



E-ISSN: 2347-5129

P-ISSN: 2394-0506

(ICV-Poland) Impact Value: 5.62

(GIF) Impact Factor: 0.549

IJFAS 2020; 8(2): 249-257

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[www.fisheriesjournal.com](http://www.fisheriesjournal.com)

Received: 07-01-2020

Accepted: 09-02-2020

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# International Journal of Fisheries and Aquatic Studies

## An approach to open a new arena for blue growth of Bangladesh by mud crab (*Scylla serrata*) fishery from the Karnafuli River estuary, Chattogram; Bangladesh

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### Abstract

Mud crab (*Scylla serrata*) is an ecologically important species naturally found in Bangladesh, especially in the tidal rivers of Khulna, Bagherhat, Satkhira, Cox's Bazar and Chattogram. Worldwide demands of mud crabs can open an arena for the socioeconomic development of Bangladesh. Bangladesh exports thousands of tons of crab worth tens of millions of US dollars every year into East and Southeastern Asian countries. From the statistical report of DoF, 2017, the part of crabs is 0.34% into the total fish production of Bangladesh. The findings of the study revealed that during the mud crab catching season from February - May (4 months), one mud crab catcher's daily income Taka. 4500 - 7350 which is greater than other districts of Bangladesh. Wild mud crab catching is a seasonal profession. Subsequently mud crab catchers livelihood is very difficult and they fight with economical poverty during off season from June - January (8 months). Wild mud crab catching from Karnafuli River estuary may become a profitable export item, which needs proper support from relevant policy makers.

**Keywords:** Mud crab, *Scylla serrata*, Karnafuli River estuary, mud crab catcher, seasonal profession

### 1. Introduction

Bangladesh, a land of rivers has predominantly four major river systems like the Brahmaputra-Jamuna, the Ganges-Padma, the Surma-Meghna, and the Chattogram Region river system. Among these Karnafuli River is the largest and most important river in Chattogram and the Chattogram hill tracts, originating in the Lushai hills in Mizoram State of India. It travels through 180 km of mountainous wilderness making a narrow loop at Rangamati and then follows a zigzag course before it forms two other prominent loops, the Dhuliachhari and the Kaptai. After coming out from the Kaptai loop the river follows another stretch of tortuous course through the Sitapahar hill range and flows across the plain of Chittagong after emerging from the hills near Chandraghona. Therefore, the river drains into the Bay of Bengal cutting across several hill ranges, viz. the Barkal, Gobamura, Chilardak, Sitapahar and Patiya of the Chattogram hill tracts and Chattogram<sup>[1]</sup>

On the other hand Bangladesh has an extensive coast line of about 710Km.<sup>[12]</sup> 710. The southeastern and southwestern coastal area of Bangladesh is mostly covered by a complex estuarine ecosystem. The Karnafuli River estuarine ecosystem is located on the southeastern part of Bangladesh has extensive mud flats and a brackish water body due to connection with the Bay of Bengal. This estuarine area forms a transition zone between fresh and saline water environment. The mixing of these two water bodies provide high levels of nutrients both in the water and in the sediment of the estuary; which make the zone very fertile and productive habitat for plants and animals. As many as 50 species of crabs have so far been identified in the coastal and marine habitat as of the Bay of Bengal of which 11 are purely marine water crabs<sup>[18]</sup>. Among these marine crabs, mud crabs are one of the most abundant animals in this region because this is the best and suitable dwelling place for them.

Mud crab (*Scylla serrata*) also known as mangrove crab or black crab, locally known as Habba Kakra, Shilla Kakra or Kankra<sup>[21]</sup> is an ecologically important species of crab found in the estuaries and mangroves of Africa, Australia and Asia. In Bangladesh, mud crabs occur abundantly in the tidal rivers of Khulna, Bagherhat, Satkhira, Cox's Bazar, Chattogram.

It is harvested from the coast line of the Bay, in the creeks and canals of the brackish water estuaries<sup>[21]</sup>.

