

**PROXIMATE COMPOSITION, MARKETING CHANNEL AND SOCIO  
ECONOMIC CONDITION OF HARVESTERS OF FRESHWATER MUD EEL  
(*MONOPTERUS CUCHIA*, HAMILTON, 1822) COLLECTED FROM SOME  
SELECTED NORTHERN DISTRICT OF BANGLADESH**



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## Certificate

This is to certify that **Md. Tamim Islam, Roll-4205**, has undertaken M.S thesis research work on the “**Proximate composition, marketing channel and socio economic condition of harvesters of freshwater mud eel (*Monopterusuchia*, hamilton, 1822) collected from some selected northern district of Bangladesh**” has been carried out under my supervision. Additionally, this study is fully to certify that it is an original work and suitable in partial fulfillment for the degree of M.S in Fisheries, University of Dhaka.

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**The Author**

## **ABSTRACT**

The mean moisture content of male and female freshwater mud eel of the experiment was 77.59 % and 79.45 % respectively. The mean protein content of male and female mud eel of the experiment was 17.48% and 17.18 % respectively. Mean ash content for male was 2.74 % and female was 3.12 % and mean lipid content for male was 1.02 % and female was .80 %. The composition of the muscle differed between the sexes. Freshwater mud eel are exported in live condition from Bangladesh. A small processing zone has been created in Uttara, Dhaka by mud eel exporter. To find out processing techniques of export oriented mud eel followed at different marketing level. The present study has been undertaken to create a better understanding of the current marketing activities and exported processing for Mud eel and to review the socio-economic condition of Mud eel harvesters. The study area was Bogra, Rangpur and Dinajpur district. The data were collected over three months from November, 2015 to January, 2016 using well-structured questionnaire from the selected area. Data were collected from randomly selected 50 freshwater Mud eel harvesters. The socio-economic condition of mud eel harvesters were belonging to the age groups of 26-30 years old (30%) in study area, majority bring out by tribal Hindus (72%). Most of the harvesters are married (88%). About 70% rests of the fishermen were in joint family. In the study area 46% family members were 2-3 persons. Educational status of the selected area was very poor, can sign only 32% and 30% have no education. Housing and sanitation facilities were not well. 90% harvesters have kacha house and 40% harvesters had kacha sanitation system. 36% respondent harvesters were used electricity while NGO have given solar plant 26% to some tribal harvesters. About 80% harvesters were dependent on village doctor and 74% harvesters most are tribal people used freshwater mud eel fish for medicinal purpose. 32% respondent harvesters had television as recreation, majority of harvesters (66%) caught mud eel by hand. Freshwater mud eel harvesters are got payment from collector by hand by hand and daily. About 50% of the harvesters had monthly income between BDT 9000-12000. 48% of the harvesters received loan from NGO's, No training received from any NGO. 56% harvesters were satisfied from freshwater mud eel harvested.

## TABLE OF CONTENTS

CHAPTER	TITLE	Page no.
	<b>ACKNOWLEDGEMENTS</b>	i
	<b>ABSTRACT</b>	ii
	<b>CONTENTS</b>	iii
	<b>LIST OF TABLES</b>	vi
	<b>LIST OF FIGURES</b>	vii
	<b>LIST OF APPENDICES</b>	ix
	<b>LIST OF SYMBOLS &amp; ABBREVIATION</b>	x
<b>CHAPTER I</b>	<b>INTRODUCTION</b>	1
<b>CHAPTER II</b>	<b>MATERIALS AND METHODS</b>	6
	<b>2.1 BIOCHEMICAL STUDY</b>	6
	<b>2.1.1 Collection and preservation of Sample</b>	6
	<b>2.1.2 Proximate analysis</b>	6
	2.1.2.1 Determination of moisture	6
	2.1.2.2 Determination of protein content	6
	2.1.2.3 Determination of lipid content	7
	2.1.2.4 Determination of ash content	7
	2.1.2.5 Statistical analysis	8
	<b>2.2 MARKETING CHANNEL OF MUD EEL</b>	8
	<b>2.2.1 Collection of Information from harvesters</b>	8
	<b>2.2.2 Collection of Information from Exporters</b>	8
	<b>2.3 SOCIO ECONOMIC STATUS</b>	9
	2.3.1 Flow chart of Methodology	9
	2.3.2 selection study area and study duration	10
	2.3.3 Target group and sample size	11
	<b>2.3.4 Data collection method</b>	11
	2.3.4.1 Primary data collection	11
	2.3.4.1 (a) Questionnaire interview	11
	2.3.4.1 (b) Group Discussion	11
	2.3.4.1 (c) Cross check interview	11
	2.3.4.2 Secondary data collection	12
	<b>2.3.5 Data processing and analysis</b>	12

<b>CHAPTER</b>	<b>TITLE</b>	<b>Page no.</b>
<b>CHAPTER III</b>	<b>RESULTS</b>	13
	<b>3.1 PROXIMATE COMPOSITION</b>	13
	<b>3.2 MARKETING CHANNEL</b>	14
	<b>3.2.1 Harvesting and transportation</b>	15
	3.2.1.1 Collection of freshwater mud eel	15
	3.2.1.2 Weighing and storage	15
	3.2.1.3 Transportation and supply	15
	3.2.1.4 Quality control	16
	<b>3.2.2 Export related activities</b>	16
	3.2.2.1 Freshwater Mud eels collection & storage	16
	3.2.2.2 Processing	17
	3.2.2.3 Packaging and Delivery	19
	<b>3.2.3 Pricing at various level of marketing chain</b>	19
	<b>3.2.4 Case study on Production and earning of mud eel at collector</b>	20
	<b>3.3 SOCIO ECONOMIC CONDITION OF MUD EEL HARVESTER</b>	23
	<b>3.3.1 Human resource</b>	
	3.3.1.1 Age group distribution	23
	3.3.1.2 Religious status	24
	3.3.1.3 Marital status	25
	3.3.1.4 Family size and structure	25
	3.3.1.5 Education status	26
	<b>3.3.2 Household amenities and life style</b>	27
	3.3.2.1 Housing and sanitation facilities	27
	3.3.2.2 Health care facility	29
	3.3.2.3 Source of drinking water	30
	3.3.2.4 General food consumption pattern	30
	3.3.2.5 Modes of recreation	30
	3.3.2.6 Fishing Practices	31
	<b>3.3.3 Financial and technical aspects</b>	32
	3.3.3.1 Payment system	32
	3.3.3.2 Monthly income from fishing activities	33
	3.3.3.3 Credit access/ Sources of credit	33
	3.3.3.4 Training & Financial supports	34
	3.3.3.4 Savings	34

<b>CHAPTER</b>	<b>TITLE</b>	<b>Page no.</b>
	<b>3.3.4 Miscellaneous aspects</b>	34
	3.3.4.1 Job satisfaction	34
	3.3.4.2 Socio-economic limitations of mud eel harvesters	35
	3.3.4.3 Harvester's opinion on current status of Mud eels	35
<b>CHAPTER IV</b>	<b>4.1DISCUSSION</b>	37
	4.2 Recommendations	44
<b>CHAPTER V</b>	<b>CONCLUSIONS</b>	45
	<b>REFERENCES</b>	46
	<b>APPENDIX</b>	51

## List of Tables

TABLE	TITLE	PAGE
Table 1	Proximate composition (mean $\pm$ SEM) of male and female <i>M. cuchia</i>	13
Table 2	A selected collector transport mud eel from Bogra district to Dhaka during July,2014– June2015	20
Table 3	Education status of hervester in the selected study area	27
Table 4	Health care facility of hervester in the study area.	29
Table 5	General food consumption pattern of hervester in the study area.	30
Table 6	Fishing vaction of hervester of the study area	32
Table 7	Monthly income from fishing activities	33



## List of Figures

FIGURE	TITLE	PAGE
Figure 1	Mud eel ( <i>Monopterusuchia</i> )	4
Figure 2	Flowchart showing Steps of research methodology.	9
Figure 3	Map showing Study area in Bogra, Rangpur and Dinajpur districts	10
Figure 4	proximate composition compare of male and female M. cuchia	14
Figure 5	Typical mud ell export marketing channel of Bangladesh (n=50).	14
Figure 6	Collector Transport in the study area (N=14).	15
Figure 7	Flowchart showing different processing techniques of export oriented mud ell followed at different marketing level	18
Figure 8	Flow chart of price control	18
Figure 9	Total collection in a year of selected collector	21
Figure10	Invested on mud eel business in a year of selected collector	21
Figure 11	Profit of mud eel business in a year of selected collector	22
Figure 12	Death mud eel removes in a year of selected collector	23
Figure 13	Age group distribution of freshwater mud eel harvester in the study area (n=50).	24
Figure 14	Status of religious beliefs among the freshwater mud eel harvester in the study area (n=50	24
Figure 15	Marital status of mud eel harvesters in the study area. (n=50).	25
Figure 16	Family size and structure of mud eel harvesters in the study area. (n=50)	26
Figure 17	Housing condition of mud eel harvesters in the study area (n=50)	28
Figure 18	Sanitary condition of mud eel harvesters in the study area (n=50).	28
Figure 19	Use of Freshwater mud eel fish for medical purpose of harvesters in the study area. (n=50).	29
Figure 20	Modes of recreation of mud eel harvesters in the study area. (n=50).	30
Figure 21	Fishing times of gear mud eel harvesters in the study area. (n=50).	31

Figure 22	Capture of freshwater mud eel fish of harvesters in the study area. (n=50).	32
Figure 23	NGO Facility of mud eel harvesters in the study area. (n=50).	33
Figure 24	Savings of mud eel harvesters in the study area. (n=50).	34
Figure 25	Job satisfaction of mud eel harvester in the study area. (n=50).	35

## List of Appendices

Appendix	Title	page
Appendix 1	Interview schedule on socio-economic condition and the livelihood of the mud eel fish harvesters in study area.	51
Appendix 2	Descriptive and ANOVA for protein content of <i>M. cuchia</i> .	56
Appendix 3	Descriptive and ANOVA for lipid content of <i>M. cuchia</i>	56
Appendix 4	Descriptive and ANOVA for Ash content of <i>M. cuchia</i>	57
Appendix 5	Descriptive and ANOVA for moisture content of <i>M</i>	58
Appendix 6	Photo of proximate composition, transport & marketing channel	59

## List of Symbols and Abbreviations

<b>Symbols</b>	<b>Details</b>
%	Percentage
<	Less than
ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
AOAC	Association of Official Analytical Chemists
BDT	Bangladesh taka
BFRI	Bangladesh fisheries research institute
CuSO <sub>4</sub>	Copper sulfate
DoF	Department of fisheries
EPB	Expert Promotion Bureau
<i>et al</i>	And others(et alliori)
GD	Group discussion
GDP	Gross domestic production
h	Hour
H <sub>2</sub> SO <sub>4</sub>	Sulfuric acid
IUCN	International union for conservation of nature
K <sub>2</sub> SO <sub>4</sub>	Potassium sulfate
Kg	Kilogram
L	Liter
ml	Milliliter
SES	Socio-economic status
SPSS	Statistical Package For Social Sciences
UFO	Upazila Fisheries Officer
USD	United States Dollar

## CHAPTER I

# INTRODUCTION

### 1.1 Background

Bangladesh is interwoven with hundreds of rivers. The climate of Bangladesh is unique for fisheries resources. Fisheries sector plays an important role in the socio-economic development of Bangladesh contributing 3.69% to the national GDP 22.6% of agriculture sector. Fish is main source of animal protein of the country man as 63% animal protein comes from fish alone (Chowdhory, 2001).

The freshwater mud eel (*Monopterus albus*, Hamilton, 1822), also known as cuchia or swamp eel. It belongs to the family **Synbranchidae** of the order **Synbranchiformes**. Is one of the popular delicious native fish species and sometime underestimated due to its morphological resemblance with snake's. The genus *Monopterus* has six species are found only in Asia. The rice field eel (*M. albus*) is one close relative of mud eel. *Monopterus albus* commonly occurs in the freshwater of Bangladesh, Pakistan and throughout India (Jhingran and Talwar, 1991). Especially in Bangladesh, mud eel is generally available in open water resources such as mud holes, shallow beels haors, baors, paddy fields canals, and floodplains etc (Hasan *et al*, 2012).

Mud eel is carnivorous and nocturnal, prefers animal based foods like, small fishes, molluscs and worm's. They often spend their daytime hiding under stones and mud or having a burrowing habit (Nasar, 1997). The gills of mud eel are reduced and the fish has a pair of air breathing organ in the form of a sac on two sides of the head. In Bangladesh, the tribal people and a few of other castes eat this fish. It is commercially important due to its high demand for export (Ahmed, *et al.*, 2009).

Mud eel is a threatened fish species of Bangladesh (IUCN, 2000). With ecological importance and high nutritional components this fish can play a unique role for the development of socio-economic status of harvesters as well as with short of culture practice. However, recently, due to extreme amount of export causes this fish reduced from nature faster than any other time in past abundance of this species in nature has been decayed due to heavy fishing pressure, habitat destruction, aquatic pollution and indiscriminate uses of pesticides. Common diseases of freshwater fishes of Bangladesh are

tail and fin rot, bacterial gill rot, dropsy, various types of fungal diseases, protozoan diseases, parasitic diseases, nutritional disease, and various tumors (Chowdhury, 1998). It is necessary to determine the causes of its vulnerable condition to undertake any management program to conserve the species. Though the fish is only expended by the tribal people in Bangladesh. The fresh blood of mud eel is directly consumed to cure weakness, anemia, asthma (Jamir and Lal, 2005; Kakati *et al*, 2006), some people consumed gall bladder of mud eel to cure asthma, anemia, piles and diabetes (Saikia and Ahmed, 2012; Chakravarty and Kalita, 2012).

The demand for freshwater eel in Bangladesh for domestic consumption is less. Usually, rejected underweight freshwater eel for export and damage eel come to the local and urban markets for domestic consumption. Tribal people buy dead eel for their consumption due to low price can be ranged 70-80 BDT per kg, however, it is commercially important due to its high demand for export and the value of earnings has been steadily increasing.

Maximum freshwater eel is being exported from Sylhet district of Bangladesh 120 tons per month (M. Hasan, 2012). It can generate employment directly and indirectly in terms of people employed in the marketing and other associated business while more than 8,000 fishers, traders, transporters and exporters are found to be involved in this sector. (M. Hasan, 2012).

Bangladesh began exporting freshwater eel around 1987-88 and since 1992 the value earning has been increasing. In 2002 freshwater eel ranked 4 terms of frozen food export items (Faruque, 2015). The freshwater mud eel is an exported item in Bangladesh and its export is increasing yearly. According to the information of Department of fisheries (DoF), 7157 tons of freshwater mud eel exported from Bangladesh in 2013-2014 fiscal year. 6817 tons in 2012-2013, 5057 tons in 2011-2012, 3295 tons in 2010-2011 and 1782 tons by 2009-2010. That means the exported this fish is increasing both amount of foreign currency earning.

According to the information of Export Promotion Bureau (EPB) Bangladesh has been earns 1, 49, 78,000 USD by exporting this fish in 2013-2014 and 1, 09, 21,000 USD in 2012- 2013. According to the EBD 95% of freshwater eel is exported last year in china

with around 1,41,62,00 USD, in USA 3, 25,000 USD, in Honkong 2, 71, 000 USD, in South Korea 69,000 USD, and Taiwan 64,000 USD.

