# PROFITABILITY AND EFFICIENCY OF MUD CRAB FATTENING IN BANGLADESH

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# PROFITABILITY AND EFFICIENCY OF MUD CRAB FATTENING IN BANGLADESH

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## CERTIFICATE

This is to certify that the thesis entitled **'PROFITABILITY AND EFFICIENCY OF MUD CRAB FATTENING IN BANGLADESH'** submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science (MS) in Development and Poverty Studies** embodies the result of a piece of *bona-fide* research work carried out by **MD. HAYDER KHAN SUJAN, Registration No. 11-04247** 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, received during the course of this investigation has been duly acknowledged.

Dated: June, 2019
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_____
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# Dedicated To

## *My Beloved Parents*

# ACKNOWLEDGEMENT

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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 |
| EPB | = | Export Promotion Bureau |
| *et al.* | = | And others |
| etc. | = | Etcetera |
| FAO | = | Food and Agricultural Organization |
| FY | = | Financial year |
| GDP | = | Gross Domestic Product |
| gm | = | Gram (s) |
| GM | = | Geometric mean |
| 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 |
| Km | = | Kilometer |
| MFC | = | Marginal Factor Cost |
| MoYS | = | Ministry of Youth and Sports |
| MT | = | Metric ton |
| MVP | = | Marginal Value of Product |
| NGO | = | Non-Government Organization |
| No. | = | Number |

| | | |
|------|---|-----------------------------------|
| P | = | Probability |
| SAU | = | Sher-e-Bangla Agricultural University |
| SD | = | Standard Deviation |
| sq. | = | Square |
| Tk. | = | Taka |
| UFO | = | Upazila Fisheries Office |
| USD | = | United States Dollar |

# ABSTRACT

The study explored the profitability and resource use efficiency of mud crab fattening in Bagerhat and Satkhira district of Bangladesh. Primary data were collected from 150 randomly selected crab fatteners through farm level survey by using a suitable pre-tested questionnaire in February-March, 2018. Cobb-Douglas production function was used to satisfy the objectives. Per hectare variable cost and total cost of production were Tk. 364,900 and Tk. 518,861, respectively. The average gross return, gross margin, and net return were Tk. 894,374, Tk. 529,474 and Tk. 375,513 per hectare, respectively. Undiscounted BCR was 1.72. Human labour, crablets and feed costs were dominating factors of mud crab fattening but these inputs were still under-utilized. This crab fattening has significant impact on the livelihood of coastal people. Solving the problems like frequent diseases infestation, shortage of capital, lack of training and unavailability of improved crablets can enhance the productivity as well as efficiency.

# CHAPTER I

# INTRODUCTION

## 1.1. Background

Bangladesh ranked third in the world in terms of inland fish production in 2018 after China and India (FAO, 2018). The country has produced a total of 41.34 lakh metric ton (MT) fish in the year of 2016-17 which contributed 3.61 percent to the GDP and 24.43 percent to the country's total agricultural productions (BER, 2018). Rich inland waters and river systems of the country has significant contribution for these achievements (Shamsuzzaman *et al.,* 2017). Fisheries in Bangladesh are diverse, there are about 795 native species of fish and shrimp in the fresh and marine waters of Bangladesh and 12 exotic species that have been introduced. In addition, there are 10 species of pearl bearing bivalves, 12 species of edible tortoise and turtle, 15 species of crab and 3 species of lobster (FAO, 2008). In Bangladesh, sixteen species of crabs were recorded by different researcher (Khan, 2005; Siddiqui and Zafar, 2002). Crab, a super dietary item for human, has an equal taste of shrimp (Siddiqui, 2001). Among the identified crab species only *Scylla serrata* has been fattening in Bangladesh due to good market price. It is generally known as 'green crab' or 'mangrove crab' and locally known as 'shila kankra', 'habba kankra' or 'kankra' (Saha and Ahmed, 1999).

*Scylla serrata* is a euryhaline bottom feeder invertebrate belongs to the family Portunidae, widely distributed in the Indo-West-Pacific region as mangrove associated fauna (Amin *et al.,* 2016; Macintosh *et al.,* 2002). It constitutes an important secondary crop in the traditional shrimp or fish culture systems in the Asian countries including Bangladesh. It is widely distributed in the coastal water of Bangladesh (Zafar and Siddique, 2000). Though this crab seems to prefer mangrove swamps, they exist in large numbers in the shrimp ponds and in the burrows of the peripheral dikes (Azam *et al.,* 1998). The importance of live mud crab as an export commodity has opened up a great opportunity for crab farming in Bangladesh (Begum *et al.,* 2009). Gravid female with full orange-red egg masses are in great demand in seafood restaurants of the South-east Asian countries. Due to its high price, people started to hold immature female crabs in some kind of enclosures and fed them until the gonads developed and filled the mantle cavity. Actual culture technique of mud crab is not yet developed in Bangladesh due to the seed scarcity (Amin *et al.,* 2016). Farmers are still dependent on natural seeds.

1

People of the coastal region of Bangladesh follow traditional fattening process to fatten crab in small ponds. These ponds are fenced by bamboo sticks to prevent escaping the crab. Fattening usually requires 12-15 days to complete. Within this time, premature crabs are well fed to develop their gonad and muscle fully. As very few mud crab hatcheries have been established in Bangladesh, fattening is mostly dependent on wild seed stock. Local people usually collects the crablets from wild source such as mangrove swamps, shrimp farming ghers, rivers etc.



**Figure 1.1** Male and Female Mud Crab with Developed Gonad (Sources: Internet)

## 1.2. Importance of Mud Crab Fattening

In FY 2016-17, the total amount of crab production was 14,421 MT in Bangladesh with a significant growth rate of 9.58% and an average production of 534 kg/ha (DoF, 2017). The mud crab farming is gaining popularity in the coastal districts of Bangladesh owing to the good demand and higher price in the international market (Islam *et al.,* 2015). After shrimp, crab has become the second-most exported crustacean of the country. Bangladesh has exported crabs in live and frozen form towards 17 countries worth USD 23.82 million in 2015-16, which was USD 7.2 million in 2010-11 (EPB, 2017) although the exporting was started in 1977 (Jahan and Islam 2016a, b). Crabs are exported live to China, Taiwan, Thailand, Singapore, Malaysia, Japan, Hong Kong, South Korea, the European Union and the United States. China, USA, Japan, South Korea and Thailand are the top five consumers of crab. China is the single largest crab importer from Bangladesh. The countries that were popular destinations for prawn exports now have

a great demand for crabs, including: Hong Kong, Singapore, the USA, Myanmar, Sri Lanka, India, and others. Live crab marketing is a profitable business. About 2.5-3.0 lakh people are directly involved in crab value chain in Bangladesh (Jahan and Islam, 2016a, b). Nevertheless, millions of poor fishers, traders and transporters are directly or indirectly dependent on crab fishery in Bangladesh (Molla *et al.,* 2009; Zafar, 2004). Crab farming is three to four times profitable than shrimp farming as well as less susceptible to disease. As a result, small shrimp farmers are switching to crab farming (Salam *et al.,* 2012). Besides, to enhance the crab production by adapting improved technologies the government of Bangladesh along with different development partners and NGOs has been initiating and implementing different projects and programmes like establishing hatchery, innovating new technology and expanding them to the field level etc.

## 1.3. Rationale of the Study

Mud crab fattening is a flourishing contemporary venture in Bangladesh. It has higher profitability and lower disease susceptibility than shrimp cultivation. Fatteners can be benefited significantly by establishing mud crab fattening farm rather than other traditional one. A number of researches were carried out to assess the production practices of crab fattening. Fewer researches were also conducted to assess the socio-economic status of the crab fatteners. The engagement of a marginalized group of people in the collection and fattening practices of crabs in the southwestern part of Bangladesh has also increased the importance to conduct a study to assess the impacts of crab fattening practices in those area. Therefore, the present study has been taken to estimate the profitability, resource use efficiency and the livelihood impacts of mud crab fattening practices in southern Bangladesh. The constraints faced by mud crab fatteners has also be identified under this research work. Based on the study, some recommendations will also be generated to overcome the existing problems and for further improvement. The outcomes of this research will be helpful to the planners, policy makers and extension workers for better understanding the current scenario and for taking strategies to accelerate regional development programs specifically in the southwestern coast of Bangladesh. This study will also be helpful to the academicians and researchers for further conceptualization who will work in fisheries and its related sectors in Bangladesh.

## 1.4. Objectives

a) To delineate the socio-demographic profile of mud crab fatteners;
b) To assess the profitability of mud crab fattening practices;
c) To estimate the resource use efficiency of mud crab fattening in the study area;
d) To explore the impacts of mud crab fattening on the fatteners livelihood; and
e) To identify the constraints faced by mud crab fatteners during their fattening and to recommend some suggestions;

## 1.5. Key Research Questions of the Study

Besides the assessment of profitability and resource use efficiency of mud crab fatteners several other components were also observed. The key research questions of the study are as follows-

a) What are the demographic characteristics of the mud crab fatteners?
b) What are the socio-economic status of the mud crab fatteners?
c) How much cost incurred during the mud crab fattening practices?
d) How much gross margin obtained by mud crab fatteners?
e) What is the profit margin of the mud crab fattening practices?
f) Where remain the efficiency of resources used for mud crab fattening practices?
g) What are the constraints faced by the fatteners during their mud crab fattening?
h) What percentage of the income of respondents come from mud crab fattening?
i) What are the expenditure patterns of the mud crab fatteners whose large share of the income comes from mud crab fattening?
j) What is the extent of impacts of mud crab fattening practices on the fattener's livelihood?

## 1.6. Organization of the Report

The background and importance of mud crab fattening, rationale and objectives of the study are described in chapter one. The second chapter comprises the review of literature. The third chapter covers of the research methodology. Chapter four describes the socio-demographic profile of the mud crab fatteners. Chapter five comprises the profitability of mud crab fattening. Chapter six consists of resource use efficiency of mud crab fattening. Chapter seven describes the impacts of mud crab fattening on the fattener's livelihood. Chapter eight depicts the constraints encountered by mud crab

fatteners and suggestions for further improvement and Chapter nine contains summary, conclusion and recommendations of the study.

## 1.7. Concluding Remarks

Mud crab fattening is a source of livelihood for a significant number of people lived in the southern coast of Bangladesh. A study on the profitability, resource use efficiency as well as impacts of crab fattening on its fattener's livelihood can be a handy tools to initiate and implement a regional development programs in Bangladesh. The development of this crab fattening industry can be a handsome sources of livelihood for the coastal people.

## CHAPTER II

## REVIEW OF LITERATURE

Generally, before conducting an experiment, it is essential to know the information about the previous research works. In this chapter, an attempt was taken to review the past research works which are relevant to the objectives of this study. This was mainly concerned with the review of profitability and resource use efficiency of mud crab fattening practices. Further emphasis was given to review impacts of mud crab fattening on the fattener's livelihood.

## 2.1. Review of Literatures on Mud Crab Fattening

Rajasekaran and Whiteford (1993) studied the rice-crab production system in south India to assess the role of indigenous knowledge in designing food security policies and found that crab contributed significantly to the protein intake of the resource poor households. On their article they discussed the influencing socio-cultural factors as well as impact of crab consumption on food expenditure.

Salam *et al.* (2003) conducted a study and compared the benefits of shrimp and crab farming in the Khulna region based on gross production, economic output and employment potential. Comparisons were made of brackish water shrimp and crab culture with moderately saline-tolerant tilapia and prawn culture, freshwater carp culture and traditional rice production systems. Though per hectare earning was found a little higher for shrimp than for crab culture, they identified shrimp as the most capital intensive and risky production system.

Kamal *et al.* (2007) evaluated the traditional practice of mud crab fattening in terms of technical and economic aspects in Khulna and found that farmers fattened only lean (empty egg) females for 1-3 weeks using low cost tilapia and/or trash fish at a rate of 5-8% day$^{-1}$ of stock biomass. They also found that the net income of a farm with an average size of 122±22 (range 90-150) m$^{-2}$ was Tk. 23,221±8,490 per year.

Begum *et al.* (2009) conducted a study to compare the survival, production and economics of mud crab fattening in Bangladesh. Comparative benefit-cost analysis of their study showed that mud crab fattening using bamboo cage attained higher net profit (Tk. 91,630) than in encircled earthen area (Tk. 9,345) from 12 crops (12-16 days per

crop) fattening period. Significantly higher total production of crab from cages was also recorded than the encircled earthen area.