In the southwest coastal belt of Bangladesh, millions of poor fishers, traders, and transporters are directly or indirectly dependent on live crab catching and collection. The production of mud crab has attracted several private sectors into this emerging and profitable sector [9]

Mud crab is one of the most important crustacean coastal aquatic species after the shrimp in Bangladesh because it is a potential export earner due to high demand in East and Southeast Asian countries [1]. Since the mid 70s, the crab marketing system has developed in Bangladesh with a view to export mud crab to foreign markets. Export of mud crab from Bangladesh started in 1977 and the first consignment was worth \$2,000 only [21]. Now the volume of mud crab export increases day by day and apart from the main destination China, crabs are also exported to Hong Kong, Taiwan and Malaysia [4]. Bangladesh shipped crabs worth \$23.82 million in 2015-16, which was \$7.2 million in 2010-11, according to Export Promotion Bureau [9]. Mr. Shafiqul Alam, an exporter and proprietor of ZF Trade International, cited that Bangladesh mainly export crabs to China where there is high demand for crabs. During July-October 2018, shipment rose 28 per cent year-on-year to \$3.5 million. Bangladesh exports about 1,200 tons of crabs a year [16]

In Bangladesh, mud crabs are comprehensively harvested from wild stock that's why a decreasing of crab population arises. Due to the high demand for mud crabs in foreign markets crab catchers and crab exporters run after their profit and business. They do not think about the sustainable catch or stock conservation because they have lack of knowledge about stock management. Moreover, there is no exact data on mud crab stock assessment to know about the present situation.

Alternatively mud crab aquaculture has been practiced for many years in the coastal regions, particularly in southeast (Chittagong, Cox's Bazar, Noakhali) and southwest (Bhola, Potuakhali, Barguna, Phirujpur, Bhagerhat, Khulna and Satkhira) Bangladesh. Mud crab farmers are to be practiced mud crab fattening in pen and cages in the coastal area by traditional methods [5]. The growth of mud crab culture is likely to lead changes to the ecological, socio-economic and

livelihoods methods [8].

Considering all above the research aimed to explore the wild mud crab catching technique, livelihood of mud crab catchers, marketing of mud crabs and cost-effectiveness analysis of mud crab catching. From this study, it was clear that the activity of wild mud crab catchers is still now had no importance or cannot grow any interest to the relevant policymakers of Bangladesh though it is a profitable business. There is a potential scope on mud crab fishery, economical condition of Bangladesh will be changed by proper management because this is an exclusively export oriented item. As a result this sector needs proper management and implementation of some rules and regulations from the fisheries policymakers.

## 2. Materials and Methods

### 2.1 Stud Site

The study was conducted in the Karnafuli river from the areas of Kalurghat Bridge to Air port Ferry Ghat (Figure 1) and Located from 22°23.7'N, 91°53.4'E to 22°15'N ,91°49.8'E by GPS coordinates.

### 2.2 Means of Data Collection

We visited different types of small boats engaged in Mud Crab by small ferry boat (Called Sampan) to collect data and take interviews of mud crab catchers. Throughout these study periods, we talked with 15 crab catchers, take their interview and collect available data from them on their catch, livelihood, investment etc. for this study. We also collected data on mud crab marketing channel, transportation system, processing method, export etc. from the crab catchers.

### 2.3 Measurement of collected samples

Samples data were brought to Zoological Laboratory of Marine Fisheries Academy and stored them in specialized plastic basket. Weight and dimension (Length, breadth) were taken by the digital weighing scales and Centimeter Scales. After taking measurement of data samples, maximum specimen were released in the water of Karnafuli River.

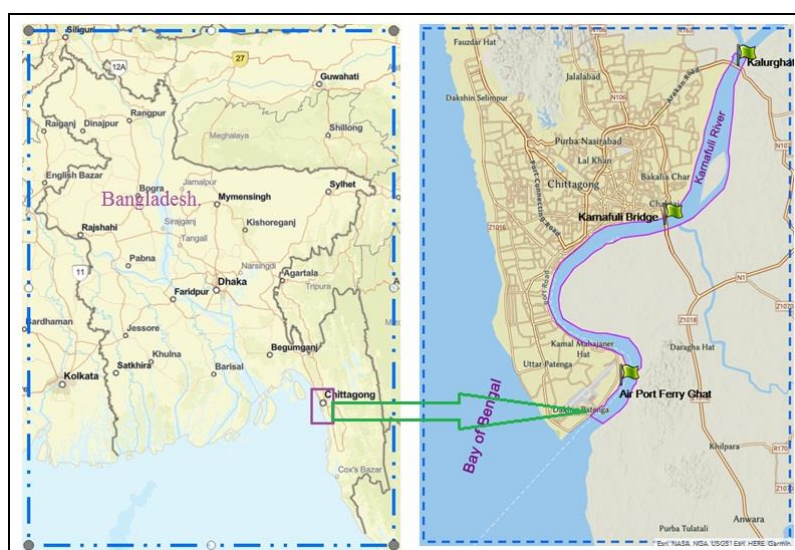


Fig 1: Study area and survey station (P) in the Karnafuli River

## 3. Results and Discussions

Mud crabs were caught from the Karnafuli River in a very traditional way. In the time of mud crab catching season, the

