

**ASSESSING MARKET STATUS OF MUD CRAB (*Scylla sp.*)
FISHERY IN PATUAKHALI AND BARGUNA DISTRICT**



A Thesis

By

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A thesis submitted in partial fulfillment of the requirements
For the Degree of Master of Science in Aquaculture

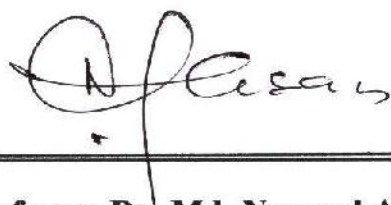
Fisheries and Marine Resource Technology Discipline
Khulna University
Khulna, Bangladesh

December, 2011

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Declaration

ASSESSING MARKET STATUS OF MUD CRAB (*Scylla sp.*) FISHERY IN PATUAKHALI AND BARGUNA DISTRICT

The results presented in the thesis with the above mentioned title are entirely of the candidate's own investigations and no part of the results has been accepted for any degree nor is it being concurrently submitted for any degree.



14.10.12

(Signature of the Candidate)

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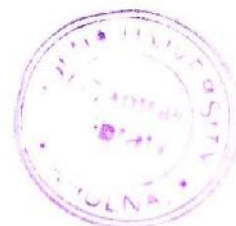


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December, 2011

DEDICATION

*This thesis is dedicated to my beloved parents who sacrificed for me, inspired
and blessed me in every way of my life.*

Acknowledgement

All my praises are due to the Omnipresent and Almighty ALLAH Who enabled me to pursue my education and complete as well as submit the thesis. I adore and remember Him at first from core of my heart.

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Abstract

A study was executed to understand the status of crab marketing at 2 Upazila namely Patharghata of Barguna District and Kalapara Upazila of Patuakhali District. The overall sex ratio of male to female was found to be 1:0.94 and 1:0.95 in Patharghata and Kalapara Upazila respectively. The total number of depots and manpower involved in crab business in the depots were estimated to be 52 and 137, respectively. Manpower involved in crab business was maximum in Kalapara sadar in Kalapara Upazila and minimum in padma union in Pathorghata Upazilla. Grading system in Kalapara Upazilla was different from Patharghata. In Pathorghata, the average selling prices of female in depots was found to be the highest in January for F1, KS-1, F2 and in February for F3. The price of male crab was the highest for XXL and XL in January, L in October, M and SM in November. But in Kalapara the average selling price of female in depots were found to be the highest in October for F1, KS-1, in January for F2, and F3 in September. The price was the highest for XXL in December, XL in February, L in November, M and SM in November. The average boat size in Pathorghata was found in length of 226.366 ± 61.006 inch, width of 59.7533 ± 4.9938 inch, and height of 33.12 ± 2.237 inch. Each boat collects 60.3333 ± 14.326 kg per 7 days in neap tide. On the other hand in Kalapara average boat size was found in length of 237.66 ± 40.083 inch, width of 60.009 ± 4.3386 inch, and height of 33.28 ± 2.015 inch. Each boat collects 60 ± 10.856 kg per week. Rate of mortality was found to be high in case of soft shell male and goandally matured female. It was found that mortality rate of crabs which comes from forest is higher than from *Gher* and it is 20 %, on an average per day. Major export markets of mud crab are Singapore, Hong Kong, China and Malaysia.

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List of Abbreviations

Sl.No.	Abbreviation	Elaboration
1.	DoF	Department of Fisheries
2.	BFRF	Bangladesh Fisheries Research Forum
3.	NGO	Non –Governmental Organization
4.	FFDA	Fish Farm Development Agency
5.	WFC	World Fish Centre
6.	PRA	Participatory Rural Approach
7.	FGD	Focus Group Discussion
8.	HH	House Hold Head
9.	KI	Key Informant Interview

1.1 Background of the study

The mud crab *Scylla serrata* is an important species of the class crustacea under the phylum arthropoda. They are common in mud flats of the littoral, parts of the supra littoral and the intertidal muddy zones of the Bay of Bengal. Crab has great ecological importance in the Sundarbans Mangrove Forest. The Sundarbans Reserved Forest (SRF) is located in between latitude 21°27'30" and 22°30'00" North and longitude 89°02' and 90°00' East. Bangladesh has a coastline of 710 km with 6,18,780 ha of mangrove tidal flat and 80,000 ha of prime area which is suitable for brackish water aquaculture (Anon, 2003). In the Sundarban, there are 4 families and 26 species of crab. This species is also called mangrove crab or green crab. It is locally known as Shilla Kakra 'Haubba kakra', appears to be the most important crab species in Bangladesh for food and trade. It occurs in the coastal waters of 15-30 ppt salinity and particularly dominates in the mangrove fauna. It is also harvested from shrimp (*Penaeus monodon*) ponds (gher) along the whole coastal zone of Bangladesh. They are essentially euryhaline, but die beyond 70 ppt. and rarely tolerate turbid waters (Khan and Alam, 1991). Shrimp and crab live in similar environmental conditions. They are quite abundant in places 40-50 km inland from the Bay, in the creeks and canals of the brackish water estuaries (Khan and Alam, 1991).

The peak abundance of adult crab occurs during mid and late monsoon (June-August). The early monsoon (April-May) and post monsoon (September-October) are the seasons of fairly good abundance. Less abundance appears during the winter months from November to February (Ahmed, N. 1999).

Already crab has got position and reared with shrimp. Crabs are commercially important, commanding high prices in local and international market and used a source of income for coastal fisher folk and also for domestic consumption. In past it was a virgin stock and marketed only locally and in negligible quantities. Non-Muslims like Hindu, Buddhists etc. are traditionally consumed as food item but the Muslim populations don't due to religious barrier.

In recent years, live mud crab has become one of the most important exportated commodities due to high price and demand in the international market. The mud crab leading the supreme position among the various crab species in Bangladesh in the view of market demand, economic profit,

excellent food quality, large size than the other countries and as profession of the minority group. The export of the live *Scylla serrata* from Bangladesh has increased significantly in the past few years. Unfortunately the crab fishery has not yet been established.

Marketing is defined as a social and managerial process by which individuals and groups obtain what they need and want through creating and exchanging products and value with others (Levitt, 1990).

Marketing is the theory and practice of presenting, advertising and selling commodities. Marketing is the business function that identifies organization, customer needs and wants, determines which target markets it can serve best and designs appropriate products services and programs to serve those market. However marketing is much more than just isolated business functions (Kotler and Armstrong, 1995).

From mid-ninety, the crab marketing system expanded with foreign markets opening up. Mud crab first appears as an export item in 1977-78 and settled from 1982 (SEAFDEC, 1998). In recent years, it is exported to international market, particularly Singapore, Hongkong, and Taiwan (Azam et. al., 1998). It is now being harvested in an increasing scale. In recent years, the mud crab has emerged as one of the potential export oriented trades in Bangladesh. The export value of live crab commended with 2,000 US \$ during 1977-78, which had increased to 37,80,000 US \$ during 1992-93, registering a 1890- fold increase Due to high consumer demand, market price and low availability in the wild, the culture of mud crab has received great attention in many countries of the indo pacific region (Azam et al., 1998).

The most wandering places for mud crab from East and South Africa to Southeast and East Asia (from Southeast of China and Sri Lanka), and Northeast Australia, Eastern around the Marianas, Fidji and Samoa Island and acquaintance in the Hawaii Archipelago. It also inhabited in Northeast coast of India and in some parts of Malaysia, Indonesia and Thailand (Lloris, 2000).

The Barguna District is surrounded by many rivers. On the south, Barguna is bounded by the Patuakhali District, and the Bay of Bengal. Important rivers of Barguna district include the Payra River, Bishkhali River and the Baleshwar River. Patharghata is an Upazila of Barguna District in the Division of Barisal, Bangladesh. Patharghata is located at 22°02'45"N 89°58'08"E / 22.0458°N 89.9689°E. It has a total area of 387.36 km². On the other hand Patuakhali is a district in South-western Bangladesh. Kalapara (also known as Khepupara) is an Upazila of Patuakhali District in the Division of Barisal. Kalapara is located at 21°59'10"N 90°14'32"E / 21.9861°N 90.2422°E. It is located near to the Bay of Bengal and containing a portion of Mangrove forest. It has a total area of 483.08 km² are mostly suitable places for wandering of wildlife and occurring the natural and potential resources availability as well as holding many rivers, canals and gher etc. My study was executed about assessing market status of mud crab (*Scylla serrata*) fishery in potuakhali and borguna district and also recorded how the marketing network extent over the country and transported to the foreign market.

1.2 Objectives

The present study was undertaken:

- To assess the marketing network and transporting system of mud crabs in Patuakhali and Barguna District.
- To understand the pricing system of mud crabs in Patuakhali and Barguna District.

Chapter 2

Review of Literature

A limited number of studies on crab marketing have been conducted in southern part of Bangladesh. Different researchers just mentioned about the abundance of mud crab (*Scylla serrata*) with some economic information in the context of Bangladesh.

Mahmood (1977) reported 16 crab species of the coast of Bangladesh. Bhuyan and Das (1976) made a taxonomic investigation and reported 15 species of crab from the intertidal zone. They reported that the mud crabs are a significant component of the Sundarban ecosystem in terms of energy transfer, nutrient trapping, substrate modification, and a food item. Live export of the species contributes significantly to the national economy.

Khan and Alom, (1991) mentioned that in recent years, live mud crab has become one of the most important exportated commodities due to high price and demand in the international market. The mud crab leading the supreme position among the various crab species in Bangladesh in the view of market demand, economic profit, excellent food quality, large size than the other countries and as profession of the minority group. The export of the live *Scylla serrata* from Bangladesh has increased significantly in the past few years.

Khan and Alam, (1991) reported that Bangladesh also rich as natural resource of mud crab around the coastal region (including river) of Cox's Bazar, Chittagong, Barisal, Potuakhali, Satkhira, Noakhali, and the inshore islands of Moheshkhali, Kutubdia, Sandwip, Hatia and Dubla, i.e. all inshore islands, except Saint Martin. Mangrove forest areas and Chokaria Sundarbans areas are mostly suitable places for wandering of mud crab and remaining abundantly as well as containing a great resource potentiality in future. May be unbelievable but it is truth that shrimps and crabs inhabited in same and identical environmental conditions, although shrimp culture also recognized here as old practice. About 40-50-km inland areas from



the Bay of Bengal including rivers, canals, estuaries and gher touching with brackish water are nicely wandering and inhabited

Bhaumik and Saha, (1994) stated that crab already has got position and reared with shrimp. Crabs are commercially important, commending high prices in local and international market and used a source of income for coastal fisher folk and also for domestic consumption. In past it was a virgin stock and marketed only locally and in negligible quantities. Non-Muslims like Hindu, Buddhists etc. were traditionally consumed as food item but the Muslim population was not involved because of their religious barrier. With the mixing of the modern culture their attitude are gradually starting to change

Ahmed (1992) mentioned about the seasonal abundance of mud crab. He mentioned that the peak abundance of adult crab occurs during mid and late monsoon (June-August). The early monsoon (April-May) and post monsoon (September-October) are the seasons of fairly good abundance. Less abundance appears during the winter months from November to February

Khan and Alam, (1991) mentioned that shrimp and crab live in similar environmental conditions. They are quit abundant in places 40-50 km inland from the Bay, in the creeks and canals of the brackish water estuaries

Azam *et al.*, (1998) reported that from mid-ninety decade, the crab marketing system expanded with foreign markets opening up. Mud crab first appears as an export item in 1977-78 and settled from 1982 (SEAFDEC, 1998). In recent years, it is exported to international market, particularly Singapore, Hongkong, and Taiwan (Azam *et. al.*, 1998). It is now being harvested on an increasing scale. In recent years, the mud crab has emerged as one of the potential export oriented trades in Bangladesh .The export value of live crab commended with 2,000 US \$ during 1977-78, which had increased to 37,80,000 US \$ during 1992-93, registering a 1890- fold increase Due to high consumer demand, market price and low availability in the wild, the culture of mud crab has received great attention in many countries of the indo pacific region

✓ Levitt (1990) described about the trading of mud crab. He mentioned that the mud crab trading made a part of interference between the supplier, exporter and the consumer as a business pattern. To explain this definition i examine the following important term: Needs, wants and demands; products; value and satisfaction; exchange; transactions and relationships and markets. In a recent study khan is pioneer for describing the importance of mud crab (*Scylla serrata*) in our country, Ahmed described about the seasonal abundance of adult mud crab. On the other hand Azam *et al* showed economic analysis in different years. However they did not mentioned the procedure of crab farming or fattening & how it affects on livelihood of the poor local community.

人 My study was executed about assessing market status of mud crab (*Scylla serrata*) fishery in potuakhali and borguna district and also recorded how the marketing network extent over the country and transported to the foreign market. There is no study so far has been carried out specifically on this part of the country which has some variation in grading and price.