Molla *et al.* (2009) conducted a study to assess the socio-economic conditions of mud crab collectors and fatteners in Khulna and Satkhira districts of Bangladesh and found the annual income of crab collectors as less than Tk. 90,000 whereas the lowest annual income of the crab fatteners was Tk. 90,000-150,000. Based on their study, they opined that these practices became an alternative source of income and sustainable livelihood for the disadvantaged people in the southwest Bangladesh.

Chandra *et al.* (2012) conducted a study to estimate the production and assess the marketing of mud crab in the south-western Bangladesh and found a total production of mud crab about 6,945 tons. The prices of mud crabs varied with grade and season. They also found that the mud crab marketing was highly export oriented and the major export markets were Taiwan, Singapore, Hong Kong, Malaysia, Thailand and USA.

Mahmud and Abdullah-Al Mamun (2012) conducted a study in the mid coastal region (Noakhali) of Bangladesh to identify the feasibility of mud crab culture. Their study explored that the average yearly collection of mud crabs from that area was about 890 tons. Existence of a potential marketing channel with 3-4 middlemen was also observed.

Salam *et al.* (2012) assessed the crab culture potential in south-western Bangladesh as an alternative to shrimp culture for climate change adaption. They found that farmers are transferring to crab farming as it was less susceptible to disease, resistant to adverse environmental conditions and has a good market price. Their findings also reveal that a considerable amount of land fell under very suitable (28.33%) and moderately suitable (62.22%) category for crab culture.

Ferdoushi (2013) conducted a study to assess the socio-economic condition of the crab fatteners in the southwest part of Bangladesh and found about 52% farmers having an experience of 5-10 years. She also found the Hindus in the coastal region having more interest in crab farming. Result showed that about 40% farmers have higher satisfaction by crab fattening while, few farmers reported some negative perception.

Ferdoushi and Xiang-guo (2013) conducted a study in southwestern Bangladesh and identified twelve (12) important barriers of mud crab fattening practices among which

insufficient credit, lack of proper knowledge about crab farming and price influenced by marketing operator were ranked 1st and 2nd and 3rd in the position.

Rahman (2016) conducted a study in Satkhira district of Bangladesh and found the average annual net profit from a very small pond was Tk. 4,955. He found that the mud crabs fattening in the small lands was thrived as an alternative means of livelihoods that played important role in income generation of marginal households of coastal areas.

Haque *et al.* (2017) conducted a study to assess the impacts of integration of tilapia into mud crab culture and found that the women and their household members improved their incomes and consumption of high quality protein. Overall, the integration of tilapia provided a more sustainable method for growing mud crab while also enhancing the livelihoods of farmers.

Hungria *et al.* (2017) conducted a study and found that the total production of crabs was almost 1300 thousand tons in 2015. They also found that the internet was one of the most important marketing channels for soft-shell crab, with prices starting at USD 3.5/ unit, but going up to USD 8.0 -10.0/ unit, depending on the size and presentation form of the product.

Istiak (2018) conducted a study to assess the market chain and value-added products of mud crab in Bangladesh and found that it has been playing an alternative role to shrimp culture. He also found that those crabs were collected from nature, shrimp farm, coastal pen, and cage. His research also revealed the crab's value chain as farms/nature-collectors-small depot, large depot and exporters. Result of the study also revealed that crab export has significantly increased from 2009 to 2016.

## 2.2. Research Gap of the Study

Several literatures are accessible about the estimation of resource use efficiency for different agricultural activities except mud crab fattening (Majumder *et al.,* 2009; Islam *et al.,* 2011; Rahman, 2011; Ahmed *et al.,* 2009; Bapari, 2016; Sujan *et al.,* 2017a, b; Sarker *et al.,* 2018; Khatun *et al.,* 2019). Very few researches had conducted to improve of crab production practices. Among the limited studies on crab production practices only a few researchers had attempted to assess the profitability of mud crab fattening. To the best knowledge of the researcher, no significant studies were carried out to estimate the resource use efficiency and impacts of mud crab fattening of the fatteners

livelihood. This is the research gap of the study. Hence, the researcher carried out the present study to assess the influencing factors and resource use efficiency of mud crab fattening in southern Bangladesh.

# CHAPTER III

# METHODOLOGY

To attain the objectives of the study, methodology is very essential. The purpose of this chapter is to describe the study area, research design and the procedures used to collect and analyze the data for answering the research questions. The study was conducted based on primary data collected through farm survey by using a suitable pre-tested questionnaire from southern Bangladesh during February and March 2018.

## 3.1. Locale of the Study

Selection of the study area is very important to fulfil the study objectives. Bagerhat, Khulna and Satkhira districts are the top three mud crab producing districts of Bangladesh and together they account for about 70% of all crab production of the country (Istiak, 2018). To serve the purpose of the study Bagerhat Sadar and Rampal upazila of Bagerhat district and Shyamnagar upazila of Satkhira district were selected purposively. The map of Bagerhat and Satkhira district has shown in Figure 3.1 and the specific study location namely Bagerhat Sadar, Rampal and Shyamnagar upazila have also been presented in Figure 3.2, Figure 3.3 and Figure 3.4.
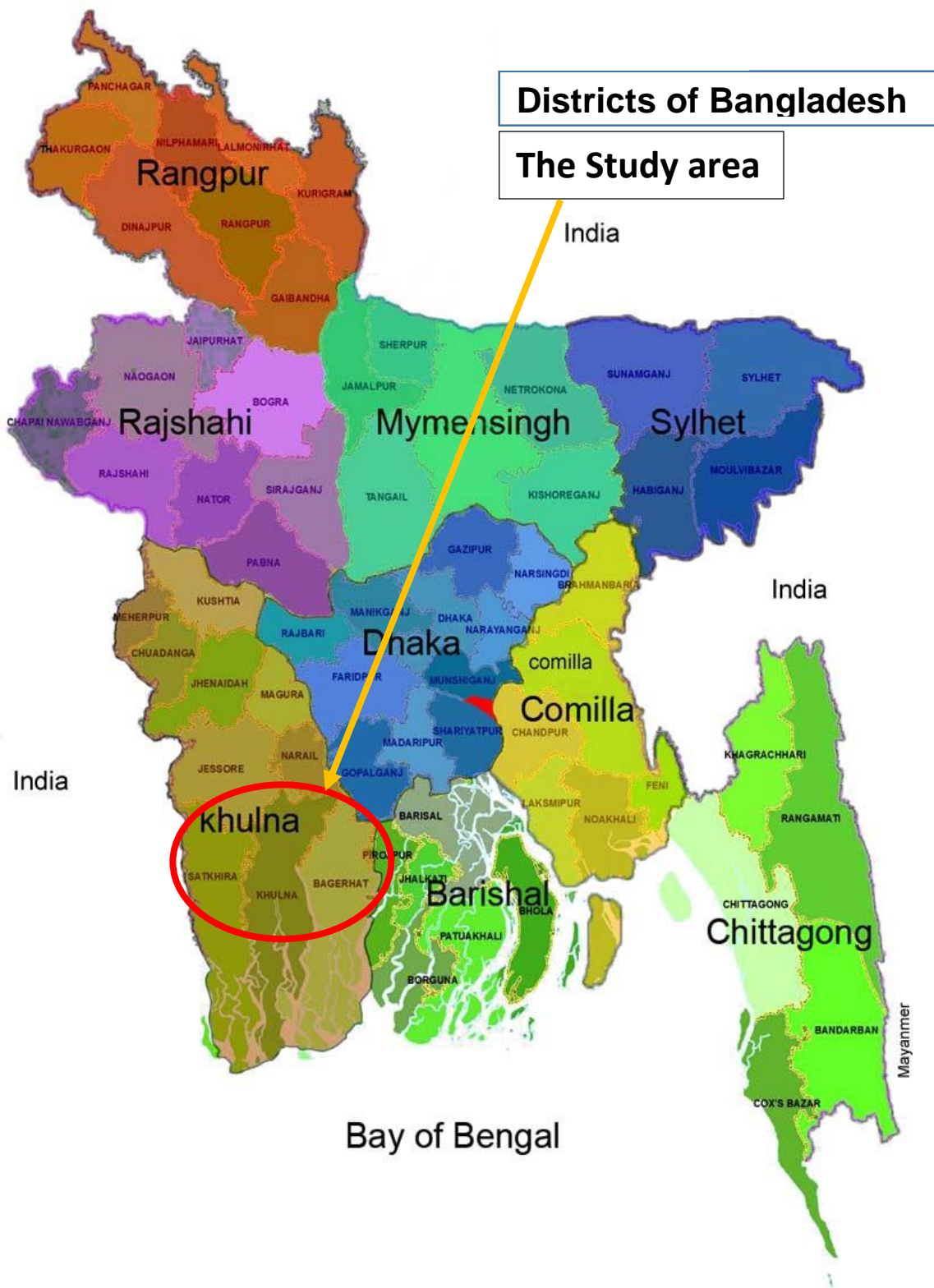
**Figure 3.1** Map of Bangladesh Showing Study Areas at Bagerhat and Satkhira District (**Sources:** Wikipedia, 2019)

**Figure 3.2** Map of Bagerhat Sadar Upazila Showing a Part of the Study Area
(**Sources:** Internet)

## 3.2. Description of the Study Area

### 3.2.1. Bagerhat sadar upazila

The area of Bagerhat Sadar upazila (Bagerhat district) are 316.97 sq km, located in between 22°35' and 22°50' north latitudes and in between 89°38' and 89°53' east longitudes. It is bounded by Fakirhat and Chitalmari upazilas on the north, Rampal and Morrelganj upazilas on the south, Kachua (Bagerhat) upazila on the east, Fakirhat and Rampal upazilas on the west. Notable water bodies are Bhairab, Chitra, Daudkhali and Taleswar rivers. According to Banglapedia, the features of the farmers and agriculture at Bagerhat Sadar upazila are as follows-

i. Main sources of income: Agriculture 42.01%, Non-agricultural labourer 7.41%, Industry 1.27%, Commerce 21.31%, Transport and communication 4.55%, Service 10.61%, and Others about 12.84%;

ii. Ownership of agricultural land: Landowner 56.38%, Landless 43.62%;

iii. Main crops: Paddy, wheat, jute, sugarcane, potato, betel leaf, pulse, vegetables;

iv. Main exports: Coconut, betel nut, shrimp and crabs.
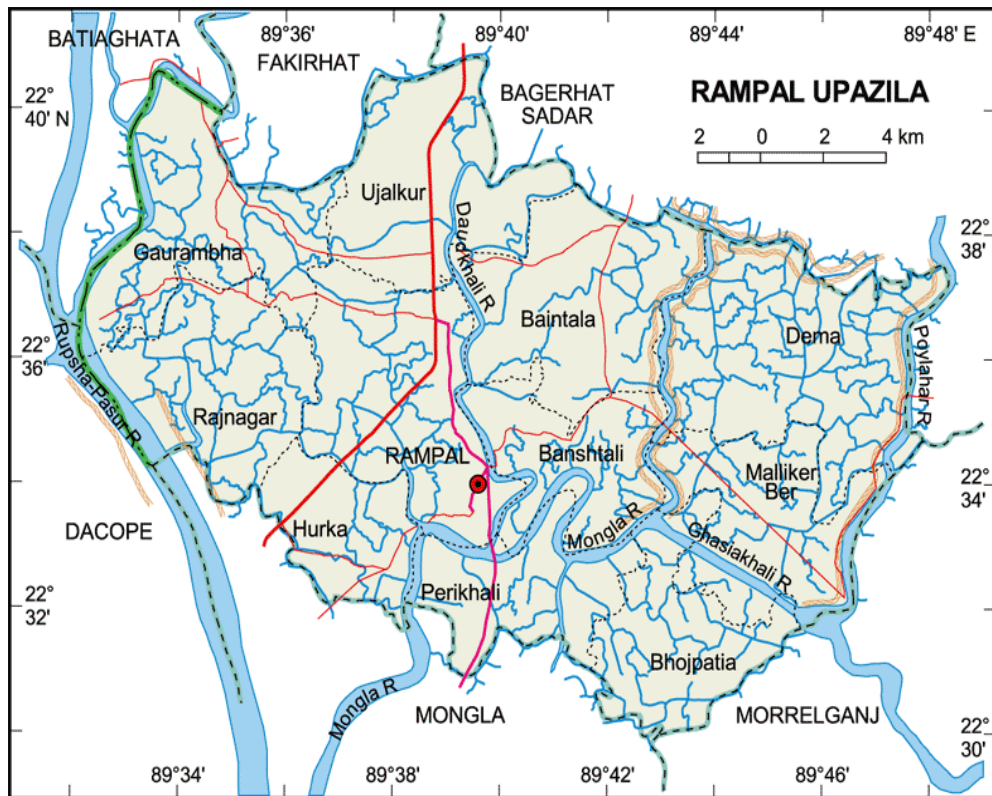
**Figure 3.3** Map of Rampal Upazila Showing a Part of the Study Area