It is time to think about expanding freshwater eel fisheries and develop new technologies to increase its production for capture the world market. By improving cultural techniques we can earn lot of foreign currency and this will help to develop national economy of the country. Therefore, the freshwater mud eel, *M. cuchia* was observed considering suitable environments for rearing with live and dead feeds for survival and growth as well as compare the production of this fish in Bangladesh in different culture regimes. Considering high export demand and high nutritional elements of *M. cuchia*, this research work may be an alternative livelihood for people involved in fisheries sector.

### **1.2 Socio-economic concept**

Socio-economic status (SES) is a unit of an individual's or family's economic and social position in relation to others, based on various variables responsible for that like education, income, occupation, family effluence, physical assets, social position, social participation, caste, muscle power, political influence, etc. Majority of researchers agree that income, education and occupation together best represent SES, while some others feel that changes in family structure, family effluence etc. should also be considered. Wealth is also considered a determining factor of SES, which is a set of economic reserves or assets, presents a source of security providing a measure of a household's ability to meet emergencies, absorb economic shocks, or provide the means to live comfortably. Wealth reflects intergenerational transitions as well as buildup of income and savings (Gaur DKL, 2013).

Socio-economic status is classically broken into three categories, high SES, middle SES, and low SES to describe the three areas of a family or an individual may fall into. When placing a family or individual into one of these categories. All of the three variables (income, education, and occupation) can be measured (Werner *et al.*, 2007).

### **1.3 Proximate composition**

Proximate composition of any edible animal, including fish, is a key indicator of its biological and functional condition. Measuring body composition is the key factor for

evaluating the physiological condition, but is a time consuming process (Ali *et al.*, 2005). Proximate analysis for quantifying body composition of a fish is done through gaging different ingredients such as protein, fat, moisture content, ash content, fiber and organic contents of that fish (Jakhar *et al.*, 2012). On account of the presence in negligible amount carbohydrate and non-protein compounds present are typically ignored (Cui, 1988). A lot of work is being carried out all around the world on body composition of different fish species such as *Monopterus albus* (MiaoAn, *et al.*, 2000), *Clarias batrachus* (Sina and pal., 1990), rainbow trout (Shearer., 1984), European Seabass (Kaushik *et al.*, 2008), northern pike (Salam., 1994), herring fish (Iles., 1965), carps (Pongmaneerat *et al.*, 1993), yellowtail (Shimeno *et al.*, 1993), socheye salmon (Brett *et al.*, 1969), and *Labeo rohita* (Sarkar *et al.*, 2008). Tilapia (Soltan *et al.*, 2008).

#### 1.4 Scientific Classification

Kingdom: Animalia

Phylum: Chordata

Class: Actinopterygii

Order: Synbranchiformes

Family: Synbranchidae

Genus: Monpterus

Species: *M. cuchia* (Hamilton, 1822)



**Figure 1: Mud eel (*Monopterus cuchia*)**



## 1.5 Objectives

The proposed research had been planned to address the following objectives:

- a. to determine and compare the proximate composition of *M. cuchia* of different sex in order to find out the stock of better food value.
- b. to study the freshwater mud eel various aspects of freshwater mud eel export chain including backward linkage and international export system
- c. to assess the socio-economic status of freshwater mud eelharvesterin the selected study area.
- d. to know the harvesting and marketing chain of freshwater mud eel in northern part of Bangladesh.

## CHAPTER II

### MATERIALS AND METHODS

## 2 BIOCHEMICAL STUDY

### 2.1 Collection and preservation of Sample

Sample is collection randomly from study area around Bogra, Rangpur and Dinajpur district. After collection sample is preserved and prepare for proximate analysis.

#### 2.1.2 Proximate analysis

The percentage of proximate composition of fish was determined by conventional method of AOAC (2000). Triplicate determinations were carried out on each chemical analysis.

##### 2.1.2.1 Determination of moisture

The initial weight of the sample was taken then samples were dried in an oven at about 105°C for about 8 to 10 h until constant weight was reached and the samples were mince in an electric grinder. Moisture content determined as loss of weight.

Weight of the foil =  $W_0$

Weight of the foil + Wet sample =  $W_1$

Weight of the foil + Dry sample =  $W_2$

$$\% \text{ of moisture} = \frac{(W_1 - W_0) - (W_2 - W_0)}{(W_1 - W_0)} \times 100$$

$$\text{Moisture factor} = \frac{(100 - \text{moisture})}{100}$$

##### 2.1.2.2 Determination of protein content

The total nitrogen (crude protein) was determined using the Kjeldahl method. About 0.5 g of the fish sample was weighed on a Nitrogen-free paper. The paper was wrapped round the sample and dropped at the bottom of the Kjeldahl digestion flask together with 6-8 glass beads, 4-5 spatulas full of granular mixture of  $\text{CuSO}_4$  and  $\text{K}_2\text{SO}_4$  as catalyst and 20 ml of concentrated  $\text{H}_2\text{SO}_4$  was carefully added. The flask was gently heated on a Gerhardt heating mantle in an inclined position in a fume cupboard until full digestion was achieved (when the liquid changed from brown to colorless). The contents of the

flask were then transferred to a clean 100 ml volumetric flask, and 25 ml aliquot was used for the distillation and total nitrogen was determined calorimetrically.

The percentage of nitrogen in the sample was calculated by using the following formula:

$$\% \text{ of nitrogen} = \frac{(S-B) \times A \times C \times 100}{\text{Weight of sample} \times 100}$$

Where,

S= Titration reading for sample

B= Titration reading for blank

A= Strength of 0.01N HCL (0.01)

C= Digest taken for distillation factor  $\cong 20$

% Crude protein =  $N_2 \times 6.25 \times$  moisture factor

### 2.1.2.3 Determination of lipid content

The percentage lipid content in the muscles was determined using the soxhlet extraction method (Bolawa, et. al., 2011). An empty extraction thimble was weighed and noted as  $W_1$ , about 5 g of the ground muscle was measured into the empty thimble, the weight of the extraction thimble plus the sample was recorded as  $W_2$ .

The percentage lipid was calculated as follows:

$$\% \text{ lipid content} = \left( \frac{W_3 - W_2}{W_1} \times 100 \right) \times \text{moisture factor}$$

Where;

$W_1$  = Weight of empty extraction thimble

$W_2$  = Weight of extraction thimble plus sample extraction

$W_3$  = Weight of extraction thimble plus sample residue after extraction

### 2.1.2.4 Determination of Ash content

Ash content of fish samples was determined by incineration in a carbolated Sheffield LMF3 muffle furnace at 5000 °C (AOAC 2000). The difference in weight of the fish samples before and after heating was taken as the ash content, the formula is as follows;

$$\% \text{ Ash content} = \left( \frac{W_2 - W_0}{W_1 - W_0} \times 100 \right) \times \text{moisture factor}$$

Where;

W<sub>0</sub> = Empty crucible,

W<sub>1</sub> = Dry sample; and

W<sub>2</sub> = Ash sample

#### **2.1.2.5 Statistical analysis**

The data were analyzed through one way Analysis of variance (ANOVA) using SPSS (ver. 20) followed by Turkey HSD to find out whether any significant difference existed among treatment means. Standard deviation in each parameter and treatment was calculated and expressed as mean ( $\pm$  SD). The level of significance was set at 5% ( $P > 0.05$ ).

## **2.2 MARKETING CHANNEL OF FRESHWATER MUD EEL**

### **2.2.1 Collection of Information from harvesters**

For the present study, among the major mud eel production zones, North Bengal region was chosen to identify various aspects of marketing chain from harvesting to supply to exporters. The actual data was collected during the period of November 2015 to January 2016 from mud eel harvesters and bulk suppliers of Bogra, Rangpur and Dinajpur region. Both primary and secondary data were used during this investigation involving various qualitative and quantitative survey techniques. To identify various points of field level marketing chain, a total of 50 harvesters and 14 collector of the fishing community were interviewed using a pre-tested questionnaire. Well-structured interviewing, wealth ranking and Rapid Market Appraisal, through well-structured interviewing were used particularly given emphasis. In the pre-testing much attention was given to any new information in the draft questionnaire in order to reach the objectives of the study.

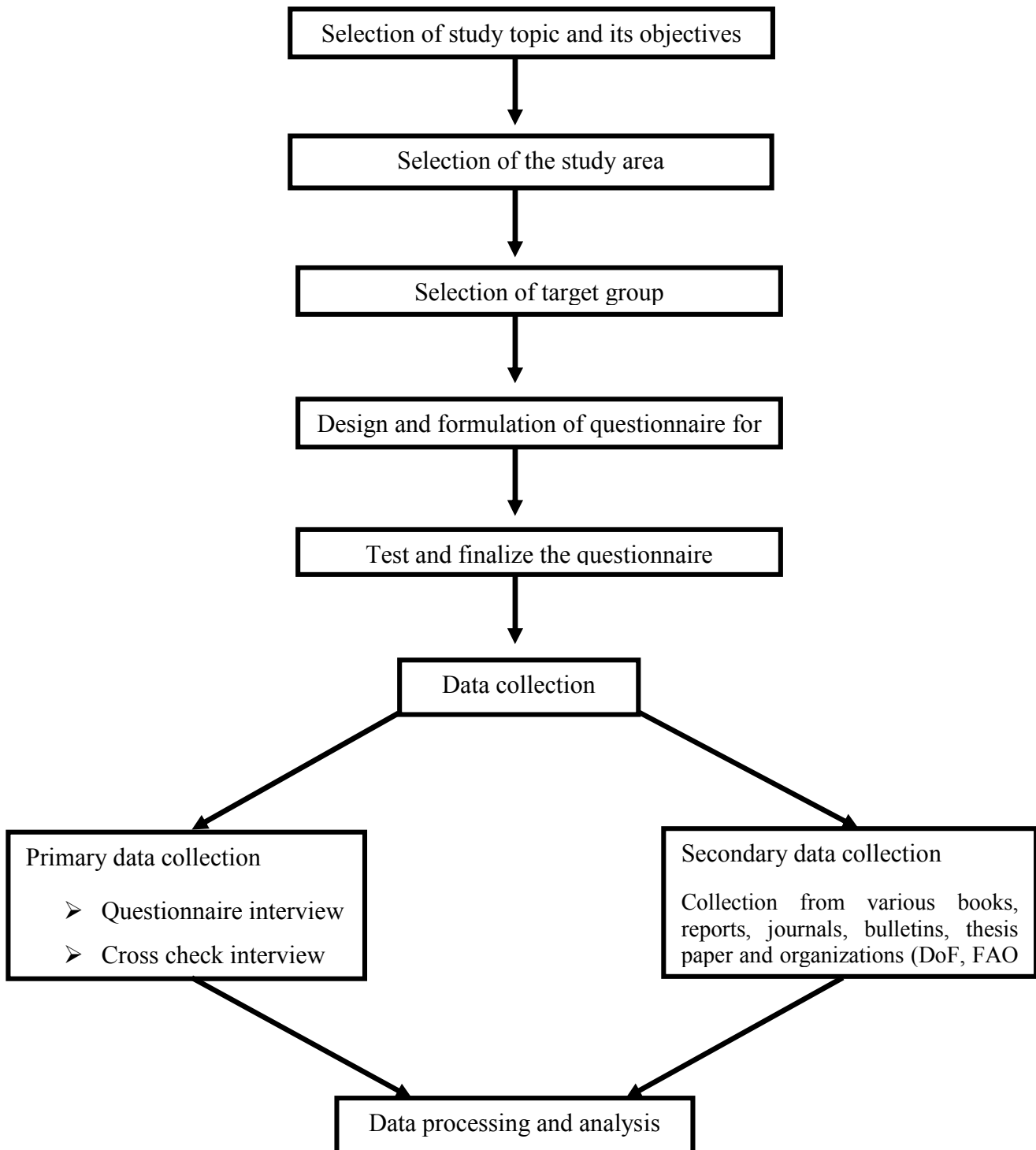
### **2.2.2 Collection of Information from Exporters**

For collection of information on mud eel exporters, several visits have been made to the largest and most important mud eel export zone of Bangladesh. In the survey schedule, Sunday was given preference as largest consignments are usually shipped on Sunday. Cross section of people including labour and facility manager were thoroughly interviewed. To gather information on different aspects of mud eel export chain including backward linkages, preservation and processing methods, transportation, foreign clients and orders etc., oral interview, observation, pre-formed questionnaire were used. Secondary data were also collected from Exporter's society regarding export volume and earnings.

## 2.3 SOCIO ECONOMIC STATUS

### 2.3.1 Flow chart of Methodology

The study socio economic status has been followed and completed according to the following order of methodology (Figure 2).



**Figure 2: Flowchart showing Steps of research methodology.**

### 2.3.2 Selection Study area and study duration

The study was carried out during the periods between November 2015 to January 2016 on the fishing community alone Bogra, Rangpur and Dinajpur (Figure 3). It is difficult to distinguish the harvesters offreshwater mud eel fish. The survey was held in winter season. The main criteria behind the selection of the study area:

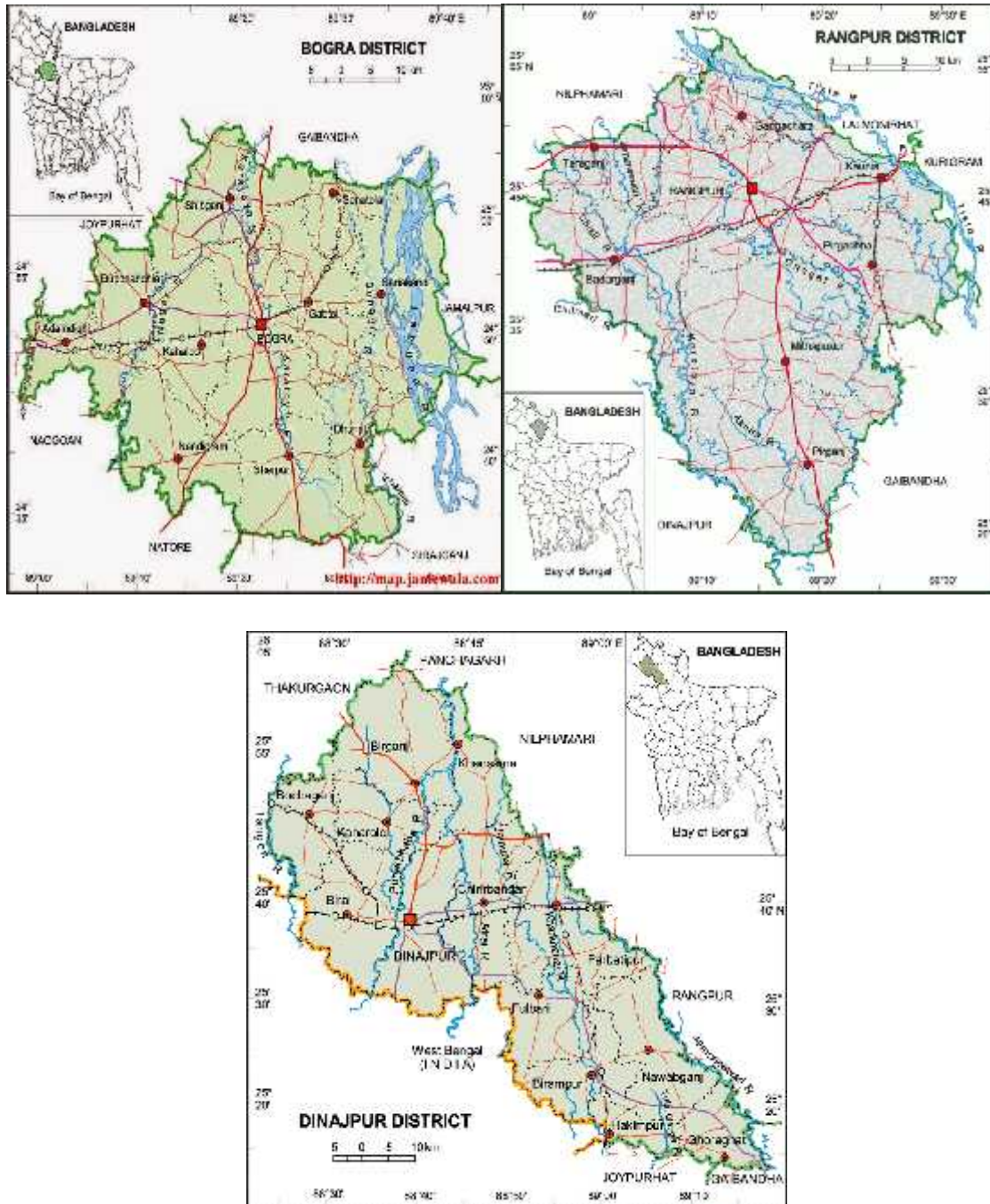


Figure 3: Map showing selectedStudy area in Bogra, Rangpur and Dinajpur districts

### **2.3.3 Target group and sample size**

The target group was harvesters who were involved in freshwater mud eel fishing permanently (as primary income source) and partially (as secondary income source) for their livelihood. The data were collected randomly from 50 harvesters of different locations.

