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A survey on the production and marketing of mud crab, *Scylla serrata* (Forskal, 1755) in the south-western part of Bangladesh

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Abstract

An investigation was conducted to estimate approximate production and assess the marketing of mud crab in the south-western region of Bangladesh. Crab culture was done by hardening and fattening collected from the natural source. Most of the fattening farms were 0.2 to 2 acres. Fattening and hardening period varied from 10 to 30 days. The Sundarban mangrove, tidal rivers, estuaries, canals, shrimp farms and fattening ponds were the sources of mud crabs. The total number of mud crab depots was 328. Three types of physical conditions of the crab depots were recorded, Kacha (110), Semi-pacca (150) and Pacca (68). The grading system of crabs varied depending on sex and size. The total production of mud crab was 6945.62 (t) in Khulna-Satkhira-Bagerhat districts. The maximum (2655.91 t) mud crab was produced in Bagerhat district and the minimum (1777.15) in Satkhira. The production was maximum (3567.86) in the monsoon and the lowest (1306.95) in summer season. The prices of mud crabs varied with grade and season. The mud crab marketing was highly export oriented and the major export markets were Taiwan, Singapore, Hong Kong, Malaysia, Thailand and USA. Some rudimentary domestic markets were found in the region based on rejected crabs at depots for domestic consumption at low price. During transportation the mortality was about 14-20%. Three types of marketing with a chunk of profit were found in middlemen or brokers.

Keywords: Fattening and hardening, marketing channels, mud crab, Bangladesh.

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1. Introduction

The mud crab (*Scylla serrata*) generally locally called as " Habba kakra", "Silla kakra" or "Kankra" is one of the most important coastal aquatic species after the tiger shrimp in Bangladesh due to its high demand and price in the international market [1]. It occurs throughout the coastal waters of Bangladesh particularly in the estuaries, swamps of the Sundarban Reserve Forest and shrimp ghers [2, 3]. Among the 16 marine species only mud crab is commercially important [4]. It is

one of the biggest crustaceans under the Portunidae may attain 2 kg. in weight [5] also distributed in the Indo-West-Pacific region [6] and the most popular and costly sea foods in the South-East Asian countries [7]. Bangladesh earns considerable amount of foreign exchange through exporting this animal in live condition. Its fishery supports the livelihood of millions of poor fishers, traders and transporters. It is a voracious predator of young fish and prawns [8]. Thus it plays a vital role in the ecological balance. It is nocturnal in behavior, remaining buried during the day time and emerging at night [9].

The mud crab fishery is absolutely based on wild catch mainly from the swamps of the Sundarbans and vast areas of the traditional shrimp ghers along the coastal region of Bangladesh [10]. Its actual culture technique of mud crab has not yet been developed in our country. People of the coastal region follow traditional fattening process to grow crab. Simple small ponds are used in coastal areas for crab fattening in Bangladesh. These ponds are fenced by bamboo sticks locally known as "Pata" to prevent escaping of crab. Fattening usually requires 2-4 weeks to complete. Within this time, premature crabs are well fed to develop their gonad fully.

The mud crab was first exported in 1977-78 fiscal year and become a stable business in 1982 [11]. Before 1977 it was a virgin stock and the local market was very small. The Muslim community in Bangladesh doesn't accept mud crab as a regular food item. During 2006-07 fiscal year mud crabs has taken the 3rd rank among the fish and fisheries export earnings from Bangladesh [12]. Therefore, the export of live mud crab from Bangladesh has increased many folds in the last decades [13].

In Bangladesh crabs are indiscriminately harvested only from wild stock, resulting in a noticeable decline in their population. There is a huge harvesting pressure because of high demand in international market. The resource has already been over-fished [14]. But no information is available on the marketing and transportation of mud crabs in Bangladesh. Therefore, the present study was conducted in order to assess the approximate production of mud crab from the south-western region of Bangladesh and their marketing.

2. Materials and Methods

The survey work was carried out in south-western (SW) region i.e. Khulna Satkhira and Bagerhat districts during November, 2007 to October, 2008. Data were collected through interviewing different farmers and stakeholders involved in mud crab marketing and transportation (catchers, middleman, depot owners and exporters) by a prescribed questionnaire covering following key issues: Number of mud crab depots; Number of mud crab traders in depots; Production of mud crab; Marketing channel and methods; Transportation system; Grading and pricing system; Causes of mortality or losses of mud crab etc. In terms of construction materials, the depots were categorized into 'Kacha' (made of bamboo, bamboo-fence and by Nypa-leafs with earthen floor), 'Semi-pacca' (made of bamboo wood and tin roof with concrete floor) and 'Pacca' (made of bricks and RCC). In addition, relevant information was also collected as secondary sources, viz., published reports, journals, literatures etc. All the collected data were analyzed by using a PC. Microsoft Excel software was used for statistical analyses. Production of mud crab was expressed in tons (t). The grade-wise production of mud crab was estimated from randomly selected depots. The total numbers of mud crab depots were multiplied by the average production from randomly selected depots.

