 20 percent of prawn farmers reported that this problem was hampering their total production. For overcoming this problem community based management should be developed.

Theft of Prawn from Farm: About 17 percent of prawn producing farmers reported that theft of prawn from farm was another vital problem. Farmers should look after their prawn farm at a regular basis. A guard could be appointed for the prawn farm. Local government should provide the social security.

Oxygen Deficiency: This was another alarming problem of prawn farming. About 11 percent of prawn farmers complained that oxygen deficiency was one of the serious problems in prawn farming. Necessary measures should be taken care for resolving this problem.

Crisis of Fresh Water: About 8 percent of prawn farmers were noted that crisis of fresh water was very much highlighted in the study area. It could hamper the total production of prawn. Prawn farmers should take care about this problem for better production.

Lack of Transportation Facilities: According to the farmers this was one of the barriers of prawn farming. About 8 percent of prawn farmers complained about this problem. Local government should take necessary steps for solving the problem.

7.3 Suggestions of the Shrimp and Prawn Farmers

After analyzing the problems shrimp and prawn farmers gave some suggestions. The respondents thought that these suggestions could help them in both shrimp and prawn farming. The suggestions are listed below.

Table7.2 Suggestions of the Shrimp and Prawn Farmers

Shrimp Farming				Prawn Farming			
Suggestion	**No. of respondent**	**Percent (%)**	**Rank**	**Suggestion**	**No. of respondent**	**Percent (%)**	**Rank**
Supplying quality feed	56	56	1st	Ensuring credit facilities at lower interest rate	53	53	1st
Ensuring credit facilities at lower interest rate	48	48	2nd	Supplying quality feed	50	50	2nd
Arrangement of training programme	45	45	3rd	Development of transportation facilities	46	46	3rd
Establishment of hatchery	39	39	4th	Arrangement of training programme	40	40	4th
No idea	27	27	5th	No idea	33	33	5th

Source: Field survey, 2019

Note: one shrimp and prawn farmer reported more than one suggestions, so the addition of percentage will not necessarily equal to 100.

Supplying Quality Feed: This was ranked as 1st and 2nd suggestion in shrimp and prawn farming respectively. Feed is very much important for the growth of shrimp and prawn. For the better production best quality feed should be needed.

Ensuring Credit Facilities at Lower Interest Rate: Farmers needed credit at lower interest rate for shrimp and prawn farming. It could help them to enhance the production and also inspire the respondents.

Arrangement of Training Programme: This is counted as a major problem of shrimp and prawn farming. So the respondents of shrimp and prawn farming were highly needed training facilities for improving them.

Establishment of Hatchery: Shrimp farmers suggested that they need hatchery for shrimp production. For out of season production and genetic improvement hatchery is needed by the shrimp farmers.

Development of Transportation Facilities: Prawn farmers suggested to develop transportation facilities for transferring prawn from farm to market or any other

places. As prawn are perishable products so quick transportation should be done. So the respondents wanted this facility.

No Idea: The farmers who gave no suggestion were 27 percent and 33 percent in shrimp and prawn farming respectively.

7.4 Concluding Remarks

The above mentioned problems are interrelated with one another and need to be removed intensively by an integrated program for the overall development of shrimp and prawn farming. The problems were ranked on the basis of corresponding percentages. Most of the farmers were announced that shortage of high quality fingerlings was the main constraint for their shrimp production. And this problem occupies first position according to its ranking. But I think there is some inconsistency of their answer. My opinion is that high price of feed and the insufficient water in the dry season were the main constraints hampering shrimp production. Government is taken necessary steps to supply the best quality of fingerlings to the shrimp farmers. So, this should not be a severe problem for the farmers. On the other hand, low price of output was reported the most severe problem of prawn farming. Government is concern about this matter also and mandatory solutions are also given to the farmers for better prawn production.

The suggestions which were suggested by the shrimp and prawn farmers should give more emphasis. Because farmers gave the suggestions by their field experience. So besides govt. initiatives these suggestions should also be implemented.

CHAPTER VIII

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

8.1 Summary

Fisheries sector is playing an important role in the economy of Bangladesh. People of Bangladesh are popularly known as 'Mache Bhate Bangali' or 'fish and rice makes a Bengali'. This sector plays a major role in meeting the demand of protein, foreign exchange earnings as well as socio-economic development of the rural poor people by eradicating poverty over employment generation.

Agriculture sector contributes 10.67 percent to the Gross Domestic Product (GDP) in the FY 2017-18. In 2017-18, fisheries sub-sector contributed about 3.56 percent to the Gross Domestic Product (GDP). The ecology of our country is suitable for the growth and production of the fisheries resources. The production of fish in different kinds of water bodies are increasing day-by-day with the improvements of modern technology. Fish production has increased to 41.34 lakh MT in 2016-17, which was 32.62 lakh MT in 2011-12. Bangladesh is gifted with vast water bodies such as 39.08 lakh hectares of open water fisheries, 8.75 lakh hectares of culture fisheries and 0.48 sq. nautical miles of marine fisheries. The country earned about Tk. 3559 crore during the year 2015-16 by exporting fish, shrimp and prawn of contributes Tk. 3003 crore. In Bangladesh, shrimp industry is the second largest foreign currency earner after the garment industry.