Chapter 3

Materials and Methods

3.1 Selection of the study area

The study was executed about assessing market status of mud crab (*Scylla serrata*) fishery in Kalapara Upazila in Potuakhali District and Pathorghata Upazila in Borguna District and also recorded how the marketing network extent over the country and transported to the foreign market. Kalapara is located at 21°59'10"N 90°14'32"E / 21.9861°N 90.2422°E and Pathorghata is located at 22°02'45"N 89°58'08"E / 22.0458°N 89.9689°E. Kalapara and Pathorghata has a total area of 483.08 km² and 387.36 km² respectively. It belongs to the mangrove Forest Sundarbans and many rivers where crab has great ecological importance.

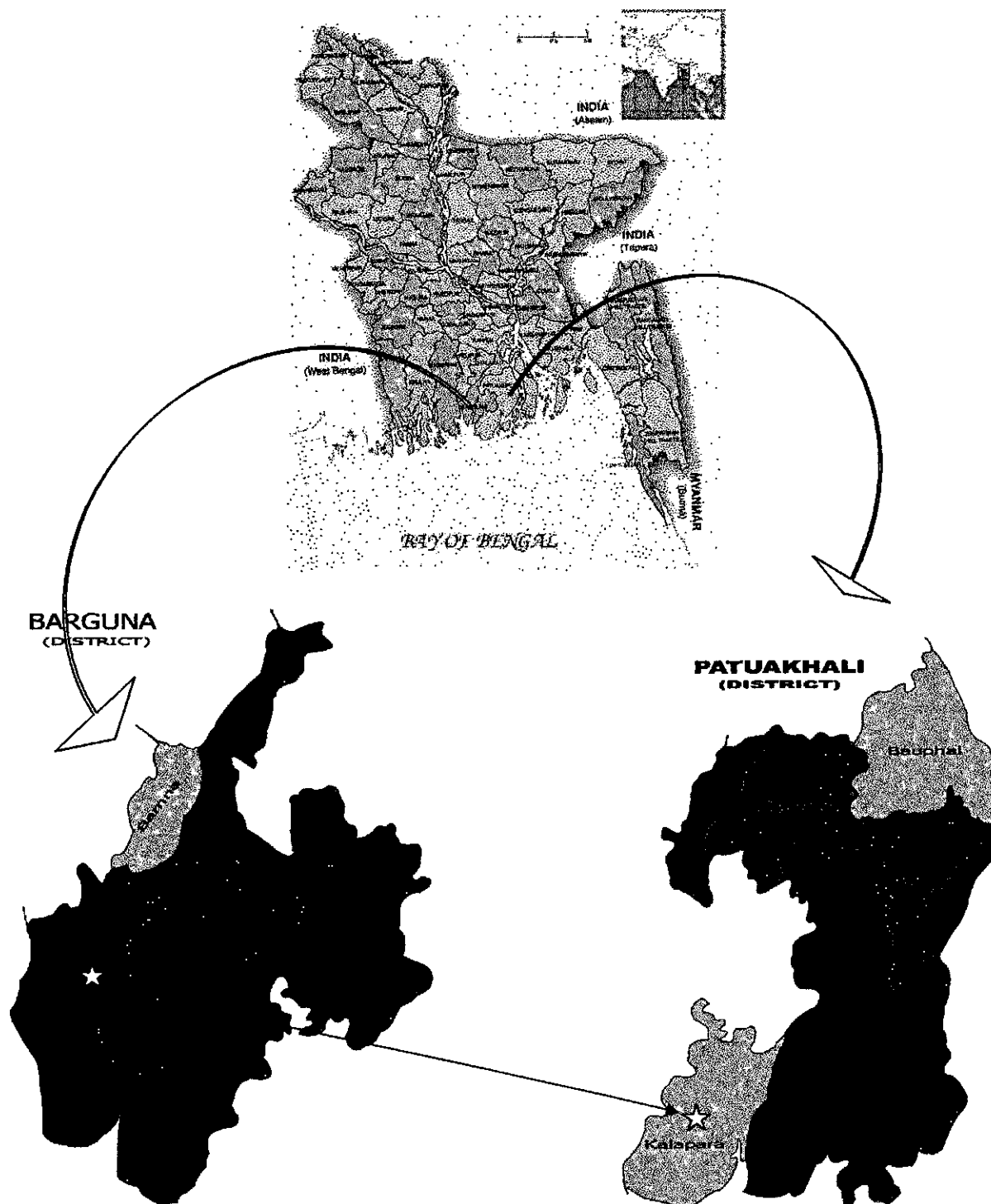


Fig 3.1. Study area (Kalapara Upazila in Patuakhali District and Pathorghata Upazila in Barguna District)

3.3 Survey design and sampling procedure during data collection

In order to collect data on mud crab marketing and transportation systems, monthly field visit was made in Kalapara Upazila in Potuakhali District and Pathorghata Upazila in Borguna District. The following information was collected during the field surveys:

- ▶ Marketing channel and methods of mud crab
- ▶ Transportation system of mud crab
- ▶ Packaging materials
- ▶ Number of mud crab traders
- ▶ Grading and pricing system of mud crab
- ▶ Mortality and causes of mortality or losses
- ▶ Problems facing by the stakeholders.

The overall data collection methodology is presented in a flowchart format and detailed description of methodology is mentioned below.

Data was collected from two sources.

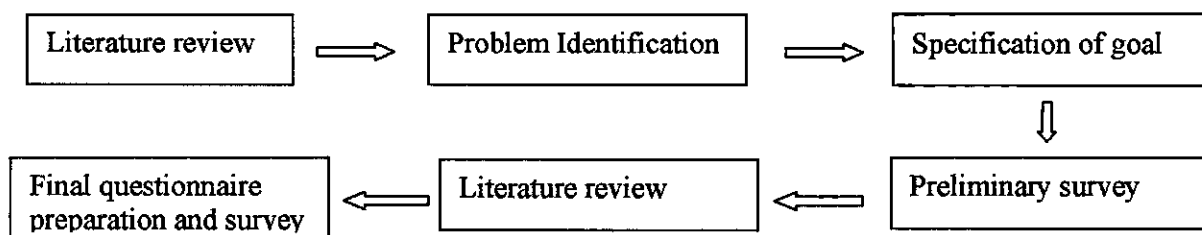
- (a) Primary sources and
- (b) Secondary sources

(a) Primary sources

At first, preliminary survey was done in the study areas. Secondly, on the basis of preliminary survey, a questionnaire was prepared.

i. Questionnaire preparation

During Questionnaire preparation following steps was followed.



ii) Reconnaissance survey

This survey was helped to identify the representative areas. The area was mainly selected on the basis of the concentration (i.e. representative community) of crab farmers community. This

survey was also considered the opportunity of practicing PRA in the village by getting community response and acceptance.

In marketing survey data was collected using an interview schedule and their selling record in the respective month. The draft survey schedule was used for pre-testing in the non-sampled crab depots before finalization. The suggestions offered by the respondents were recorded. Thus the final survey schedule was modified and improved on the basis of experience from the pre-test. The interview schedule contained both pre-coded and open-ended questions on technical and economical point of view related with crab marketing and transportation system. The questionnaire form was filled up through interviewing mud crab traders and fishers directly from the field. The questionnaire was constructed in English and then translated into Bengali during face-to-face interviews.

To ensure a comprehensive research study, random data collection techniques were applied to gather information from the depots owners and the crab collectors.

iii) Participatory Rural Appraisal (PRA)

PRA is a group of methods for gathering information from the target group in a participatory fashion. The information collected through wider participation of the community is likely to be more elicited and accurate. PRA tools are to a greater extent generated, analyzed, owned and shared by local people as part of a process of their empowerment and here lies the advantage of PRA over other methods. The participation of respondents provides an opportunity for cross-checking individual opinions as well as explaining their views and important issues to be discussed rather than responding to a questionnaire. PRA was conducted with the depots owners, crab collectors and marketing agents to determine availability of crab, collection process, marketing system, price variation etc. All the selected PRA tools (e.g. focus group discussion, economic well-being category, seasonal calendar, mobility chart and activity plan etc) were employed during these sessions.

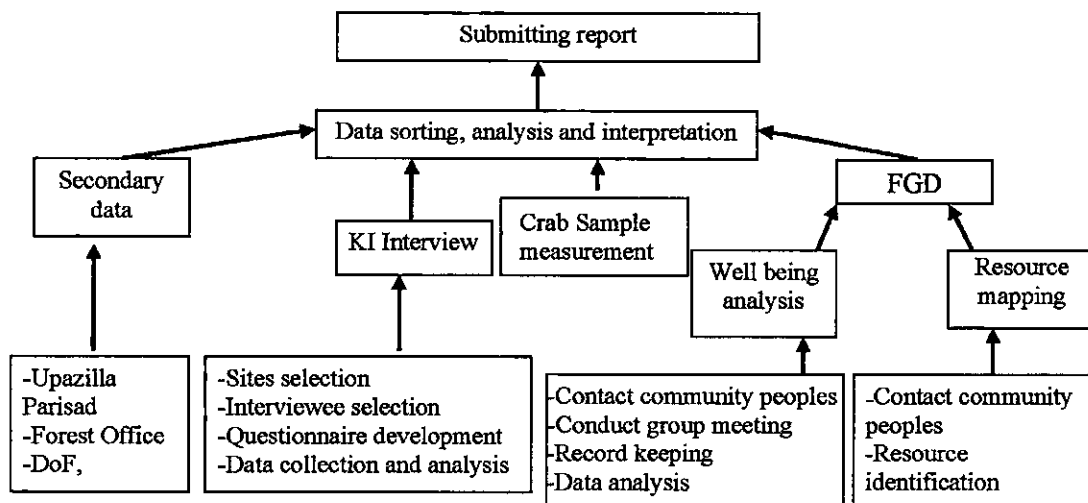


Fig 3.2. Flow diagram of methodology of the present study

iv) Sampling

Crab samples were measured which were caught by using the gear locally known as 'Don', which is an angling type device. It is composed of a polyester thread (3-4m long) with 1m long wooden sticks, earthen sinkers, and nylon threads for ticking bait and scoop nets. Samples were collected at monthly interval between November, 2010 to October 2011 at high tide. The crabs were kept alive in bamboo baskets and boats covering different types of leaves until completion of fishing for a few periods of 5-7 days.

To observe boat operated for crab catching according to capacity of boat 30 boats were selected randomly from the study area to measure length, weight, height, capacity of boats and amount of dadon taken by the collectors. Destructive nets for the crab seeds were also recorded during the study period.

v) Observation of sex and maturity:

The sex of individuals was determined on the basis of eye observation. Crabs with widen abdomen were identified as female. In similar way crabs with narrow abdomen were considered as male. The sexual maturity of female crab was determined by the wider and dark abdomen. All other females were recorded as immature. Male maturity could not easily be determined from the external characteristics but its market value is determined by the hardness of abdomen. However,

in male crabs it was determined on the basis of the presence of mating scar and spermatozoa in anterior vas deference of testis (Robertson and Kruger, 1994).

vi) Sex ratio:

Sex ratio is the ratio of the males to females of a given population. It was estimated by the formula:

$$SR = \text{No. female crab} / \text{No. of male crab (Poovachiranon, 1987)}.$$

vii) Rejection:

Generally dead, broken appendages and undersized crabs were rejected by the depot owners. Rejection level was calculated by observing randomly selected 15 depots of each Upazila.

b) Collection, organization and assessment of secondary data and information

Secondary data are essential to have an idea about the background information of mud crab abundance, sexual maturity of mud crab, spawning season etc. Other reports related to marketing analysis and PRA was also strengthened the present study. Data and information related to the proposed work were collected from different national (BBS, DoF, BARC) and international (ICLARM, DFID) organizations, previous study related to crab marketing, seminar, research journals, reports and WebPages available on the Internet and central library of Khulna University.

3.4 Data Management and Analysis

Immediately after the completion of data collection, the data was entered into the computer. Normally MS Excel was used for data entry. All the quantitative data was processed and analyzed using SPSS Windows 12.0. Data was mostly presented in tabular form. In most of the cases, the data was analyzed by using conventional statistical tools like cross tabulation, frequency tables, mean, standard deviation, percentages, histograms, pie graphs etc. GIS software was used to prepare appropriate map of the study area.

Chapter 4

Results

4.1 Sex Ratio

In Patharghata the overall sex ratio of male to female was found to be 1:0.94 (Table 4.1). The highest occurrence of female was found in December while the lowest was in September. The highest percentage of male was found in September while the lowest in December. During September the difference in male to female ratio was the highest while in October it was minimum (Fig 4.1). The highest sex ratio was found in December (1:1.5) while the lowest was in September (1:0.53) (Table 4.1).