(**Sources:** Internet)

### 3.2.2. Rampal upazila

The area of Rampal upazila (Bagerhat district) are 291.22 sq km, located in between 22°30' and 22°41' north latitudes and in between 89°32' and 89°48' east longitudes. It is bounded by Bagerhat sadar and Fakirhat upazilas on the north, Mongla and Morrelganj upazilas on the south, Morrelganj and Bagerhat sadar upazilas on the east, Batiaghata and Dacope upazilas on the west. Notable water bodies: Daudkhali, Ghasiakhali, Pasur, Mongla, Paylahar are the main rivers of Rampal upazila. According to Banglapedia, the features of the farmers and agriculture at the upazila are as follows-

i.   Main sources of income: Agriculture 52.41%, Non-agricultural labourer 7.71%, Industry 0.79%, Commerce 20.71%, Transport and communication 3.64%, Service 5.26% and Others 9.48%;

ii.  Ownership of agricultural land: Landowner 55.59%, Landless 44.41%;

iii. Main crops: Paddy, sweet potato, vegetables;

iv.  Main exports: Shrimp and crab.
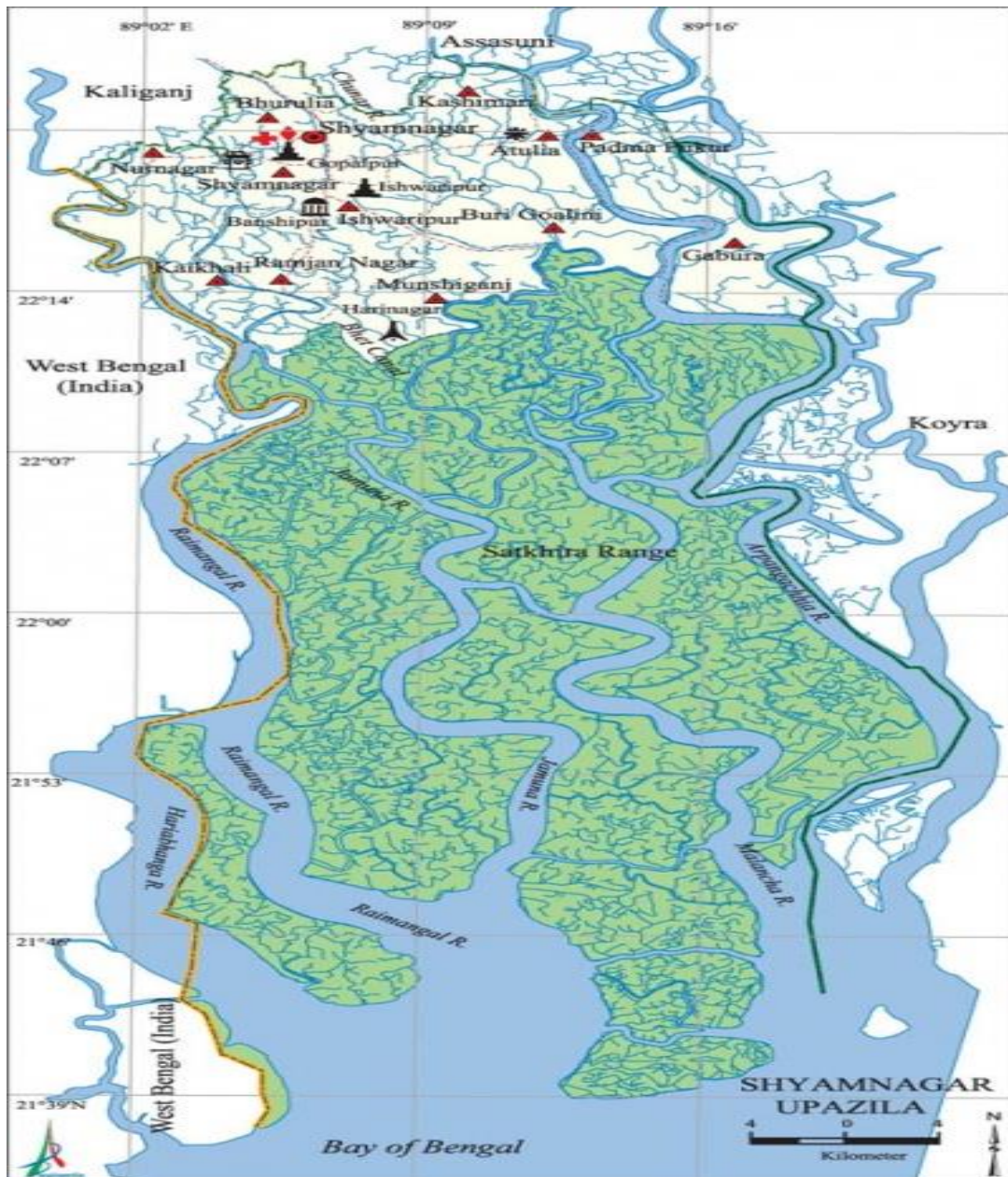
**Figure 3.4** Map of Shyamnagar Upazila Showing the Study Area (**Sources:** Internet)

### 3.2.3. Shyamnagar upazila

The area of Shyamnagar upazila (Satkhira district) are 1968.24 sq km, located in between 21°36' and 22°24' north latitudes and in between 89°00' and 89°19' east longitudes. It is bounded by Kaliganj (Satkhira) and Assasuni upazilas on the north, West bengal state of India and the Bay of bengal on the south, Koyra and Assasuni upazilas on the east, West Bengal state of India on the west. Jamuna, Raymangal, Arpangachhia, Malancha, Hariabhanga, Chunar and Bhet Canal are the notable water bodies of Shyamnagar upazila. According to Banglapedia, the features of the farmers and agriculture at the upazila are as follows-

i. Main sources of income: Agriculture 64.98%, Non-agricultural labourer 6.02%, Industry 0.61%, Commerce 14.60%, Transport and communication 1.58%, Service 3.53% and Others 8.64%.

ii. Ownership of agricultural land: Landowner 56.69%, Landless 43.31%.

iii. Main crops: Paddy, jute, wheat, potato, mustard, sesame, pulse, vegetables.

iv. Main exports: Paddy, jute, shrimp and crabs.

## 3.3. Population of the Study

All the farmers who fattened mud crab at Bagerhat sadar and Rampal upazila of Bagerhat district and Shyamnagar upazila of Satkhira district constituted the population of the study. To attain the objectives of the study, the number of mud crab fatteners were determined approximately by consulting with UFO, field level assistant of the Department of Fisheries and local farmers. With the help of them three rough list were prepared for the three upazila comprising the mud crab fatteners. The total number of mud crab fatteners under Bagerhat sadar, Rampal and Shyamnagar upazila were approximately 1200, 1500 and 1200. Hence the population of the study was approximately 3900 mud crab fatteners.

## 3.4. Sample, Sample Size and Sampling Procedure

The farm survey were carried out for mud crab fattening by applying the multistage stratified random sampling technique for selecting crab fatteners.

At the first stage, the 2 districts were selected based on the highest contribution in the mud crab production of Bangladesh. At stage two, for selecting the 3 upazilas, the major crab cultivating upazilas were selected through district fisheries office. Finally, the mud crab fatteners were selected randomly from the community level. Sample size of the study was determined by applying the following formula (Arkin and Colton, 1963):

$$n = \frac{Nz^2p(1-p)}{Nd^2+z^2p(1-P)} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where: n = Sample size

N = Total number of mud crab fatteners (approximately 3900)

z = Confidence level (at 95% level z = 1.96)

p = Estimated population proportion (0.5, this maximizes the sample size)

d = Error limit of 10% (0.10)

Equation (1) suggest that a sample of above 94 respondents would be representative for the population but total of 150 crab cultivating households, 50 from each upazila were randomly selected from the population (Table 3.1). The selected mud crab fattening households were surveyed with structured survey schedule to gather the required information for the study.

**Table 3.1** Sample of the Study

| Name of the district | Name of the upazila | Sample size |
|---|---|---|
| Bagerhat | Bagerhat Sadar | 50 |
| | Rampal | 50 |
| Satkhira | Shyamnagar | 50 |
| **Total** | | 150 |

### 3.5. Data Collection Methods and Tools

### 3.5.1. Data collection methods

Different types of data and information are needed to complete a meaningful study. For this reason primary and secondary information were collected rigorously.

### 3.5.1.1. Primary data collection

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

### 3.5.1.2. Secondary data collection

An extensive study regarding all the information of a research topic is essential for conducting a sound research. To enrich the quality of the research and enhance the depth of study, secondary data were collected from different sources. These sources were as follows;

    a) Relevant books and journals
    b) Department of Fisheries (DoF)
    c) Relevant thesis, reports, official records and newspaper
    d) Statistical data from different books

### 3.5.2. Data collection tools

A structured interview schedule was prepared earlier to attain the objectives of the study. The prepared schedule embodied with both open and closed ended questions. The questions of the schedule were formulated in a simple and unambiguous way and arranged in a logical order to make it more attractive and comprehensive. The instruments were first developed in English and then translated into Bengali. The survey tools were initially constructed based on an extensive literature reviews. The schedule was pre-tested with 15 randomly selected mud crab fatteners in the study area. The pre-test was helpful in identifying faulty questions and statements in the draft schedule. Thus, necessary additions, deletions, modifications and adjustments were made in the schedule on the basis of experiences gained from pre-test. The questionnaires were also checked for validity by supervisor and educational experts at Sher-e-Bangla Agricultural University, Dhaka. Finally, based on background information, expert's appraisal and the pre-test the interview schedule was finalized.

### 3.5.3. Data collection period

During data collection, necessary co-operation was obtained from field staff of different GOs, NGOs, local leader and obviously from the respondents. Before going to the respondent's home for interviewing they were informed verbally to ensure their availability at home as per schedule date and time. According to the survey experience in some cases, the respondents felt hesitate to give answer at some aspect of questioning. The primary data were collected during February and March 2018.

### 3.6. Variables and Their Measurement Techniques

The variable is a characteristic, which can assume varying, or different values in successive individual cases. A research work usually contains at least two important variables viz. independent and dependent variables. There are several factors that influence the resource use efficiency of mud crab fattening but among them most important six components were studied to analyze the factors affecting mud crab fattening as well as resource use efficiency of that practices. The dependent variable of the study was return from mud crab fattening.

### 3.6.1. Measurement of independent variables

The most important six inputs of mud crab fattening i.e. human labor, crablets, feed, lime, bamboo fencing and other costs were treated as independent variable of the study. The methods and procedures in measuring the independent variables of the study are as follows:

### 3.6.1.1. Human labour cost

Human labour was first calculated based on hourly requirement for one hectare and then converted to days. As eight hours of labour are treated as a man-days so labour hour were divided by eight to get labour man-days. Total human labour costs were calculated by multiplying the required man-days per hectare with the wage per man-days.

### 3.6.1.2. Crablets cost

The cost of crablets was calculated on the basis of required resource investment in taka per hectare. At first required amount of crablets per hectare were determined in kg. Then, crablets costs were calculated by multiplying required amount of crablets per hectare with price per kg.

### 3.6.1.3. Feed cost

Feed cost was calculated on the basis of required taka per hectare. In mud crab fattening, feeds are applied from two sources such as households supplied home-made food and food bought from markets. Both are included in the feed requirement of the mud crab fattening. Total feed cost per hectare was calculated by multiplying the required amount with price per kg.

### 3.6.1.4. Lime cost

Lime cost was calculated on the basis of required taka per hectare. Cost of lime was calculated by multiplying the required (kg.) amount per hectare with the price per kg.

### 3.6.1.5. Bamboo fencing cost

The cost of bamboo fencing was calculated on the basis of required taka for fencing a hectares of mud crab farm with bamboo fence.

### 3.6.1.6. Other costs

Other than human labour, crablets, feed, lime and bamboo fencing costs there also incurred some other costs like for lease value of land, pond preparation, netting, guard shed preparation, machinery installation, pesticide, current bill, pond repair and water purification etc. Those costs were calculated and amassed per hectare to investigate their effects on the efficiency of the use of resources.

### 3.6.2. Measurement of dependent variable

The dependent variable of this study was the return from mud crab fattening practices. At first, crab production of the farms was measured in terms of produced quantity in kilograms. Crab fatteners may harvest crab on several times. All the harvested amounts were recorded and amassed. Finally, total amount of return was calculated by multiplying these amounts with price per kg. These return in taka per hectare is treated as dependent variable.