crab catchers stay on their non mechanized wooden boat (small/large) where they spent four months. By this boat, they travel from one place to another on the river and fix the traps



in suitable places where the possibility of mud crabs availability. They do it by using their work experiences from several years. They have no modern equipments to locate mud crab's habitat. Generally, they use baited bamboo traps called Chai or khancha, which is locally made in Moheshkhali Island. These traps are supplied to them by the Party, who

also gave them advance payment for mud crab catching. The number of traps are varied in a boat according to the number of crab catchers and size of boats, for example, 70 traps were found in a boat where only two peoples worked and 120 traps found in a boat where four people's worked; their boat is bigger than the former one.



**Fig 2:** Small boat with 2 catchers and boats

Small sized blowfishes (order Tetraodontiformes) are utilized as bait in the bamboo traps. These fishes are very cheaper and collected from the Karnafuli cold store, Sadarghat, Chattogram, Bangladesh at a rate of Taka 30 per Kilogram. Normally they catch mud crabs from the river twice in a day. They follow the tidal period of river water for fixing or lifting the traps, such as at the endpoint of low tide traps are fixed under the river water below 30 - 40ft. and at the end of high tide traps are lifted from the water. The quantity of mud crab catch is higher if they use new trap than the old trap. They do not catch brooder because of less demand from the consumer.



**Fig 5:** Mud crab catchers engaged in work bucket.



**Fig 3:** Blowfishes.



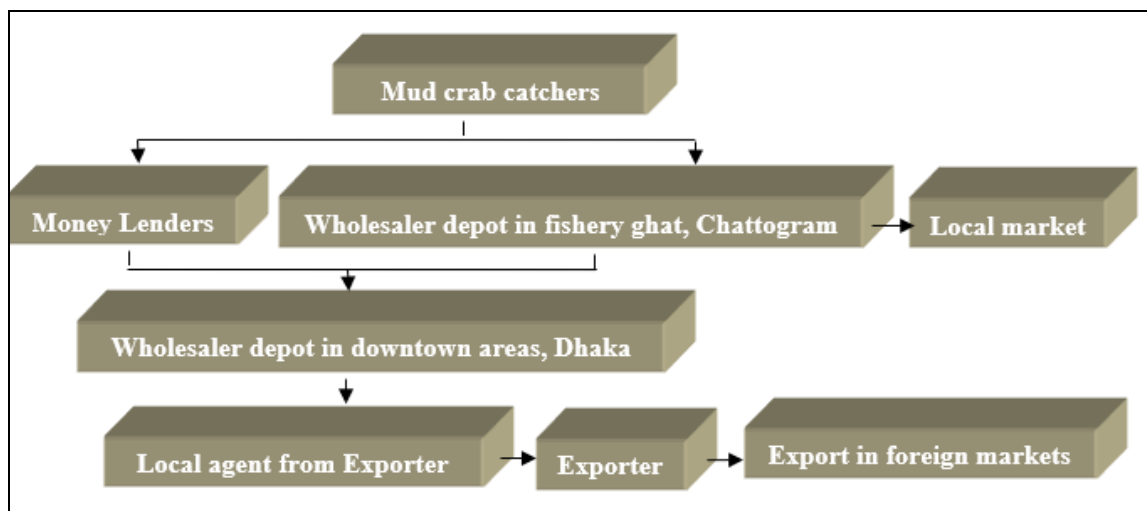
**Fig 6:** Mud crabs preserved in plastic



**Fig 4:** Mud crab catching trap

### 3.1 Marketing of mud crab

At the end of the day, the money investors or lenders (the crab catchers called them 'Party') collect every day's catch from the mud crab catchers. On the other hand mud crab catchers also send their catch to the wholesale market, where mud crabs are generally marketed alive. A large number of people are involved in mud crab marketing system. Here reveal the mud crab marketing channel (Figure 6) in a concise form (According to mud crab catcher Md. Miraz, 26 May 2019, Anu Mazir Ghat, Karnaphuli River Estuary)



**Fig 7:** Marketing channel of mud crab

Mud crab is a non-traditional item. Very few people in Bangladesh eat it. An area has been developed at Uttara in Dhaka for shipping live crabs by air to various destinations [16]. There is a high demand for large-sized male and female mud crabs in world market. Local exporters have been shipping crabs for the last couple of decades [16].