### **2.3.4 Data collection method**

#### **2.3.4.1 Primary data collection**

Several PRA tools were used to collect the data from the freshwater mud eel fishing communities such as, personal interview, crosscheck interview with extension agents and older persons, and transect walk and case study. Data were collected by two data collection methods: (a) Primary data collection and (b) Secondary data collection.

Primary data were collected through field survey at village level, field, and fishing place and collector house by using well-constructed questionnaire. Primary data collections were consists of two methods:

#### **2.3.4.1(a) Questionnaire interview**

For questionnaire interview, a random sampling method was followed for 50 harvesters along the Bogra, Rangpur, and Dinajpur. Data were collected by using questionnaire interview method during fishing and from during selling (The information was recorded by researcher himself. Time required for each interview was about 30 minutes.

#### **2.3.4.1(b) Group Discussion**

A group discussion (GD) is a group of individuals with similar interest who gather one or the other formally or informally to bring up ideas, solve problems or give comment. It's also a good source of data collection.

#### **2.3.4.1(c) Cross check interview**

After collecting the data through questionnaire interviews it was necessary to check the information for justification of collected data if there were such items, which had been contradictory, then information's were collected from key information's. Cross-check

interviews were conducted with Upazilla Fisheries Officer (UFO) and Fisheries Extension Officer (FEO).

#### **2.3.4.2 Secondary data collection**

Secondary data were collected from various books, reports, journals, bulletins, thesis paper and Organizations (DoF, BFRI, and UFO etc.)

#### **2.3.5 Data processing and analysis**

After the collection of all survey, data were accumulated, grouped, summarized and finally arranged. Then data were presented in textual, tabular and graphical form according to the objectives of the study. Data were presented in the tabular form and in the graphical form for easy understanding



## CHAPTER III

### RESULTS

#### 3.1 PROXIMATE ANALYSIS

The Mean moisture content of male and female mud eel of the experiment was 77.59 % and 79.45 % respectively. Moisture content showed significant differences ( $P < 0.05$ ) in male and female. The Mean protein content of male and female mud eel of the experiment was 17.48% and 17.18 % respectively. Protein content showed significant differences ( $P < 0.05$ ) in both sex of freshwater mud eel. Mean lipid content for male was 1.02 % and female was .80 %. Lipid content showed significant differences ( $P < 0.05$ ) in both sex of freshwater mud eel. (Mean ash content for male was 2.74 % and female was 3.12 % ash content showed were not significant differences ( $P > 0.05$ ) in both sex of freshwater mud eel (Table 1). The composition of the muscle differed between the sexes.

**Table 1:** Proximate composition (mean  $\pm$  SEM) of male and female *M. cuchia*

Nutrient	Male	Female
<b>Moisture (%)</b>	77.59 $\pm$ 1.07 <sup>a</sup>	79.45 $\pm$ 0.72 <sup>b</sup>
<b>Protein (%)</b>	17.48 $\pm$ 0.95 <sup>a</sup>	17.18 $\pm$ 0.76 <sup>b</sup>
<b>Lipid (%)</b>	1.02 $\pm$ 0.045 <sup>a</sup>	0.80 $\pm$ 0.07 <sup>b</sup>
<b>Ash (%)</b>	2.74 $\pm$ 0.45 <sup>a</sup>	3.12 $\pm$ 0.18 <sup>a</sup>

Moisture, protein and lipid content in *M. cuchia* sampled from male and female were significant. At each level of parameter, values with different superscripts in the same row were significantly different ( $p < 0.05$ ), and values with same superscripts in the same row were not significantly different ( $p > 0.05$ ).

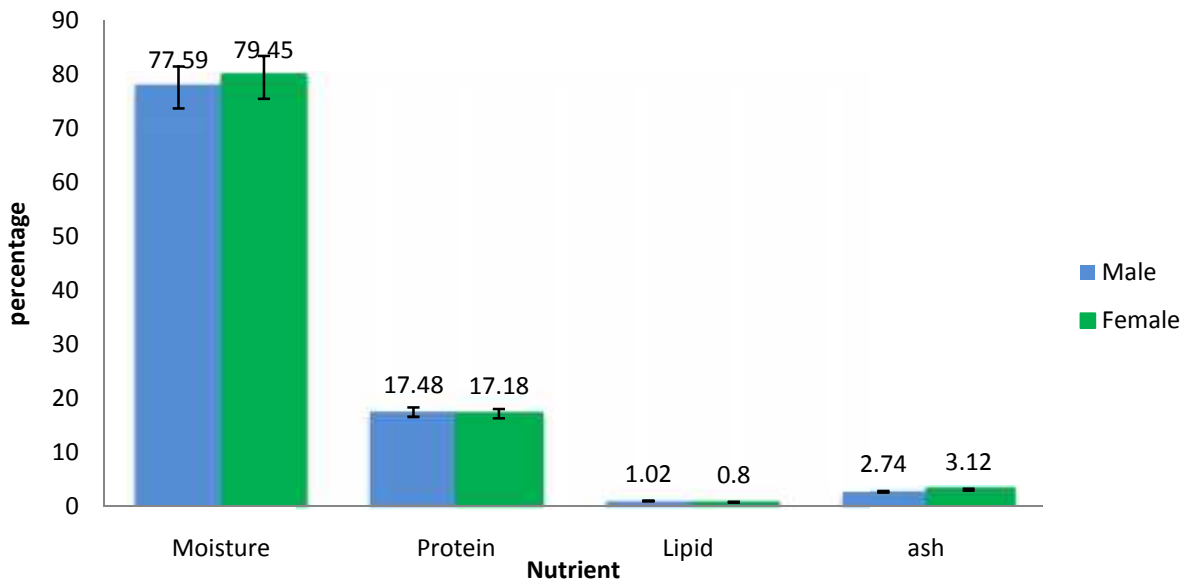


Figure 4: proximate composition compare of male and female *M. cuchia*

### 3.2 MARKETING CHANNEL

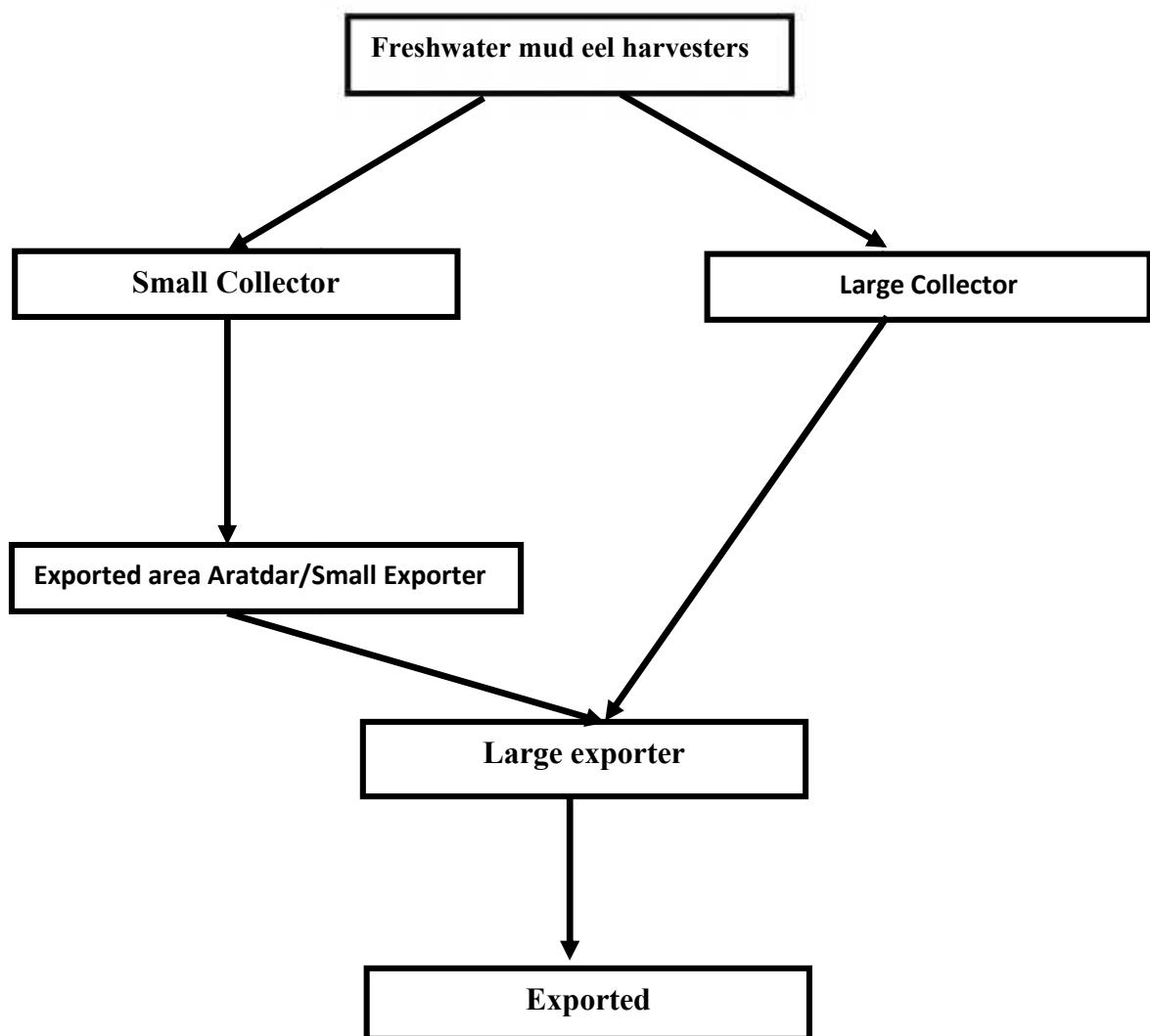


Figure 5: Typical mud eel export marketing channel of Bangladesh

### 3.2.1 Harvesting and Transportation

#### 3.2.1.1 Collection of mud eel

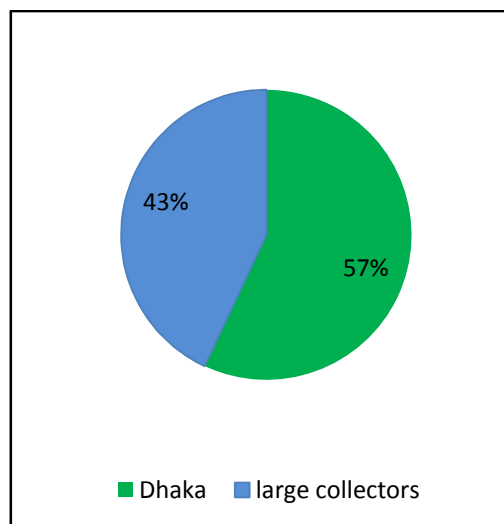
Freshwater mud eel is found of both freshwater and saline water fish. Naturally freshwater mud eel is breeding in soil hole near to water. In the survey area harvesters are catch freshwater mud eel from pond, river, beels, cannel, agriculture land etc.

#### 3.2.1.2 Weighing and storage

Collectors weigh their catches in digital or analog weighing machine and store them house in half drum or cemented tiled tanks. In this eels are kept alive usually for 3-5days before transport. During storage time they do not provide any feed and only use water depending on environmental temperature. Small quantity mortality was recorded during storing time.

#### 3.2.1.3 Transportation and Supply

Collectors collect freshwater mud eel in two ways. Some large collectors collect fish directly from fixed harvesters on contractual basis and others from small collectors. Large collectors send the fish directly to mud eel export zone in Uttara, Dhaka. Small collectors are transport to large collector. In the present survey, about 57.1% of large collectors sell their fish directly to Dhaka whereas remaining sells their product only to large collectors. (Figure 6)



**Figure 6: collector transport in the selected study area (N=14).**

Dhaka (Uttara) is the major export processing area in Bangladesh mud eel export. Collectors transport their freshwater mud eel depending on the stored amount of fish as well as demand. They sometime store the fishes in live condition and only send them to

Dhaka when considerable amount are accumulated. From North Bengal of Bangladesh collectors usually transport eel in plastic oil drums daily by bus at night in small volume but in case of large consignment transport pickup or truck is used in anytime of the day. They use for freshwater mud eel fish transport.

Discarded oil drums are used transporting mud eel and to facilitate fastening with rope some hole are created upper side of the drums. An oil drum usually can accommodate about 60-70 kg of eel. Some freshwater is used with the fishes and upper portion is covered with polythene and tied with rope. After long journey, processing area personnel receive the consignment either from bus just before dawn. Trucks carrying eel fish are directly taken to the processing zone. Collectors are getting their payment by commercial bank transaction in the following day.

#### **3.2.1.4 Quality control**

Generally dead eels are generally not received by the importing country. But in general 1-2% mortality of freshwater mud eel was common in eel export farms at Dhaka. On an average about 2-3% of the freshwater mud eel was rejected from each collector due to various quality related issues. To minimize the financial burden due to rejection, rejected eels are sent different hill tract district especially to Khagrachari for tribal people at a rate of 70-80tk/kg.

#### **3.2.2 Export Related Activities**

Freshwater mud eel are exported in live condition From Bangladesh. Far East Asian countries including China, Japan, Hong Kong, Vietnam, Thailand, Taiwan etc. are among the main export market for freshwater mud eel.

##### **3.2.2.1 Mud eels collection & storage**

The samples of *M. mud eel* for the study were collected from the North Bengal region of Bangladesh. For the ease of export through Hazrat Shahjalal International Airport a small processing zone has been created in Uttara, Dhaka just outskirts of airport. Processing plant manager is in overall control of plant. They maintain communication with eel aratdar/ collector place order according to the export demand. Price fixing with field level suppliers has also been carried out by processing farm manager. Collector is used

sent their freshwater mud eel from whole country by pick-up, truck or bus in processing plant.