Table 4.1 Monthly Variation in sex ratio of *S. serrata* at depots in Patharghata Upazila (From November, 2010 to October 2011)

Month	Male (%)	Female (%)	Sex Ratio
January	44.89	55.1	1:1.22
February	44.44	55.55	1:1.25
March	47.36	52.63	1:1.11
April	60.6	39.39	1:0.65
May	56.52	43.47	1:0.77
June	56.41	43.6	1:0.77
July	58.33	41.66	1:0.71
August	60	40	1:0.66
September	65.51	34.48	1:0.53
October	47.83	52.17	1:1.09
November	43.75	56.25	1:1.29
December	40	60	1:1.5
Total	51.41	48.58	1:0.94

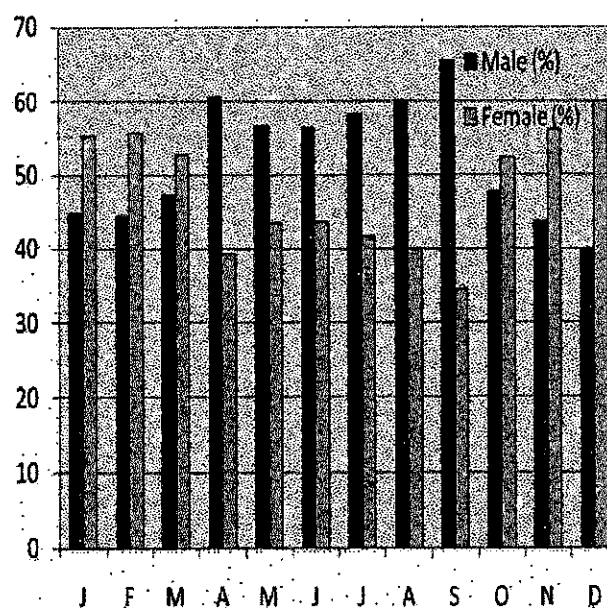


Fig 4.1 Monthly variation of mud crab at depots in Patharghata Upazila (From November, 2010 to October 2011)

In Kalapara the overall sex ratio of male to female was found to be 1:0.95 (Table 4.2). The highest occurrence of female was found in December while the lowest was in April. The highest percentage of male was found in April while the lowest in December. During April the difference in male to female ratio was the highest while in October it was minimum. (Fig 4.2) The highest sex ratio was found in December (1:1.6) while the lowest was in April (1:0.5) (Table 4.2).

Table 4.2 Monthly Variation in sex ratio of *S. serrata* at depots in Kalapara Upazila (From November, 2010 to October 2011)

Month	Male (%)	Female (%)	Sex Ratio
January	41.3	58.69	1:1.42
February	41.86	58.39	1:1.39
March	48.57	51.42	1:1.06
April	66.66	33.33	1:0.5
May	53.06	46.93	1:0.88
June	54.05	45.94	1:0.85
July	58.33	41.66	1:0.71
August	62.79	37.2	1:1.55
September	64.28	35.71	1:0.59
October	48.9	51.11	1:1.05
November	45.65	54.34	1:1.19
December	38.46	61.53	1:1.6
Total	51.15	48.84	1:0.95

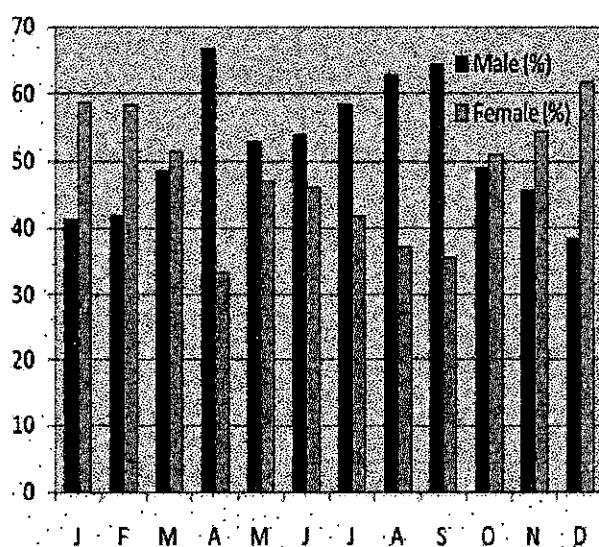


Fig 4.2 Monthly variation of mud crab at depots in Kalapara Upazila (From November, 2010 to October 2011)

4.2 Season at Gonadal Maturity

All the mature and immature female crab was determined by the wider and dark abdomen. All other females were recorded as immature. By checking all the mature and immature female (frequency %) were plotted against different months and the result is shown in Fig4.3. It shows that in February, March and April mature female were most abundant.

Table 4.3 Number and ratio of mature female mud crab in different month from Pathorghata and Kalapara Upazila

Month	Total female no.(n)	Number of mature female	Mature female %
January	30	20	66.66
February	30	22	73.33
March	30	27	90
April	30	21	70
May	30	8	26.66
June	30	2	10
July	30	1	0.03
August	30	1	0.03
September	30	1	0.03
October	30	2	10
November	30	5	16.66
December	30	8	26.66

4.3 Season of availability

Collectors both in Pathorghata and Kalapara reported that they catch in maximum amount from October to November but it remains moderately less amount until February. On the other hand catches were minimum from June to August though crabs were collected more or less all the year round. But in winter mature crabs were found in higher number in forest than *gher* whereas situation is vice-versa in rainy season.

Collectors reported that crabs in Pathorghata and Kalapara spawns from March to April.

4.4 Location and Physical Condition of Depots

Most of the mud crab depots were located nearby the river and or road and easily connected with the high ways. The location of the depots depends on supply of mud crab from various sources. In terms of construction materials, the depots were categorized into *Katcha* (made of bamboo, bamboo-fence, and by Nypa-leaves with earthen floor), *Semi-pacca* (made of bamboo, wood and tin roof with concrete floor), and *Pacca* (made of bricks, RCC and concrete). Different type depots at 2 Upazillas are shown in Table 4.4. The numbers of *Katcha*, *Semi-pacca* and *Pacca* crab depots in Patharghata and Kalapara Upazila were estimated to be 20, 17 and 15 respectively. The maximum and numbers of depots were counted in Kalapara and Alipur union and minimum depots were counted in Padma Union.

Table 4.4 Physical condition of mud crab depots at Patharghata and Kalapara Upazila in Barguna and Patuakhali District in 2011

Condition	Name of Union in Patharghata Upazila				Name of Union in Kalapara Upazila							Total	(%)
	Charduani	Kathaltoli	Pathor ghata	Padma	Kolapara	Hajipur	Badurtoli	Baliatoli	Alipur/ Mohipur	Kuakata	Company para		
<i>Katcha</i>	-	1	-	1	3	3	1	3	4	2	2	20	38.46
<i>Semi-pacca</i>	2	2	-	-	3	2	1	1	3	2	1	17	32.69
<i>Pacca</i>	1	-	3	-	4	1	-	1	3	2	-	15	28.84
Total	3	3	3	1	10	6	2	5	10	6	3	52	100

Source: Field survey, 2011.

4.5 Distribution of Mud Crab Depots, Manpower and Number of Boat given dadon

During the period of study, the numbers of people engaged in mud crab trading were estimated for all the Upazillas. Out of 2 Upazillas in Barguna District, the number of depots in Charduani, Kathaltoli, Pathorghata Bazar and Padma were counted to be 3, 3, 3, and 1 respectively. The numbers of manpower involved in depots were counted to be 8, 7, 8, and 2 respectively in Charduani, Kathaltoli, Pathorghata Bazar and Padma. But in Patuakhali District, the number of

depots in Kalapara, Hajipur, Badurtoli, Alipur/Mohipur, Kuakata and Companypara were counted to be 10, 6, 2, 5, 10, 6 and 3 respectively. The numbers of manpower involved in depots were counted to be 35, 12, 4, 10, 33, 12, 6 respectively in Kalapara, Hajipur, Badurtoli, Alipur/Mohipur, Kuakata and Companypara. Manpower involved in crab business was maximum in Kalapara in Kalapara Upazila and minimum in padma union in Pathorghata Upazilla. The total number of depots and manpower involved in crab business in the depots were estimated to be 52 and 137 respectively. In the study area farmers are very poor that's why they take money or depots holder or exporters give some money to the crab collectors it is called *dadon*. Maximum number of boats in Charduani in Pathorghata Upazila were given dadon where as in Kalapara maximum number of boat were given dadon in Alipur and that was 195000 taka and 750000 taka in a year respectively.

Table 4.5 Distribution of mud crab depots, manpower and Number of Boat given *dadon*

District	Upazila	Bazar/Market	Number of Depot	Manpower	Number of Boat given dadon	Amount (tk) Given/Year	Given amount (average) of dadon (tk) per Boat per Year
Barguna	Pathorghata	Charduani	3	8	65	195000	3000
		Kathaltoli	3	7	60	170000	2833.33
		Pathorghata Bazar	3	8	50	140000	2800
		Padma	1	2	7	26000	3714.28
		Total	10	25	182	531000	2917.58
Potuakhali	Kolapara	Kolapara	10	35	110	450000	4090.9
		Hajipur	6	12	70	210000	3000
		Badurtoli	2	4	15	52500	3500
		Baliatoli	5	10	65	195000	3000
		Alipur/Mohipur	10	33	150	750000	5000
		Kuakata	6	12	65	190000	2923.07
		Companypara	3	6	25	62500	2500
		Total	42	112	500	1910000	3820
Grand Total			52	137	682	2441000	3579.179

4.6 Grading system

The price of the mud crab depends on sex, size, and gonadal maturation. Therefore, mud crab traders use several types of grading system on the basis of body weight, sexual maturity and hardness of the carapace of the animal. Generally both the male and the female mud crabs were graded into some fixed categories in all the Upazillas (Table 4.6). However, the grading system for the female crabs in Kalapara Upazilla was found to be different than Patharghata Upazilla. In Kalapara Upazilla, when depots owner buy male crabs having over 400 gm in weight with hard shell called grade 1, over 200 gm in weight with hard shell called grade 2 and over 300 gm in weight with hard shell called grade 3 but when they sell that product they follow the usual grading system (Table 4.6). Male crabs with soft abdomen known as water crab. They sell water crab at different rate at comparatively low price. Difference in grading system in female crab also observed. In kalapara depots owner collect female crab from collectors at low price by merging 2 grades like F1 and KS1 as grade 1 which is above 180 gm with or without full hepatopancreas. They also merge F2 and F3 grade as grade 2 which is above 120 gm with or without full hepatopancreas. Only for analysis data were recorded according to usual grading system. In Kalapara there was no crab fattening point which was available in Pathorghata Upazila.

Therefore, mud crab traders use several types of grading system on the basis of body weight, sexual maturity and hardness of the carapace of the animal. Generally both the male and the female mud crabs were graded into some fixed categories in all the unions when they marketing it to Dhaka and Khulna.

Table 4.6 Grading system of mud crab (*Scylla serrata*) by sex and weight in Patharghata and Kalapara Upazila in Barguna and Patuakhali District

Male					
Name of Grade	SM	M	L	XL	XXL
Weight (gm)	>200	>250	>300	>400	>500
Female					
Name of Grade	F1	KS-1	F2	F3	
Weight (gm)	>180	>180	>150	>120	

* KS-1 (greater than 180 gm in weight with partial hepatopancreas, locally called *Khosha*)

(Male crabs with soft abdomen known as water crab.) Source: Field survey, 2011

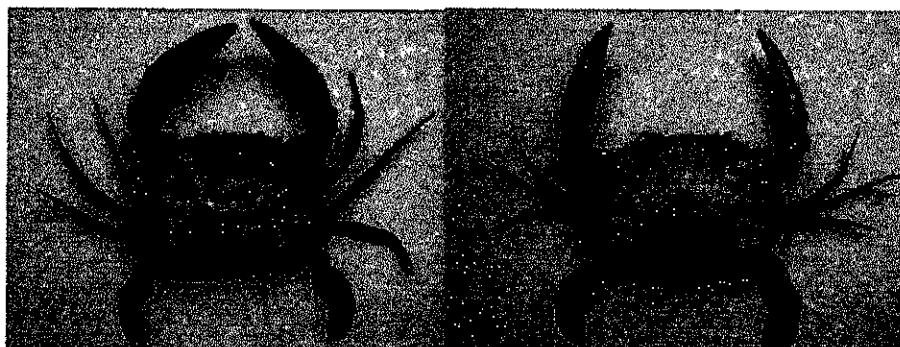


Fig 4.3 Male Crab

Fig 4.4 Female Crab

4.7 Variation of Price of Mud Crab in Pathorghata and Kalapara Upazilla

The grade wise average price was calculated from randomly selected 3 depots at each Upazilla from Barguna and Patuakhali District in 2011 (Table 4.7, 4.8, 4.9 and 4.10). In Pathorghata the average selling prices of female from depots was found to be highest in January 680 ± 123.413 Tk./kg for F1, 286.666 ± 43.2235 Tk./kg for KS-1, 256.666 ± 49.9256 Tk./kg for F2 and 103.33 ± 23.7881 Tk./kg in February for F3. The prices were highest for XXL 486.66 ± 92.610 Tk./kg in January, XL 390 ± 74.449 Tk./kg in January, L 158.33 ± 30.989 Tk./kg in October, M 163.33 ± 41.828 Tk./kg in November, and SM 171.66 ± 43.748 Tk./kg in November.