3. Results and Discussion

Technique of fattening and hardening

Juvenile crabs were collected from Sundarban and adjacent rivers for hardening and fattening and the rejected crabs were brought in crab ghers from crab depots. They were transferred for trading again into the crab depots. The size of mud crab fattening and hardening ponds varied from 0.2 - 2 acres. Most of the ponds were divided into 3 - 4 components by using bamboo fences of 1 to 2 meter in height. The pond depth varied from 0.25 - 1.50 m. and water ranged between 0.50 - 0 .75 m. Most of the ponds were rectangular having a common inlet and outlet made of PVC pipes. The peak season for fattening was winter and summer but they continued it during the whole monsoon. The stocking density varied from 15,000 - 25,000 individuals/acre and fed at 5-10% of body weight once in a day during evening hours. The farmers used crabs feed such as trash fishes, snail meat, offal of chicken and cattle. The period of fattening and hardening varied from 10 to 30 days depending on the stage of gonad and/or hepatopancreas development, shell development and price of fattened crabs in the depots. Almost no management practices were found for fattening mud crabs. Exchange of water was done only before stocking new batch or when water quality deteriorated severely. Farmers usually did not use any kind of fertilizer or lime in their pond. Only fattened crab and hardened crab were found to be harvested regularly. Hardened crabs were checked by hand striping. Selective harvesting of fattened crabs was done with baited trap and small push net and total harvesting by hand after dewatering the pond.

Distribution and manpower of mud crab trading depots

The total number of crab depots and manpower involved in SW region were estimated to be 328 and 790 respectively. The total number of depots and manpower involved Khulna, Satkhira and Bagerhat districts in crab business were estimated to be 140, 85, 103 and 345, 215, 230 respectively. The number of locality was counted to be 13, 12 and 16 (**Table 1**).

Table 1: Distribution and manpower of mud crab trading depots

District	No. of Upazillas	Locality	No. of Depots	Manpower
Khulna	5	13	140	345
Satkhira	5	12	85	215
Bagerhat	5	16	103	230
Total	**15**	**41**	**328**	**790**

Physical condition of mud crab trading depots

Most of the mud crab depots were located nearby the river or road and easily connected with the high ways. Out of 328 mud crab depots 33.54%, 45.73% and 20.73% were ‘Kacha’, ‘Semi-pacca’ and ‘Pacca’ respectively (**Table 2**).

Table 2: Physical conditions of mud crab depots

Condition	District				
	Khulna	Satkhira	Bagerhat	Total	%
Kacha	30	30	50	110	33.54
Semi-pacca	83	34	33	150	45.73
Pacca	27	21	20	68	20.73

Total	**140**	**85**	**103**	**328**	**100.00**

Grading system

The grades of the mud crab depended on sex, size, body weight, gonadal maturation and hardness of the carapace of the animal. Two types of grading systems (local and international) were found in Bangladesh.

Local grading system

The female crabs having over 180 g in weight with full hepatopancreas were called Fl, over 180 g with partial hepatopancreas were KSI, over 150 g with poor hepatopancreas are F2 and over 120 g without hepatopancreas were called F3. For male crabs the grading system was the same for all locations. Male crabs having body weight over 400 g, 300 g, 250 g and 200 g with hard shell were called XL, L, M and SM respectively (**Table 3**).

Table 3: Grading system of mud crab by sex and weight in local market

Male				
Grade	**XL**	**L**	**M**	**SM**
Weight (gm)	>400	>300	>250	>200
Gonad condition	Partial	Nil	Nil	Nil
Shell condition	Hard	Hard	Hard	Hard
Female				
Grade	F1	KS1	F2	F3
Weight (gm)	>180	>180	>150	>120
Gonad condition	Full	Partial	poor	Nil
Shell condition	Hard	Hard	Hard	Hard

International grading system

In international grading male crabs having body weight greater than 500 g, 400 g, 300 g, 250 g, 200/150 g are called XXL, XL, L, M and SM respectively. The female crabs having over 200g in weight with full hepatopancreas were called FF1, over 180 g in weight with full hepatopancreas were called F1, over 180 g in weight with partial hepatopancreas were called KS1, over 150 g poor hepatopancreas were called F2, over 120 g in weight with no hepatopancreas were called F3 and the females having body weight less than 120 g were called KS3 (**Table 4**).