Once the mud eels reached processing plant, they are then weighed and stored in tiled cemented rectangular tanks until exporting. Eels are usually exported daily but particularly larger consignments are shipped on Sunday.

### **3.2.2.2 Processing**

Processing prior to packaging and delivery are generally carried out by direct instruction of foreign buyers with through internet with the help of different social communication applications. Necessary instructions were given on the basis of processing and packaging steps monitored directly online. Processing starts 4-5 hours before delivery time. Dead and injured fish are removed in pre-processing steps. Unusually 8-10 skilled labors participate in each shift of processing.

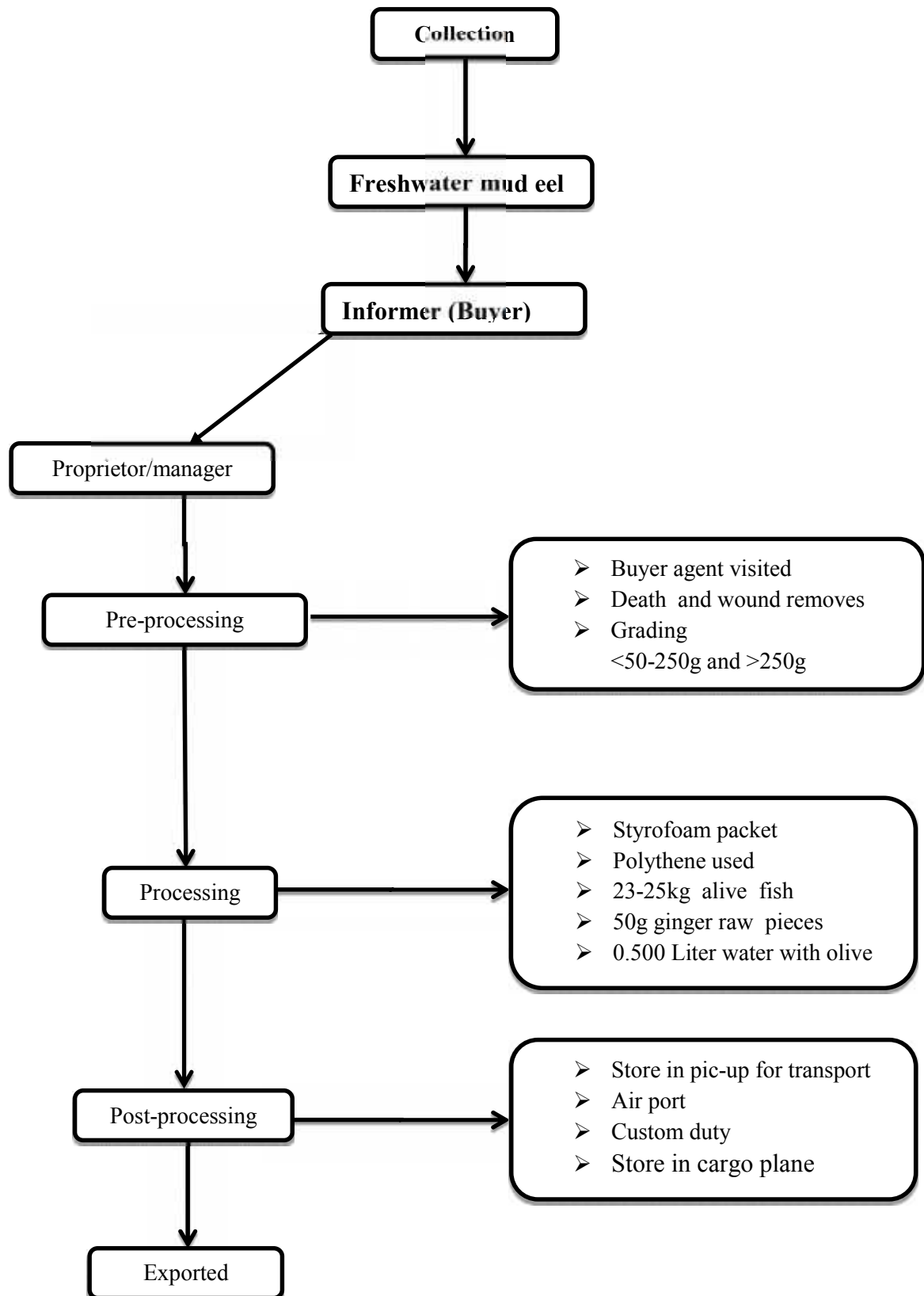


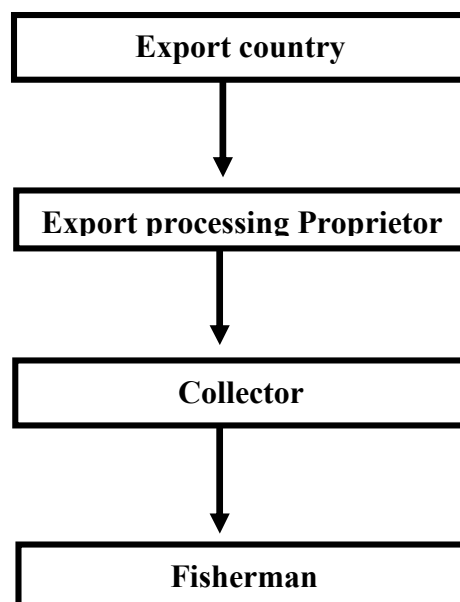
Figure 7: Flowchart showing different processing techniques of export oriented freshwater mud eel followed at different marketing level.

### 3.2.2.3 Packaging and Delivery

In a shipment day freshwater mud eel are filled in Styrofoam packages. First polythene sheets were laid down inside the Styrofoam packs then 23-25kg live fish (according to the buyer's requirement) were placed into it. Then 50g raw ginger pieces, 0.5 litter of freshwater mixed with olive oil and two ice bags (0.75L+0.75L) are placed inside the pack for live preservation purpose. Filled Styrofoam packs are the covered and sealed with strong adhesive tape. After that, ready packages are stacked in pickups and destined for airport. After completion of necessary customs formalities the packages containing eels are loaded in cargo planes. In a busy shipment day up to 80 tons of mud eels are exported in a single consignment.

### 3.2.3 Pricing at various level of marketing chain

Harvesters are sale their freshwater mud eel directly to fixed collector. Price is not fixed, it change daily. Marketing channel analysis of freshwater mud eel, it was found that price control from export country agent/buyer. Agents price distinguish to proprietors via cellphone or internet media. Proprietor/manager tells the priceto the collector over cell phone. Harvesters are known from collector (Figure 8).



**Figure 8: Flow chart of price control**

### 3.2.4 Case study on production and earning of mud eel at collector level in North selected district:

Case study on collection and earning of mud eel at collector level in Bogra District. Selected collector Location of the collector is near to the main town of Bogra, **Tin matha mor, railway gat, Bogra**. He collected mud eel from his fixed harvesters and small collectors. Bus is used for small amount daily transport to Dhaka; large amount transport used rent a pic-up (Table 2).

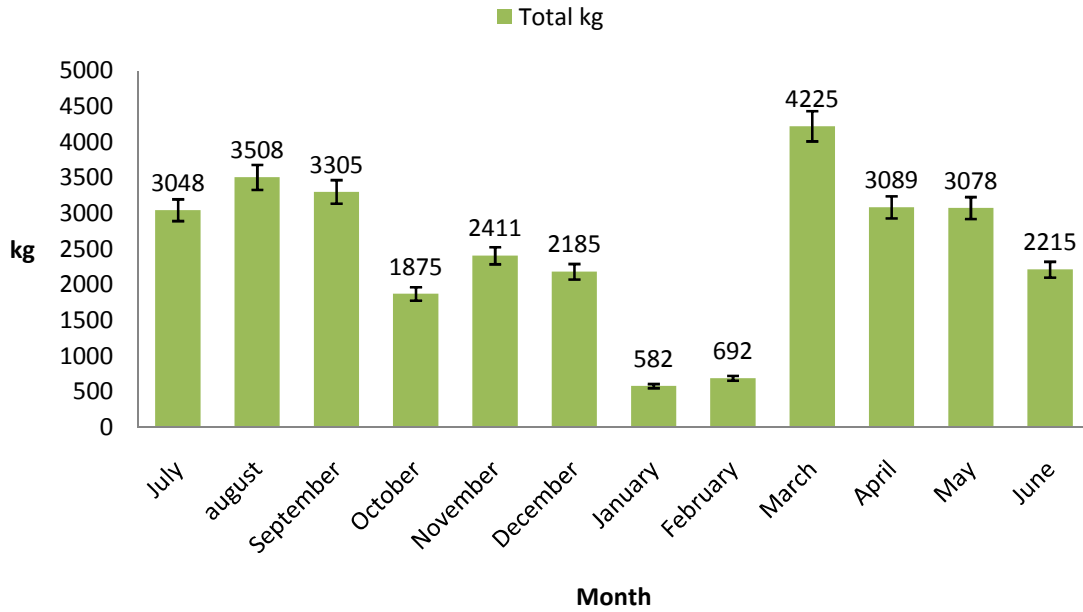
**Table 2:** A Selected collector Transport mud eel from Bogra district to Dhaka during July, 2014–June 2015.

	<b>Total (kg)</b>	<b>Total taka</b>	<b>Profit taka</b>	<b>Mortality (kg)</b>
July	3048	560680	22650	48
August	3508	872095	8690	29
September	3305	754098	38072	55
October	1875	404805	15195	126
November	2411	491375	12690	25
December	2185	439930	1935	26
January	582	127230	-650	30
February	692	158341	16363	35
March	4225	907720	33425	58
April	3089	1143485	40780	67
May	3078	725040	26400	93
June	2215	425865	15290	25
<b>Total</b>	<b>30245</b>	<b>7010660</b>	<b>230840</b>	<b>617</b>

#### a. Total collection in a year

In a Bogra district a collector transport total 30245 kg mud eel in July, 2014 –June, 2015 (Figure 9). August- September and March- April collected more mud eel than other months. January- February collected small amount mud eels.

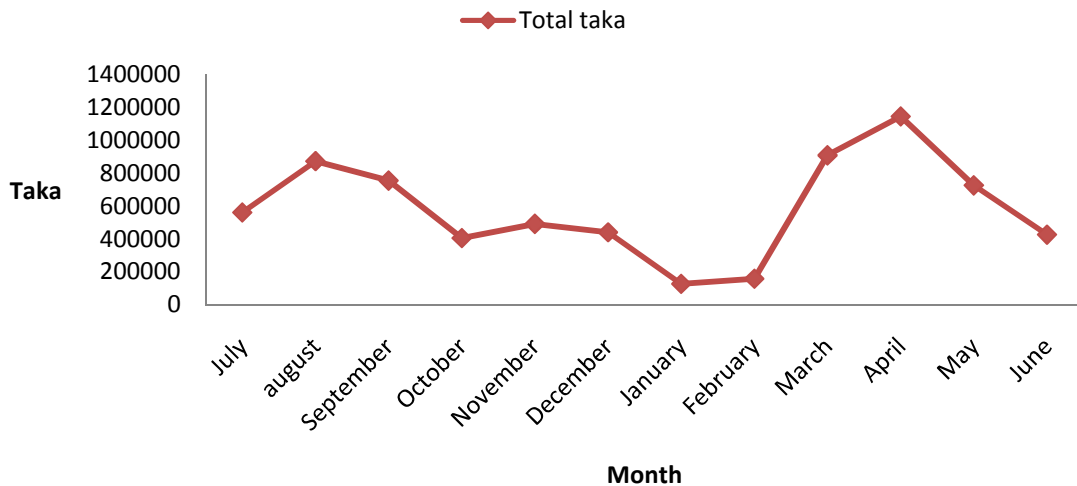




**Figure 9: Total collection in a year of selected collector**

**b. Invested on mud eel business in a year**

In the case study this collector invested in mud eel business total 7010660 taka in July 2014 –June2015 (Figure 10). Prices are change every day. High collection of mud eel need more invested. August- September and March- April invested huge amount taka in mud eel business.



**Figure 10: Invested on mud eel business in a year of selected collector**

### c. Profit of mud eel business in a year

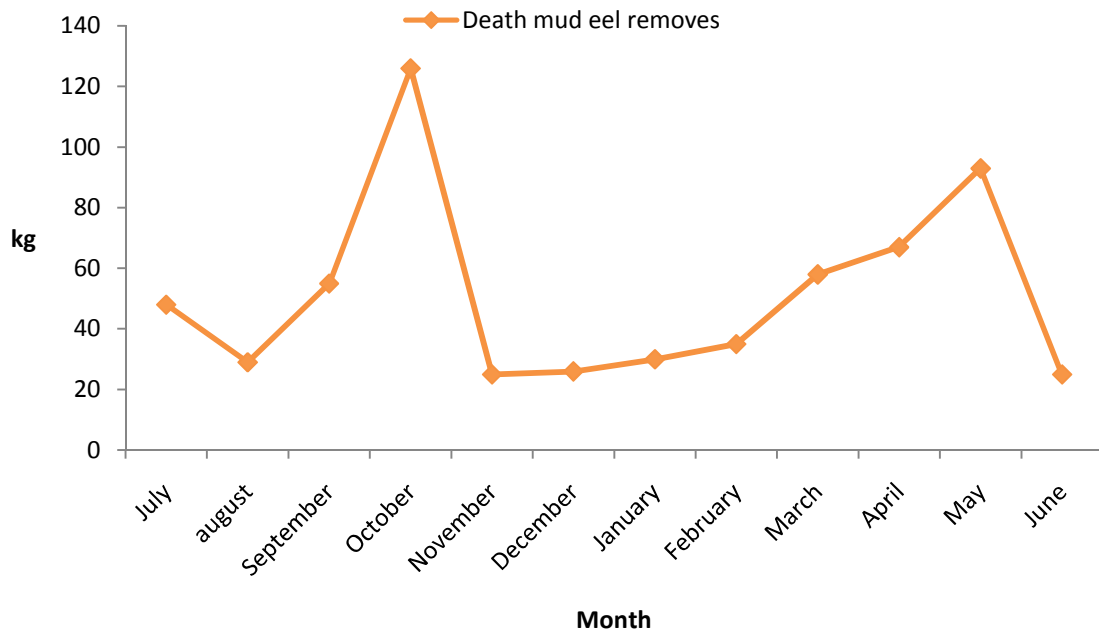
Mud eel business profit change with the production. Large amount invested on mud eel got more profit in mud eel business. In the case study this collector Profit from mud eel business total 230840 taka in July, 2014 –June, 2015(Figure 11).



**Figure 11: Profit of mud eel business in a year of selected collector**

### d. Death mud eel removes in a year

Alive mud eel exported from export processing plant. Collector are transport live mud eel from harvested area. All stage of transport removes death mud eel. Summer season mortality rate is high. In the case study this collector totals 617 kg death mud eel removes of 7010660kg collection in July, 2014 –June, 2015 (Figure 12).