### 3.7. Data Processing

After completion of data collection from field, some interview schedules had verified randomly for the sake of consistency and completeness. Bogdan and Biklen (2006) insist that data analysis is also an on-going part of data collection. Editing and coding had done before putting the data in computer. Initially, all collected data were carefully entered in Microsoft Access then exported to Microsoft Excel. Exported data were checked randomly against original completed interview schedule. All the collected data were summarized and scrutinized carefully to eliminate maximum possible errors. If errors were detected, necessary corrections were made accordingly. The summery tables were made in MS Excel work sheet.

### 3.8. Data Analysis and Analytical Techniques

Collected primary data from sample surveys were coded where appropriate, entered into a database system using Microsoft office software package. Finally, data were exported from Microsoft Excel program to STATA 14 statistical software package which offered statistical tools applied in social research. For the sake of statistical analysis for drawing inferences, some qualitative data were converted into quantitative numbers.

Both descriptive and analytical methods were employed in order to analyze the data. Descriptive techniques was used to illustrate current situations (socio-economic), describe different variables separately and construct tables. These techniques included: frequency distribution, percentage, range, mean and standard deviation etc. Analytical technique was applied to determine the affecting factors and resource use efficiency of mud crab fattening. Cobb-Dauglus production function model was used in this study for making a meaningful inference.

### 3.8.1. Analysis of profitability

Different parameters of costs and return were analyzed to measure the profitability of mud crab fattening in the study area. The following algebraic equation was used to assess the costs and returns of mud crab fattening.

$$GR_i = \sum_{i=1}^{150} Q_i \times P_i$$

Where,

$GR_i$ = Gross return from mud crab for the $i^{th}$ farm (Tk./ha)

$Q_i$ = Quantity of mud crab produced in $i^{th}$ farm (kg/ha)

$P_i$ = Average price of mud crab of the $i^{th}$ farm (Tk./kg)

i = 1,2,3,………150 (number of individual farm)

Net return was calculated by deducting all costs (variable and fixed) from gross return. The following equation was used to determine the net return of mud crab fattening:

$$\pi = GR_i - \sum_{i=1}^{150} \sum_{j=1}^{n} X_{ij} P_{xij} - TFC_i$$

Where, $\pi$ = Net return (Tk./ha)

$GR_i$ = Gross return from mud crab for the $i^{th}$ farm (Tk./ha)

$X_i$ = Quantity of $j^{th}$ input of $i^{th}$ farm (kg/ha)

$P_{xi}$ = Price of $j^{th}$ input of $i^{th}$ farm (Tk./kg)

$TFC_i$ = Total fixed cost of $i^{th}$ farm (Tk./ha)

i = 1,2,3,……..…150 (Number of individual farm)

j = 1,2,3………….n (Number of input)

**Benefit-Cost Ratio (BCR) analysis**

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

$$\text{BCR on TC} = \frac{GR}{TC}$$

Where, GR = Gross return; TC = Total Cost and the decision rules are that, when

BCR>1, the return from mud crab fattening was economically satisfactory;

BCR<1, the return was not economically satisfactory; and

BCR=1, there exist economic breakeven point of mud crab fattening.

## 3.8.2. Resource use efficiency

The Cobb-Douglas production function was used for functional analysis. It is the most widely used model for fitting agricultural production data, because of its mathematical properties, ease of interpretation and computational simplicity (Heady and Dillon, 1969). It is a homogeneous function that provides a scale factor enabling one to measure the return to scale and to interpret the elasticity coefficients with relative ease. Thus, Cobb-Douglas specification provides an adequate representation of the agricultural production technology. The production of mud crab is likely to be influenced by different factors like human labour, crablets, feed, lime, bamboo fencing, and other costs etc. The functional form of the Cobb- Douglas regression equation was as follows:

$$Y = AX_1^{\beta_1} X_2^{\beta_2} \text{-------------------------------} X_n^{\beta n} e^{ui}$$

The production function was converted to logarithmic form so that it could be solved by least square method i.e.

$$\ln Y = \alpha + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \dots\dots\dots\dots\dots + \beta_n \ln X_n + U_i$$

The empirical production function was the following:

$$\ln Y = \alpha + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + U_i$$

Where,

Y = Return from mud crab fattening (Tk./ha);

$X_1$ = Human labor cost (Tk./ha);

$X_2$ = Crablets cost (Tk./ha);

$X_3$ = Feed cost (Tk./ha);

$X_4$ = Lime cost (Tk./ha);

$X_5$ = Bamboo fencing cost (Tk./ha);

$X_6$ = Other costs (Tk./ha);

α = Intercept;

$\beta_1, \beta_2$ ---- $\beta_6$ = Coefficients of the respective variables to be estimated; and

$U_i$ = Error term.

In order to analyze the resource use efficiency, the ratio of marginal value product (MVP) to the marginal factor cost (MFC) for each input was computed and tested for its equality to 1,

$$\text{i.e. } \frac{MVP}{MFC} = r$$

Where,

MVP = Value of change in output resulting from a unit change in variable input (Tk.) and MFC = Price paid for the unit of variable input (Tk.).

Under this method, the decision rules are that, when;

r >1, the level of resource use is below the optimum level, implying under-utilization of resources. Increasing the rate of use of that resource will help to increase productivity.

r <1, the level of resources use is above the optimum level, implying over utilization of resources. Reducing the rate of use of that resource will help to improve productivity.

r = 1, the level of resource use is at optimum implying efficient resource utilization.

The marginal productivity of a particular resource represents the additional to gross returns in value term caused by an additional unit of that resource, while other inputs are held 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 ($X_i$) as well as gross return (Y) at their geometric means (Dhawan and Bansal, 1977). Since all the variables of the regression model were measured in monetary value, the slope co-efficient of those explanatory variables in the function represented the MVPs, which are calculated by multiplying the production co-efficient of given resources with the ratio of geometric mean (GM) of gross return to the GM of the given resources, i.e.;

$$\ln Y = \ln \alpha + \beta_i \ln X_i$$

$$\frac{dY}{dX_i} = \beta_i \frac{Y}{X_i}$$

Therefore, MVP ($X_i$) $= b_i \dfrac{\overline{Y}(GM)}{\overline{X}_i(GM)}$

Where,

$\overline{Y}$ = Mean value (GM) of gross return in Tk.

$\overline{X}_i$ = Mean value (GM) of different variable input in Tk.

i = 1, 2,………………..

MFC is the price of input per unit. If the MFC of all the inputs expressed in terms of an additional taka in calculating the ratio of MVP to MFC, the denominator will always be one, and therefore, the ratio will be equal to their respective MVP.

# CHAPTER IV

## SOCIO-DEMOGRAPHIC PROFILE OF THE MUD CRAB FATTENERS

In accordance with the objectives of the study, the recorded observations have been reported in a systematic way and probable discussion of the findings have done with their justifiable and relevant researches. The findings of the study and their interpretation have been presented from this chapter to onwards.

Various characteristics of the respondent might have significant contribution to the attitude or behavior they do in their entire life. Many of those traits can be discussed to explain the socio-demographic profile of the smallholder mud crab fatteners. But in this study, ten characteristics of the respondents were selected including their age, level of education, family size, farm size, annual household income, annual income from mud crab fattening, experience of mud crab fattening, extension media contact, training exposure and knowledge on mud crab fattening that might have great influence to the mud crab fattening activities of the respondents. More or less same attributes were studied by Molla *et al.* (2009) and Islam (2016) in their study. These above mentioned attributes are explained in this section of the report.

### 4.1. Age Distribution of the Crab Fatteners

The age of the mud crab fatteners varied from 19 to 64 years with an average and standard deviation of 37.07 and 10.15, respectively. Considering the recorded age, crab fatteners were classified into three categories 'young', 'middle' and 'old' aged as classified by MoYS (2012). The distribution of the respondents in accordance of their age is presented in Figure 4.1.
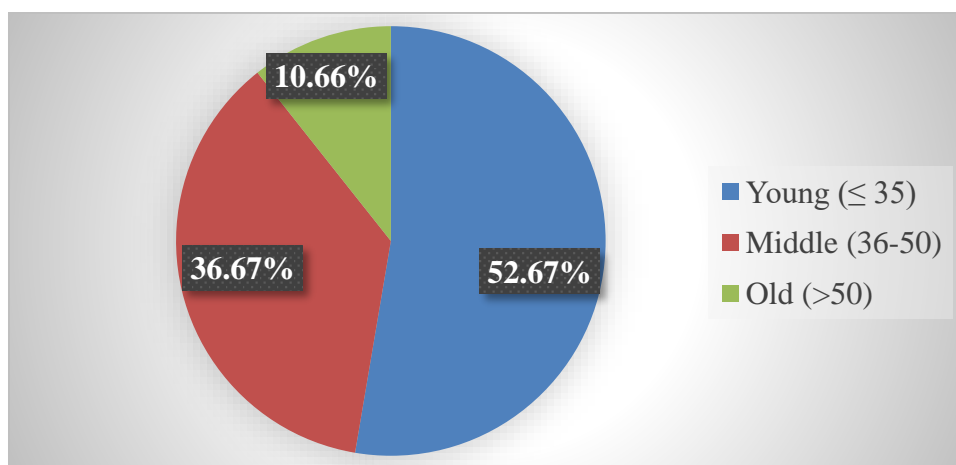


**Figure 4.1** Distribution of the Crab Fatteners Based on Their Age

Figure 4.1 reveals that the young-aged fatteners comprised the highest proportion (52.67%) followed by middle (36.67%) and old (10.66%) aged category. Results also indicates that the young and middle aged category constitute 89.34 percent of the total fatteners. The result seems that, the young and middle aged farmers were generally more involved in crab fattening activities after the realization of the extra profit generating capacity of that practices.

## 4.2. Educational Status of the Respondents

The level of education of the mud crab fatteners ranged from 0 to 16 years with an average of 7.69 years. Based on education years, the fatteners were classified into four categories arbitrarily. The distribution of fatteners according to their level of education is presented in Table 4.1.

**Table 4.1** Distribution of the Fatteners According to Their Level of Education

| Category | Basis of categorization (years) | Observed range (years) | Crab fatteners | | Average education level |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Illiterate | 0 | | 9 | 6.00 | |
| Primary education | 1-5 | | 35 | 23.33 | |
| Secondary education | 6-10 | 0-16 | 80 | 53.34 | 7.69 |
| Above secondary | >10 | | 26 | 17.33 | |
| Total | | | 150 | 100.00 | |

The result shows that the fatteners under secondary education category constitute the highest proportion (53.34%) followed by primary (23.33%) and above secondary (17.33%) education category. On the other hand, the lowest 6.00 percent of the respondents were found under the illiterate category. Therefore, the data reveals that 94.00% of the crab fatteners were literate which is better than the average literacy rate of Bangladesh (Islam, 2016).

## 4.3. Family Size of the Mud Crab Fatteners

Family size of the crab fatteners ranged from 2 to 8 members with an average and standard deviation of 4.09 and 1.21, respectively. More or less same result were found by Molla *et al.* (2009). According to family size, the crab fatteners were classified into

three categories by adding and subtracting standard deviation with the average family size as 'small', 'medium' and 'large' family. The distribution of the fatteners according to their family size is presented in Table 4.2.

**Table 4.2** Distribution of the Fatteners According to Their Family Size

| Category | Basis of categorization (members) | Observed range (members) | Crab fatteners | | Average family size | SD |
|---|---|---|---|---|---|---|
| | | | Number | Percent | | |
| Small family | ≤ 3 (Mean-1SD) | | 53 | 35.33 | | |
| Medium family | 4-6 (Mean ± SD) | 2-8 | 91 | 60.67 | 4.09 | 1.21 |
| Large family | > 6 (Mean+1SD) | | 6 | 4.00 | | |
| Total | | | 150 | 100.00 | | |

Result indicates that the medium size family constitute the highest proportion (60.67%) followed by the small (35.33%) sized family. Only 4.00% of the respondents had large family. Such finding is quite normal as per the situation of Bangladesh. Results of the study indicated that average family size of the study area was almost similar with national average of 4.06 (HEIS, 2016). The trend of nuclear family has been rising in the study area and subsequently the size of the family becoming smaller with the elapse of time.

### 4.4. Farm Size in the Study Area

The farm size of the mud crab fatteners ranged from .02 acre to 12 acre with an average of 1.56 acre. A nearer results were also found by Molla *et al.* (2009). Based on their farm size, the farmers were classified into five categories following the categorization of DAE (1999). The distribution of the fatteners according to their farm size is presented in Table 4.3.

Results indicates that the small farm holder constituted the highest proportion (64.00%) and another 14.67% of the fatteners were medium farm holder. The findings of the study reveal that majority (78.67%) of the crab fatteners were small to medium sized farm holder. The average farm size of the mud crab fatteners in the study area (1.56 acre is equivalent to 0.63 hectare) was higher than that of national average (0.60 hectare) of Bangladesh (BBS, 2014).