Table 4: Grading system of mud crab by sex and weight in international markets

Male						
Grade	**XXL**	**XL**	**L**	**M**	**SM**	
Weight (gm)	>500	>400	>300	>250	>200/150	
Female						
Grade	FF1	F1	KS1	F2	F3	KS3
Weight (gm)	>200	>180	>180	>150/100	>120	>120

Production of mud crabs

The annual average production of mud crab was estimated to be 69, 45.62 (t). The production was maximum and minimum 11, 34.00 and 2, 23.54 t in July and March. Of these 2512.56, 1777.15 and 2655.91 t were produced in Khulna, Satkhira and Bagerhat districts respectively. The maximum (2655.91) production was found in Bagerhat district and the

minimum (1777.15 t) in Satkhira district. In Khulna, maximum and minimum production was (557.30 and 51.64 t) in July and February (**Table 5**). The production of mud crab showed a sharp seasonal variation.

Seasonal variation in production of mud crabs

Monsoon was found to be the peak production time ollowed by winter and summer season. The highest (3567.86 t) and the lowest (1306.96 t) were found during monsoon and summer respectively. During monsoon, the production of mud crab was 1554.20, 972.33 and 1041.33, in

Table 5: The monthly and total production (t) of mud crab (*Scylla serrata*)

Month	Khulna	Satkhira	Bagerhat	Total
January	59.50	60.51	2,71.79	3,91.80
February	51.64	43.14	1,98.63	2,93.41
March	78.45	45.60	99.49	2,23.54
April	1,29.45	74.35	91.43	2,95.23
May	2,45.15	1,30.16	1,19.46	4,94.77
June	4,54.30	2,24.82	2,64.75	9,43.87
July	5,57.30	2,72.58	3,04.12	11,34.00
August	3,59.80	2,47.91	2,89.27	8,96.98
September	1,82.80	2,27.02	1,83.19	5,93.01
October	1,74.50	2,26.31	2,61.22	6,62.03
November	1,26.60	1,28.31	2,95.68	5,50.59
December	93.07	96.44	2,76.88	4,66.39
Total	**2512.56**	**1777.15**	**2655.91**	**6945.62**

summer was 504.69, 293 .25 and 509.01 and in winter was 453.67, 511.57 and 1105.57 t in Khulna, Satkhira and Bagerhat districts respectively (**Table 6**).

Table 6: Seasonal variation in production (t) of mud crab (*Scylla serrata*)

Season	Khulna	Satkhira	Bagerhat	Total
Summer	504.69	293.25	509.01	1306.67
Monsoon	1554.20	972.33	1041.33	3567.86
Winter	453.67	511.57	1105.57	2070.81
Total	**2512.56**	**1777.15**	**2655.91**	**6945.63**

Grade wise seasonal variation in production

Among different grade crabs, the highest (30.52) and the lowest (4.56 t) production were recorded XL and M grades respectively (**Table 7**). During the summer, monsoon and winter the maximum and minimum production was recorded 3.83 and 0.18 for XL and F3 in Khulna and Satkhira, 5.18 and 0.41 for Fl and M in Satkhira and Khulna and 4.67 and 0.12 t for XL and M grade in Bagerhat and Khulna districts (**Table 8**).

Table 7: Grade wise variation in production (t) of mud crab

Season	F1	KS1	F2	F3	XL	L	M	SM	Total
Summer	6.96	2.58	1.33	1.84	8.56	2.12	1.37	2.10	26.89
Monsoon	10.47	3.55	1.89	2.18	13.52	3.00	1.90	2.45	38.99
Winter	7.11	2.39	1.27	1.71	8.42	2.12	1.28	1.84	26.18
Total	**24.54**	**8.53**	**4.49**	**5.73**	**30.52**	**7.26**	**4.56**	**6.41**	**92.08**

Table 8: Grade wise seasonal variation in production (t) of mud crab

Season	F1	KS1	F2	F3	XL	L	M	SM
Khulna								
Summer	3.44	1.13	0.65	1.13	3.83	0.96	0.66	1.06
Monsoon	2.27	0.86	0.45	0.61	2.37	0.58	0.41	0.73
Winter	0.62	0.21	0.09	0.20	0.67	0.18	0.12	0.22
Shatkhira								
Summer	1.60	0.62	0.23	0.18	2.50	0.45	0.28	0.22
Monsoon	5.18	1.69	0.86	0.58	7.82	1.55	0.89	0.77
Winter	2.15	0.53	0.33	0.22	3.06	0.78	0.34	0.21
Bagerhat								
Summer	1.91	0.82	0.43	0.52	2.21	0.70	0.42	0.81
Monsoon	3.01	0.99	0.56	0.98	3.33	0.86	0.60	0.95
Winter	4.32	1.63	0.85	1.28	4.67	1.16	0.81	1.40

Seasonal variation in price of mud crab by grade

The prices of different grades of mud crab were found highly variable among seasons. Similar pattern of prices variation were found in three different districts shown in **Table 9**.