**3.2 Transportation and Processing of mud crab**

Mud crabs were preserved as live in the boat in a plastic bucket without water or any food (Figure 6); sometimes mud crabs remained in the boat for 2-3 days. At normal surrounding environmental condition mud crabs remain fresh and live, no death or no quality deterioration occurred. All the mud crabs were transported to Dhaka by truck. During transportation mud crabs were kept in bamboo baskets; Pereiopods were tied with plastic ropes. As mud crabs can survive several days without food so it is not necessary to provide extra facilities for them but only requirement is cold water spray over the mud crabs. All the expenditure of transportation is paid by the money investors and there is no role of mud crab catchers.

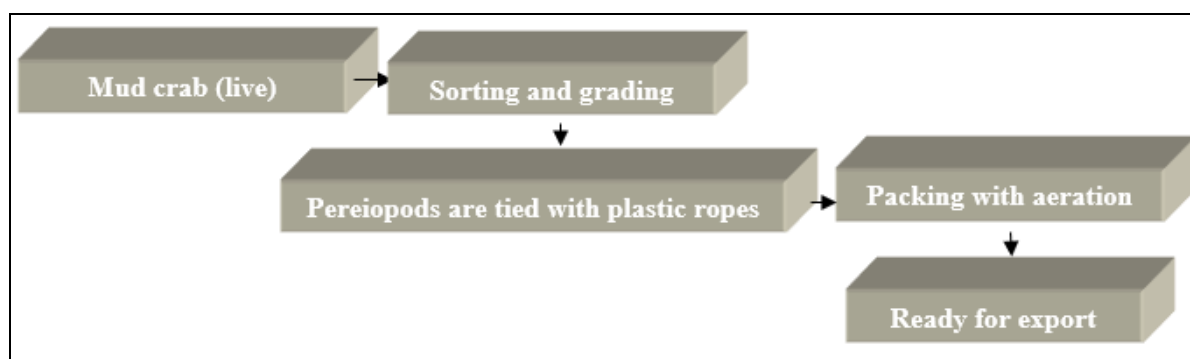
**3.3 Trading and Exportation**

Before the sunrises the workers in the wholesaler depot sorted mud crabs according to sex, size, body weight, gonadal

maturation and hardness of the carapace as well as graded following local and international grade [4]; then packed the mud crabs in plastic buckets with aeration. The whole processing work ends before midday, all plastic buckets were loaded on the trucks for shipment in airport. In the plastic buckets cold water spray applied on mud crabs after some intervals during transport to keep them moist (According to mud crab catcher Md. Miraz, 26 May 2019, Anu Mazir Ghat, Karnafuli River Estuary)



**Fig 8:** Mud crab ready for packing.



**Fig 9:** Mud crab Processing method

**3.4 Cost effectiveness analysis**

Mud crabs are one of the most valuable natural resources having economic value resulting from commercial sale to local markets and export [5]. Live mud crab marketing is become a profitable business for Bangladesh. Every year

Bangladesh exports mud crabs in East and Southeastern Asian countries. China, USA, Japan, South Korea and Thailand are the top five consumers. In recent years, crab business has been increasing due to buyers demand [12]. China is the single largest crab importer of Bangladesh [9]. In China about 35 to

40 tons of crabs are exported every day, as the foodies have a special penchant for the tasty crustacean. The country's weather, soil and water quality is particularly favorable for crab and exporters and they are in great demand in parts of Asia [10].

Catching mud crab is a low capital enterprise yielding a high priced product and the fishery should have high returns [14]. However mud crabs are caught from the Karnafuli River estuary by a traditional method, there are a few expenditures for running the business. Some people invest their money for one season to catch mud crabs, they are known as Party. Maximum parties are from Moheshkhali Island. They provide traps (as per requirement of crab catchers) as well as rope, anchor etc. the total expenditure is almost 20000 - 25000 taka. Normally, each small boat requires 70 traps and large boat

requires 120 traps for each trip. On the other hand crab catchers have no investment except the small wooden boat; used to catch mud crabs which they can use for 3-4 years and their daily food.

In January, the party comes to the crab catchers and make a deal with them. Both of them mutually fix the price of mud crabs according to current market price. Mud crab's market price varies according to demand, sex, maturity, size and weight of the crabs. There are different sizes such as 6-7 crabs make one kilogram; weight of each crab is almost 200gm, 5-10 crabs make one kilogram; weight of each crab is almost 100gm. Table 1 shows the total picture of per day crab catching scenario per wooden boat (approximate) (According to mud crab catcher's data, 2019).