**Table 4.3** Distribution of the Fatteners According to Their Effective Farm Size

| Category | Basis of categorization (acre) | Observed range (acre) | Crab fatteners | | Average farm size |
| --- | --- | --- | --- | --- | --- |
| | | | Number | Percent | |
| Landless | < 0.50 | 0.02-12 | 30 | 20.00 | 1.56 |
| Small | 0.50-2.49 | | 96 | 64.00 | |
| Medium | 2.50-7.49 | | 22 | 14.67 | |
| Large | ≥ 7.50 | | 2 | 1.33 | |
| Total | | | 150 | 100.00 | |

**Note:** Landless is with 0.0 - 0.49 acres of land, small is with 0.50 - 2.49, medium is with 2.50 - 7.49 and large is with and above 7.50 acres of land (DAE, 1999).

## 4.5. Annual Household Income of the Respondents

Annual household income of the respondents included all the incomes of the mud crab fatteners and his/her family members from different income source i. e. field crops, livestock rearing, mud crab fattening, business, services, foreign remittance and others.

The annual household income of the fatteners ranged from 25.5 to 1,542 thousand taka with an average of 242.69. Findings of the study shows that average monthly household income of the respondents were well above the national average of Tk. 15,988 (HEIS, 2016). On the basis of annual income, the fatteners were classified into three categories arbitrarily as 'low', 'medium' and 'high' annual income category. The distribution of the fatteners according to their income is presented in Table 4.4.

**Table 4.4** Distribution of the Fatteners According to Their Annual Household Income

| Category | Basis of categorization ('000' Tk.) | Observed range ('000' Tk.) | Crab fatteners | | Average annual household income |
| --- | --- | --- | --- | --- | --- |
| | | | Number | Percent | |
| Low income | ≤ 250 | 25.5-1542 | 101 | 67.33 | 242.69 |
| Medium income | 250-350 | | 31 | 20.67 | |
| High income | > 350 | | 18 | 12.00 | |
| Total | | | 150 | 100.00 | |

Result shows that the crab fatteners having low annual income constitute the highest proportion (67.33%), while 20.67% of the mud fatteners have medium annual household income. Thus, a majority (88.00%) of the mud crab fatteners have low to medium annual family income. Only 12.00% of the fatteners have high annual household income.

## 4.6. Annual Income from Mud Crab Fattening

The annual income from mud crab fattening refers to the total financial return from the fattening practices in a year. Annual income of the crab fatteners ranged from 6 to 1,400 thousand taka with an average of 163.02 thousand taka. A nearer result was also found by Rahman (2016), Ferdoushi (2013) and Molla *et al.* (2009). On the basis of annual income from mud crab fattening, the fatteners were classified into three categories arbitrarily as 'low', 'medium' and 'high' annual income group. The distribution of the mud crab fatteners according to their income from mud crab fattening is presented in Table 4.5.

**Table 4.5** Distribution of the Fatteners Based on Their Annual Income from Mud Crab Fattening

| Category | Basis of categorization ('000' Tk.) | Observed range ('000' Tk.) | Crab fatteners | | Average annual income from mud crab |
|---|---|---|---|---|---|
| | | | Number | Percent | |
| Low income | <100 | | 62 | 41.33 | |
| Medium income | 100-250 | 6-1400 | 71 | 47.34 | 163.02 |
| High income | >250 | | 17 | 11.33 | |
| Total | | | 150 | 100.00 | |

Although 41.33% of the crab fatteners have low income from their fattening, 47.34% and 11.33% of them have medium and high income from that practices, respectively. Thus, an overwhelming majority (58.67%) of the crab fatteners have medium to high annual income from the practices.

## 4.7. Mud Crab Fattening Experience

Mud crab fattening experience of the respondents ranged from 2 to 25 years with an average and standard deviation of 9.15 years and 5.14 years, respectively. Based on the

crab fattening experience, the respondents were classified into three categories by adding and subtracting standard deviation with the average experience as 'low', 'medium' and 'high' experience. The distribution of the fatteners according to their experience of mud crab fattening is given in Table 4.6.

**Table 4.6** Distribution of the Respondents Based on Their Crab Fattening Experience

| Category | Basis of categorization (years) | Observed range (years) | Crab fatteners | | Average mud crab fattening experience | SD |
|----------|--------------------------------|------------------------|----------------|----------|---------------------------------------|------|
| | | | Number | Percent | | |
| Low experience | ≤4 (Mean-1SD) | 2-25 | 23 | 15.33 | 9.15 | 5.14 |
| Medium experience | >4-14 (Mean ± SD) | | 96 | 64.00 | | |
| High experience | >14 (Mean+1SD) | | 31 | 20.67 | | |
| Total | | | 150 | 100.00 | | |

The results reveal that the majority (64.00%) of the fatteners fell in medium experience category, whereas only 15.33% in low experience category and 20.67% in high experience category. Lower to medium term crab fattening experience of majority (79.33%) of the respondent support the statement 'Farmers are shifting their land from shrimp to mud crab fattening due to higher profit and lower disease susceptibility'. Same statement were proved by Das (2017) and Salam *et al.* (2012) also.

## 4.8. Extension Media Contact of the Crab Fatteners

Extension media contact of the fatteners was defined as their extent of exposure to different personnel related with mud crab fattening practices. It was measured by computing extension media contact score on the basis of their nature of contact with five types of extension media. The respondents were asked to indicate their nature of contact (per month) with five alternative responses, like regularly (8 or above times), frequently (5-7 times), sometimes (2-4 times), rarely (only one time) and not at all basis to each of the five media and a score of four, three, two, one and zero was assigned for those alternative responses, respectively. The contact of the respondents was measured by adding the scores of five selected source of information, i. e. upazila fisheries office, attending field day activities, visiting research institute, reading books on crab fattening and reading daily newspaper. Thus, the score may vary from 0 to 20, where zero indicated no extension media contact and twenty indicated highest level of contact.

Similar technique was applied by Islam (2016) to measure the extension media contact of flower cultivators.

The result reveals that the score of extension media contact ranged from 0 to 13 with an average and standard deviation of 5.08 and 3.58 (Table 4.7). On the basis of their obtained score, the respondents were classified into three categories by adding and subtracting standard deviation with the average score. The distribution of the three categories were 'low', 'medium' and 'high' extension media contact.

**Table 4.7** Distribution of the Respondents According to Their Extension Media Contact

| Category | Basis of categorization (score) | Observed range (score) | Crab fatteners | | Average extension media contact | SD |
| | | | Number | Percent | | |
|---|---|---|---|---|---|---|
| Low contact | ≤ 2 (Mean - 1SD) | 0-13 | 41 | 27.33 | 5.08 | 3.58 |
| Medium contact | >2-8 (Mean ± SD) | | 77 | 51.33 | | |
| High contact | >8 (Mean+1SD) | | 32 | 21.34 | | |
| Total | | | 150 | 100.00 | | |

From this table, it can be concluded that majority (72.67%) of the crab fatteners had medium to high extension media contact. Findings of the study also reveals that 27.33% of the fatteners had low extension contact which demands for strengthening and improving the communication strategy. Receiving information related to crab fattening from neighbours, relatives and workmates might be some important reasons behind the low extension media contact of the fatteners.

**4.9. Training Experience on Mud Crab Fattening**

Training experience on mud crab fattening was measured on the basis of total number of days the respondents attended in different training programs on crab fattening in their entire life. Training experience of the respondents ranged from 0 to 25 days with an average of 1.76. Based on the training experience, the crab fatteners were classified into four categories arbitrarily as 'no training', 'low', 'medium' and 'high' training experience. The distribution of the crab fatteners according to their training experience is presented in Table 4.8.

**Table 4.8** Distribution of the Respondents Based on Their Training on Crab Fattening

| Category | Basis of categorization (days) | Observed Range (days) | Crab fatteners | | Average training on mud crab fattening |
|---|---|---|---|---|---|
| | | | **Number** | **Percent** | |
| No training | 0 | | 34 | 22.67 | |
| Low exposure | ≤ 2 | 0-25 | 84 | 56.00 | |
| Medium exposure | 3-5 | | 23 | 15.33 | 1.76 |
| High exposure | > 5 | | 9 | 6.00 | |
| Total | | | 150 | 100.00 | |

Although an overwhelming 77.33% of the respondents had training experience on mud crab fattening, a majority of the fatteners (56.00%) had that experience for only one to two days. Another 22.67% of the respondents hadn't the opportunity to take part in any training program regarding crab fattening. Crab fatteners skill and efficiency can be improved sharply by imparting knowledge regarding the use of improved technology on that practices. It is training which open up the opportunity to impart that knowledge into the mud crab fatteners. Trained fatteners can face any kind of challenges or adverse situation in their practices.

## 4.10. Knowledge on Mud Crab Fattening

The respondent's knowledge was measured by asking them 11 questions related to different components of mud crab fattening. These questions were on: a) releasing developed variety of crablets, b) knowledge on crablets stocking density, c) filtering crablets before stocking, d) supplying of floating food, e) supplying of food per body weight of crablets, f) exchanging the water of the farm, g) fertilizer application in the time of pond preparation, h) lime application, i) lime application per soil pH of the farm, j) water inlet-outlet opportunities of the farm, k) initiatives for disease prevention. A score of one (1) was assigned for each positive answer of these statements. Thus, the score varied from zero (0) signifying poor knowledge of mud crab fattening to eleven (11) for higher level of knowledge.

The calculated score of the knowledge on mud crab fattening of the respondents ranged from 3 to 8 with an average and standard deviation of 6.77 and 1.79, respectively. Based on the scores, the fatteners were classified into three categories by adding and

subtracting standard deviation with the average score as poor, moderate and sound knowledge category (Table 4.9).

**Table 4.9** Distribution of the Fatteners Based on Their Knowledge on Crab Fattening

| Category | Basis of categorization (score) | Observed range (score) | Crab fatteners | | Average knowledge on mud crab fattening | SD |
|---|---|---|---|---|---|---|
| | | | Number | Percent | | |
| Poor knowledge | ≤ 5 (Mean -1SD) | 3-8 | 35 | 23.33 | 6.77 | 1.79 |
| Moderate knowledge | 5-8 (Mean ± SD) | | 90 | 60.00 | | |
| Sound knowledge | > 8 (Mean+1SD) | | 25 | 16.67 | | |
| Total | | | 150 | 100.00 | | |

The results of the study reveals that 60.00% and 16.67% of the mud crab fatteners had moderate and sound knowledge on crab fattening, respectively. Thus, an overwhelming majority (76.67%) of the farmers had moderate to sound knowledge on mud crab fattening.

## 4.11. Concluding Remarks

The socio-demographic profile of the mud crab fatteners indicates the prevalence of young aged crab fatteners with medium sized family. Having primary level educational status most of them were smallholder fatteners. But an overwhelming majority of them earned medium to high annual income from their fattening practices. Though they had medium term crab fattening experience about one-fourth of them hadn't training exposure. But a major portion of them gained sound crab fattening knowledge through extension media contact.

# CHAPTER V

## PROFITABILITY OF MUD CRAB FATTENING

In this chapter researcher made a discussion on the profitability of mud crab fattening in the study area. Before the presentation of extensive explanation on the profitability, the input use pattern was discussed. Cost incurred for mud crab fattening was discussed afterward. And lastly revenue as well as profitability of the practices was explored and discussed.

### 5.1. Input Use Pattern of Mud Crab Fattening

Around thirteen different types of input were identified by the researcher which had been used for mud crab fattening in the study area. These inputs were land use, pond preparation, netting, bamboo fencing, guard, equipment, human labour, crablets, feed, fertilizer, lime, pond repairing and water treatment etc.

**Table 5.1** Input Use Pattern of Mud Crab Fattening in the Study Area

| Sl. No. | Items | Unit | Amount (Unit/ha) | % of total cost |
|---------|-------|------|------------------|-----------------|
| 01. | Land rent | Tk./ha | 70,515 | 13.59 |
| 02. | Pond preparation cost | Tk./ha | 28,858 | 5.56 |
| 03. | Netting cost | Tk./ha | 15,977 | 2.89 |
| 04. | Bamboo fencing cost | Tk./ha | 32,756 | 6.31 |
| 05. | Guard | Tk./ha | 4,438 | 0.86 |
| 06. | Equipment | Tk./ha | 2,417 | 0.47 |
| 07. | Human labour | man-days/ha | 62.17 | 9.24 |
| 08. | Crablets | kg/ha | 657.71 | 40.40 |
| 09. | Feed | kg/ha | 1704.60 | 18.27 |
| 10. | Fertilizers | kg/ha | 142.95 | 0.08 |
| 11. | Lime | kg/ha | 91.14 | 0.40 |
| 12. | Pond repairing cost | Tk./ha | 8,953 | 1.73 |
| 13. | Water treatment cost | Tk./ha | 1,081 | 0.21 |
| **Total %** | | | | **100.00** |

Among these inputs, resource allocation for crablets comprises the highest (40.40%) percent followed by feed (18.27%), land rent (13.59%), human labour (9.24%), bamboo fencing (6.31%), pond preparation (5.56%) and others. Details regarding the use of different inputs in mud crab fattening practices is presented in Table 5.1.