Table 9: Grade wise seasonal variation in price (Tk/kg) of mud crab

Season	F1	KS1	F2	F3	XL	L	M	SM
Khulna								
Summer	236.25	187.50	172.50	71.75	197.50	96.25	48.00	30.50
Monsoon	221.25	182.50	165.00	70.50	194.00	101.25	52.25	31.25
Winter	230.00	181.25	166.25	65.00	191.25	93.25	47.75	28.25
Shatkhira								
Summer	220.00	178.75	172.50	61.25	192.50	102.00	48.50	31.25
Monsoon	210.00	185.00	168.75	61.25	190.00	98.75	53.00	31.25
Winter	198.75	182.50	165.00	56.75	187.50	93.25	49.50	30.00
Bagerhat								
Summer	225.00	180.00	167.50	61.25	193.75	99.50	51.00	30.50
Monsoon	203.75	177.50	172.50	57.00	187.50	98.25	49.75	31.75
Winter	203.75	187.50	171.25	55.50	192.00	97.75	48.50	31.25

Mud crab transportation

Harvested mud crabs from various wild sources were transported to Dhaka by various means. Depending on the sources of harvest, harvested crabs were reached Dhaka within 7 hours to 7 days.

Transport to local depots

Harvested mud crabs were transported to the depots by small wooden boats and sometimes by mechanized trawlers, from ghers carried in bamboo baskets, plastic pots and to local depots by bi-cycle or Van. It took 2-3 hours to reach at local depots by the forias and middle men. Fishers kept the harvested crabs moist spraying river water over them.

Transport to Dhaka

All products (crabs) were transported to Dhaka through associations. Plastic baskets of different sizes were used to transport from local depots to Dhaka. The baskets were long necked in shape and covered with sackcloth or gunny bags. A layer of wet betel-nut leaf was placed at the bottom of the baskets to keep low temperature and to prevent dehydration. Crabs of different grades were placed together in the same baskets. Each basket contained about 30-100 kg crabs. Baskets full of crabs were transported to Dhaka by bus and mini-truck (Pick up) at night hours depending on the quantity and availability of suitable vehicles (**Table 10**).

Table 10: Timing and mode of transportation for mud crab from SW region to Dhaka

Locality	Mode of transportation	Time required (hours)
Khulna	Bus, Pick-up	6-9
Satkhira	Bus, Pick-up	9-12
Bagerhat	Bus, Pick-up	8-11

International transportation

Immediately after reaching in Dhaka at early morning hours, crabs were again graded following international grades and packed in small bamboo baskets. Each basket contained 15 kg of crabs. The baskets were stacked one over another. Plastic baskets were used to airfreight the crabs from Sahajalal International Airport, Dhaka.

Export of mud crab

The domestic market of mud crabs has not yet developed because of high price and religious prohibition among the Muslims. All the harvested crabs were sent to the foreign countries through airfreight. Major export markets of mud crabs were reported to be Singapore, Hong Kong, Malaysia, Thailand and Taiwan. Besides this the crabs were also exported to UK, Japan, Germany, Belgium, China, France, Korea, South-Africa, Netherlands, Saudi Arabia, India, Austria, Qatar, Kuwait, Mexico, UAE, Uganda, Oman, Bahrain, Honduras and Malawi.

Mortality of mud crab

The mortality is common to mud crab and the rate was the highest in summer and lowest in winter. The mortality also varied in different regions in the same season (**Table 11, Table 12**).