But in Kalapara (Table 4.10) the average selling prices of female from depots were found to be highest in October 613.33 ± 79.738 Tk./kg for F1, 266.66 ± 37.448 Tk./kg for KS-1 in January , 346.66 ± 77.208 Tk./kg for F2 in September and 163.33 ± 36.892 Tk./kg in September for F3. The prices were highest for XXL 488.33 ± 104.12 Tk./kg in December, XL 403.33 ± 85.126 Tk./kg in February, L 293.33 ± 80.708 Tk./kg in November, M 198.33 ± 57.272 Tk./kg in November, and SM 195 ± 52.15 Tk./kg in November (Table 4.9).

In Pathorghata (Table 4.8) the average selling prices of female from depots were found to be minimum 280 ± 123.413 Tk./kg for F1 in September, 156.666 ± 43.2235 Tk./kg for KS-1 in September, 98.3333 ± 49.9256 Tk./kg for F2 in September and 55 ± 23.7881 Tk./kg for F3 in August. For male the average selling prices of female from depots were found to be minimum 200 ± 92.610 Tk./kg for XXL in August, 130 ± 74.449 Tk./kg for XL in July, 100 ± 30.989 Tk./kg for L in May, 45 ± 41.828 Tk./kg in July for M and 41.666 ± 43.748 Tk./kg for SM in August (Table 4.7) .

Table 4.7 Grade wise variation in price of male mud crab (*Scylla serrata*) in Patharghata Upazila in Barguna District in 2011.

Month	Male									
	XXL		XL		L		M		SM	
	Buying price	Selling price	Buying price	Selling price	Buying price	Selling price	Buying price	Selling price	Buying price	Selling price
January	473.33	486.66	373.33	390	146.66	155	90	96.666	90	96.666
February	453.33	466.66	280	296.66	110	118.33	100	105	100	106.66
March	265	280	163.33	171.66	116.66	126.66	85	93.333	86.666	91.666
April	270	280	166.66	176.66	96.666	106.66	63.333	68.333	63.333	66.666
May	260	270	200	203.33	93.333	100	46.666	51.666	48.333	53.333
June	250	256.66	200	210	93.333	103.33	53.333	56.666	55	60
July	195	203.33	123.33	130	68.333	73.333	40	45	40	46.666
August	190	200	133.33	143.33	66.666	73.333	45	50	35	41.666
September	260	260	170	180	93.333	106.66	43.333	48.333	45	51.666
October	346.66	366.66	253.33	270	148.33	158.33	153.33	161.66	155	163.33
November	356.66	365	266.66	280	160	170	155	163.33	156.66	171.66
December	306.66	326.66	206.66	226.66	106.66	120	61.666	68.333	60	66.666
Mean	302.22	313.46	211.38	223.19	108.33	117.63	78.055	84.026	77.916	84.720
SD	90.391	92.610	71.286	74.449	30.091	30.989	40.550	41.828	41.723	43.748

Table 4.8 Grade wise variation in price of female mud crab (*Scylla serrata*) in Patharghata Upazila in Barguna District in 2011.

Month	Female							
	F-1		F-2		KS-1		F-3	
	Buying price	Selling price	Buying price	Selling price	Buying price	Selling price	Buying price	Selling price
January	643.333	680	246.666	256.666	276.666	286.666	90	130
February	633.333	648.333	220	236.666	253.333	266.666	83.333	103.33
March	510	526.666	186.666	196.666	273.333	283.333	81.666	100
April	386.666	403.333	120	128.333	243.333	256.666	73.333	75
May	390	400	116.666	126.666	226.666	233.333	56.666	65
June	356.666	380	111.666	120	210	216.666	50	63.333
July	343.333	356.666	133.333	143.333	216.666	220	50	63.333
August	280	300	103.333	113.333	160	168.333	53.333	55
September	263.333	280	93.3333	98.3333	153.333	156.666	43.333	46.666
October	436.666	453.333	166.666	181.666	203.333	210	73.333	91.666
November	410	426.666	133.333	140	173.333	178.333	66.666	78.333
December	426.666	440	143.333	151.666	233.333	238.333	63.333	90
Mean	423.333	441.24	147.916	157.777	218.610	226.249	65.416	80.1384
SD	120.537	123.413	47.9431	49.9256	41.0334	43.2235	15.0943	23.7881

Table 4.9 Grade wise variation in price of male mud crab (*Scylla serrata*) in Kalapara Upazila in Patuakhali District in 2011.

Month	Male									
	XXL		XL		L		M		SM	
	Buying price	Selling price	Buying price	Selling price	Buying price	Selling price	Buying price	Selling price	Buying price	Selling price
January	326.66	433.33	326.66	350	213.33	243.33	123.33	136.66	123.33	136.66
February	366.66	466.66	366.66	403.33	226.66	240	116.66	123.33	126.66	136.66
March	216.66	273.33	216.66	183.33	106.66	123.33	83.333	91.666	83.333	91.666
April	213.33	253.33	213.33	193.33	88.3333	103.33	61.666	60	60	66.666
May	228.33	250	228.33	226.6	83.333	86.666	43.333	51.666	46.666	53.333
June	216.66	238.33	216.66	220	93.333	100	46.666	50	50	60
July	286.66	350	286.66	276.66	126.66	216.66	80	166.66	63.333	113.33
August	323.33	416.66	323.33	340	133.33	226.66	90	173.33	66.666	113.33
September	333.33	473.33	333.33	373.33	200	273.33	116.66	166.66	96.666	166.66
October	326.66	486.66	326.66	386.66	270	290	176.66	193.33	173.33	193.33
November	346.66	483.33	346.66	388.33	273.33	293.33	181.66	198.33	176.66	195
December	343.33	488.33	345	391.66	266.66	286.66	176.66	193.33	170	190
Mean	294.02	384.44	294.16	311.10	173.46	206.94	108.05	133.74	103.05	126.38
SD	58.66	104.12	58.799	85.126	75.773	80.708	49.585	57.272	49.530	52.15

Table 4.10 Grade wise variation in price of female mud crab (*Scylla serrata*) in Kalapara Upazila in Patuakhali District in 2011.

Month	Female							
	F-1		F-2		KS-1		F-3	
	Buying price	Selling price	Buying price	Selling price	Buying price	Selling price	Buying price	Selling price
January	353.33	533.33	153.33	253.33	353.33	266.66	146.66	160
February	340	473.33	156.66	236.66	340	260	83.333	103.33
March	280	436.66	150	196.66	280	183.33	73.333	90
April	276.66	403.33	106.66	128.33	276.66	166.66	65	78.333
May	286.66	400	103.33	126.66	286.66	166.66	58.333	70
June	256.66	380	105	120	256.66	166.66	50	76.666
July	266.66	416.66	200	283.33	266.66	176.66	103.33	120
August	310	450	196.66	276.66	310	196.66	110	135
September	323.33	596.66	323.33	346.66	323.33	243.33	145	163.33
October	390	613.33	183.33	336.66	390	230	146.66	170
November	373.33	546.66	170	253.33	373.33	200	133.33	153.33
December	373.33	526.66	163.33	250	373.33	233.33	80	100
Mean	319.16	481.38	167.63	234.02	319.16	207.49	99.581	118.33
SD	46.366	79.738	59.401	77.208	46.366	37.448	36.243	36.892

In Kalapara the average selling prices of female from depots were found to be minimum 380 ± 79.738 Tk./kg for F1 in June, 166.66 ± 37.448 Tk./kg for KS-1 in April, May and June,

✓ 120±77.208 Tk./kg for F2 in June and 70±36.892 Tk./kg for F3 in May. For male the average selling prices of female from depots were found to be minimum 238.33±104.12 Tk./kg for XXL in June, 183.33± 85.126 Tk./kg for XL in March, 100±80.708 Tk./kg for L in June, 50±57.272Tk./kg in June for M and 60±52.15 Tk./kg for SM in June (Table 4.9 and 4.10).

There were also some underweighted (bellow 80 gm) crabs which were known as *Pich crab* and sold by the collectors in the local market at a rate of 5-7 taka per crab.

4.8 Mode of payment

4 Mutual understanding is the major factor upon which the mode of payment was found to depend in the case of purchasing and selling of mud crabs in the research area. The payment was found to be generally 40 % immediate or advance (Dadon) and 60 % provided later, usually Dadon was given for one year. In Patharghata, Barguna there was 10 depots and they give dadon approximately 182 boats at about 2917.58 taka each per boat in a year and in Kalapara, Patuakhali there was 42 depots and they give dadon approximately 500 boats at about 3820 taka per boat in a year but the amount ranges from 2-10 thousand in some cases (Table 4.5). But Exporters kept some due of money when depots owner supply crabs to them until they supply next segment.

4.9 Rejection

➤ Generally dead, broken appendages and undersized crabs were rejected by the depot owners. In Patharghata , on the average 4.06±1.579 % of the crabs were rejected from each depot, whereas 4.6±1.454 % crabs were rejected by the depots in Kalapara in Patuakhali districts (Fig 4.6).

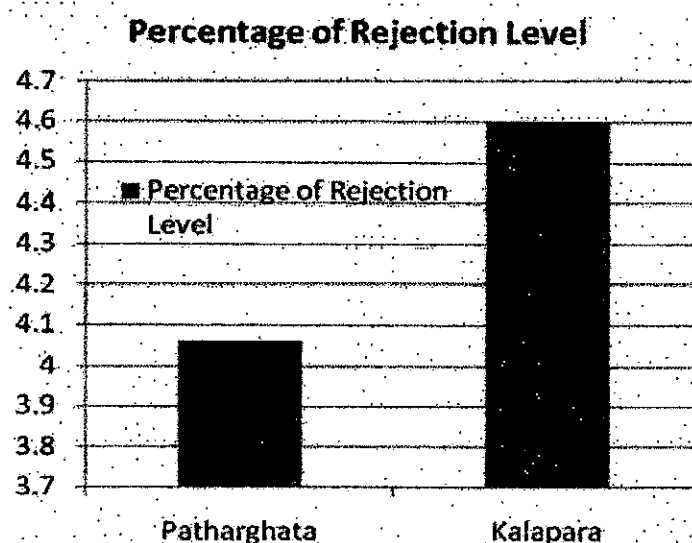


Fig 4.5 Rate of Rejection in Patharghata in Barguna District and Kalapara in Patuakhali District.

4.10 Marketing channel at Upazila level

The trading pattern of mud crab business involves a series of intermediaries between the harvesters, supplier, exporter and the consumer. The final price of the product depends on the marketing network. The greater the number of the intermediaries, the higher the price of the crab (Ladra and Lin, 1991).

The harvesters harvest crabs from the sources and sold to small depot or to broker or directly to the supplier. The marketable crabs from the small depot owner are sold to suppliers. The exporter purchase crab directly from the supplier located at the Union and Upazila level. A big chunk of the profit goes to middleman or brokers. Broker act as a middleman between catcher and supplier. The rejected crabs (under grade and broken claws or legs) are transferred to the local market for domestic consumption at low price. The immature crabs are transported to *gher* for fattening.