Here, the average use of human labour input was 62.17 man-days requiring to invest Tk. 47,954 per hectare. On the other hand, average input of crablets was 657.71 kg/ha requiring Tk. 209,640 per hectare. From this analysis, it can be interpreted that mud crab fattening practices is not a labour intensive industry but capital.

Only about nine percent resources employment for human labour input refers that mud crab fattening is not a labour intensive farming practices. Because labour intensive farming activities like rice farming or potato cultivation requires about one-fourth of the resources invested for the farming practices (Sujan *et al.,* 2017a, b). The requirement of more than forty percent resources to invest in crablets stalking also intensify the correctness of the earlier inference.

## 5.2. Cost of Mud Crab Fattening in the Study Area

For determining the cost of mud crab fattening practices, all the variable costs like cost for crablets, feed cost, human labour cost, fertilizers cost, lime cost, pond repairing cost and water treatment cost were calculated per hectare basis. The fixed cost of mud crab fattening included the cost of land use, pond preparation cost, netting cost, bamboo fencing cost, cost for guard and equipment etc. The netting and bamboo fence made once in a year but can be utilized over the time which covers several shift of mud crab fattening. That's why the cost incurred for netting and bamboo fencing were treated as fixed cost. The cost of land use was calculated on the basis of per hectare lease value of land as calculated by Sujan *et al.* (2017a, b). The total cost included fixed cost and variable cost.

**Table 5.2** Cost of Production of Mud Crab Fattening in the Study Area

| Sl. No. | Items | Amount (Tk./ha) | % of total cost |
|---------|-------|-----------------|-----------------|
| A. | **Fixed cost** | | |
| | Land rent | 70,515 | 13.59 |
| | Pond preparation | 28,858 | 5.56 |
| | Netting | 14,977 | 2.89 |
| | Bamboo fencing | 32,756 | 6.31 |
| | Guard | 4,438 | 0.86 |
| | Equipment | 2,417 | 0.47 |
| | **Total fixed cost** | **153,961** | **29.67** |
| B. | **Variable Cost** | | |
| | Crablets | 209,640 | 40.40 |
| | Feed cost | 94,784 | 18.27 |
| | Human labour | 47,954 | 9.24 |
| | Fertilizer | 424 | 0.08 |
| | Lime cost | 2,065 | 0.40 |
| | Pond repair | 8,953 | 1.73 |
| | Water treatment | 1,081 | 0.21 |
| | **Total variable cost** | **364,900** | **70.33** |
| | **Total Cost (A+B)** | **518,861** | **100.00** |

The cost of mud crab fattening was estimated to be Tk. 518,861 and Tk. 364,900 per hectare on total cost and variable cost basis, respectively. The major share in total cost was the cost for crablets (40.40%), followed by feed cost (18.27%), land rent (13.59%) and human labour cost (9.24%). Details of the analysis regarding cost of mud crab production is presented on Table-5.2.

## 5.3. Profitability of Mud Crab Fattening

The average yield of crab fattening was about 785.66 kg/ha which was lower than the national average of 1,196 kg/ha (DoF, 2018). Gross return and gross margin of mud crab fattening were Tk. 894,374 and Tk. 529,474 per hectare, respectively. The net return of crab fattening was Tk. 375,513 per hectare. The undiscounted benefit cost ratios was 1.72 on total cost basis (Table 5.3).

**Table 5.3** Profitability of Mud Crab Fattening in the Study Area

| Sl. No. | Items | Formula | Unit | Amounts |
|---------|-------|---------|------|---------|
| 01. | Yield of Crab | Y | kg/ha | 785.66 |
| 02. | Farm gate Price | P | Tk./kg | 682.40 |
| 03. | Gross return | GR | Tk./ha | 894,374 |
| 04. | Total variable cost | TVC | Tk./ha | 364,900 |
| 05. | Total cost | TC | Tk./ha | 518,861 |
| 06. | Gross margin | GR-TVC | Tk./ha | 529,474 |
| 07. | Net return | GR-TC | Tk./ha | 375,513 |
| 08. | Undiscounted BCR | GR/TC | - | 1.72 |

More or less similar profit were explored by Rahman (2016) at the time of studying small-scale mud crab fattening practices in Satkhira district. Shawon *et al.* (2018) found a nearer profitability and BCR for shrimp farming in the coastal area of Bangladesh. But profitability and BCR analysis for other crops like rice, potato etc. by Sujan *et al.* (2017a, b) in different parts of Bangladesh refers that mud crab fattening is more profitable than other agricultural practices. Though this profit margins are more or less consistent to shrimp farming in the southern district of Bangladesh, farmers are shifting toward crab fattening due to its higher potentialities and lower disease susceptibilities than other ventures.

## 5.4. Concluding Remarks

Among the input factors crablets, feed, land use and human labour costs were the main contributor to cost of mud crab production. Some fixed cost hubs of the practices were the cost for land use, bamboo fencing, pond preparation and netting etc. The average yield of mud crab was satisfactory. Undiscounted BCR of the mud crab fattening practices indicates that the fatteners obtained a handsome net return from their investment.

# CHAPTER VI

## RESOURCE USE EFFICIENCY OF MUD CRAB FATTENING

Cobb-Douglas production function was applied to determine the affecting factors and resource use efficiency of mud crab fattening practices in the study area. Findings of the research are being discussed in this chapter.

### 6.1. Factors Affecting the Return from Mud Crab Fattening

In order to assess the contribution of different inputs like cost on human labor, crablets, feed, lime, bamboo fencing and other costs for crab fattening practices, Cobb-Douglas production function model was used. Similar determinants were also studied by Hamad (2012) in the time of determining alternative source of sustainable feeds for mud crab farming in Tanzania. The estimated values of co-efficient and related statistics of Cobb-Douglas production function have been presented in Table 6.1.

**Table 6.1** Estimated Co-efficient and Their Related Statistics of Production Function of Mud Crab Fattening

| Explanatory Variable | Co-efficient | Sd. Error | P-values |
|---|---|---|---|
| Intercept | 1.15 | 1.35 | 0.39 |
| Human labor $(X_1)$ | 0.17** | 0.06 | 0.01 |
| Crablets $(X_2)$ | 0.60*** | 0.06 | 0.00 |
| Feed $(X_3)$ | 0.12** | 0.05 | 0.03 |
| Lime $(X_4)$ | -0.02 | 0.05 | 0.72 |
| Bamboo fencing $(X_5)$ | 0.11 | 0.08 | 0.18 |
| Other costs $(X_6)$ | 0.08 | 0.13 | 0.51 |
| Adjusted $R^2$ | 67.79% | | |
| F-value | 53.26*** | | |
| Return to scale | 1.06 | | |

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

The co-efficient for human labour and feed were positive and significant at 5% level. The co-efficient of crablets was also positive and significant at 1% level.

Bamboo fencing and other costs variables had also positive impact on the yield of crab production but their effects were not significant. Lastly, the coefficient of lime application was negative but the effects were not significant at the desired level of significance. Human labour, crablets or seed and feed are found to have significant effects on the yield of almost all of the agricultural practices as found by different researcher like Majumder *et al.* (2009), Islam *et al.* (2011), Rahman (2011), Bapari (2016), Sujan *et al.* (2017a ,b), Sarker *et al.* (2018) and Khatun *et al.* (2019).

## 6.2. Interpretation of the Production Function

### Human labor *(X₁)*

The regression co-efficient of human labor cost was 0.17 which was significant at 5 percent level of significance. It indicates that considering all other factors constant, one percent increment of cost of human labor would increase gross return from mud crab fattening by 0.17 percent.

### Crablets *(X₂)*

The regression co-efficient for the costs of crablets was 0.60 which was significant at 1 percent level of significance. It indicates that considering all other factors constant, one percent increasing costs on crablets would increase gross return from mud crab fattening practices by 0.60 percent.

### Feed *(X₃)*

The regression co-efficient of feed cost was 0.12 which was significant at 5 percent level of significance. It indicates that considering all other factors constant, one percent increasing cost on feed would increase gross return from mud crab fattening practices by 0.12 percent.

### Lime *(X₄)*

The regression co-efficient for the cost of lime application was -0.02 which was not significant at desired level of significance.

**Bamboo fencing** *(X₅)*

The regression co-efficient for the cost of bamboo fencing was 0.11 but not significant at the desired level of significance.

**Other costs** *(X₆)*

The regression co-efficient for the cost incurred by other variables was 0.08 which was positive not significant at the desired level of significance.

**Adjusted R²**

The co-efficient of multiple determinations, Adjusted $R^2$ of the model were 0.6779, which indicates that about 67.79 percent of the variations in gross return of mud crab fattening practices have been explained by the explanatory variables included in the model.

**F -Value**

The F - values of the equation derived 53.26 which were highly significant at 1 percent level of significance, implying that all the explanatory variables were important for explaining the variations in gross returns of the operators.

**Returns to scale:**

The summation of all the production co-efficient indicates returns to scale. For the mud crab fattening practices, the summation of the coefficients was 1.06 which means that the production functions exhibit increasing returns to scale. An increasing amount of investment in this venture would further increase the returns from the farm.

## 6.3. Findings of the Resource Use Efficiency of Mud Crab Fattening

Resource use efficiency means how efficiently the farmers can use their resources in the production process. Because of the scarcity of resources, its efficient use is important. For calculating resource use efficiency, six input factors like cost on human labor, crablets, feed, lime, bamboo fencing and other costs were considered.

**Table 6.2** Resource Use Efficiency of Mud Crab Fattening

| Variable | Geometric mean (GM) | $\overline{Y}(GM)/\overline{X}_i(GM)$ | Co-efficient ($\beta$) | MVP ($X_i$) | $r$ =MVP/ MFC | Decision rule |
|---|---|---|---|---|---|---|
| Yield of Crab (Y) | 519895.72 | | | | | |
| Human labor ($X_1$) | 27143.58 | 19.15 | 0.17 | 3.18 | 3.18 | Under-utilization |
| Crablets ($X_2$) | 125686.83 | 4.14 | 0.60 | 2.47 | 2.47 | Under-utilization |
| Feed ($X_3$) | 55755.95 | 9.32 | 0.12 | 1.10 | 1.10 | Under-utilization |
| Lime ($X_4$) | 1446.58 | 359.40 | -0.02 | -6.07 | -6.07 | Over-utilization |
| Bamboo fencing ($X_5$) | 25314.72 | 20.54 | 0.11 | 2.33 | 2.33 | Under-utilization |
| Other costs ($X_6$) | 126990.63 | 4.09 | 0.08 | 0.34 | 0.34 | Over-utilization |

From the Table 6.2, it is evident that the ratios of marginal value products (MVP) and marginal factor cost (MFC) of human labour, crablets, feed and bamboo fencing were greater than unity which indicates the under-utilization of those resources. Increment of use of those resources would be helpful to further increase the productivity. Same ratios for lime and other costs were less than unity, thereby indicating over-utilization of the said variables. Reduction of use of those resources would be helpful to further improvement of the productivity. Hence, resources employed on human labour, crablets, feed and bamboo fencing were under-utilized in the crab fattening farms of Bagerhat Sadar, Rampal and Shyamnagar upazila whereas lime and other costs were over-utilized. Though under-utilization of human labour was also found by several

other researchers like Sujan *et al.* (2017a, b), over-utilization was also found by some others like Majumder *et al.* (2009) and Bapari (2016) in several other agricultural practices irrespective to labour-intensive or not labour-intensive farming practices.

## 6.4. Concluding Remarks

Among the studied input factors crablets, feed and human labour were found as the most influential factors of the mud crab fattening. Key inputs of that practices like crablets, feed, human labour and bamboo fencing were not fully utilized. The crab fatteners had the opportunity to increase their productivity as well as profitability by proper utilization of these resources.