**Table 1:** Market price of mud crabs according to their weight

Grade of Mud crabs	Weight of each crab (gm)	Number of mud crabs caught in each catch /Wooden boat/Day	Weight of mud crabs in each catch (kg) /Wooden boat/Day	Market Price/kg (Taka)
5 -10	≥ 100	40 -50	4-5 (Minimum)	500-700
		100 - 150	10-15 (Maximum)	
6-7	≥ 200	40 -50	4-5 (Minimum)	1000 - 1200
		100 - 150	10-15 (Maximum)	

\*Taka is the currency of the People's Republic of Bangladesh.

From collected data it was found that annual fixed expenditure for mud crab catching in the Karnafuli River estuary is 20000 – 25000 taka; given by the Party not by the catchers. Mud crab catcher Shaikh Abdul Mannan, 2019 informed us that they caught 1-5 mud crabs in each trap per catch effort; depends on luck as he mentioned. Now, if we

consider his data, an estimated price value is come out in front of us which are pointed out in Table 2 to Table 5.

**3.5 Cost effectiveness analysis for one small boat per catch effort (with 2persons, 70 traps)**

**Table 2:** Selling price of mud crab/4 months

Number of mud crab caught in each trap	Number of mud crabs caught in 70 traps	Weight of each mud crab (gm)	Total weight of mud crabs (kg)	Price/Day (Taka*)	Price/Month (Taka*)	Price/4 Months (Taka*)
1	70	100	7	3500 - 4900	105000 - 147000	420000 - 588000
5	350	100	35	17500 - 24500	525000 - 735000	2100000 - 2940000
1	70	200	14	14000 - 16800	420000 - 504000	1680000 - 2016000
5	350	200	70	70000 - 84000	2100000 - 2520000	8400000 - 10080000

\*Taka is the currency of the People's Republic of Bangladesh.

**Table 3:** 4 months income of one mud crab catcher of small boat.

Number of mud crab caught in each trap	Number of mud crabs caught in 70 traps	Weight of each mud crab (gm)	Total weight of mud crabs (kg)	Average income of 2 mud crab catchers/4 months (Taka*)	Average income of 1 mud crab catcher/4 months (Taka*)
1-5	70 - 350	100	7 - 35	1260000 - 1764000	630000 - 882000
1-5	70 - 350	200	14 - 70	5040000 - 6048000	25520000 - 3024000

\*Taka is the currency of the People's Republic of Bangladesh.

It is clear that, the average income of one mud crab catcher vary according to the number of catch and weight of mud crabs. For 7-35 numbers of mud crabs and 100gm weight of each, the average 4 months income is 630000 - 882000 Taka and for 14-70 numbers of mud crabs and 200gm weight of

each, the average 4 months income is 25520000 - 3024000 Taka (Tables 3, column 6).

**3.6 Cost effectiveness analysis for one large boat (with 120 traps) per catch effort**

**Table 4:** Market price of mud crab/4 months (Large wooden boat 120 traps).

Number of mud crab caught in each trap	Number of mud crabs caught in 120 traps	Weight of each mud crab (gm)	Total weight of mud crabs (kg)	Market Price/catch (Taka*)	Market Price/Month (Taka*)	Market Price/4 Months (Taka*)
1	120	100	12	6000 - 8400	180000 - 252000	720000 - 1008000
5	600	100	60	30000 - 42000	900000 - 1260000	3600000 - 5040000
1	120	200	24	24000 - 28800	720000 - 864000	2880000 - 3456000
5	600	200	120	120000 - 144000	3600000 - 4320000	14400000 - 17280000

\*Taka is the currency of the People's Republic of Bangladesh.



**Table 5:** Four months income of one mud crab catcher (Large boat, 120 traps)

Number of mud crab caught in each trap	Number of mud crabs caught in 120 traps	Weight of each mud crab (gm)	Total weight of mud crabs (kg)	Average income of 4 mud crab catchers/4 months (Taka*)	Average income of 1 mud crab catcher/4 months (Taka*)
1-5	120 - 600	100	12 - 60	2160000 - 3024000	540000 - 756000
1-5	120 - 600	200	24 - 120	8640000 - 10368000	2160000 - 2592000**

\*Taka is the currency of the People’s Republic of Bangladesh. \*\* This type of income is absolutely not possible.

For 12-60 numbers of mud crabs and 100gm weight of each, the average 4 months income is 540000 – 756000 Taka and for 24-120 numbers of mud crabs and 200gm weight of each, the average 4 months income is 2160000 – 2592000 Taka (Table 5, column 6).