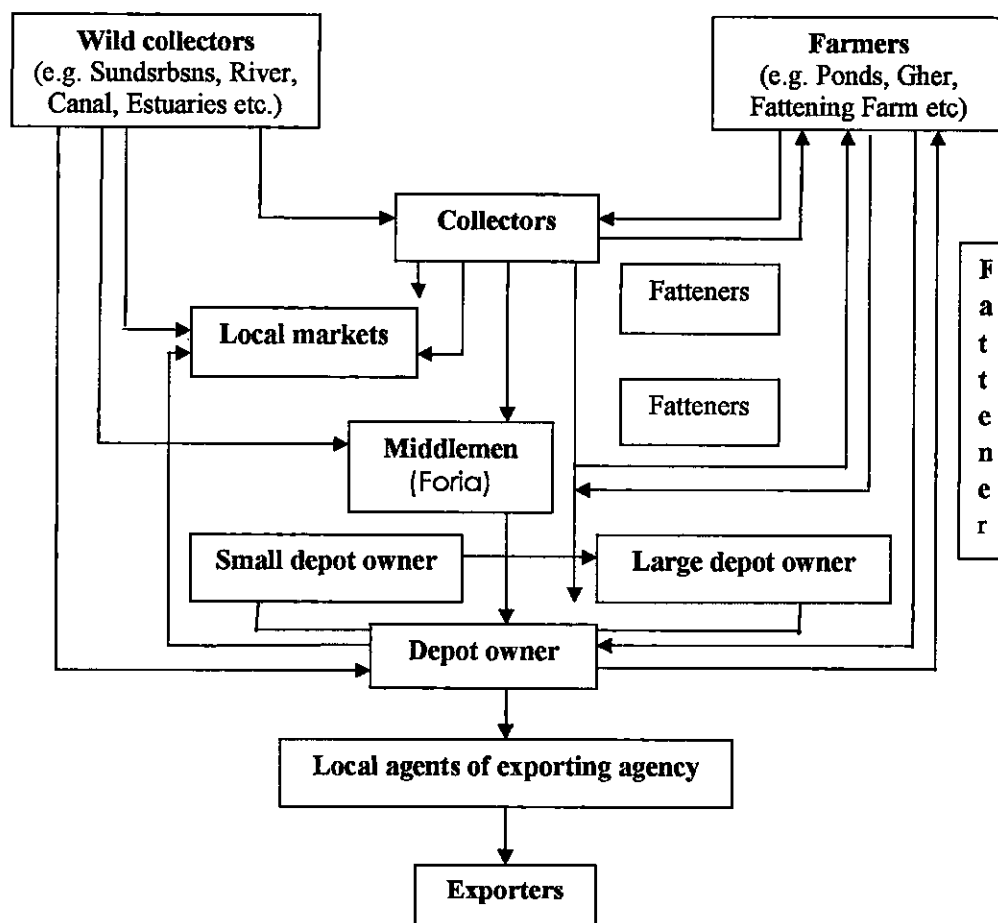


Fig 4.6 Marketing channel of mud crab

4.11 Transportation system for mud crab marketing in Patharghata and Kalapara Upazila .

4. 11.1 Catching area

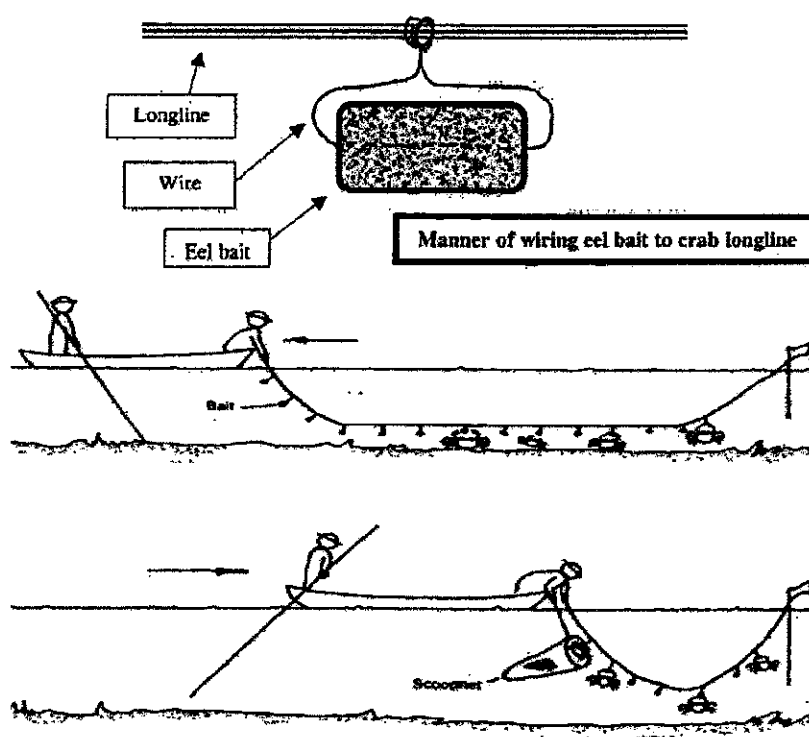
In Pathorghata upazila , the main sources of mud crabs were the Sundarban mangrove forests, tidal rivers and shrimp *ghers*. But in Kalapara upazila the main sources of mud crabs were tidal rivers and the Sundarban mangrove fores. During the winter (November to January), major crabs were harvested from the mangrove areas and tidal rivers. During rainy season (June to August), shrimp *ghers* were the principle sources of mud crab. The maximum catching attains during spring tide and neap tide (locally called *goon*). At the time of *gher* operation the crab seeds are

entered into the *ghers* through inlet gates. Without any kind of management the crab seeds are reared with shrimp. After maturation it is harvested from the *ghers*.

4.11.2 Using Crafts and Gears

4.11.2.1 Gears used for crab fishery

Rope line, Hook line and set bagnet were the most widely used type of gears was recorded for mud crab catching along the tidal river and mangrove areas. Iron hooks, boom, thopa, bait sticks etc was found in capturing crabs in shrimp *ghers*.



Khan *et.al.*, (1991)

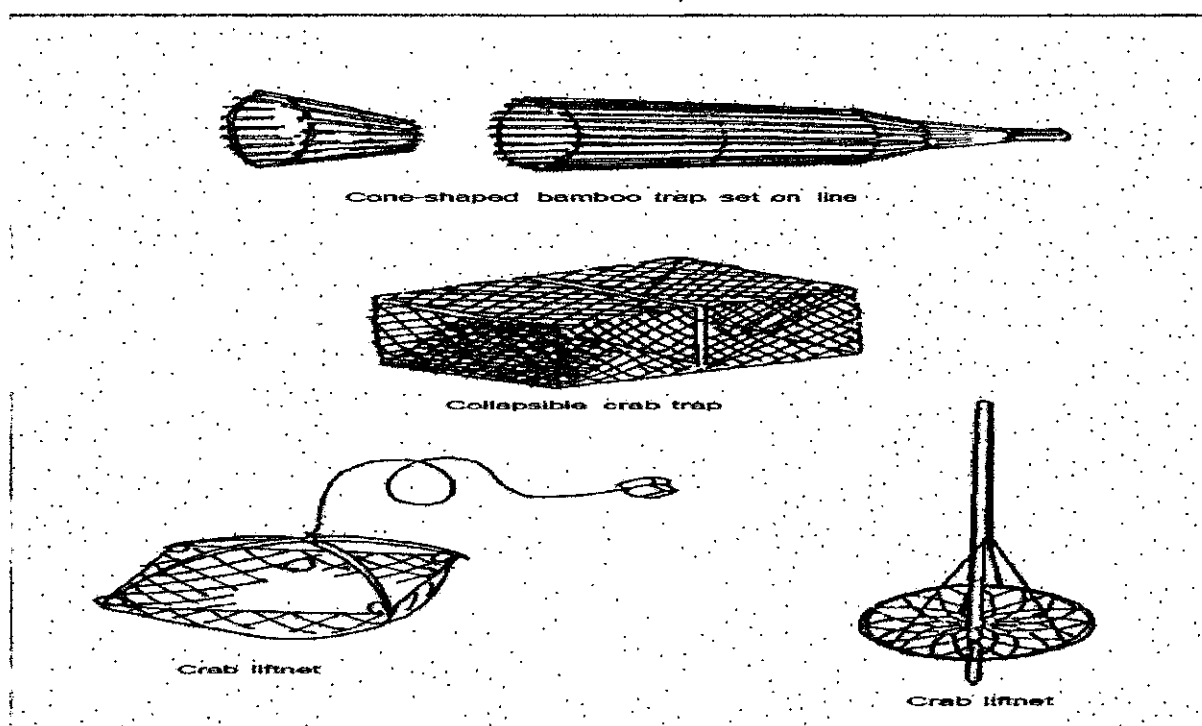
Fig 4.7 Long line used in crab fishery

The gear named rope line (locally called *don*) has a main line of 200-700 ft. Short metal wire or plastic fiber lines are tied to the main line at 3-ft spacing. Baits are attached to the short line. A main line can hold about 70-200 baits. One end of the main line is tied to a tree and another end is tied to a brick, which acts as an anchor. The long line is set in the river or khal bottom and is checked at every 30 minutes. The crab holds the bait and the long line is raised, then the

fisherman collects the crab with a scoop net. Two peoples generally operate this gear during the day. In Patharghata and Kalapara catches was higher during January to February by rope line.

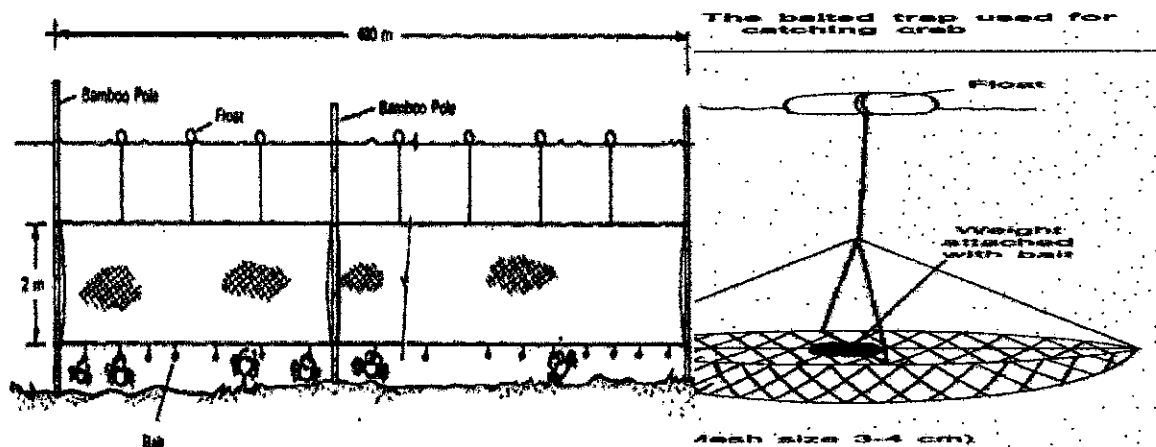
From the tidal river and mangrove areas, the crabs is also caught by hook line gear that consists of a single line made of nylon filament with a hook attached at its end. The line is put into the water to attract the crab. As soon as a crab grabs the bait after then the line is slowly hauled and collected with a scoop net.

During the regular water exchanges through the sluice gates in shrimp *ghers*, set bagnets are installed at the mouth of gate to prevent the escaping of shrimp. During this activity, some crabs are entrapped into the nets.



Khan *et.al.*, (1991)

Fig 4.8 Different types of crab gear



Khan et.al., (1991)

Fig 4.9 Crab net – Nail Jal

Fig 4.10 Baited trap

Iron hooks are also known as fishing hooks and widely used along the shrimp *ghers* in Khulna District. An iron rod of 3-4 ft. in length is used to make a hook and is fitted with a wooden or bamboo handle.

Boom trap is made of bamboo mainly used along the *gher* and also in tidal rivers, estuaries, and mangrove areas. Thopa is an angling type of fishing device, consists of polyester line, wooden stick, sinkers and thread for tying bait and nets. Bait strikes and bamboo baskets are also used. In Patharghata and Kalapara catches was higher during April to June by Boom trap.

4.11.2.2 Bait used for catching crab

Different types of baits are used for catching crabs. These baits were used as raw or dried condition in different types of gears. Often catchers used meat of hen or viscera of different animals for catching crabs.

Table 4.11 Different types of baits used for catching crab

Local Name	Scientific Name
Tilapia	<i>O. mosambicus</i>
Amadi	<i>Weberogobius amadi</i>
Kuche	<i>Monopterusuchia</i>
Parse	<i>Liza parsia</i>
Puti	<i>Puntius sp.</i>
Silver carp	<i>H. molitrix</i>
Tengra	<i>Mystus gulio, Mystus vittatus</i>
Kukur jib	<i>Paraplagusia bilineata</i>

4.11.2.3 Destructive nets for crab production:

Most of the collectors/harvesters reported that set bag net which is also known as *Behundi jal* is the most destructive for crab fishery. During the breeding season and after the breeding season huge amount of crab seed were caught by set bag net. Which ultimately play a negative role in our national economy.

Behundi Jal (set bagnet)

The net is widely used throughout the forest, tidal rivers in pathorghata and kalapara Upazila. The shape of the net is like an elongate tapering funnel. The mouth opening is rectangular and held open by two vertical bamboo poles. The mesh size of the net decrease towards the bag end. At the mouth opening the mesh size is about 5 inch where at the bag end it is only about 1.25 inch. The length of the net, width of the mouth and height of the mouth varies at different area. The net is placed in the tidal stream and catches fish with the tidal current and passively swift in to the net. Huge amount of crab seed and mature crabs were entangled in the elongate tapering funnel in the breeding season reported by the collectors of Pathorghata and Kalapara Upazila. In the study area set bagnet fishing usually starts after the southwest monsoon and continues until the end of the north -east monsoon. According to the fisheries statistics of Bangladesh (DOF, 1993).

Table 4.12 Conflicts involved with practical and recommended mesh size of different gears

Gear Name	Practiced Mesh size	Recommended Mesh Size by Marine Fisheries Ordinance	Remarks
SBN (Set Bag Net)	22-5 mm at the codend	Minimum at the codend 30mm.	The recommended mesh size is too high. Fishermen could not obey it.

Table 4.13 Conflicts involved with fishing season.

Gear Name	Practical Fishing season	Recommendation on fishing season	Remarks
SBN	Mid -September to February	Prohibitate in November to June	The gear should be used cautiously.

4.11.2.4 Catching of immature crab/ Fate of unsold and small crabs

Immature and small crabs were treated as rubbish and these were dried and grind for making fish meal. In the study area small crabs were dried in different location. Such as- Sonar char, Andar char, Bablatola, Char montaz, Gangamoti, Chaply etc. These small crabs were sold as rubbish 700-1000 taka/mon.

4.11.2.5 The craft used for crab fishery

The craft used for crab fishery is a small wooden boat, with or without engine. Small wooden boats (engine less) are popularly used in the mangrove areas and the tidal rivers. During spring tide, when the catches is higher crab fishermen go out on 2-3 days trips, while during neap tide they go on 5-8 days trips to harvest crab. Average boat size in Pathorghata was found in length 226.366 ± 61.006 inch, width 59.7533 ± 4.9938 , and high 33.12 ± 2.237 . Each boat can carry a more amount than the actual catch per 7 days and it's approximately 60.3333 ± 14.326 kg per week but each boat can carry 645.3333 ± 120.58 kg per week. Number of collectors in each boat was 2.4666 ± 0.639 (Table 4.14).