# CHAPTER VII

# IMPACTS OF MUD CRAB FATTENING ON THE FATTENER'S LIVELIHOOD

From the analysis of profitability and resource use efficiency of mud crab fattening it is apparent that the fattening activities significantly increase the income of the crab fatteners. This positive income must be allocated to different components of their livelihood. So, based on their expenditure level, respondents were categories into three different groups like low, medium and high expenditure group. Secondly, the percentage of total expenditure comes from mud crab fattening was assessed. Finally, the allocation of income from mud crab fattening towards different components of livelihood of the fatteners were analyzed. Thus, an endeavor was taken to explore the impacts of mud crab fattening on the livelihoods of the fatteners. Sheheli (2011) also attempted to discover the ways how improved household income affect its member's livelihood applying a nearer technique.

## 7.1. Expenditure Category of the Mu Crab Fatteners

Annual household expenditure of the respondents included all the expenses of the mud crab fatteners and their family members to different purposes like food consumption, clothing, health, house repairing, household assets, livestock rearing, drinking water, sanitation facilities, education, festival, loan repayment, social development work, savings and other expense (if any). Islam (2016) also attempted to assess the impact of flower cultivation to the cultivator's livelihood applying a more or less similar technique.

The annual household expenditure of the fatteners ranged from 119.5 to 415.5 thousand taka with an average and standard deviation of 242.59 and 59.35 thousand taka, respectively. Results of the study reveals that average monthly household expenditure of the respondents were higher than the national average of Tk. 15,715 (HEIS, 2016). Based on the annual household expenditure, the fatteners were categorized into three groups by adding and subtracting standard deviation with the average expenditures as 'low', 'medium' and 'high' annual expenditure group. The distribution of the fatteners according to their expenditure category is presented in Table 7.1.

**Table 7.1** Distribution of the Respondents Based on Their Annual Household Expenditure

| Category | Basis of categorization ('000 Tk.) | Observed range ('000 Tk.) | Crab fatteners | | Annual average expenditure | SD |
| --- | --- | --- | --- | --- | --- | --- |
| | | | Number | Percent | | |
| Low expenditure | < 183.14 (Mean -1SD) | | 23 | 15.33 | | |
| Medium expenditure | 183.14-301.84 (Mean ± SD) | 119.5-415.5 | 103 | 68.67 | 242.49 | 59.35 |
| High expenditure | > 301.84 (Mean+1SD) | | 24 | 16.00 | | |
| Total | | | 150 | 100.00 | | |

Findings of the study shows that 68.67 percent of the fatteners belongs to medium expenditure group and another 16.00 percent of the respondents belongs to high expenditure group. Low expenditure group comprises about 15.33 percent of the mud crab fatteners. Thus, an overwhelming majority (84.67%) of the fatteners belongs to medium to high expenditure category. Higher income generating capacity of mud crab fattening practices is the reason for shifting mud crab fatteners from low expenditure group to medium and higher expenditure group.

## 7.2. Contribution of the Income from Mud Crab Fattening to the Household Expenditure of the Fatteners

Residents of the study area were involved in different type income generating activities like agricultural work, fisheries activities, livestock rearing, agricultural and non-agricultural labour, business, service, small entrepreneurship and so on. Mud crab fattening is one of the most prolific sources of income in these areas. Thus, total household expenditure of the respondents was contributed by mud crab fattening as well as others sources. Contribution of the mud crab fattening practices were analyzed and presented in this section.

Overall average annual household expenditure of mud crab fatteners was about 242.49 thousand taka of which about 65 percent were contributed by mud crab fattening. Findings of the study regarding different expenditure category of the respondents show that the contribution of income from mud crab fattening were higher in low expenditure

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group (79.52%) and followed by high (63.28%) and medium (62.02%) expenditure group. Rather than mud crab fattening, several other income generating opportunities like field crops, livestock rearing, business etc. for the medium and high expenditure mud crab fattener groups were the underlying causes for this kind of variations.

On the other hand, around eighty percent livelihood expenditure of the low expenditure group contributed by mud crab fattening seems that they have fewer income sources than other two groups. Though a significant portion of the livelihood expenditure of medium and high expenditure crab fatteners group come from mud crab fattening, it can be concluded that smallholder mud crab fatteners are highly dependent on crab fattening for their sources of livelihood rather than medium or higher group of mud crab fatteners. Details of the findings is presented on Table 7.2.

**Table 7.2** Contribution of Income from Mud Crab Fattening to the Livelihood Expenditure

| Category | Crab fatteners | Average expenditure (Tk.) | Average income (Tk.) | | % of income from crab |
|---|---|---|---|---|---|
| | | | **Crab** | **Total** | |
| Low expenditure group | 23 (15.33%) | 159,848 | 137,563 | 166,193 | 79.52 |
| Medium expenditure group | 103 (68.67%) | 237,435 | 155,390 | 241,745 | 62.02 |
| High expenditure group | 24 (16.00%) | 313,359 | 220,152 | 320,069 | 63.28 |
| Overall | 150 (100.00%) | 242,486 | 163,019 | 242,692 | 64.90 |

NB: Number in the parenthesis indicates percentage of mud crab fatteners

## 7.3. Allocation of Annual Income from Mud Crab Fattening to the Different Components of Livelihood

To analyze the livelihood expenditure patterns of mud crab fatteners an extensive study was done on almost all the purposes of household expenditure. The major purposes of livelihood expenditure were a) food consumption, b) clothing, c) health service, d) repairing house and/or buying household assets, e) savings, f) buying livestock, g) pure drinking water, h) sanitation facilities, i) family member's education, j) social

development work, k) festival, l) loan repayment and m) others (if any). Similar technique was also applied by Rahman-Al-Mamun *at al.* (2019) to find the impact of progressive shrimp farming on farmer's livelihood in southwestern region of Bangladesh. Details regarding the allocation of income from mud crab fattening to the different components of livelihood is presented on Table 7.3.

**Table 7.3** Allocation of Annual Income from Mud Crab Fattening to the Different Components of Livelihood

| Sl. No. | Purpose of expenditure | Low expenditure group | | Medium expenditure group | | High expenditure group | | Overall Expenditure | |
|---|---|---|---|---|---|---|---|---|---|
| | | Amount (Tk.) | Percent | Amount (Tk.) | Percent | Amount (Tk.) | Percent | Amount (Tk.) | Percent |
| a. | Food consumption | 84,299 | 61.28 | 80,997 | 52.13 | 94,599 | 42.97 | 84,737 | 51.98 |
| b. | Clothing | 6,974 | 5.07 | 11,235 | 7.23 | 20,672 | 9.39 | 12,047 | 7.39 |
| c. | Healthcare | 5,764 | 4.19 | 5,477 | 3.53 | 6,296 | 2.86 | 5,624 | 3.45 |
| d. | House repair and/or assets | 9,341 | 6.79 | 11,359 | 7.31 | 17,238 | 7.83 | 11,721 | 7.19 |
| e. | Savings | 5,406 | 3.93 | 8,508 | 5.48 | 15,455 | 7.02 | 8,770 | 5.38 |
| f. | Livestock | 1,499 | 1.09 | 3,869 | 2.49 | 8,564 | 3.89 | 4,190 | 2.57 |
| g. | Pure drinking water | 935 | 0.68 | 1,585 | 1.02 | 2,994 | 1.36 | 1,598 | 0.98 |
| h. | Hygienic sanitation | 1,334 | 0.97 | 2,051 | 1.32 | 3,677 | 1.67 | 2,233 | 1.37 |
| i. | Family member's education | 4,388 | 3.19 | 7,552 | 4.86 | 14,376 | 6.53 | 8,053 | 4.94 |
| j. | Social development work | 234 | 0.17 | 839 | 0.54 | 2,003 | 0.91 | 994 | 0.61 |
| k. | Festival | 9,519 | 6.92 | 14,987 | 9.65 | 27,233 | 12.37 | 15,438 | 9.47 |
| l. | Loan repayment | 6,644 | 4.83 | 4,864 | 3.13 | 3,148 | 1.43 | 6,162 | 3.78 |
| m. | Other expense (if any) | 1,224 | 0.89 | 2,067 | 1.33 | 3,897 | 1.77 | 1,451 | 0.89 |
| | Total | 137,563 | 100.00 | 155,390 | 100.00 | 220,152 | 100.00 | 163,019 | 100.00 |

Findings of the study reveals that overall 51.98 percent of the income from mud crab fattening was allocated to food expenditure of the household. This allocation is more than the national average allocation of food consumption expenditure of 47.70% (HIES, 2016). Festival expenditure (9.47%) were the second highest allocating purpose of income from mud crab fattening and followed by clothing (7.39%), house repairing/buying assets (7.19%), savings (5.38%), family member's education (4.94%), loan repayment (3.78%), health service (3.45%) and others. The festival expenditure was second highest because of including some inseparable clothing cost associated with the functions.

The results were varied for different expenditure groups. Low expenditure group employed their 61.28% income from mud crab fattening to food consumption purpose which was 52.13% for medium and 42.97% for higher expenditure group. Allocation of more than sixty-one percent of income from mud crab fattening to food consumption by smallholder crab fatteners seems that mud crab fattening practices contributed more significantly to ensure food security for them. Allocation of income from other sources rather crab fattening to food consumption was the reason behind the lower contribution of income from crab fattening to food expenditure for the medium and high expenditure crab fatteners group.

Festival expenditure, clothing, house repairing/buying household assets, savings and family member's education expenditures were higher in the higher expenditure crab fatteners group and followed by medium and lower group. Higher capacity of high and medium expenditure crab fatteners group was the reason for this pattern of income allocations.

But the higher allocation of income from mud crab fattening to healthcare services and loan repayment for the smallholder crab fatteners than medium and higher crab fatteners group also indicates the importance of mud crab fattening for the livelihood of the marginalized people of the study areas.

Thus, the analysis on the allocation of income from mud crab fattening depicts the importance of the crab fattening practices towards achieving different components of livelihood. As mud crab fattening helps the fatteners to cope with and recover from stress and shocks, maintain or enhance their capabilities and assets, and provide sustainable livelihood opportunities for their next generation, it can be concluded that

mud crab fattening had a positive impact on the fattener's livelihood. A positive impact were also found by Haque *et al.* (2017) at the time of studying household consumption of protein-rich foods due to tilapia-mud crab fattening and culture practices.

## 7.4. Concluding Remarks

The impacts of mud crab fattening were assessed for low, medium and high mud crab fatteners groups. An overwhelming majority of the fatteners were found in medium to high expenditure category with another 15.33 percent of them in low expenditure group. Major portion of the livelihood expenditure of the respondents were contributed by mud crab fattening. This contribution was higher for smallholder mud crab fatteners than other two groups. Being most prolific income generating sources of the respondents mud crab fattening contributed significantly to ensure food security for the smallholder crab fatteners as well as others. For the purpose of ensuring food consumption more than fifty percent of income from mud crab fattening was employed and this contribution was higher for the smallholder crab fatteners due their fewer income generating sources.

## CONSTRAINTS ENCOUNTERED BY MUD CRAB FATTENERS AND SUGGESTIONS FOR FURTHER IMPROVEMENT

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

### 8.1. The Constraints Faced by Mud Crab Fatteners

There is no doubt about that the mud crab fattening is a profitable venture but the fatteners were encountered by some problem during their fattening practices. All the problems were ranked based on their priority measured by the higher numbers of mention by the fatteners.

**Table 8.1** Constraints Faced by Mud Crab Fatteners during Their Fattening Practices

| Sl. No. | Problem faced by farmer | Frequency out of 150 | Percent | Rank |
|---------|------------------------|----------------------|---------|------|
| 01. | Frequent disease attack | 86 | 57.33 | 1st |
| 02. | Lack of capital | 40 | 26.67 | 2nd |
| 03. | Lack of training | 37 | 24.67 | 3rd |
| 04. | Unavailability of improved crablets | 29 | 19.33 | 4th |
| 05. | Problems in collection of crablets | 25 | 16.67 | 5th |
| 06. | Death of crablets in the farm | 23 | 15.33 | 6th |
| 07. | Higher feed cost | 20 | 13.33 | 7th |
| 08. | Transportation & Marketing problem | 15 | 10.00 | 8th |
| 09. | Higher price of crablets | 10 | 6.67 | 9th |
| 10. | Unavailability of improved technology | 5 | 3.33 | 10th |

From all the constraints, frequent attack of diseases was the major barrier and about 57.33% of the respondent mentioned this problem. Besides, 26.67% of the respondents claimed that shortage of capital was another constraint which hampered their crab fattening practices. In addition, lack of training (24.67%), unavailability of improved

crablets (19.33%), problems in crablet collection (16.67%) and death of crablets after releasing in the farm (15.33%) were few other concerns for the fatteners (Table 8.1).