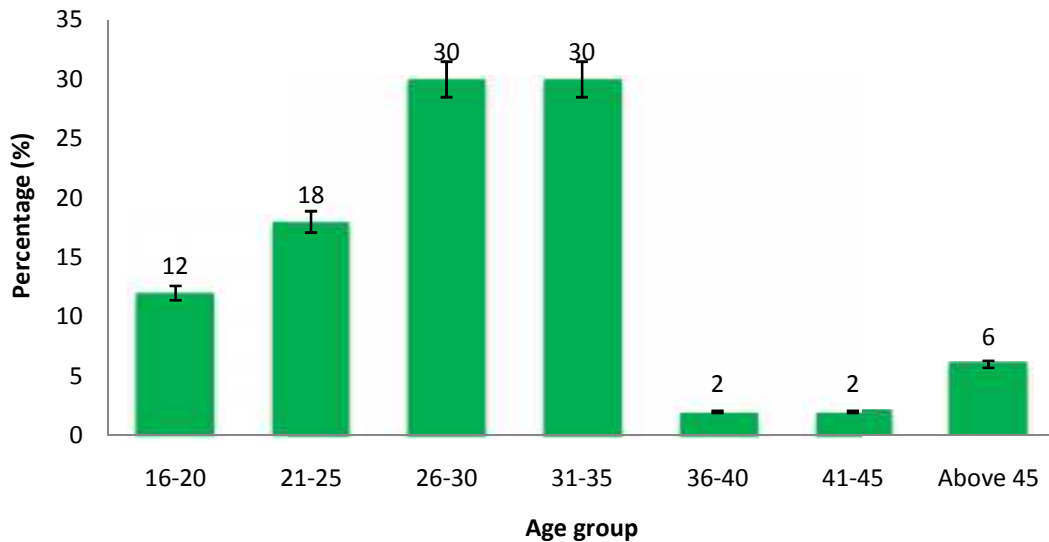
**Figure 12: Death mud eel removes in a year of selected collector**

### **3.3 SOCIO ECONOMIC CONDITION OF MUD EEL HARVESTER**

#### **3.3.1 Human resource**

##### **3.3.1.1 Age group distribution**

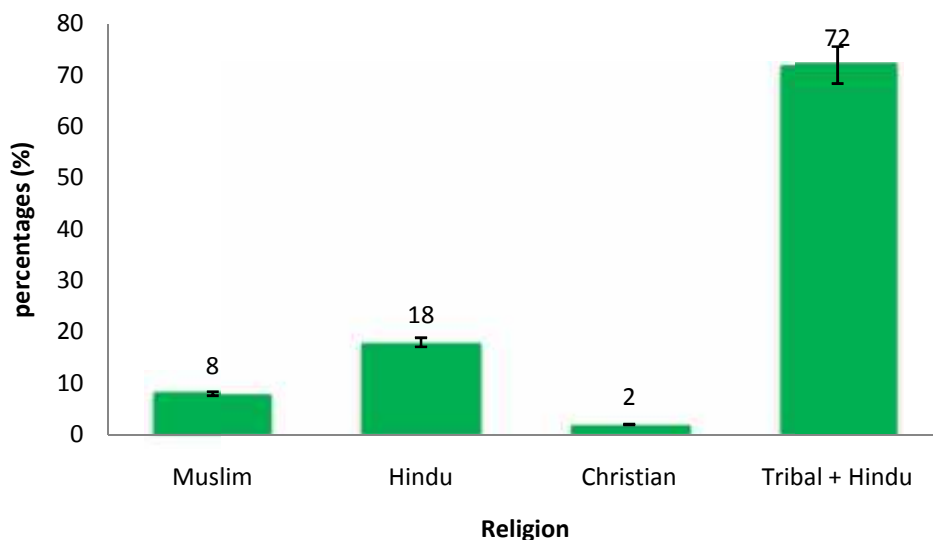
In the study it was observed that most of the freshwater mud eel harvesters 30% were in the age group of 26-30 & 31-35 years, whereas 12%, 18% of the Harvesters belonged to age groups 16-20, 21-25, 14.3%. However 2%, 2%, 6% harvesters are belonged to age groups 36-40, 41-45 and above 45 respectively (Figure 13).



**Figure 13: Age group distribution of freshwater mud eel harvester in the selected study area (n=50).**

### 3.3.1.2 Religious status

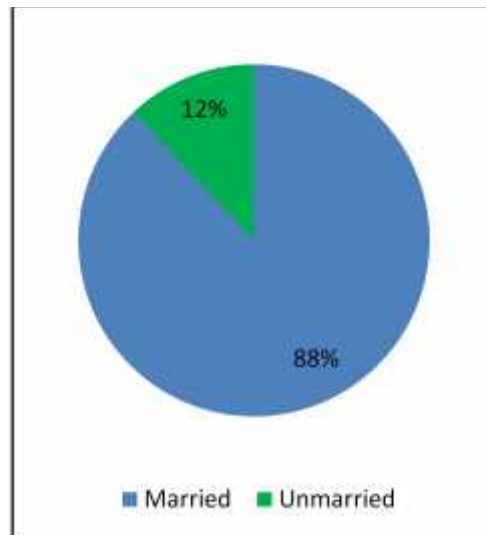
Religion plays a vital role in the social and cultural environment of people in a given area. It acts as a notable constraint and modifies social pattern of people. Tribal community we're featuring as the absolute majority of the harvesters in the selected study area. Hindu, Besides, harvesters Hindu tribal and all are %72 They consists about in harvesters %2 and Christian %8 Muslims, harvesters %18 bengali people were found the selected study area (Figure 14).



**Figure 14: Status of religious beliefs among the freshwater mud eel harvester in the selected study area (n=50).**

### 3.3.1.3 Marital status

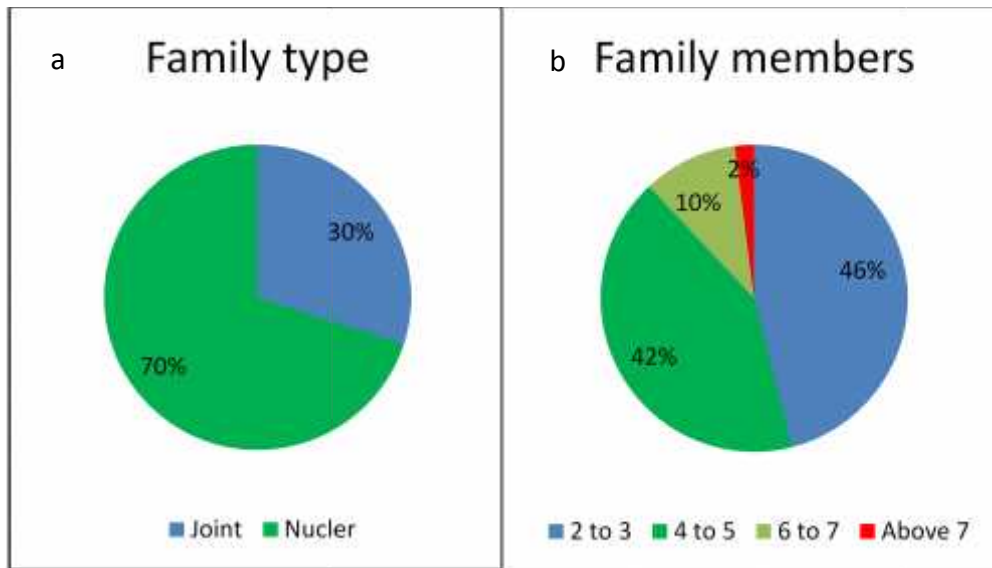
Most of the respondent of the study area were married, about Harvesters were 88% and Small portion 12% of Harvesters was unmarried (Figure 15)



**Figure 15: Marital status of harvesters in the selected study area (n=50).**

### 3.3.1.4 Family size and structure

Family size is an important socio-economic indicator as it affects the income, food consumption and socio-economic wellbeing of the households. Most of the respondent Harvesters of the study area were found having nuclear family, 70% rest of the harvesters were in joint family (Figure 16.a). It happened because they were economically poor, as the children are separated from their families when parents grown. In the study it was observed that it was observed that 46%, of the Harvesters had 2-3 members in their family, whereas 42%, 10% 2% of Harvesters had 4-5, 6-7, above 7 members in their family, respectively (Figure 16.b).



**Figure 16: Family type (a) and members (b) of harvesters in the selected study area. (n=50)**

### 3.3.1.5 Educational status

Actually it is true that education is not an essential subject for fishing, but chooses to follow and be aware and familiar with the latest technology and appropriate use of it, education is must. Human resource development was largely a function of education. In the present study it was found that most of the harvesters of the selected area can sign only, 32%. The Figure also show that harvesters had 30% no education, 2% up to primary level (2 class), 22% up to primary level (3 to 5 class), 8% up to secondary level, 4% up to SSC and 2% HSC (Table 3).

**Table 3:** Educational qualification of harvesters in the selected study area.

Educational qualification's	Number of respondents	Percentages
<b>No education</b>	15	30
<b>Can sign only</b>	16	32
<b>Primary (up to 2 class)</b>	1	2
<b>Primary (3 to 5 class)</b>	11	22
<b>Secondary (6 to 8 class)</b>	4	8
<b>Secondary (9 to 10 class)</b>	0	0
<b>S.S.C.</b>	2	4
<b>H.S.C.</b>	1	2
<b>Total</b>	<b>50</b>	<b>100</b>

### 3.1.2 Household amenities and life style

#### 3.3.2.1 Housing and sanitation facilities

Economically solvent person always try to build their houses with bricks or in permanent nature but the poorer section of the society cannot do it. It is also the indicator of one's economic capability and choice. In this study one major categories of house was found. 90% Harvesters have kacha house and only 8% Harvesters have pacca house 2% are rental. (Figure 17.a).

Electricity facility is one of the major commodities for better living. 36% respondent harvesters were used electricity while NGO have given solar plant 26% to some tribal harvesters. There are 38% harvesters not use electricity (Figure 17.b).

It was observed that, harvesters sanitation condition in the selected study area were poor. Kacha toilet- made of bamboo with leaf shelter and inadequate drainage system and Sanitary toilet- made of bamboo walled, ring slave with good drainage system were found to be used. 40% Harvesters had kacha, 6% Harvesters had semi-pakka. only 8% Harvesters had pacca sanitation system. 46% harvesters had no sanitary facility (Figure 18).

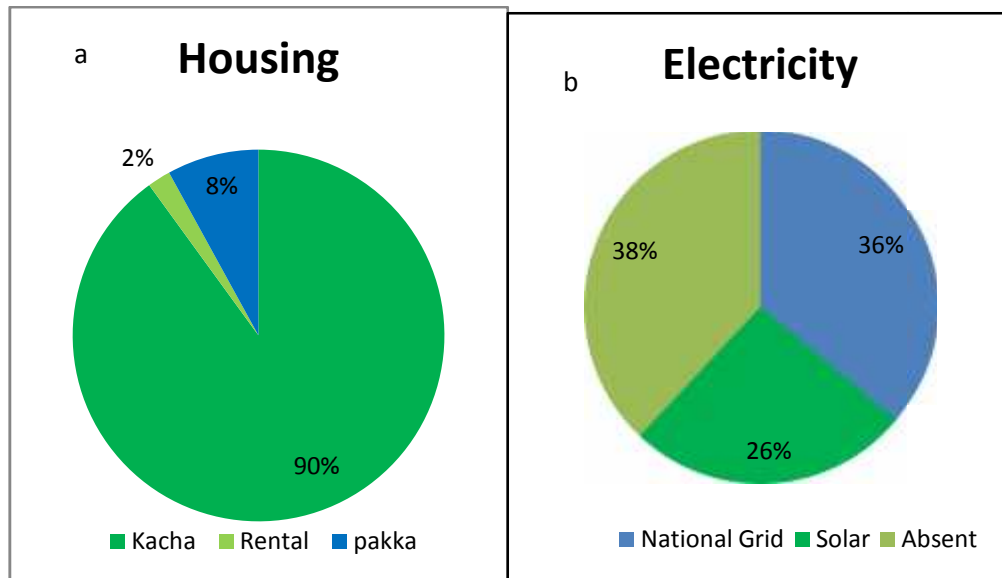


Figure 17: Housing condition (a) and electricity facility (b) of harvesters in the selected study area (n=50)

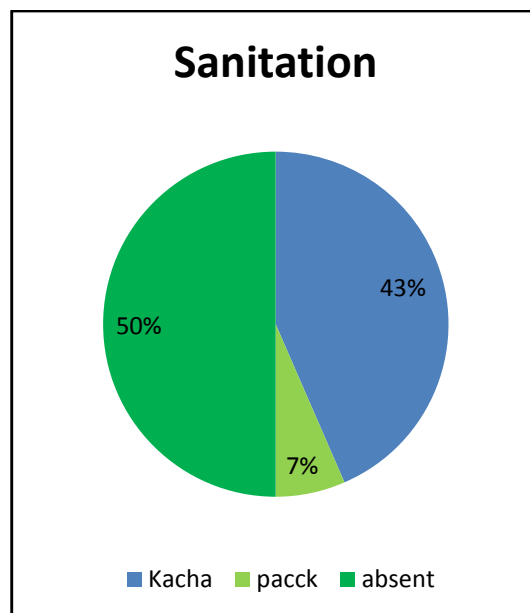


Figure 18: Sanitary condition of mud eel harvesters in the selected study area (n=50).

### 3.3.2.2 Health care facility

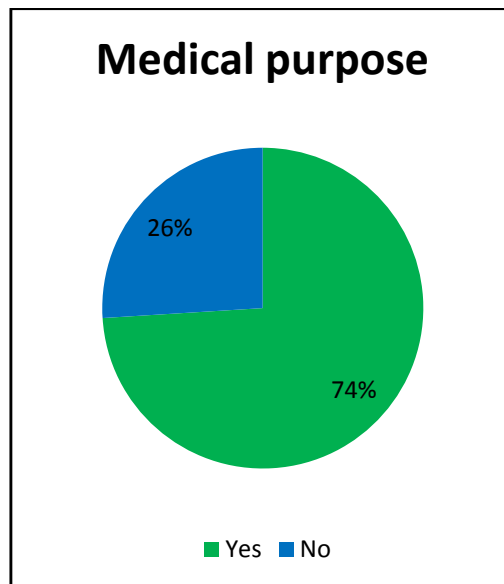


Generally harvesters took medium health support from unskilled non-professional village doctor. It was found that about 80% Harvesters were dependent on Village Doctor, about 18% Harvesters were dependent on local clinic and only 2% Harvesters are went to Upazila Hospital (Table 4).

**Table 4:** Health care facility of mud eel harvesters in the selected study area.

Health Facility	Number of respondents	Percentages
Village Doctor	40	80
Local clinic	9	18
Upazila Hospital	1	2
<b>Total</b>	<b>50</b>	

The fresh blood of freshwater mud eel is directly consumed to cure weakness, anaemia, asthma (Jamir and Lal, 2005; Kakati *et al*, 2006). 74% harvesters most are tribal people used freshwater mud eel fish for medicinal purpose. 26% are not use (Figure 19).



**Figure 19:** Use of Freshwater mud eel fish for medical purpose of harvesters in the selected study area (n=50).

### 3.3.2.3 Source of drinking water

The provision of clean and safe drinking water is considered to be the most valued elements in the society. All the harvesters in study area used tube-wells for drinking water but 27% harvesters use common tube well.