Table 4.14 Boat operation and Catch according to capacity of randomly selected 15 Boats in Patharghata Upazila in Barguna District 2011.

SL.	Length (Inch)	Width (Inch)	High (Inch)	Manpower	Capacity (kg)	Catch (kg) per 7 days
1	210	60	34	2	680	80
2	170.5	55	30	2	500	40
3	150	55	30	2	480	40
4	240	60	34	3	700	60
5	330	70	34.5	4	800	80
6	210	60.1	34	2	680	65
7	192.5	55	30	2	500	50
8	330	65	35.6	3	800	70
9	240	60	35	3	700	70
10	210	57	35	2	680	70
11	150	55.2	30.7	2	480	45
12	320	70	34	3	800	75
13	170	57	30	2	500	40
14	262.5	60	35	3	700	60
15	210	57	35	2	680	60
Mean	226.366	59.7533	33.12	2.4666	645.3333	60.3333
SD	61.006	4.9938	2.237	0.639	120.5858	14.326

On the other hand in Kalapara average boat size was found in length 237.66 ± 40.083 inch, width 60.009 ± 4.3386 inch, and high 33.28 ± 2.015 inch. Each boat collect 60 ± 10.856 kg per week but it



has capacity to carry 689.333 ± 106.0637 kg per week. Number of collectors in each boat was 2.466 ± 0.639 (Table 4.15).

Table 4.15 Boat operation and Catch according to capacity of randomly selected 15 Boats in Kalapara Upazila in Pataukhali District 2011.

SL.	Length (Inch)	Width (Inch)	Hight (Inch)	Manpower	Capacity (kg)	Catch (kg) per 7 days
1	227.5	58.3	32	2	700	65
2	245	60	33.5	2	730	70
3	262.5	60	34.5	3	750	70
4	280	60.04	35	3	800	70
5	175	55.5	30	2	500	40
6	210	58	33.5	2	680	65
7	192.5	57	30	2	500	45
8	240	59.5	35	2	700	60
9	297.5	70	35.6	4	800	70
10	262.5	60	34.5	3	750	60
11	175	55.5	30	2	500	45
12	210	58	33.5	2	680	60
13	227.5	58.3	32	2	700	55
14	297.5	70	35.6	3	800	75
15	262.5	60	34.5	3	750	50
Mean	237.66	60.009	33.28	2.466	689.333	60
SD	40.083	4.3386	2.015	0.639	106.0637	10.856

4.11.3 Tie up the crabs

Mud crabs are highly cannibalistic animals. They have two powerful claws by which they can cause serious injury. Generally the claws of live mud crab are tied with plastic tape or coir rope by an experienced handler to prevent the physical damage or mortality.

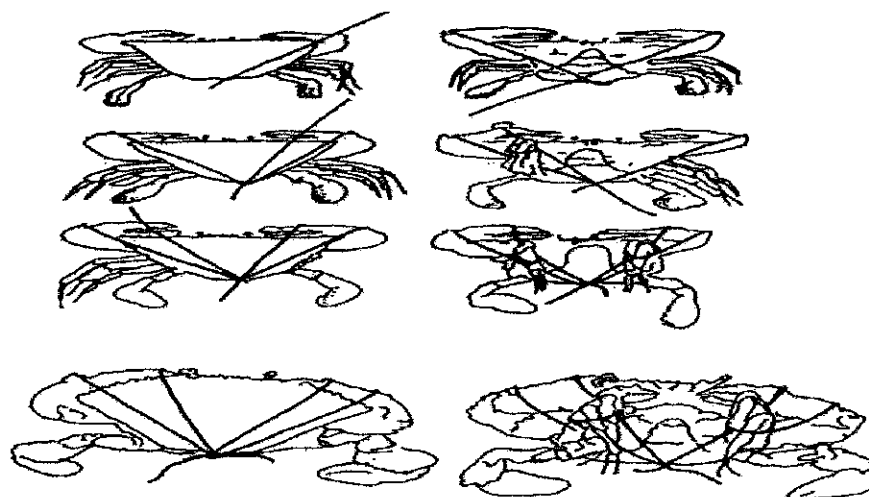
Khan *et.al.*, (1991)

Fig 4.11 Tying mud crab with plastic thread

4.11.4 Transport to Depots

There was no standard transportation system exists for mud crab. Harvested mud crabs were transported to the depots from tidal rivers and mangrove areas in small wooden boat (locally called *nawka*), trawler etc. From *gher*, the mud crabs were carried by bamboo basket, plastic pots etc. on to bicycle or van.

4.11.5 Selling system

In Patharghata Upazila, 70% of the crab collectors sold their catches to the depots, 17% to the *Farias* (middleman) and 13% to the local markets whereas in Kalapara Upazila, 65% of the crab collectors sold their catches to the depots, 14% to the *Farias* and 21% to the local markets (Fig. 5).

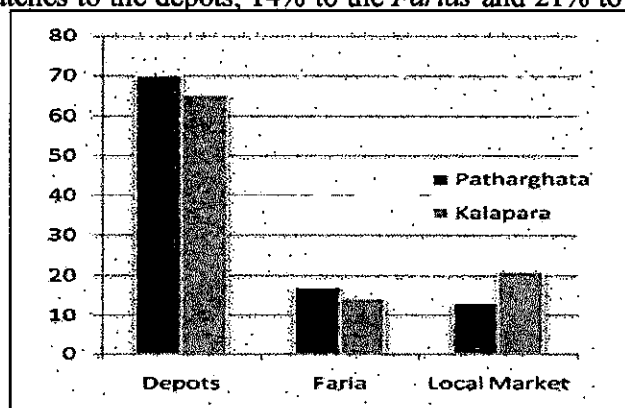


Fig 4.12 Selling system of the collected crabs

4.11.6 Transport to Dhaka and Transporting Materials

Bamboo baskets of different sizes are used to transport mud crabs from local depot to Dhaka. The baskets are long-necked, which covers with sackcloth or gunny bag. A layer of wet betel-nut leaf is placed in the bottom of the container to provide some cooling and to prevent dehydration. Marketable crabs that grading under local measurement (such as SM, M, L, XL, XXL, and F1, F2, F3) is placed in the baskets randomly, each containing about 70-90 kg crabs. Crabs are transported to Dhaka by bus, truck etc. at night hours, when the ambient



Fig 4.13 Use of basket during transportation

temperature is lower. After reaching to Dhaka the crabs are grading again under the central measurement constantly. After then it is exported to foreign country by placing in knitted bamboo basket. Each basket contains 15 kg of crab. The baskets are stacked one over the other. The bottom of baskets is covered with polythene sheets to avoid leakage.

4.11.7 Mortality Estimation

The rate of mortality was high for forest crab than the source of shrimp *ghers*. Because, it take more time to reaching to the depots. The rate of damage of harvested crab from the catching point to Dhaka before cargo booking is about 10-15 % in case of forest crab and 3-5% for shrimp *ghers*. Rate of mortality was found high in case of soft shell male and goandally matured female (Table 4.16).

Table 4.16 Tendency of mortality during handling and transportation

Types of Crabs	Tendency of Mortality
Immatured Male	Low
Hard Shell Male	Midium
Soft Shell Male	High
Immatured Female	Low
Goandally Matured Female	High
Goandally Immatured Female	Midium

In the study area it was found that during transportation after catching the rate of mortality is relatively higher at the stages of boat transportation and transportation from divisional market to Dhaka for air flight (Fig 4.15).

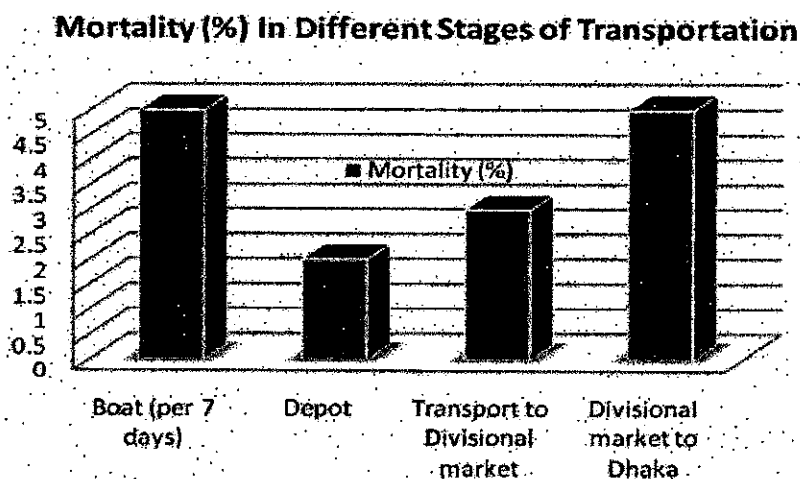


Fig 4.14 Mortality at different stages of transportation

It is important to transport mud crab in live condition but mortality of crab depends on various factors its source, stages of transportation, waste of time, season etc. In the study area it was found that mortality of male was higher in winter whereas it was higher in case of female in summer (Fig 4.16).

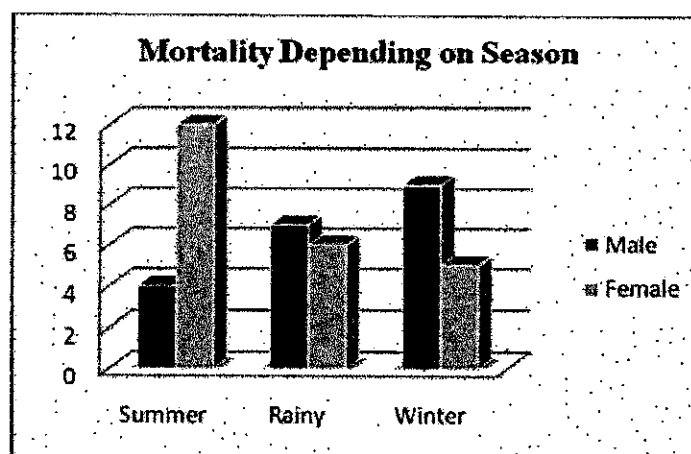


Fig 4.15 Mortality Depending on season

There are various reasons for waste of time or delay to reach the destination. It depends on marketing channel, transportation system & flight of airplane. It was found that mortality rate of

crabs which comes from forest is higher than *Gher* & it is 20 % per day. Mud crabs hardly survive 8 days in transportation condition (Fig 4.17).

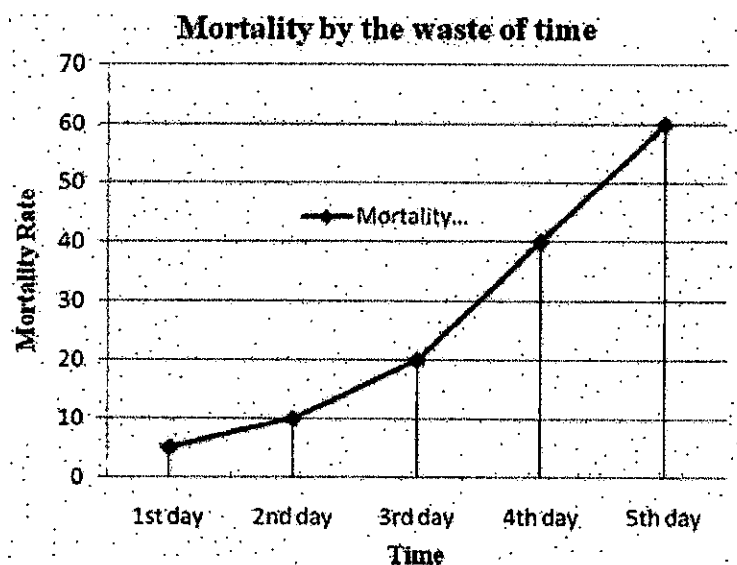


Fig 4.16 Mortality estimation with the waste of time

4. 11.8 Export

Mud crabs are at present one of the good export item in live form. Bamboo baskets are used to airfreight the crab from Zia International Airport two or three times a week. Singapore, Hong Kong, Malaysia are the major importing country of live mud crab from Bangladesh. It has also been exported to Thailand, Japan, Taiwan, Sweden, South Korea, Indonesia etc.