Though the mud crab catchers did not share with us about their seasonal income (4 months) but during this study it was finally revealed that average four months income of a mud crab catcher is almost 540000 - 882000 Taka (approximately) (Tables 3 & 5, Column 6). From this data we can estimate one crab catcher’s daily income; which is shown in Table 6.

**Table 6:** Daily income of one mud crab catcher

Average income of 1 mud crab catcher/4 months (Taka*)	Average income of 1 mud crab catcher/ Month (Taka*)	Average income of 1 mud crab catcher/Day (Taka*)
540000 - 882000	135000 - 220500	4500 - 7350

\*Taka is the currency of the People’s Republic of Bangladesh.

**3.7 Livelihood of mud crab catchers:**

The mud crab catchers work in the Karnafuli River during the month of February-May in each year, the peak period of mud crab catching. Actually, mud crab catchers are original fishermen. Their basic profession is fishing. They engaged in fishing from the Karnafuli River throughout the year except for February-May. Some crab catchers are coming from the Moheshkhali Island, during offseason they went back to their home in the island. There they work for fish drying and small scale fishing in the coastal region (Olsen Barua, Mud crab catcher, Karnafuli River estuary, 2019).

Maximum mud crab catchers informed us that mud crab catching becomes their main source of income because currently, fishes are not available in the Karnafuli River; during offseason, they caught only 2-3 kg of anchovy, catfish and some other small fishes per day. Price of these fish is 600 - 700 Taka and this is their daily income; which is very negligible for their livelihood. But during mud crab catching season their daily income is Taka. 4500 – 7350



**Fig 10:** Traps are drying during offseason



**Fig 11:** Boats on the river bank during offseason

The present study was conducted to explore the way of wild mud crab catching from the Karnafuli River Estuary, catch statistics and related aspects of economic value or opportunities of wild mud crab catching as well as livelihood of mud crab catchers.

First of all, the mud crab catchers follow most traditional and ancient method to catch mud crabs and they use ordinary handicraft bamboo traps for catching. One bamboo trap can be used for 1-3 months, depends on the quality of the trap and the force of water current acts on them. Condition of the trap is very important for better catch. If they use new bamboo traps, then catch is high but when these traps become older then mud crabs escaped from the traps, as a results, amount of catch declined. The mud crab catchers are not aware of this type of loss. They take it as a usual matter consequently they use old traps for the time being until the traps are fully damaged. It was found that actually the catchers always believe on their fate so they depend on nothing but wait for how many mud crabs are trapped into the traps. Then they are able to collect the crabs and give them to the Party. This is happened because of lack of educational knowledge and awareness about modern technology of the catchers. Another important thing is that the bamboo traps are given by the Party at the beginning of the season. So there is also a fact remains in this situation that is carelessness of the Party. He does not understand the importance of strong and good quality bamboo traps which is one of the foremost items for his business. This research revealed that when the catchers and the Party understand the reality then quantity of mud crab catch will be increase.

Second thing is that the quantity of daily catch, price of mud crab as well as the numbers of boats engaged in the Karnafuli River estuary were varies from one mud crab catcher’s data to another. Actually, no detailed data were given by mud crab catchers to know exact feature of this business. According to field survey, all the collected data are summarized in Table 7.

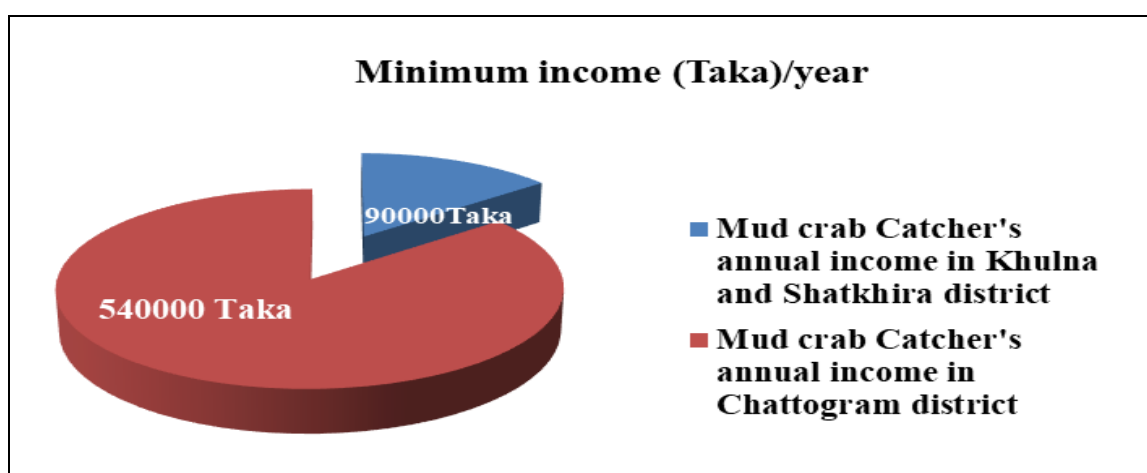
**Table 7:** Summarized data on mud crab catching in the Karnafuli River estuary