**3.3.2.4 General food consumption pattern**

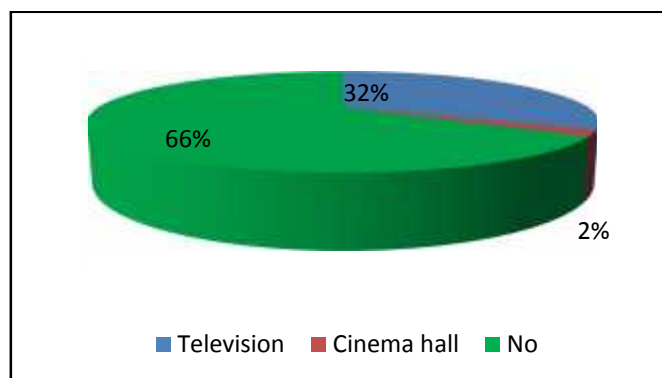
As the harvesters are economically poor, they had meal with fish only a few days in a week. Almost all fish they catch were sold by them. Only 16% harvester take their meal with fish daily 34% harvesters take their meal with fish sometimes (3-4 days after). 46% harvesters eat fish weekly. 4% are generally not eating fish for poverty (Table 4).

**Table 4:** General food consumption pattern of harvesters in the selected study area.

Eating white Fish	Number of respondents	Percentages
Daily	8	16
Sometimes(3-4 days after)	17	34
Weekly	23	46
No	2	4
<b>Total</b>	<b>50</b>	<b>100</b>

**3.3.2.5 Modes of recreation**

Bangladesh is developing country. In the rural area poor people had no proper recreation. Only 32% respondent harvesters had television as recreation. 2% harvesters went to cinema hall. There are 66% harvesters were not any recreation (Figure 20).

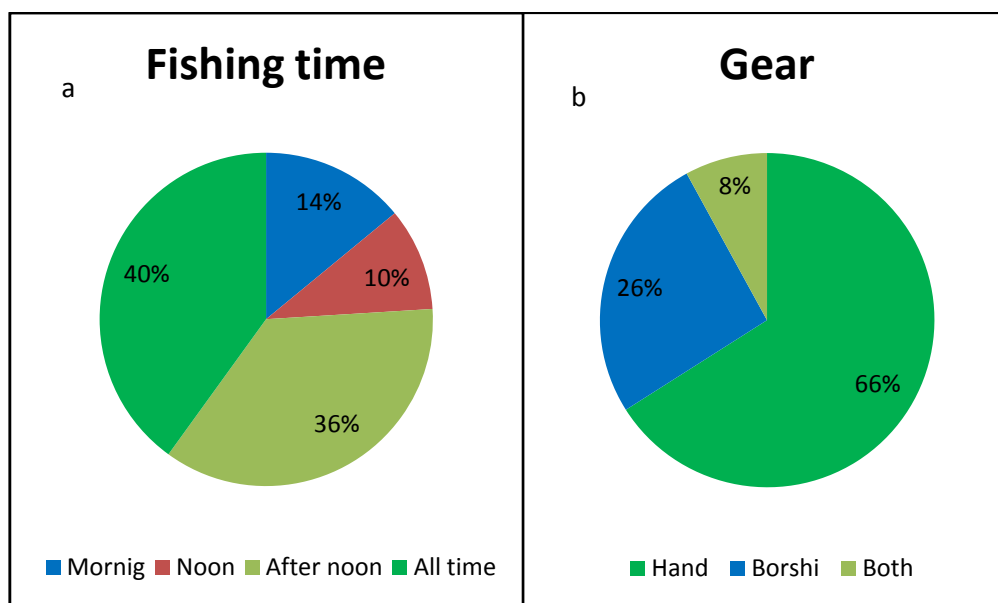


**Figure 20: Modes of recreation of mud eel harvesters in the selected study area. (n=50).**

### 3.3.2.6 Fishing Practices

Harvesters catch fish for his suitable time and availability of freshwater mud eel fish. 40% harvesters caught fish all the time in day 36% harvesters catch in afternoon, 14% in the morning and about 10% at noon (Figure 21.a).

Harvesters catch freshwater mud eel fish used by different gear. 66% harvesters caught mud eel by hand, 26% used Borshi. Small portion 8% of harvesters caught freshwater mud eel fish used both hand and borshi (Figure 21.b).



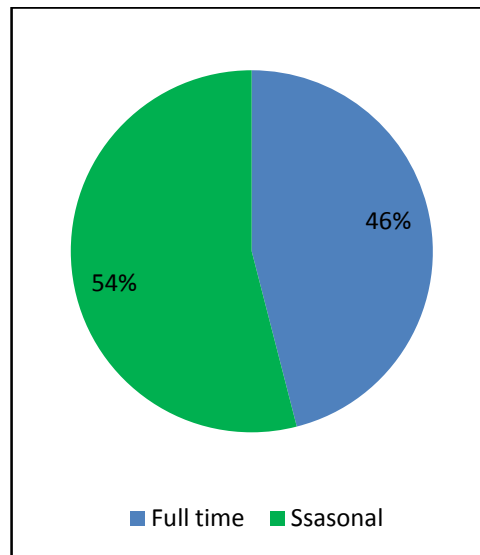
**Figure 21: Fishing times (a) and gear (b) mud eel of harvesters in the selected study area (n=50).**

Freshwater mud eel harvesters are very poor. They eat from hand to mouth. in the survey area mud eel harvesters are rest in a week for maintains there family and others house works. 52% harvesters are caught freshwater mud eel fish regularly, 38% harvesters stop work for 01 day in a week .10% harvesters stop caught freshwater mud eel for 02 days in a week respectively (Table 5).

**Table 5: Fishing vaction of mud eel hervester of the study area.**

Fishing vacation	Number of respondents	Percentages
No	26	52
01 day	19	38
02 days	5	10
<b>Total</b>	<b>50</b>	<b>100</b>

In the survey area there are 46% harvesters catch freshwater mud eel fish full time. Some freshwater mud eel harvesters catch freshwater mud eel seasonally because others time they work in agriculture land and others seasonal business. 54% harvesters catches freshwater mud eel fish seasonally (Figure 22).



**Figure 22: Capture of freshwater mud eel fish of harvesters in the selected study area (n=50).**

### 3.3.3 Financial and technical aspects

#### 3.3.3.1 Payment system

Freshwater mud eel harvesters are got payment from collector instantly on daily basis. In the morning freshwater mud eel harvesters got small percentage money from collector for their own daily purchases and went caught freshwater mud eel, afternoon there are back and gave freshwater mud eel to collector and got full money.

#### 3.3.3.2 Monthly income from fishing activities

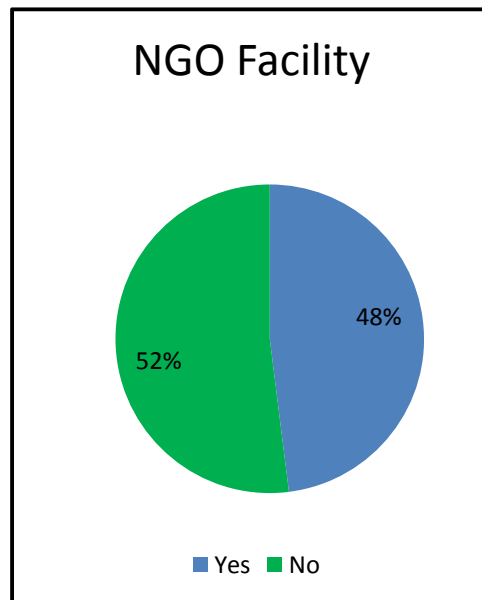
Harvesters were grouped into three categories based on the level of monthly income. Monthly incomes of the harvesters were varied from BDT 9000-18000. The selected it was found that about 50% of the harvesters had monthly income between BDT 9000-12000 and 34% of the respondent had income in the ranged BDT 12000-15000 (Table 7).

**Table 7:** Monthly income from fishing activities

Monthly income BDT	Number of respondents	Percentages
<b>Low 9000-12000</b>	<b>25</b>	<b>50</b>
<b>Medium 12000-15000</b>	<b>17</b>	<b>34</b>
<b>High 15000-18000</b>	<b>8</b>	<b>16</b>
<b>Total</b>	<b>50</b>	<b>100</b>

### 3.3.3.3 Credit access/ Sources of credit

Credit is necessary for purchasing freshwater mud eel fish and family maintenance. It was found that about 48% of the Harvesters received loan from NGO's (BRAC, GRAMEEN Bank). 52% harvesters did not receive any loan (Figure 23).



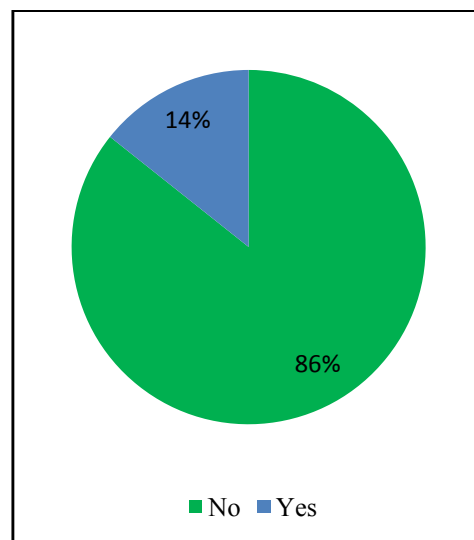
**Figure 23:** NGO Facility of mud eel harvesters in the selected study area. (n=50).

### 3.3.3.4 Training & Financial supports

Training is a very important tool for fishing efficiently. No training received from any NGO or Government in this survey area. But training in home to caught freshwater mud eel by family members

### 3.3.3.5 Savings

Savings play an important role for future planning of harvesters. In the selected study area, it was found that only 14% harvesters can do savings while 86% cannot (Figure 24).



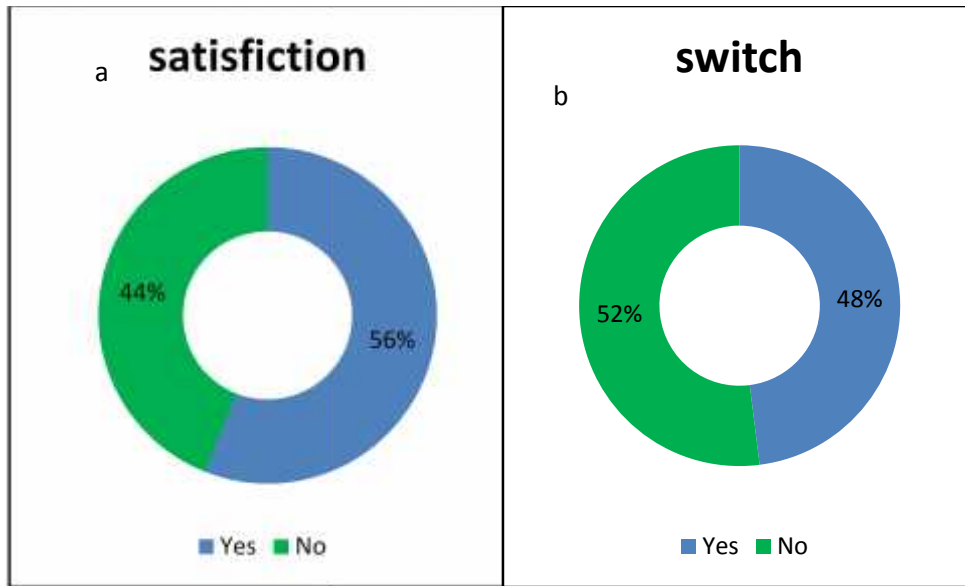
**Figure 24: Savings of mud eel harvesters in the selected study area. (n=50).**

### 3.3.4 Miscellaneous aspects

#### 3.3.4.1 Job satisfaction

Freshwater mud eel fish are not suitable business in present day. Daily prices change, lack of money cannot continue to this business for collector. 56% harvesters were satisfied from freshwater mud eel fishing while 44% were not.

Harvesters are said that production of freshwater mud eel fish decreasing day by day. In this causes 48% harvesters are change their occupation. There is 58% harvesters are fixed in this occupation (Figure 25).



**Figure 25: Job satisfaction (a) & switch (b) of mud eel harvester in the selected study area. (n=50).**

#### 3.3.4.2 Socio-economic limitations of the harvesters

There are some problems found in freshwater mud eel transport in north Bengal of Bangladesh. Main problem is hijack on the road. Several occurs found in Bogra region said some collector who transport freshwater mud eel fish. In summer season few freshwater mud eel fish are died and wound by long transport system from north Bengal.

- Reduction of fish stock and catch.
- Not available throughout the year,
- Catch mortality of freshwater mud eel by harvesters using achra, iron rod, borshi
- Lack of economic ability of collectors
- Insufficient credit facilities and financial support.
- Vandalism i.e. hijack freshwater mud eel track, police harassment
- Fluctuation in price
- Price controlled by exporter agents
- Low fish price rate
- Lack of training facilities.

#### 3.3.4.3 Harvester's opinion on current status of Mud eels

Harvesters are said that production of freshwater mud eel fish decreasing day by day. Some causes are found out in the survey area and harvesters are said specially.

## Causes

- a. Brood fish caught in breeding season
- b. Avoid catch under 100g freshwater mud eel fish
- c. More harvesters
- d. Lack of open water resources



## CHAPTER IV

### 4.1 Discussion

#### Proximate composition

The mean moisture content of male and female mud eel of the experiment was 77.59 % and 79.45 % respectively. The mean protein content of male and female mud eel of the experiment was 17.48% and 17.18 % respectively. Mean ash content for male was 2.74 % and female was 3.12 % and mean lipid content for male was 1.02% and female was .80%. Proximate composition of Nile Tilapia found Male and female moisture 80.6% and 79.6%, protein 14.5% and 14.6% , lipid 0.52% and 0.54%, ash 1.14% and 1.17% (Alemu et al, 2013) . In the winter season, spawning relative fat content decreased. Energy changes during spawning consist of re-allocation of previously acquired energy and do not involve acquisition of new energy.

Moisture content was nearly the same for both sexes (Alemu et al, 2013). The moisture content of male fish is slightly higher than female corresponding similar age category.(Alemu et al, 2013). Different researchers have reported that, moisture content of male fish higher than female fish (Amer et al., 1991; Islam and Joadder, 2005; Nargis, 2006;) lower moisture content in female Nile Tilapia can be attributed to muscles of female fish contain more organic materials and less water than male (Amer et al., 1991).

Sexual maturation has been found to reduce lipid body stores in female salmon because these species stop feeding during maturation and lipid stores are being directed to gonad lipids or used for energy (Shearer, 1994; Bell *et al.*, 1998). Study conducted on fatty acids and energetic substrates Nile Tilapia showed that body mass increased and the protein content decreased (Viera *et al.*, 2011).

There is higher protein content in medium sized Koi fish and gradually decreased with an increase in age (Nargis, 2006). Nile Tilapia as compared to male may be attributed to relatively higher protein and fat in females than males (Amer *et al.*, 1991). Smaller fish contained high protein as compared to bigger fish may be due to fish expend a great deal of energy during egg formation.

Lipid content was increased with increase of fish age, however, the average lipid content shown no significant difference between male and female fish (Toppe *et al.*, 2006).

The ash content was 1.14 % in male and 1.17 % in female fish. No significant ( $p>0.05$ ) variation in ash content was found between male and female fish (Alemu *et al.*, 2013).

The study was conducted to find out the present status of socio-economic condition of freshwater mud eel harvesters of selected areas. As mentioned earlier, during the study, three districts selected around the Bogra, Rangpur and Dinajpur. 50 Harvester were randomly selected from the study area to collect the data for analysis of the socio-economic condition of harvesters.