Table 4.17 Means of transportation

	Media of packing	Means of transportation	Time required
Collector to depots	Tie up with tape	Mechanized or non mechanized Boat & bicycle or van	3-7 days
Depots to Dhaka	Bamboo basket, Polythene, mat, sackcloth or gunny bag	Bus, Truck	6-8 hrs
Dhaka to foreign country	Bamboo basket	Aero plane	4-6 hrs

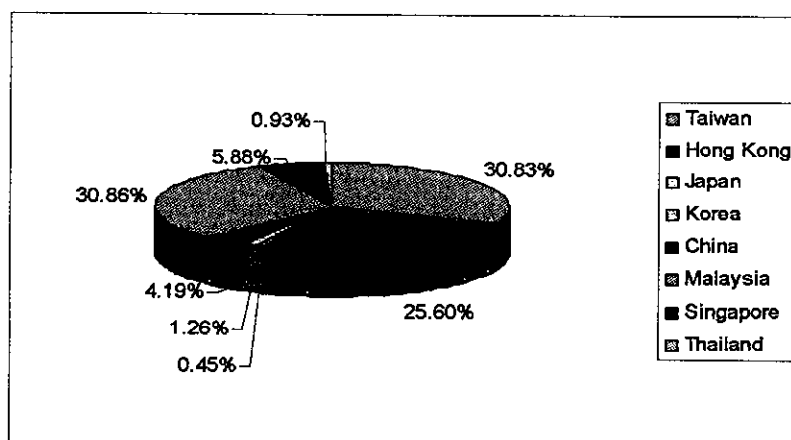
By comparing with 2002-2003, the total export quantity increased by more than 6 times during 2007-2008 (4283.27 MT), while during 2008-2009 the export quantity decreased from 4283.27

MT to 3264.62 MT. This might be due to over exploitation and less production or damage caused by cyclone Aila which hit the south-west coast of Bangladesh on 25 May 2009. From 1997-1998 to 2006-2007 Bangladesh earned US\$21,064,000 (excluding local sales) by exporting crabs to 23 countries around the world. More than 96% of total export earnings came from Asian countries. Figure shows the percentage of export value from South East Asian and East Asian countries from 1997-98 to 2006-2007. Taiwan and Malaysia were found to be biggest consumers of mud crab from Bangladesh.

Table 4.18 Export value of mud crab from 1997-98 to 2008-2009

Year	Export value (in thousand US\$)
1997-1998	1700
1998-1999	1100
1999-2000	200
2000-2001	300
2001-2002	900
2002-2003	2700
2003-2004	2600
2004-2005	5000
2005-2006	3900
2006-2007	4900
2007-2008	7800
2008-2009	5800

Ferdoushi *et al.*, (2010)



Ferdoushi *et al.*, (2010)

Fig 4.17 Percentage of total export earnings from East Asian and South East Asian countries through mud crab exports from 1997-98 to 2006-07

4.12 Major problem in marketing of mud crab in Pathorghata and Kalapara Upazila .

Mud crab marketing system faces a number of problems, which are enumerated below:

- Lack of proper transportation system of mud crab from remote area to depot;
- Lack of buyer and market information;
- Social and religious custom;
- Presence of unproductive middleman;
- Supply of mud crab depends on foreign demand;
- Robbery problem in Sundarban area;
- Grading fraudulence by the exporter;
- Inadequate aircraft space and desired flights to importer countries;
- High mortality rate as a result of mishandling and transportation system.

4. 13 Major problems in transportation

In the transportation system of mud crab, the problems were:

- From the mangrove area including the tidal rivers, maximum time the harvested mud crabs are transported through manually operated boats. It takes more time to reach to the near depots. As a result, the mortality rate becomes high.
- Local buyers have got one-time vehicles facilities only for transporting to the central market in Dhaka.
- The socio-economic status of the fishermen is so lower that they cannot afford even a bicycle to carry their harvest to the market
- The roads are not well constructed in locality.
- Implementation of rules and regulation improperly in water transportation system.
- Violence and corruption.
- Aricha ferryghut is a great obstacle to the transportation of mud crabs from southwestern region to Dhaka.

Chapter 5

Discussion

The study was conducted to assess market status of mud crab (*Scylla serrata*) fishery in Patharghata and Kalapara Upazila in Barguna and Patuakhali District. Although, these areas have huge water areas, mangrove forest and shrimp culture *ghers*, which are very suitable as habitat for the mud crabs. It is evident from the review of literature and existing crab marketing outcome that crab marketing and transportation is very much important and efficient tool in case of livelihood development.

Present findings indicated that formal as well as long term policy may have potentials for the improvement in crab marketing. Therefore, necessary supports from the line agencies to overcome the problems are also required while making formal as well as long term agreements between crab farmers or collectors and traders or depot holders.

The study further showed that a substantial part of wild crabs has no market value simply because of soft shell or inadequate female gonad. In addition, handling and transportation of live crabs is also responsible for huge post-harvest loss usually incurred by the collectors themselves. Most depot owners buy all the crabs delivered to them, rejecting only weak, dead and undersized crab. Thus, a proper post harvest handling knowledge and development of live preservation techniques for crab are deemed necessary that might add extra value to the total catch of individual poor collectors.

Raj (1992) reported that the medium and large crab of more than 14 cm CW and weighing more than 400 g were collected exclusively for export in India. Crab stay alive out of water only for maximum of about 72 hours. The grading system of crabs were 1 kg upwards crabs are called extra large, 500g-1 kg large, 300g-500g medium, 200g-300g crabs small, 200g- 300g crabs water crab and 200 g- 400g crabs were also called red crab. However, the grading system for the female crabs in Kalapara Upazilla was found to be different than Patharghata Upazilla. In Kalapara Upazilla, when depots owner buy male crabs having over 400 gm in weight with hard

shell called grade 1, over 200 gm in weight with hard shell called grade 2 and over 300 gm in weight with hard shell called grade 3 but when they sell that product they follow the usual grading system. In kalapara depots owner collect female crab from collectors at low price by merging 2 grades like F1 and KS1 as grade 1 which is above 180 gm with or without full hepatopancreas. They also merge F2 and F3 grade as grade 2 which is above 120 gm with or without full hepatopancreas.

Lee stated (1992) that the price of mud crabs varied seasonally, depending on fluctuating landings and seasonal demand. Practically price of crab is entirely dependent on the demand in foreign market. If foreign demand is high and availability of crab is low, then the price of crab increased. In the lower temperature, much quantities of female crab are found than the male crab. In Pathorghata the average selling prices of female from depots was found to be highest in January 680 ± 123.413 Tk./kg for F1, 286.666 ± 43.2235 Tk./kg for KS-1, 256.666 ± 49.9256 Tk./kg for F2 and 103.33 ± 23.7881 Tk./kg in February for F3. The prices were highest for XXL 486.66 ± 92.610 Tk./kg in January, XL 390 ± 74.449 Tk./kg in January, L 158.33 ± 30.989 Tk./kg in October, M 163.33 ± 41.828 Tk./kg in November, and SM 171.66 ± 43.748 Tk./kg in November. But in Kalapara (Table 4.10) the average selling prices of female from depots were found to be highest in October 613.33 ± 79.738 Tk./kg for F1, 266.66 ± 37.448 Tk./kg for KS-1 in January , 346.66 ± 77.208 Tk./kg for F2 in September and 163.33 ± 36.892 Tk./kg in September for F3. The prices were highest for XXL 488.33 ± 104.12 Tk./kg in December, XL 403.33 ± 85.126 Tk./kg in February, L 293.33 ± 80.708 Tk./kg in November, M 198.33 ± 57.272 Tk./kg in November, and SM 195 ± 52.15 Tk./kg in November

Tookwinas *et al* (1992) stated that frozen crab is the most exported product in followed by salted, dried and smoked meat in airtight containers. Generally dead, broken appendages and undersized crabs were rejected by the depot owners. In Patharghata , on the average 4.06 ± 1.579 % of the crabs were rejected from each depot, whereas 4.6 ± 1.454 % crabs were rejected by the depots in Kalapara in Patuakhali districts. But in my study area or even in our country there were no processing plant for crab while a large amount of crabs were rejected and died (10-25%) during transportation. That's why frozen, salted or processed crabs were not exported from Bangladesh which needs to be taken in consideration.

Khan and Alom, (1991) mentioned that in recent years, live mud crab has become one of the most important exportated commodities due to high price and demand in the international market. The mud crab leading the supreme position among the various crab species in Bangladesh in the view of market demand, economic profit, excellent food quality, large size than the other countries and as profession of the minority group. The export of the live *Scylla serrata* from Bangladesh has increased significantly in the past few years. Although the mud crabs industry has developed day by day, but in the study area the livelihood status of the crab fishermen remains far behind the average poverty level of Bangladesh. Most of the time traders merged some intermediate grade when they collect crab from farmers for their profit. Through dadon system the major portion of the profit is going to the crab traders but the fishermen didn't get right share.

Through this research effort, it had been possible to find out that many countries imported crabs from Bangladesh, which indicated that it had large international market. Several recent studies examined crab markets worldwide and suggested that the market was very large and increasing (Brien and Miles, 1994 and GLOBEFISH, 1995).

Gillespie and Bruke (1992) reported that mud crab, usually packed in waxed cardboard cartons, and are distributed in Australia using air and road transport. The mortality rate is high during transportation. Relative humidity of 95 percent at 16-20°C was found to be optimal transport condition. Temperatures below 20°C significantly enhanced survival time relative to those of 20°C. Exposure to direct sunlight for long time has a negative effect on survival. Lee (1992) reported a higher mortality of mud crab due to stress during the long transportation. In the study area the rate of mortality was high for forest crab than the source of shrimp *ghers*. Because, it take more time to reaching to the depots. The rate of damage of harvested crab from the catching point to Dhaka before cargo booking is about 10-15 % in case of forest crab and 3-5% for shrimp *ghers*. Rate of mortality was found high in case of soft shell male and goandally matured female. It was found that during transportation after catching the rate of mortality is relatively higher at the stages of boat transportation and transportation from divisional market to Dhaka for air flight. In the study area it was found that mortality of male was higher in winter where as it was higher in case of female in summer.

Ladra and Lin (1992) reported that females with mature ovaries were particularly expensive in the Philippines. Experienced farmers could tell whether the ovaries were full examining against the light and also pressing its shell to feel if the crab is full and firm. Mud crab in the Philippines can be classified into three major groups. Mud crab of 15-18 pcs/kg was used utilized for culture. Transport mortality was 5-40 percent depending on the mode of transport. Mortality rate of crabs which comes from forest is higher than Gher & it is 20 % per day. It was found that mud crabs hardly survive 8 days in transportation condition but Lee (1992) reported that mud crab survive in air for about 4-5 days (under optimum conditions) has enabled their shipment to distant markets. Because, most of the time the crabs were transported by manually operated boat and it reached too late to the depots. A few crab fishermen use trawler facilities in crab transportation. On the other hand, the rate of damage is minimum (4-7%) for crab harvested from shrimp ghers.

Jayamanne (1991) reported that the feeding habits of *Scylla serrata* change with age. Juvenile crab, measuring about 2-7 cm CW, feed mainly on crustaceans, while subadults of about 7-13 cm CW feed chiefly on bivalves and gastropods. Larger crab consume smaller crab and fish. But during my study I found that mud crab mainly feed on *Telapia* (*O. mosambicus*), *Kuche* (*Monopterus albus*) for male, *Puti* (*Puntius sp.*), *Silver carp* (*H. molitrix*) with salt, *Head of chingri* etc.

Findings of the present study strongly indicated that increasing the institutional support can be an important approach to improve crab marketing. The overall findings of the present study can be considered as the mixture of success and setbacks for the improvement of crab marketing.



Chapter 6

Conclusion

Mud crab marketing was considered as a profitable and feasible business by most of the marketing operators. If we could preserved and maintains this resources it will contain a great economic return from local and international market. The natural production of mud crabs is well. A huge number of people are engaged in this sector that is maximum from minority group. Trades and business of mud crabs is promoting day by day. In the study area farmers are very poor that's why they take or depots holder or exporters give some money to the crab collectors it is called *dadon*. The maximum numbers of depots were counted in Kalapara and Alipur union and minimum depots were counted in Padma Union. In Patharghata, Barguna there was 10 depots and they give dadon approximately 182 boats at about 2917.58 taka each per boat in a year and in Kalapara, Patuakhali there was 42 depots and they give dadon approximately 500 boats at about 3820 taka per boat in a year but the amount ranges from 2-10 thousand in some cases. But their existing harvesting and marketing system are not enough structured to carry out the sustainable development. Most of the harvesters reported that set bag net which is also known as *Behundi jal* is the most destructive for crab fishery. During the breeding season and after the breeding season huge amount of crab seed were caught by set bag net. Immature and small crabs were treated as rubbish and these were dried and grind for making fish meal. These small crabs were sold as rubbish 700-1000 taka/mon. Rate of mortality was found high in case of soft shell male and goandally matured female during transportation. More attention should be given by Bangladesh Govt. through providing loans by banks or any extension of help by Export Promotion Bureau. This will hold the depot not only to develop but also result in earning a further greater amount of foreign exchange.