S. No	Concern matter	Minimum range	Maximum range
1.	Quantity of mud crab catch per day	4 kilogram	15 kilogram
2.	Numbers of boats engaged	100	200
3.	Market price of mud crab per kilogram	250 Taka*	1200 Taka*
4.	Daily income of one mud crab catcher	4500 Taka*	7350 Taka*

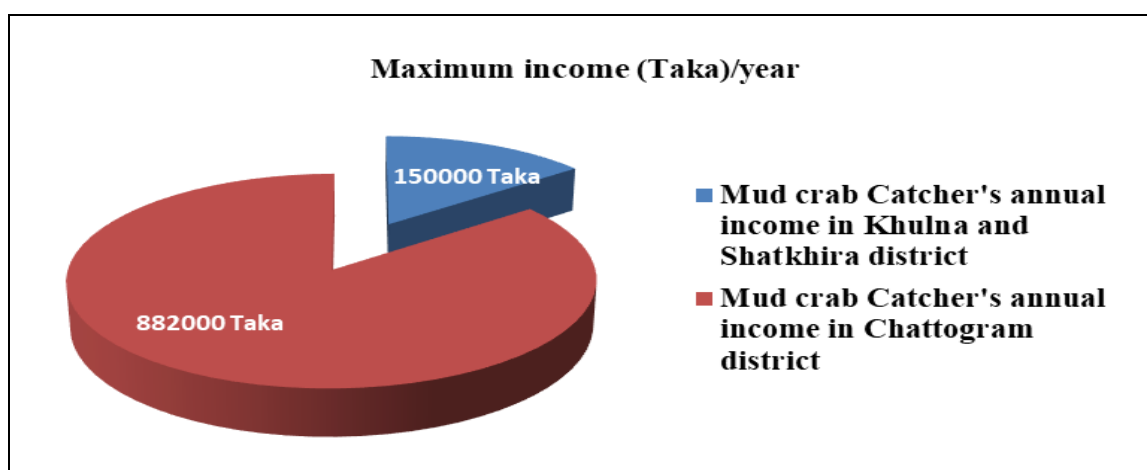
\*Taka is the currency of the People’s Republic of Bangladesh.

Mud crabs are caught from the Karnafuli River since 10 years without following any scientific method or using modern gears. On the basis of this study it can understood that there is no exact survey data to determine mud crab’s annual stock of the Karnafuli River. A designed and methodical study is needed to determine the present status of wild mud crab catching in the Karnafuli River of Bangladesh with a view to undertake appropriate measures to conserve and manage this aquatic resource in a sustainable way. As excessive catches from natural sources may affect biodiversity, cultivating fries in hatcheries has become important, according to officials of

Department of Fisheries, Bangladesh <sup>[16]</sup>. When considering the income of other district’s crab catchers, for example in Khulna and Satkhira districts we find that annual income of most of the crab catchers were less than Tk. 90000 while 20% of them earned Taka 90000 - 150000 respectively <sup>[15]</sup>. In contrast most of the mud crab catcher’s of Chottagram earn Taka 540000 - 882000 in one season (4 months). This comparison revealed a distinct demarcation line between Chottagram and other districts crab catcher’s yearly income. That proves mud crab catchers of Chottagram district have better income than the other districts