### **MARKETING CHENNEL**

Mainly oil drums are used as transporting materials. Besides, jute bags, plastic buckets and small nets are also used by some individual Harvesters. There are fixed eel depots/collectors in the selected study area. In Bangladesh, above 100 gm. per individual eel are the marketable size, internationally sold in two size ranges; 50-250g and above 250g. Exporter took mud eels at a different rate sold in above mentioned two grades. Marine are different grade from freshwater. Moreover, in the selected study area 2-3% % of the total purchased eels were rejected from each depot, whereas 1-2 % was rejected by the exporters in Dhaka.

Marketing channel involved by a number of mediators between harvesters and exporters, namely collector and exporters but not as complex as crab or shrimp business (Zafar and Ahsan, 2006). Usually, the harvesters supplied mud eels to the collector and collectors supplied to the exporter.

In addition to the small collector's, large collectors, exporters play a significant role in uplifting of price and artificial crisis creating a complex chain resulted in the low price gained by the bottom leveled harvesters. The marketing and value addition pattern at the collector level remains almost similar among different study areas. On the other hand, considerable differences in pricing were observed within the harvesters from different areas. The final price of the product mostly depends on total marketing network. Finally, the last selling price of the product depends on the number of collectors, transport system and facilities, packaging cost and labor involvement; higher the distance higher the price. Bus, truck, pickup van are transport medium of mud eel in the selected study area.

Furthermore, the low returns experienced by harvesters group appeared to relate to the lack of live preservation technique as well as bargaining power in the marketing channel. In addition, the reasons for less intervention and participations at small-scale harvesters level were presumed to be the lack of market access due to various Institutional and non-institutional barriers e.g. illegal toll/taxation, and so on.

### **Exported processing**

Processing prior information is gathering through by internet. It is easy and available. Export country agents are visit to insure quality control. However export country agent given advice through directly online by closed circuit (CC) camera.

Styrofoam packages are filled according to the buyer's requirement. Alive mud eel processing used ginger raw pieces for prevent odor. Olive oil used with water for avoids foam in the packages. Two ice bags are used for temperature control to alive mud eel export.

After packaging mud eels are loaded in pic-up and destined for airport. In a busy shipment day up to 80 tons of mud eels are exported in a single consignment. Winter season shipment is delay for fog.

### **Age group distribution**

Different age groups of mud eelharvesters were involved in catching of mud eel at the study area. It was observed that the majority of the harvesters (30%) was middle aged (21-35 yrs.) and 31-35yrs. while 12% was young aged (16-20 yrs.) and 6% was old (45 years and above) age group. The age range of 21-25 years was mostly dominant (42.5%) in catching of mud eel in Purbadhala upazila, Netrokona (Rahmatullah, *et al.*, 2015).

### **Religious status**

Most of them (72%) were tribal Hindu. This is similar to present study. The graphical representation shows that 75% of the mud eel harvesters were ethnic and 25% of them were non-ethnic. (Rahmatullah *et al.*, 2015) As the majority of mud eelharvesters were ethnic people, they were the followers of Christian religion. It is similar to my study Khan *et al.*, (2011) in Tista River in Rangpur district found that 70% was Muslim, 30% Hindu respectively. White fish and mud eelharvester are less similar.

### **Marital status**

In the present survey, it was found that majority of the respondents were married (88%) and few were unmarried (12%). A similar study was conducted by (Ahmed, 1996) in Tangail. He found that married harvesters were (94%).

### **Family structure**

The present study showed that 30% harvesters had joint and 70% had nuclear families in the study it was observed that it was observed that 46%, of the Harvester had 2-3 members in their family, 42%, harvesters are 4-5 members. In this study, (Khan et al, (2011) found that only 43% had family members 1-4 Most families had only 57% 5-7 members

The survey showed that all of the harvesters were male (100%) in the field level. In the selected study area it was found that only male were involved in fishing and females were like to work as housewife. It is so difficult to catch cuchia. Marital status indicated that 100% of the sampled households were married. This implies that majority of the fisher folks shoulder a lot of responsibilities.

Women are rarely involved in fish capture at sea or in lakes because of its inherent dangers, long fishing voyage and their dominant role in household activities

### **Educational status**

They live below poverty line. Their educational status is very low. Most of them are illiterate or can write name only. 30% had no education and 32% are can sign only. The education level of mud eel harvesters in the selected study area reveals that 20% were illiterate, 27% were only able to sign their name, and 48% were educated up to primary school. Reported by (Rahmatullah *et al.*, 2015). Most of the harvesters are illiterate (88%). Only small portion of them can sign only (2%). Some are primary level of educated (10%). (Kabir *et al.*, 2012)

Inadequate consciousness and lack of educational infrastructure in the concerned area is the prime reason of the lower literacy rate.

### **Housing conditions**

90% Harvester have kacha house in the selected study area (Kabir *et al.*, 2012) reported that majority of harvesters in Old Brahmaputra River (83%) had kacha and 17% had

semi pacca house which was similar that Birulia. (Ali *et al.*, 2008) reported, about 54% of the farmers in Hamirkutsha and Kamarbari Unions of Bagmara upazilla under Rajshahi district have tinshed house while 26%, 14% and 6% of the farmers have half-building, building and kacha house respectively. (Alam *et al.*, 1995) found that about 82.22% of household Structures were kacha whilst 11.11% were semi-pacca and only 6.66% were pacca of the Basantapur beel harvesters

### **Sanitary**

It was observed that sanitary facilities of the harvesters were very poor. In the selected study area, it was found that 40% of toilets were kacha while 6% were semi-pacca only 8% harvesters had pacca sanitary system and 46% of the harvesters had no sanitary facilities. The present study revealed that the sanitary conditions of the harvesters were not satisfactory than fish farmers in Mymensingh district where Ali *et al.* in his study found that 62.5% of the farmers had semi-pacca, 25% had kacha and 12.5%. (Kabir *et al.*, 2012) it was found that 65% of toilets were kacha while 5% were semi-pacca and 30% of the harvesters had no sanitary facilities

### **Electricity facility**

It was found that 36% harvesters of the surveyed area had electricity facilities whereas, 38% had no electricity facilities. There is 26% used electricity while NGO have given solar plant. In the selected area, only 12.5% harvesters used electricity by drawing line from nearby village which was illegal and 87.5% harvesters lived without electricity facility (Rahmatullah *et al.*, 2015).

### **Health facility**

It was found that about 80% Harvester were dependent on Village Doctor. It was seen that 82.5% mud eelharvesters were dependent on village doctors and 17.5% of them went to Upazila Health Complex during their health problems. There were also similar patterns of result noted by Zafar and Ahsan, 2006 that harvesters were poor and it was found that 60% of the harvesters households were dependent on village doctors who did not have any understanding and knowledge of medical science, 30% of the harvesters got health service from upazilla health complex and remaining 10% got health service from MBBS doctors Kabir *et al.* 2012.

### **General food consumption pattern**

16% harvester take their meal with fish daily. 34% harvester take their meal with fish sometimes because harvester are live in below poverty line. Most of time their meal made of vegetable and sometimes eggs. White fish are more expensive to their income.

### **Drinking water source**

They all used tube-well water as a source of drinking water but 23% are using common tube-well. Harvester's households used tube-wells water for drinking purposes. (Kabir *et al.*, 2012). The study showed that 100% of them own tube-well. Among them 40% harvesters used their own tube well. 50% harvesters used shared tube-well land remaining 10% used neighbors tube-well (Kabir *et al.*, 2012). And among them 54% harvesters used their own tube-well, 42% harvesters used shared tube-well and remaining 4% used neighbor's tube-well. (Alam *et al.*, 1995)

### **Modes of recreation**

Only 32% respondent Harvester had television as recreation, 2% harvester went to cinema hall. 66% harvester does not have any recreation. No good source of recreation in rural area. Television is expensive to their income from chuchia. Others recreational sources are not available in study area.

### **Fishing practice**

Most of the mud eel harvested from hand (66%) in this area study area. 26% used Borshi. Small portion 8% of harvesters caught freshwater mud eel fish used both hand and borshi. Hand fishing is better from Borshi. Fishing by Borshi is causes wound and early death.

### **Payment system**

Instant payment system is observed in all the stage of mud eel payment system. Harvesters got money daily from collector.

### **Annual income from fishing activities**

Monthly incomes of the harvesters were varied from BDT 9000 to 120000. 50% of the harvesters had annual income between BDT 9000 to 18000. Annual incomes of the harvesters were varied from BDT 24000 to 50000.

### **Credit access/ Sources of credit**

It was found that about 48% of the harvester received loan from NGO's unfortunately, all of their profit during peak season were repaid for loan to this NGO. Finally, they could not upgrade their livelihood, remain poor as usual but had fall in trap of this commercial NGO business.

Only 40% became self-sufficient who did not need any financial help but 14% borrow money from their neighbors, 18% from relatives, 22% from NGO's and 6% from cooperatives for their fishing business (kabiret *al.*, 2012).

### **Training & Financial supports**

The present status of training shown the actual state of the harvesters, and indicated that they were far behind from the opportunity to development their skill from formal or informal gathering.

It has been observed in this study that only 92% harvesters had no training on one or more related matter, 8% had some training (Khan, 2013).

### **Savings**

In the selected study area, it was found that only 14% harvester can do savings while 86% cannot. Their sustention depend on daily income. Sometimes they took vacation from their work and borrow money. Major part of daily income is use in food intake.

### **Job satisfaction**

56% harvesters were satisfied from freshwater mud eel fishing while 44% were not. Daily pries change, not available through the years, summer season mortality rate high, open water resources declining day by day. In the survey area 48% mud eelharvesters switch their jobs.

### **Marketing channel**

Mud Eels are collected using hook, hand, borshi handmade tools from open water system. Harvesters since mud eel inhabit in the bottom of the water body. Daily harvest rate depends on season ranging between 1 to 20 kgs. Harvesters though mud eels are available all the year, October to December is the peak season. Due to under sized local

market comprised of only non-Muslim communities, it's trading mostly export oriented. As there are no available culture technique and technical personnel, such culture practice was no initiated in those regions.

#### **4.2 Recommendations**

- a. Overexploitation should be prohibited
- b. Closer relationship among exporter should be maintained.
- c. Price fixing is better to be done through discussing among exporter
- d. Culture technique of freshwater mud eel should be developed.
- e. Research on live cycle, habitat, and feeding, breeding biology, induces breeding, of freshwater mud eel should be done.
- f. Information (export market demand, price) via mobile, media, etc. should be available.
- g. Special vehicle system should be provided for freshwater mud eel transport.
- h. Harassment (Police, terrorist etc.) free high way transportation should be ensured.
- i. Quality enhancement
- j. Trade license system should be available.
- k. Training for harvester and collector should be provided.
- l. Storehouse handling and sanitation, good hygienic practices in handling, packaging, transportation should be ensured



## **CHAPTER V**

### **Conclusion**

The present study concerned about the socio-economic conditions of northern Bangladesh of mud eel harvester. The study has been undertaken to create a better understanding of the current marketing activities and exported processing of mud eel and to review the socio-economic conditions of harvester. The selected study area was Bogra, Dinajpur, and Rangpur District. The study was done over three months from November 2015 to January 2016. Data were collected from randomly selected 50 freshwater mud eels harvesters. The socio-economic condition of mud eel harvester's is very bad. They live below poverty line. The marketing chain passes through a number of intermediaries: harvesters, small collectors, large collectors, exporter and finally export to the foreign countries.

Mud eel marketing was considered as a profitable and feasible business by most of the marketing operators. But the harvesting of Mud eel completely depended on the natural sources in Bangladesh. Over fishing was the main reason for decreasing the stock. Besides these, there were no standard culture techniques for Mud eel s. However, the harvesters suggested that the government should pay some attention to this sector to prevent overexploitation of the species and to prevent environmental degradation affecting their habitat. Besides these, we have to develop culture technique of Mud eel.

From the survey it was found that the price is strongly affected by various factors including seasonality. The most important season is the Chinese New Year when the price increases in average up to 40-50% in most markets. Export of Mud eel from Bangladesh is expected to rise as international demand of mud eel is increasing. If we can artificially breed and culture them then we will be able to export them in large amount to fulfill the international demand. Domestic demand needs to increase through increasing social awareness and promoting awareness of the nutritive value of this export oriented species. The food value and market value of mud eel is very high. Considering the total export earnings from Mud eel, the fishery shows future potential. To achieve this, development and support from government and different nongovernmental organizations needs to be greater and perceptions regarding the activity needs to improve for more sustainable mud eel farming and marketing in Bangladesh.

## References

- AHMED NU 1996: Report of the fisherman's socio-economic survey. Fisheries Survey and Monitoring Program. Department of Fisheries, Tangail. pp. 1-4.
- AHMED, G.U., AKTER, N., NIPA, S.A. and HOSSAIN, M.M., 2009. Investigation on health condition of a freshwater eel, *Monopterus albus* from Aileebeel, Mymensingh, Bangladesh. J. of the Bang. Agricultural University, **7**(2), 421-426.
- ALAM M. F M.A BASHA ,1995. Structure of cost and profitability of small scale riverine fishing in Bangladesh. J. Res. Prog., **9**: 235-241.
- ALEMU, L. A., MELECE, A. Y., & GULELAT, D. H. 2013. Effect of endogenous factors on proximate composition of Nile tilapia (*Oreochromis niloticus*) L. fillet from Lake Zeway. Am. J. Res. Commun, **1**, 405-410.
- ALI, H., M.A.K. AZAD, M . ANISUZZAMAN M .M.R. CHOWDHURY, M. HOQUE and M.I. SHARFUL, 2009. Livelihood status of the fish farmers in some selected areas of Tarakanda upazila of Mymensingh district. J. Agrofor. Environ. **3**(2): 85-89.
- ALI, M., IGBAL, F., SALAM, A. and ATHAR, M. 2005. Comparatives study of body composition of different fish species from brackish water pond. *Int. J. Environ. Sci. Tec.***2**: 229-232.
- AMER, H.A., SEDIK, M.F., KHALAFALLA, F.A. and AWAD, H.A. 1991. Results of chemical analysis of prawn muscle as influenced by sex variations. Die Nahrung. **35**:133-138.
- AOAC (Association of official Analytical Chemists), 2000. Official Method of Analysis, 12<sup>th</sup> edition, Association of Official Analytical Chemists, Washington DC, pp. 832
- BELL,J.G., MCEVOY, J., WEBSTER, J.L., MCGHEE, F., MILLAR, R.M. & SARGENT, J.R. (1998). Flesh lipid and carotenoid composition of Scottish farmed Atlantic salmon (*Salmo salar*).J.of Agricultural and Food Chemistry, **46**, 119–127.