In this situation, the specific objectives of the study were formulated for determining relative profitability as well as to assess the resource use efficiency of shrimp and prawn farming in Bagerhat and Khulna districts. The specific objectives were given below:

a) To assess the socio-economic status of shrimp and prawn culture fish farmers;
b) To investigate comparative profitability and resource use efficiency of shrimp and prawn culture;
c) To identify the factors behind yield variations of shrimp and prawn farming and
d) To find the constraints and recommend for policy implications.

The study was totally based on primary data, which were collected by the researcher himself by interviewing the sample farmers. The shrimp and prawn farmers were selected from sadar and rampal upazila of Bagerhat district as well as dumuria and paikgacha upazila of Khulna district. Here simple random sampling technique was used for

selecting the shrimp and prawn farmers. Tabular and statistical technique was used for fulfilling the objectives of the study.

With respect to socio-economic features, the shrimp and prawn producing farmers were classified into three age groups: less than30 years, 31-45 years and above 45. In shrimp farming, out of the total sample farmers 17 percent belonged to the age group of less than 30 years and in prawn farming 16 percent belonged to the age group of less than 30 years out of total sample farmers. In shrimp farming, 43 percent belonged to the age group of 31-45 years and in prawn farming 44 percent belonged to this age group. In shrimp farming, 40 percent fell into the age group of above 45 and in prawn farming the percentage was also 40 in this age group. The average family sizes of the shrimp and prawn producing farmers were found to be 4.20 and 4.30 respectively which were slight less than the average family size of our country. This finding imply that majority of the sample farmers were in the most active age group of 31-45 years indicating that they provided more physical efforts for work in both shrimp and prawn farming. This age group is supposed to have enormous vigor and risk bearing ability. Here, the average male member, average female member, average earning member and average farming experience were- 2.16, 2.04, 1.34 and 12.98 respectively found in shrimp farming. On the other hand, average male member, average female member, average earning member and average farming experience were- 2.25, 2.05, 1.48 and 13.39 respectively found in prawn farming. Out of 100 shrimp farmers, 36 percent farmers had completed primary level education, 36 percent farmers had completed secondary level education and only 2 percent farmers were illiterate. In case of 100 prawn farmers, 32 percent farmers had completed primary level education, 43 percent farmers had completed secondary level education and only 1 percent farmers were illiterate. 76 percent farmers were involved in shrimp farming as a main occupation and 86 percent farmers were involved in prawn farming as a main occupation. 27 percent farmers were involved agriculture in shrimp farming as a subsidiary occupation and so on. In prawn farming, 39 percent farmers were involved agriculture as a subsidiary occupation and so on. In shrimp farming about 58 percent shrimp farmers were single owner, 4 percent were belonged to joint ownership and those of 38 percent had leased ownership. In prawn farming about 70 percent prawn farmers were single owner, 2 percent were belonged to joint ownership and those of 28

percent had leased ownership. In shrimp farming about 76 percent shrimp farmers were following extensive culture, 8 percent were following semi-intensive culture and those of 16 percent were following intensive culture. In prawn farming about 36 percent prawn farmers were following extensive culture, 12 percent were following semi-intensive culture and those of 52 percent were following intensive culture. 26 percent of shrimp farmers had training facilities and 74 percent of them had not. In prawn farming, 61 percent of farmers had training facilities and 39 percent of them had not. In shrimp farming, 41 percent of shrimp farmers had involvement with social organizations and 59 percent of them had not. In prawn farming, 58 percent of prawn farmers had involvement with social organizations and 42 percent of them had not. Shrimp farmers had 33.41 percent of own land and prawn farmers had 36.53 percent of own land in the study area. In shrimp farming, about 19 percent farmers were taken credit for their production and 81 percent farmers were not taken any credit facilities. In prawn farming, about 36 percent farmers were taken credit for their production and 64 percent farmers were not taken any credit facilities. Income from shrimp and prawn farming are 53 percent and 55 percent respectively. Expenditure on food is higher in both shrimp and prawn farming. This is 67.69 percent and 71.53 percent respectively. Commonly used fertilizers namely urea and TSP were used by the sample farmers in producing shrimp and prawn.