**Fig 12:** Comparing minimum annual income between mud crab catchers’s of Chattogram with Khulna and Satkhira districts

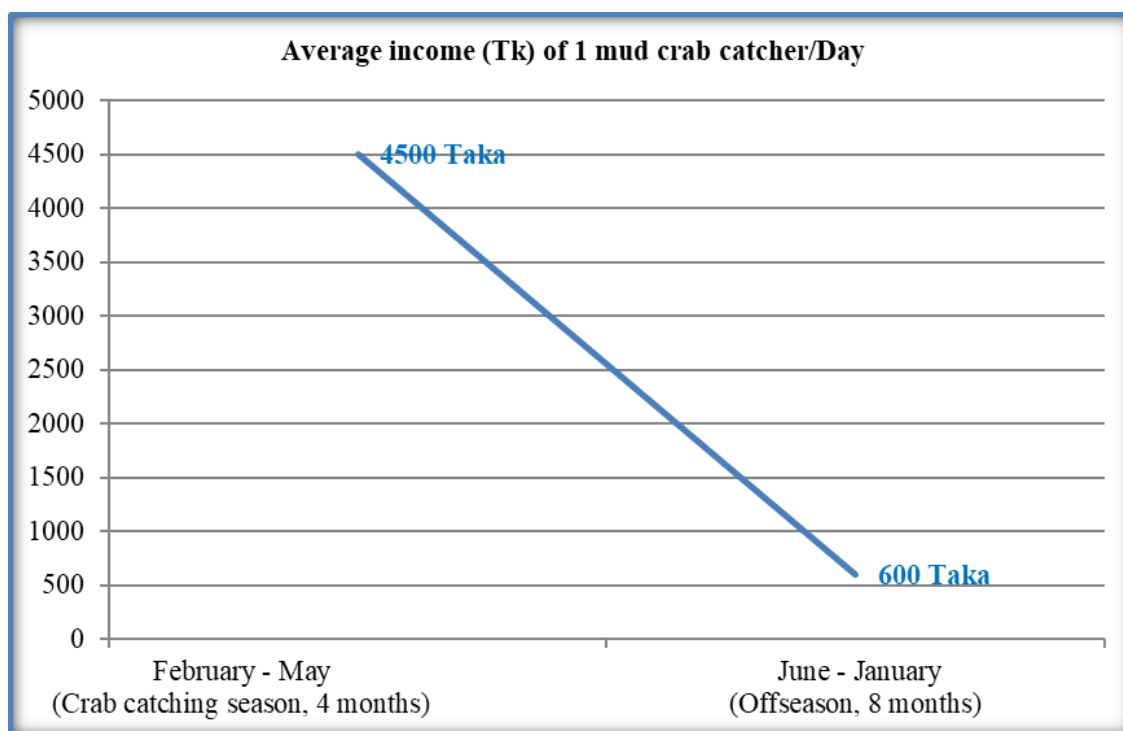


**Fig 13:** Comparing minimum annual income between mud crab catchers’s of Chattogram with Khulna and Satkhira districts.

As a result, this study clearly point towards that the mud crab catcher’s of Chattogram have a handsome earning opportunity from this profession though the period of work is very shorter than the other general professions. But this is a unique profession where low investment brings high profit for the stakeholders.

Third remarkable thing is unpredictable livelihood of mud crab catchers. This study established that the catchers lead an uncertain life in offseason that is a long period of 8 months.

There is an inclined income started during offseason in these mud crab catchers life .Economically they face different problems, especially for carrying their children’s educational cost during offseason. They informed us that they are satisfied about their 4 months income earned by mud crab catching (Tables 3 & Table 5) but other 8 months are awful to them. They need a benevolent look at their livelihood support from the government for alternate income during off season.



**Fig 14:** Average income of a mud crab catcher/Day during crab catching season and off-season.

Karnafuli River and its coastal areas are an integrated and essential part of our ecosystem and are significant vision to Sustainable Development Goal 14. In addition, this area is important for food security and human health. Wild mud crab catching from Karnafuli River estuary will become a profitable export item if proper support and study provide to this sector. One notable thing is that our shrimp industry now facing tremendous problems regarding seed supply, disease, market competition with other shrimp species, But mud crabs are less susceptible to disease and more resistant to adverse environmental conditions and climate change, so mud crab fishery may replace instead of shrimp export in Bangladesh.

#### 4. Conclusion

Every year, due to environmental disaster Bangladesh lost her natural mangrove habitats and faced coastal environmental degradation. It has a harmful effect on mud crab population because they loss their habitat. So it is very prime requirement to recover the coastal zone for ensuring a safe habitat of mud crabs. Otherwise, this promising field will decline within a very short period. At the same time mud crab catchers need attention from the governmental organization to carry on their profession more smoothly. They also need financial assistance or alternative job for them during off season. Export of mud crabs will increase by nourishing these people and also by establishing sustainable mud crab catch. More over this sector needs research to overcome limitations of knowledge in every aspect of development and regulations.

#### 6. Acknowledgement

We are grateful to Almighty Allah for being able to complete this research work with success. Then we express our thanks to those mud crab catchers, especially Sheikh Abdul Mannan who helps us by giving valuable information for this research work. We also give our thanks to Boat driver Mr. Saber Ahmed and boat crew, Mr. Mohiuddin of Marine Fisheries Academy, Chattogram for their cooperation during journey by boat in the Karnafuli River, Chattogram, Bangladesh.

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