- BRETT, J.R., SHELBOSNE, J.E. and SHOOP, C.T. 1969. Growth rate and body composition of fingerling socheye salmon *Oncorhynchus mesha* in relation to temperature and ration size. *J. Fish. Research Board of Canada*, **26**: 2364-2394.
- CHAKRAVARTY S and KALITA J C ,2012. "An investigation of anti-diabetic medicinal plants used by villagers in Nalbari district, Assam, India", *Int. J. Pharma. Sci. Res.*, **3**(6), .1693-1697.
- CHOWDHURY, A. M., and ABBAS BHUIYA. 2001. "Do poverty alleviation programmes reduce inequities in health? The Bangladesh experience." 312-32.
- CHOWDHURY, M.B.R. 1998. Involvement of aeromonad and pseudomonads in diseases of farmed fish in Bangladesh. *Fish Pathol.***33**(4), .247-254.
- CUI, Y. and WOOTTON, R.J. 1988. Bioenergetics of growth of Cyprinids, Phoxinus, the effect of the ration and temperature on growth rate and efficiency. *J. Fish Bio.* **33**: 763-77
- GAUR DKL 2013. Socio-Economic Status Measurement Scale: Thirst Area with Changing Concept for Socio-Economic Status. *Int. J. of Innovative Res. and Dev.* **2**(9), pp.139-145.
- GRIGORAKIS, KRITON, 2002. "Comparison of wild and cultured gilthead sea bream (*Sparus aurata*); composition, appearance and seasonal variations." *Int.J.of food sci. & tech.* 477-484.
- HASAN M M, SARKER B S, NAZRUL K M S, RAHMAN M M and MAMUN A, 2012. "Marketing channel and export potentiality of freshwater mud eel (*Monopterus albus*) of Noakhali region in Bangladesh", *Int. J. Life Sci. Bt & Pharm. Res.*, **1**(3), 2250-3137
- ILES, I.D. and WOOD, R.J. 1965. The fat/water relationship in North Sea herring, *Clupea harengus* and its possible significance. *J. Marine Boil Assoc., UK*, **45**: 353-366.
- ISLAM M.N. and M.A. JOADDER, 2005. Seasonal variation of the proximate composition of freshwater Gobi, *Glossogobius aureus* (Hamilton) from the river Padma. *Pak. J. of Bio. Sci.***8** (4), 532-536.
- IUCN Bangladesh, 2000: Red Book of Threatened Fishes of Bangladesh. Ameen Book Publisher, Dhaka. IUCN-The World Conservation Union. pp. xii+116.

- JAKHAR, J.K., PAL, A.K., A.D., REDDY, A.D., SAHU, N.P., VENKATESHWARLU, G. and. VARDIA, H.K. 2012. Fatty Acid Composition of Some selected Indian Fishes. *African J. Basic & App. Sci.* **4**(5): 155-160.
- JAMIR N S and LAL P (2005), "Ethno zoological practices among Nagatribes", *Ind. J. Tradit. Knowle.* **4** (1), pp. 100-104.
- JHINGRAN, A.G. and P.K. TALWAR, 1991. *Inland Fisheries of India and Adjacent Countries*. Vol, **1** Oxford and IBH publishing co. Pvt. Ltd. Calcutta. pp.514
- KABIR, K.R., R.K. ADHIKARY, M.B. HOSSAIN and M.H. MINAR, 2012. Livelihood status of Fishermen of the old Brahmaputra River, Bangladesh. *World Applied Sciences Journal*, **16**(6): 869-873.
- KAKATI L N, BENDONG AO and DOULO V, 2006, "Indigenous knowledge of zootherapeutic use of vertebrate origin by the Ao tribe of Nagaland", *J. Hum. Ecol.*, **19**(3),163-167.
- KAUSHIK, S.J., COVES, D., DUTTO, G. and BLANC, D. 2004. Almost total replacement of fish meal by plant sources in the diet of a marine teleost, the European sea bass, *Dicentrarchus labrax*. *Aquaculture*, **230**: 391-404.
- KHAN, MA RAHMAN, M. IDRIS MIAH, M. BELAL HOSSAIN, AFROZA BEGUM, and M. H. MINAR, 2013 "Fish biodiversity and livelihood status of fishing community of Tista River, Bangladesh." 417-423.
- LE CREN E.D. (1951).The Length-weight Relationship and Seasonal cycle in Gonadal Weight and condition of Perch (*Perca fluviatilis*)*J.of Animal Ecology*, **20**,pp 201-219
- MIAH, M.F., ALI, H., ZANNATH, E., SHUVRA, T.M., NASER, M.N. and AHMED, M.K., 2015. Breeding Biology and Induced Breeding Status of Freshwater Mud Eel, *Monopterus albus*. *World Academy of Science, Engineering and Technology, Int. J.I of Bio. Biomol.r, Agri., Food and Biotech. Engineering*, **9**(6), pp.637-641.
- MIAOAN, S., YOUZHI, M., & JIANCHENG, Z. (2000). An analysis of the nutritive composition in muscle of *Monopterus albus*. *J. of Fish.of China*,**24**(4), 339-344.
- NARGIS, A. 2006. Seasonal Variation in the Chemical Composition of Body Flesh of Koi Fish *Anabas testudineus*(Bloch) (Anabantidae: Perciformes). *Bangladesh J. Sci. Ind. Res.* **41**:219-226.
- NASAR, S.S.T. 1997. Backyard eel culture: *Int. Institute of Rural Reconstruction, Silag, Cavity, Philippines.* pp.88

- PONGMANEERA, J., WATANABE, T., TAKEUCHI, T. and SATOH, S. 1993. Use of different protein meals as partial or total substitution for fish meal in carp diets. *Bulletin of Jpn. Soc. Sci. Fish.* **59**: 1249-1257.
- RAHMAN AKA, 1989. Freshwater fishes of Bangladesh. Zoological Society of Bangladesh, University of Dhaka. pp. 364
- RAHMATULLAH, R., SARKER, P. and RAHMATULLAH, S. M. 2015. Socio-economic status of Kuchia harvesters at Purbadhala upazila under Netrokona district. *Research in Agriculture Livestock and Fisheries*, **2**(2), 363-368.
- SAIKIA K and AHMED R ,2012. “Wetland fish biodiversity of Majuli river island (India) and their medicinal values”, *The Clarion*, **1**(2), pp.81-86.
- SALAM, A. and DAVIES, P.M.C. 1994. Body composition of Northern Pike (*Esox lucius L.*) in relation to body size and condition factor. *Fisheries Research*, **19**: 193-204.
- SARKAR, P., ABID, M., RANDHAWA, H.S. and PRABHAKAR, S.K. 2008. Effect of dietary lysine and methionine supplementation on growth, nutrient utilization, carcass compositions and haemato biochemical status in Indian Major Carp, Rohu (*Labeo rohita H.*) fed soy protein-based diet. *Aquaculture Nutrition*, **24**: 23-30.
- SCONES I, 1998. Sustainable rural livelihood: A frame work for analysis. IDS working paper No.72. Brighton: IDS, UK.
- SHEARER, K.D, 1994. Factors affecting the proximate composition of cultured fishes with emphasis on salmonids. *Aqua.*, **119**,63–88.
- SHEARER, K.D., 1984. Changes in the elemental composition of hatchery reared rainbow trout (*Salmo gairdneri*) associated with growth and reproduction. *Canadian J. Fish. and Aquatic Sci*, **41**: 1592-1600.
- SHIMENO, S., MASUNOTO, T., TUJITA, .T, MIMA, L., and UENOS, S. 1993. Alternative protein sources for fish meal in diets of young yellowtail. *Nippon Suisan Gakkaishi*, **59**: 137-143.
- SINHA, G.M. and PAL, P.C. 1990. Seasonal variation in protein, lipid and carbohydrate contents of ovary, liver and body muscle in relation to gonadosomatic index and Oogenesis of *Clarias batrachus*(Linn.). Impacts of Environment on Animal and *Aquaculture*, **2**: 107-112.

- SNEDECOR G.W. and COCHRAN W.G. 1967 Statistical Methods, Oxford and IBH Publishing Company, New Delhi India. pp.593
- SOLTAN, M.A., HANAFY, M.A. and WAFI, M.I.A. 2008. Effect of Replacing Fish Meal by a Mixture of Different Plant Protein Sources in Nile Tilapia (*Oreochromis niloticus*) Diets. *Global Veterinaria*, **2**: 157-164.
- TOPPE, J., ALBREKTSEN, S., HOPE, B. and AKSNES, A. 2006. Chemical composition, mineral content and amino acid and lipid profiles in bones from various fish species. *Comparative Biochemistry and Physiology, Part B*. 146:pp.395–401.
- VIERA, V.A., HILSDORF, A.W. and MOREIRA, R.G. 2011. The fatty acids profile and energetic substrates of two Nile Tilapia (*Oreochromis niloticus*, Linnaeus) strains, Re-stirling and chitralada, and their hybrid. *Aqua. Res.* 1-12.
- WERNER, SHIRLI, MALASPINA, DOLORES, RABINOWITZ, and JONATHAN 2007: Socioeconomic Status at Birth is associated with Risk of Schizophrenia: Population-Based Multilevel Study. *Schizophrenia Bulletin*, **33** (6) 1373-1378.
- ZAFAR M and MN AHSAN. 2006. Marketing and value chain analysis of mud crab (*Scylla* sp.) in the coastal communities of Bangladesh. *Bang. Fish. Res.Forum.* pp. 25-53.

## APPENDICES

**APPENDIX-1:** Interview schedule on socio-economic condition and the livelihood of the mud eel fish harvesters in study area.

SL.No. -----

Date: -----

1. Harvesters Name : -----

2. Father's Name : -----

Age: -----Involved this business:        years

3. Address:

Village: ----- Union: -----

Upazila: ----- District: -----

4. Sex:

<input type="checkbox"/> Male	<input type="checkbox"/> Female
-------------------------------	---------------------------------

5. Religion: tribal  yes  no

<input type="checkbox"/> Muslim	<input type="checkbox"/> Hindu	<input type="checkbox"/> Christian	<input type="checkbox"/> Buddhist
---------------------------------	--------------------------------	------------------------------------	-----------------------------------

6. Education of harvester :

<input type="checkbox"/> No education	<input type="checkbox"/> Can sign only	<input type="checkbox"/> Primary (up to 2 class)
<input type="checkbox"/> Primary (3 to 5 class)	<input type="checkbox"/> Secondary (6 to 8 class)	<input type="checkbox"/> Secondary (9 to 10 class)
<input type="checkbox"/> S.S.C.	<input type="checkbox"/> H.S.C.	

7. Marital status:

<input type="checkbox"/> Married	<input type="checkbox"/> Unmarried
----------------------------------	------------------------------------

8. Family member:

Total	
-------	--

9. Family type:

<input type="checkbox"/> Joint family	<input type="checkbox"/> Nuclear family
---------------------------------------	---

10. Housing condition:

<input type="checkbox"/> Own house:		<input type="checkbox"/> Rental:	
<input type="checkbox"/> Kacha	<input type="checkbox"/> Semi-pacca	<input type="checkbox"/> Pacca	
Construction materials (if Kacha):			

11. Source of drinking water:

<input type="checkbox"/> Tube-well	<input type="checkbox"/> Pond	<input type="checkbox"/> River	<input type="checkbox"/> Canal	<input type="checkbox"/> Others
------------------------------------	-------------------------------	--------------------------------	--------------------------------	---------------------------------

12. Sanitary facilities:

<input type="checkbox"/> Kacha	<input type="checkbox"/> Semi-pacca	<input type="checkbox"/> Pacca	<input type="checkbox"/> Absent
--------------------------------	-------------------------------------	--------------------------------	---------------------------------

13. Health facilities:

<input type="checkbox"/> Village Doctor	<input type="checkbox"/> Upazila Hospital	<input type="checkbox"/> M.B.B.S.	<input type="checkbox"/> Kabiraj
---	---	-----------------------------------	----------------------------------

14. Electricity facilities:

<input type="checkbox"/> Yes	<input type="checkbox"/> No
------------------------------	-----------------------------



19. Fish eat:

<input type="checkbox"/> daily	<input type="checkbox"/> weekly
<input type="checkbox"/> no	<input type="checkbox"/> sometimes( 3-4 days)

20. Recreation:

<input type="checkbox"/> TV	<input type="checkbox"/> Going park
<input type="checkbox"/> cinema hall	<input type="checkbox"/> others

21. Involved any NGO: yes / No

If yes, name:

22. Fishing time:

<input type="checkbox"/> Morning	<input type="checkbox"/> Noon
<input type="checkbox"/> After Noon	<input type="checkbox"/> Night

23. Type of gear used in catching mud eel fish:

<input type="checkbox"/> hand	<input type="checkbox"/> borshi	<input type="checkbox"/> polo	<input type="checkbox"/> others
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24. Average weekly income from mud eel fishing: -----

25. Capture mud eel fish:

<input type="checkbox"/> full time	<input type="checkbox"/> half time
<input type="checkbox"/> seasonal	<input type="checkbox"/> sometimes

26. Stop work in a week:  No  01d  02d

27. Get payment:  daily  weekly  monthly

28. Production day by day:  increasing  Decreasing

If Decreasing causes:

29. How does increasing production:

30. Any training:  No  Gov.  NGO

31. Savings:

Yes  No

32. Any complain to collectors:  yes  No

If yes:

33. Wise to switch from this work:  yes  no

34. Job Satisfaction:  Yes  No

35. Suggestions from harvesters to conserve mud eel fish diversity:  Yes  No

36. Any sign you feel that huge fish will be caught:  Yes  No

37. Do you use mud eel fish for medicinal purpose?  Yes  No

38. Any demand to government:

Thank you for your kind co-operation

---

(Signature of the interviewer)

Date: -----

**APPENDIX-2 Descriptive and ANOVA for moisture content of *M. cuchia***

**Descriptive**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Male	3	77.5900	1.07392	.62003	74.9222	80.2578	76.38	78.43
Female	3	79.4567	.72418	.41810	78.6577	82.2556	79.98	80.29
Total	6	79.0233	1.77100	.72301	77.1648	80.8819	76.38	80.29

**ANOVA**

	Sum of Squares	df	Mean Square	F	Sig.
Between sex	12.327	1	12.327	14.694	.019
Within sex	3.355	4	.839		
Total	15.682	5			

**APPENDIX-3: Descriptive and ANOVA for protein content of *M. cuchia***

**Descriptive**

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Male	3	17.4833	.95422	.55092	15.1129	19.8537	16.43	18.29
Female	3	17.1833	.76794	.44337	13.1890	17.0043	14.21	15.15
Total	6	16.2900	1.51953	.62034	14.6954	17.8846	14.21	18.29

## ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between sex	8.544	1	8.544	11.390	.028
Within sex	3.001	4	.750		
Total	11.545	5			

APPENDIX-4: Descriptive and ANOVA for lipid content of *M. cuchia*Descriptive table of lipid contents of *M. cuchia* fish

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Male	3	1.0233	.04509	.02603	.9113	1.1353	.98	1.07
Female	3	.8033	.07024	.04055	.6289	.9778	.73	.87
Total	6	.9133	.13155	.05371	.7753	1.0514	.73	1.07

## ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between sex	.073	1	.073	20.842	.010
Within sex	.014	4	.003		
Total	.087	5			

APPENDIX-5 Descriptive and ANOVA for ash content of *M. cuchia*

## Descriptive

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Male	3	2.7467	.45545	.26295	1.6153	3.8781	2.23	3.09
Female	3	3.1200	.18083	.10440	2.6708	3.5692	2.93	3.29
Total	6	2.9333	.37130	.15158	2.5437	3.3230	2.23	3.29

## ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between sex	.209	1	.209	1.741	.257
Within sex	.480	4	.120		
Total	.689	5			

### Appendix-6: Photo of proximate composition, transport & marketing channel



Ash of the Sample in Crucibles



Distillation and digestive chamber



Lipid extraction by Soxhlet Method



Store freshwater mud eel



Styrofoam packs



Ginger raw pieces



ice pbag



Water with olive oil



weighting



interview



Transportation 1



Transportation 2