For determining the profitability of shrimp and prawn farming both the inputs and outputs were esteemed at market price during the study period. For analytical advantages, the cost item were identified as human labor, fertilizer, lime, fingerling, feed, land use cost, pond maintenance, netting, construction of guard shed, equipment cost and interest on operating capital. Cost and returns were functioned here for estimating profitability of shrimp and prawn production. Per hectare total cost, gross return, net return and gross margin of shrimp farming were Tk. 441973.00, Tk. 525000.00, Tk. 83027.00 and Tk. 182503.00 respectively. In prawn farming, per hectare total cost, gross return, net return and gross margin of were Tk. 377466.00, Tk. 616250.00, Tk. 238784.00 and Tk. 324555.00 respectively. Benefit Cost Ratio (BCR) was found to be 1.19 for shrimp farming and 1.63 or prawn farming.

In this study, Cobb-Douglas production function model was used for determining the specific effects of key variable inputs. The most important five explanatory variables

were included in the model to explain the gross production of shrimp and prawn farming. Most of the variables in the production function of shrimp farming were significant in explaining the gross production except the insignificant effect of fertilizer and feed. And in prawn farming, the variables were significant in explaining the gross production except a negative and insignificant effect of lime and fingerling. The coefficient with expected sign indicates the selected inputs contributed positively to the gross return. The values of the coefficient of multiple determination of shrimp farming was 0.53 which implied that about 53 percent of the total variation in the gross return could be explained by the included explanatory variables of the model. And the coefficient of multiple determination of prawn farming was 0.58 which implied that about 58 percent of the total variation in the gross return could be explained by the included explanatory variables of the model. Production function for shrimp farming exhibits increasing returns to scale (1.21). This means that, if all the variables specified in the model were increased by 1 percent, gross return would also increase by 1.21 percent. Again, the production function for prawn farming exhibits increasing returns to scale (1.23). This means that, if all the variables specified in the model were increased by 1 percent, gross return would also increase by 1.23 percent The F-value for the shrimp and prawn farming was 18.24 and 16.17 respectively which were significant at 1 percent level. Resource use efficiency indicated that all of the resources were under used for shrimp production except overutilization of feed. Here, in terms of prawn production, human labor, fertilizer and feed were underutilized as well as lime and fingerling were over utilized.

This study also identified some of the problems related to shrimp and prawn farming. The findings discovered that shortage of high quality fingerlings, attack of shrimp/prawn viral diseases, lack of training facilities, lack of water supply in dry season, attack of disease infestation, lower production, high price of feed, flooding in rainy season, low price of output, high soil temperature, lack of drainage facilities, fish poisoning by enemy, theft of prawn from farm, oxygen deficiency, crisis of fresh water and lack of transportation facilities etc. were the major barrier which stand in the way of shrimp and prawn farming in the study area.

There are some suggestions also, which were given by the respondents of the study. They are- supplying quality feed, ensuring credit facilities at lower interest rate, arrangement of

training programme, establishment of hatchery, development of transportation facilities etc. for both shrimp and prawn farming in the study area.

8.2 Conclusion and Policy Recommendations

It may be concluded that comparing shrimp and prawn farming, prawn farming is highly profitable in the study area. If modern inputs with production technology can be made available to farmers in time, production will be increased which can help farmers to increase their income as well as improve standard of living. There is an abundant opportunity to improve per hectare production of year round shrimp and prawn farming. For enhancing the productivity, efficiency as well as effectiveness of shrimp and prawn farming, the following recommendations are made as a part of present study which is acting as a formulating strategy to enhance shrimp and prawn production in Bagerhat and Khulna district.

i. As the government is already given subsidy on fertilizer like urea and other inputs required for shrimp and prawn farming but fair prices of inputs should be ensured so that the farmers can get the available inputs at a reasonable price.
ii. Proper quality of feed should be supplied or the betterment of production.
iii. High quality fingerlings should be available and ensured for the farmers.
iv. Bank loan as well as institutional credit should be made available on easy term and conditions for the shrimp and prawn farmers.
v. The farmers should be provided with training, suitable services, information and necessary facilities for coping with new and improved situation.
vi. The fair prices of the outputs should be ensured here.
vii. Attention should be given to improve transportation as well as marketing facilities of the study area.
viii. Law and order enforcing organizations should be aware in the study area for minimizing the social tension and improve the situation of shrimp and prawn farming areas.

8.3 Limitations of the Study

It is very simple that there is no study without some limitations. The study I have made is of great importance and oblige me huge work and time. Throughout preparing this paper, I have tried my level best. But at the time of conducting this study I had to face a number of problems. The problems were-

I. Most of the data collected by interviewing of the farmers. So sometimes they were less-cooperated with the interviewer.
II. The information was collected mostly by the memories of the respondents which may be incorrect in sometimes.
III. Lack of experience and time hampered the in-depth of the study.
IV. It is very difficult to collect secondary data and may be conflicting. All the information may not based on valid data.

8.4 Avenues for Further Research

As the study identified some limitations, some new avenues of research which might be started in the context of Bangladesh. These are discusses below.

- Similar study considering a large number of samples could be taken.
- As the present study covered only four upazila of Bagerhat and Khulna districts, a similar study could be conducted covering various geographical regions of the country and made a cross country comparisons of shrimp and prawn farming.

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