Ferdoushi and Zhang (2013) also conducted a study titled, 'An assessment on the barriers in mud crab (*Scylla sp.*) fattening and marketing in Bangladesh' and identified a total of twelve (12) important barriers. Among different barriers addressed by farmers they found insufficient credit and lack of proper knowledge about crab farming ranked 1st and 2nd in position in barrier ranking. In that sense, their findings were also nearer to the present study.

## 8.2. Suggestions for the Improvement of Mud Crab Fattening in Bangladesh

Different problems faced by mud crab fatteners during their fattening practices discussed in the above section. The fatteners also proposed some suggestions to overcome those barriers as well as to harness the productivity and profitability of this practices. Those suggestions are being discussed in this section of the research paper. Among the proposed suggestions arranging more training, supplying disease free improved crablets, supplying quality feed in lower price, availability of loan with low interest rate and establishing hatchery for crablets supply were mostly mentionable (Table 8.2).

**Table 8.2** Suggestions for the Improvement of Mud Crab Fattening in Bangladesh

| Sl. No. | Suggestions for the improvement | Frequency out of 150 | Percent | Rank |
|---|---|---|---|---|
| 01. | Arranging more training | 58 | 38.67 | 1st |
| 02. | Supplying disease free improved crablets | 49 | 32.67 | 2nd |
| 03. | Supplying quality feed in lower price | 37 | 24.67 | 3rd |
| 04. | Availability of loan with low interest | 32 | 21.33 | 4th |
| 05. | Controlling measure for disease infestation | 20 | 13.33 | 5th |
| 06. | Availability of improved technology | 19 | 12.67 | 6th |
| 07. | Establishing hatchery for crablets | 13 | 8.67 | 7th |
| 08. | Ensuring market stability | 10 | 6.67 | 8th |
| 09. | Quality medicine for disease control | 9 | 6.00 | 9th |
| 10. | Improving transportation facilities | 7 | 4.67 | 10th |

To overcome the problems of mud crab fattening most of the respondents mentioned that authorities may take initiatives to supply different inputs like disease free improved crablets (32.67%), quality feed for crabs (24.67%) and medicine for disease control (6.00%) etc. at a subsidized rate. Although a number of respondents mentioned about disease infestation in crab fattening farm but it was comparatively lower than that of other ventures. Measures should be taken for ensuring the availability of extension services to control and reduce the frequent disease attack (13.33%).

To increase the know-how of the crab fatteners more training (38.67%) should be arranged. According to 21.33% fattener's opinion, loan with lower interest may facilitate the fattening practices. Some of the fatteners (12.67%) urged for some improved technology like soil testing machine, pH metre, aerator etc. Some of them (8.67%) also urged for establishing hatchery for facilitating improved crablets supply.

## 8.3. Concluding Remarks

Mud crab fatteners of the study areas were encountered by some inevitable constraints like frequent attack of diseases, shortage of capital, lack of training, unavailability of improved crablets and problems in crablet collection. To overcome the problems and further improvement, different suggestions were proposed by the fatteners. Among them arranging more training, supplying disease free improved crablets, supplying quality feed in lower price, increasing the availability of loan with low interest rate, increasing the availability of improved technology and establishing hatchery for crablets were mostly mentionable.

# CHAPTER-IX

## SUMMARY, CONCLUSION AND RECOMMENDATIONS

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

### 9.1. Summery

Khulna region is the single most crab cultivating area of Bangladesh. Bagerhat, Khulna and Satkhira district of this region produced around 70% crabs of the country. Bagerhat Sadar and Rampal upazila from Bagerhat district and Shyamnagar upazila from Satkhira district were selected as the study area of this research to delineate the socio-demographic profile of the mud crab fatteners, to estimate the profitability and resource use efficiency of mud crab fattening, to explore the impacts of that practices on the fatteners livelihood and to identify the problems encountered by the fatteners.

Besides extensive study on all the secondary sources, 150 mud crab fatteners were randomly selected for conducting field level survey to collect primary data. A structured interview schedule were developed based on the background information, expert's appraisal and pre-test questionnaire.

Data obtained by administering interviews with the respondents were coded appropriately and entered into a database system using Microsoft Excel. Finally, obtained dataset were analyzed using MS Excel and STATA 14 statistical software. Descriptive statistics (percentage, mean, range, standard deviation etc.) were used to describe the socio-demographic variables and Cobb-Dauglus production functions models was used to analyze the resource use efficiency.

The socio-demographic profile of the mud crab fattener's reveals that the highest (52.67%) proportion of the fatteners were young-aged followed by middle (36.67%) and old aged category (10.66%). Among the respondents an overwhelming 70.67% had at least primary education. Medium sized family (60.67%) were more prevalent in the study area. Smallholder mud crab fatteners constituted the highest proportion (64.00%)

of the respondents. Majority of the crab fattening household (58.67%) had medium annual income. An overwhelming majority (58.00%) of the crab fatteners earned medium to high income from the fattening practices. Majority (64.00%) of the fatteners have medium duration (>4 to 14 years) crab fattening experience. A significant portion (51.33%) of the fatteners have medium term extension contact for the purpose of crab fattening. Though a significant portion of the fatteners (22.67%) haven't any training opportunity, a majority of them (71.33%) have low to medium (1-5 days) term training experience. The study also reveals that, about 77 percent of the respondents have medium to sound knowledge on mud crab fattening practices.

Profitability analysis of the study shows that around thirteen different inputs were used for mud crab fattening practices. Among those inputs, resource allocation for crablets constituted the highest (40.40%) and followed by feed (18.27%), land rent (13.59%), human labour (9.24%), bamboo fencing (6.31%), pond preparation (5.56%) and others. Major fixed cost hubs of the fattening practices were land use cost, bamboo fencing cost, pond preparation cost and netting cost etc. Major variable cost hubs were crablets cost, feed cost, labour cost etc. The cost of mud crab fattening was Tk. 518,861 and Tk. 364,900 per hectare on total cost and variable cost basis, respectively. The average yield of crab was about 785.66 kg/ha. Gross return and gross margin of mud crab fattening was Tk. 894,374 and Tk. 529,474 per hectare, respectively. The net return from the fattening was Tk. 375,513 per hectare. The undiscounted benefit cost ratio was 1.72 on total cost basis.

To estimate the influential factors of mud crab fattening, the major inputs like human labor, crablets, feed, lime, bamboo fencing and other costs of that practices were studied. The estimated co-efficient for crablets was 0.60 with 1% level of significance implying 1% increment of crablets cost would increase the return by 0.60%, remaining other things constant. The co-efficient for human labour and feed were 0.17 and 0.12, respectively with 5% level of significance. Adjusted-$R^2$ of the estimated production function were 0.6779.

Resource use efficiency of mud crab fattening shows that human labour, crablets, feed and bamboo fencing inputs were under-utilized. On the other hand, lime and other costs of mud crab fattening were over-utilized.

The impacts of mud crab fattening were assessed for low (15.33%), medium (68.67%) and high (16.00%) crab fatteners groups. Overall average annual household expenditure of mud crab fatteners was about 242.49 thousand taka of which about 65 percent were contributed by mud crab fattening. The contribution of mud crab fattening to the total expenditure were higher for low expenditure group (79.52%) and followed by high (63.28%) and medium (62.02%) expenditure group.

Overall 51.98 percent of the income from mud crab fattening was allocated to food expenditure of the household. Festival expenditure (9.47%) were the second highest income allocating purpose and followed by clothing (7.39%), house repairing/buying assets (7.19%), savings (5.38%), education (4.94%), loan repayment (3.78%), healthcare (3.45%) and others.

It is also evident that low expenditure group employed their 61.28% income from mud crab fattening to food consumption which was 52.13% for medium and 42.97% for higher expenditure group. Festival expenditure, clothing, house repairing/buying household assets, savings and education expenditures were higher in the higher expenditure group and followed by medium and lower group. But the higher allocation of income to healthcare services and loan repayment for the smallholder crab fatteners than medium and higher crab fatteners group also indicates the importance of mud crab fattening for their livelihood.

Constraints faced by the mud crab fatteners and suggestions for improvement were explored by offering open ended questions regarding the constraints of mud crab fattening and suggestions for improvements.

Among the different constraints mentioned by the fatteners, frequent diseases attack was the major barrier and about 57.33% of the fatteners mentioned this problem. Besides, 26.67% of the respondents claimed on the shortage of capital. In addition, lack of training (24.67%), unavailability of improved crablets (19.33%), problems in crablet collection (16.67%) and death of crablets after releasing in the farm (15.33%) were few other concerns for the mud crab fatteners.

Among the different suggestions proposed by the crab fatteners arranging more training, supplying disease free improved crablets, supplying quality feed in a subsidized price, increasing the availability of loan with low interest rate, increasing

the availability of improved technology, establishing hatchery for crablets and ensuring market stability were mostly mentionable.

## 9.2 Conclusion

The demographic profile of the crab fatteners indicates the prevalence of young aged mud crab fatteners with medium sized (of 4-6 members) family. Having primary level educational status most of them were smallholder fatteners. But an overwhelming majority of them earned medium to high annual income from their fattening practices. Though they had medium term mud crab fattening experience around one-fourth of them hadn't training exposure. But a major portion of them gained sound crab fattening knowledge through extension media contact.

Mud crab fattening is not a labour intensive venture but capital. Highest portion of the resources were required to spend for crablet stocking and feeding. Thus, crablets, feed and human labour were the most influential factors of the fattening practices. Some fixed cost hubs of the practices were the cost for land use, bamboo fencing, pond preparation and netting etc. The average yield of crab was satisfactory. BCR of the farm indicates the fatteners obtained a handsome net return from their investment. But the inputs like crablets, feed, human labour and bamboo fencing were not fully utilized. Crab fatteners had the opportunity to increase their productivity by proper utilization of these resources.

As mud crab fattening is the most prolific sources of income in the study area, most of the (about 65%) annual household expenditure of the respondents was contributed by this practice. As smallholder mud crab fatteners have fewer income sources than medium and higher crab fatteners, the contribution of income from mud crab fattening was higher in low expenditure group than high and medium group. Allocation of around fifty-two percent income from mud crab fattening to food expenditure depicts the importance of this practices to ensure food security for the coastal marginal people. As mud crab fattening help the fatteners to cope with and recover from stress and shocks, maintain or enhance their capabilities and assets, and provide sustainable livelihood opportunities for their next generation, it can be concluded that mud crab fattening had a positive impact on the fattener's livelihood.

Mud crab fatteners of the study area were encountered by some inevitable constraints like frequent diseases attack, shortage of capital, lack of training, unavailability of improved crablets and problems in crablet collection. Different suggestions were proposed by the fatteners to overcome the problems as well as further improvement. Among them arranging more training, supplying disease free improved crablets, supplying quality feed in a subsidized price, increasing the availability of loan with low interest rate, increasing the availability of improved technology and establishing hatchery to facilitate crablets supply were mostly mentionable.

## 9.3. Recommendations

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

- ➢ Mud crab fatteners of the study area were inefficient to use their resources on crablet stocking, feed cost, labour cost and bamboo fencing cost due to inadequate knowledge on crab fattening. Respective authority like Department of Fisheries may arrange frequent field days, demonstration and training programs to impart crab fattening knowledge of the fatteners. More extension service should be provided by the respective authority.

- ➢ Major cost of the fattening practices constituted by crablets. But smallholder fatteners faced frequent diseases attack to their farms due to poor quality of crablets. To prevent these attack, disease free improved crablets were must. Government may take initiatives to ensure the supply of disease free improved crablets in a subsidized rate. Moreover, establishment of crablet hatchery is a must for ensuring uninterrupted disease free crablets supply.

- ➢ Feed was also an important input. But quality feed was also scarce though their price were very high. Crab fatteners urged for supplying quality feed with lower price. Respective authority may take necessary initiatives.

- ➢ A significant portion of the fatteners mentioned the unavailability of capital. Larger cost has been incurring for collecting capital from the existing sources. Majority of them urged for supplying loan with a lower interest rate. Government may take this initiative to facilitate the establishment of this crab fattening practices.

**9.4. Limitations of the Study**

Considering the time, respondents, communication facilities and other necessary resources available to the researcher and to make the study meaningful, it became necessary to impose certain limitations as mentioned bellow-

i. The study was confined to Bagerhat Sadar and Rampal upazila of Bagerhat district and Shyamnagar upazila of Satkhira district which may fail to represent the actual scenario of the whole situation as people develop their strategies according to the concrete situation they face.

ii. Only six important inputs were studied to determine the affecting factors and resource use efficiency but fatteners may use few other inputs.

iii. Control group and treatment group were required to analyze the impact of mud crab fattening which was not possible to maintain due to time constraint of the research.

iv. Data on at least two interval of time were required for analyzing the impact of mud crab fattening but it was not possible to collect data on two interval due to shorter period of research time.

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