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Photo Gallery

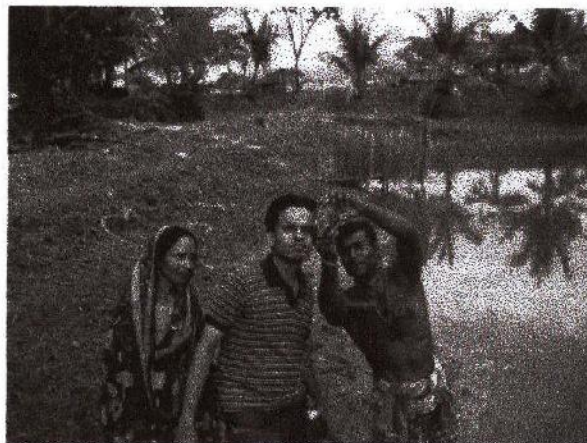


Fig 8.1. Checking of gonad development

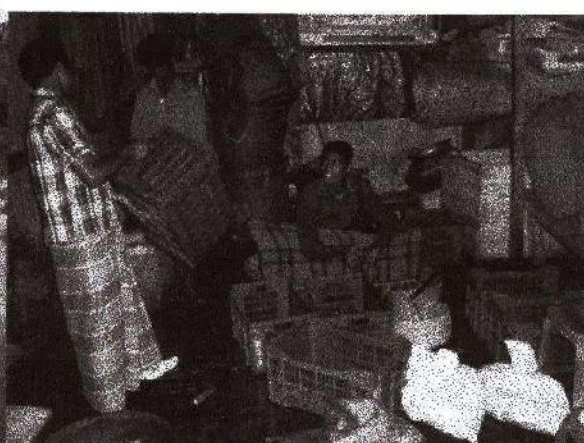


Fig 8.2. Worker working in crab depot.

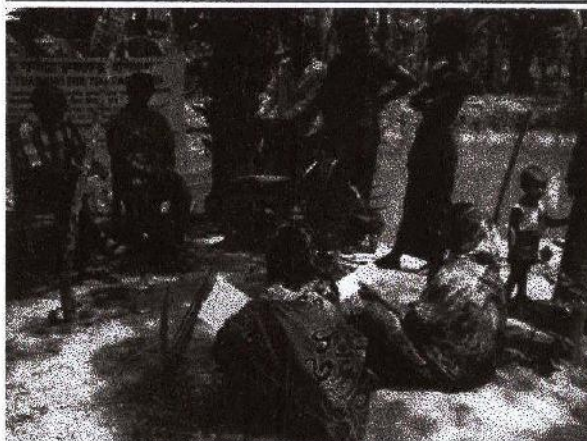


Fig 8.3. Field training on crab culture and marketing



Fig 8.4. Crabs preparing for marketing

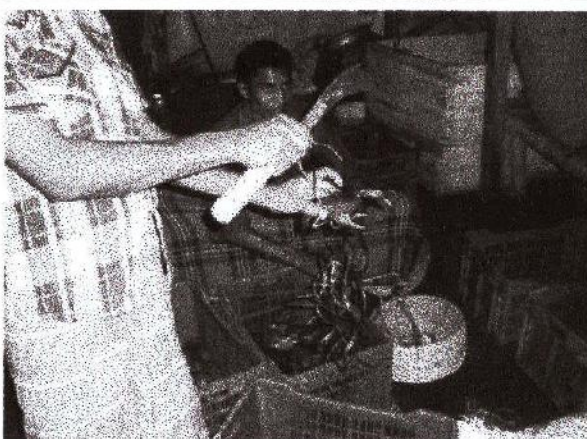


Fig 8 5 Tie up the crabs

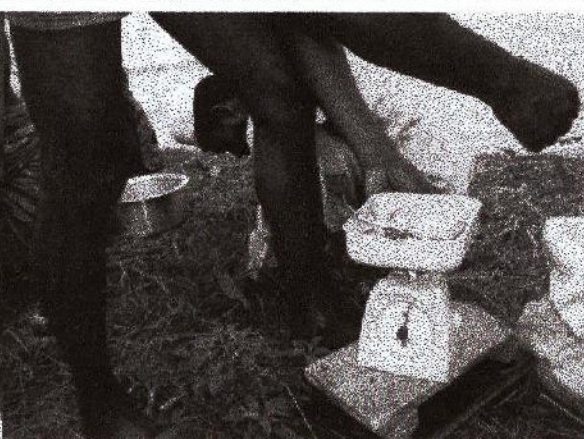


Fig 8 6 Taking weight and grading



Fig 8.7. Catching crabs for gonad check



Fig 8.8. Taking data from depots owner.



Fig 8.9. Conversation with the other stakeholders

Fig 8.10. Recording data from field



Fig 8.11 Gears for catching crabs

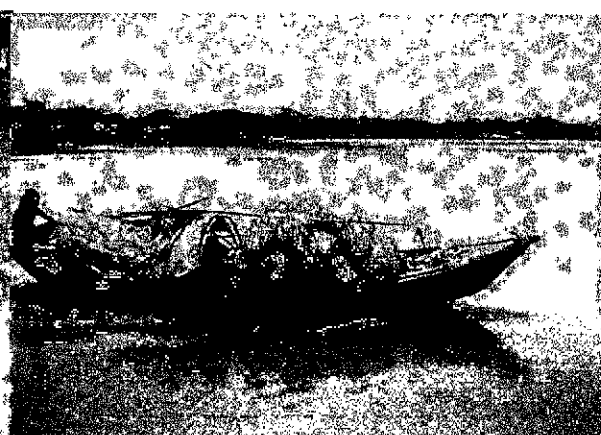


Fig 8.12. Boat ready for operation

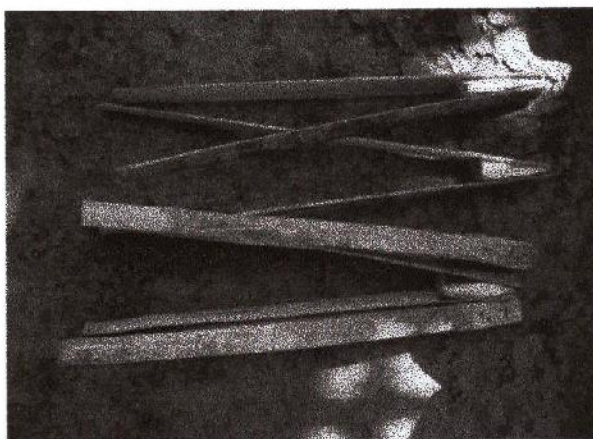


Fig 8.13. Gear (hatol) for catching crabs

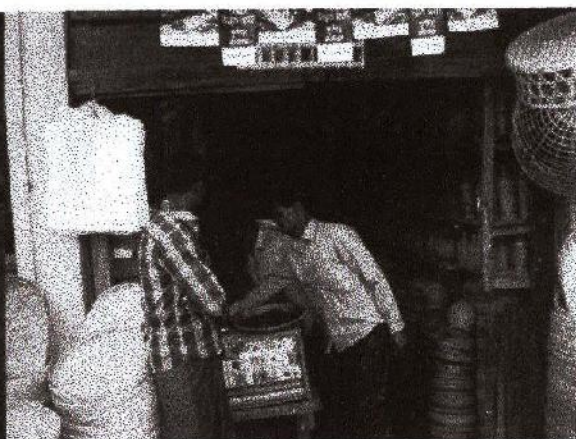


Fig 8.14. Gears are selling in the market

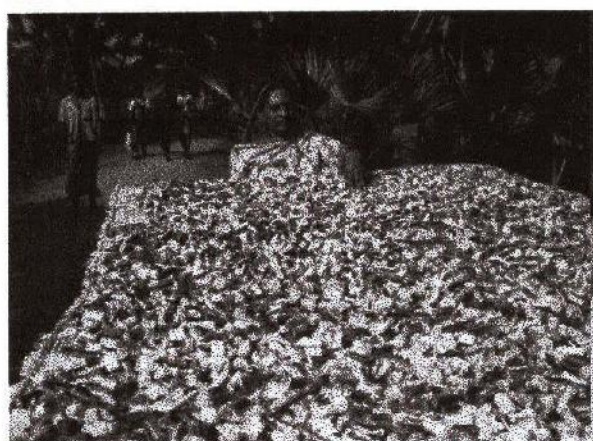


Fig 8.15. Baits are drying



Fig 8.16. Different types of baits in the boat

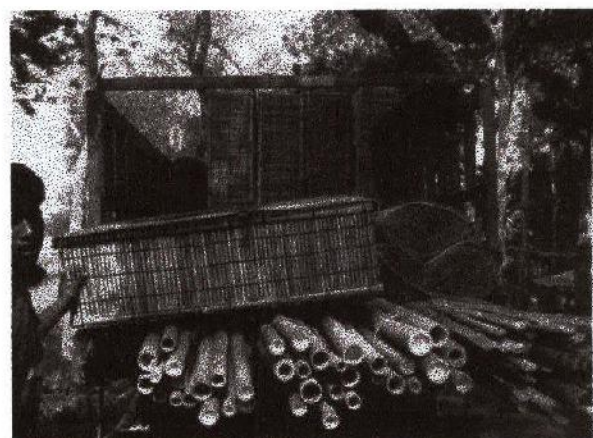


Fig 8.17. Materials taking for crab culture

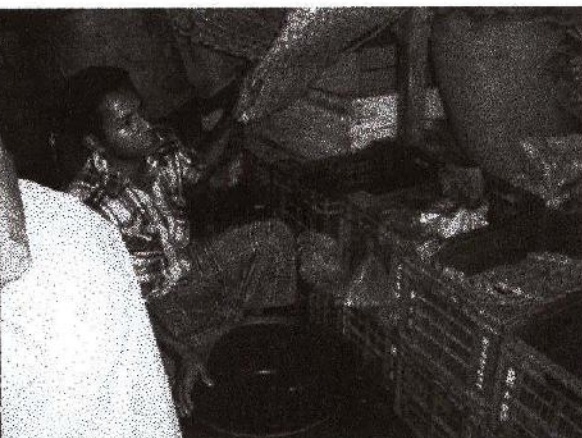


Fig 8.18. Materials using for transportation in winter

Assessing Market Status of Mud Crab (*Scylla sp.*) Fishery in Patuakhali and Barguna District

A Questionnaire for Survey

Questionnaire Id: _____

Date of Survey: _____

Personal Profile:

Name of the Respondent: _____

Type of stakeholders: _____

Sex : ☐ Male ☐ Female Age : ☐ Religion : ☐ Marital status ☐ Academic Qualification: _____Profession: a) Primary profession ☐ b) Secondary profession ☐

Present address: Vill. Thana. District.

Permanent address: Vill. Thana. District.

Residential status: a) Local ☐ b) Migration ☐**Market Profile:**

1. How many years are you involved in crab trading?
2. What did you do before involving in crab trading?
3. Annual income: ☐ 10000-50,000 ☐ 50,000-1, 00,000 ☐ 1,00,000-3, 00,000
☐ 3,00,000-5,00,000 ☐ Above
4. Grading:

	Grade	Weight	Claw condition (full of meat/partial development)	Shell condition (hard/soft)
Male	XXL/			
	XL/			
	L/			
	WXL/			
	WL/			
	M/			
	SM/			
	Others			
Female			Full/partial/immature gonad	
	F1/			
	KS1/			
	F2/			
	F3/			

	Others			
--	--------	--	--	--

15. Price:

Landing center	Local market	Export market	others

5. Source of crab (Locality): ☐ Gher ☐ Sundarban ☐ River ☐ Others

6. Where did you collect these crab?

7. Fishing gear:

8. At what season it is caught in greater number?

9. At what season it is caught in less number?

10. Main market: ☐ Domestic ☐ Export

11. Mode of transport to the market: ☐ Bus ☐ Track ☐ Van ☐ Rickshaw ☐ Boat ☐ Trawler
☐ Others

12. Transportation media: ☐ Basket ☐ Bag ☐ Wooden box ☐ Others

13. Capacity of the media (Kg or piece):

14. Time takes to reach this market (Hr):

15. Mortality during transport (%):

16. Do you pay bribe during transport? ☐ Yes ☐ No

17. Risk analysis: ☐ Mortality ☐ Unavailability ☐ Cannibalism ☐ Time (day 7-10)

18. Mode of payment:

19. Source of finance:

20. Sex ratio:

21. Season at Gonadal Maturity:

21. Rejection:

21. Problems in crab marketing (i.e. over exploitation, low price, lack of demand, supply, credit facility, influence of agent, depot owners, exporters, accessibility to market information):

Crab collectors	
Fatteners	
Middlemen	
Depot owners	
Suppliers	
Exporters	
Retailers	

22. Source of crab:

Season	Sundarbans (%)	Tidal river/canal (%)	Shrimp gher (%)
--------	----------------	-----------------------	-----------------

Summer			
Rainy			
Winter			
Total			

23. Grading system and price:

Male			Female		
Name of grade	Ind. Weight (g)	Price	Name of grade	Ind. Weight (g)	price

24. Record of crab trading:

Date	F1	KS-1	F2	F3	XL	L	M	SM

25. Major problems in crab business

Capital collection:

Crab transportation:

Marketing:

Export:

Taxing:

License:

Others:

26. Means of transportation

	Media of packing	Means of transportation	Time required (hr.)
Collector to depots			
Depots to Dhaka			
Dhaka to foreign country			

27. Mortality estimation (%)

Source	Summer (%)	Monsoon (%)	Winter (%)

28. Did you take any loan to start your business

When	
From whom	

How much	
Was it sufficient	

29. Annual volume of crab

Name of depot	Geographic location of depot		Annual volume	Construction features			Size of depots	Manpower
	Long.	Lat.		Katcha	Semi-pacca	Pacca		

30. Previous record:

Grade												
F1												
KS-1												
F2												
F3												
XL												
L												
M												
SM												

31. Crafts and Gears used for collecting crabs:

Signature of the Respondent