Table 11: Seasonal variation in mortality (%) of mud crabs from catcher to export

Region	Catcher to depot			During packaging in depot			Transportation to Dhaka		
	Summer	Monsoon	Winter	Summer	Monsoon	Winter	Summer	Monsoon	Winter
Khulna	2.30	2.20	2.15	13.90	9.50	8.30	4.82	3.80	3.50
Satkhira	1.70	1.60	1.65	14.20	11.90	8.70	5.20	4.30	3.80
Bagerhat	1.20	1.20	1.10	13.80	12.30	11.60	5.00	4.50	3.10

Table 12: Seasonal variation in mortality (%) of mud crabs

Season	Catcher to depot	At packaging in depot	Transportation to Dhaka	Total
Summer	1.73±0.55	13.97±0.20	5.07±0.19	20.77
Monsoon	1.66±0.50	11.23±1.51	4.20±0.36	17.09
Winter	1.63±0.52	9.53±1.80	3.46±0.35	14.62

Marketing channel in mud crab trading

The marketing channel of the mud crab business was found to be consisted with the harvesters, forias (middlemen), depot owner's suppliers, agents and exporters. The trading pattern involved a series of intermediaries from harvesters to consumers. In general it was found to be similar at all three districts. In the whole region, three major types of marketing channels (Figures 1, 2 and 3) were observed.

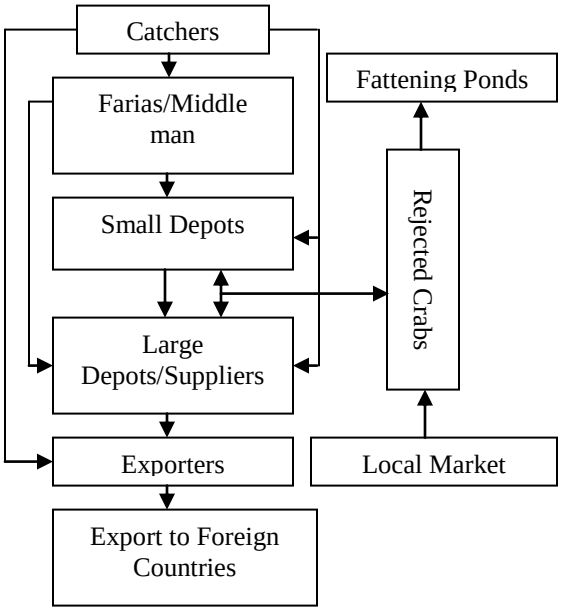

Fig: 1. Marketing Channel-1

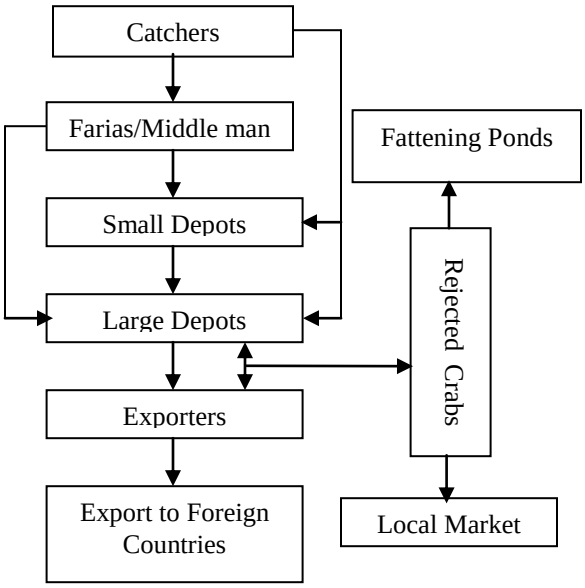

Fig: 2. Marketing Channel-2

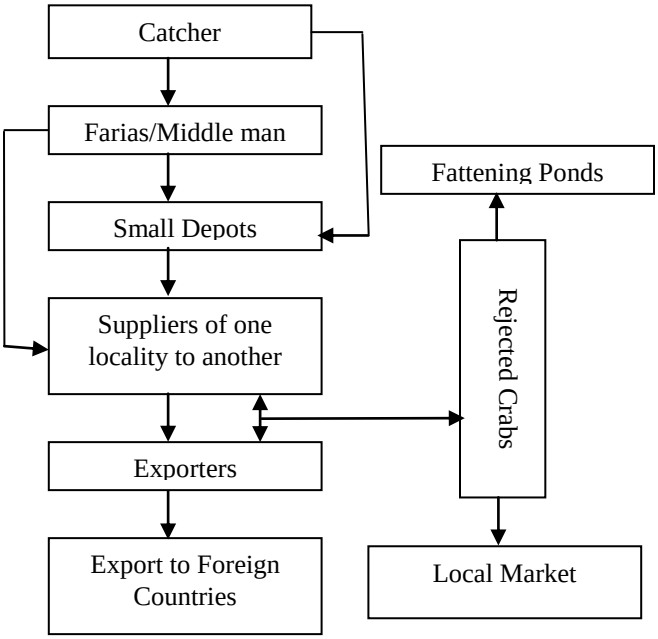

Fig: 3. Marketing Channel-3

In south-west part of Bangladesh most of the mud crabs depots are located nearby the river for easy landing of harvested crabs. The farm size varied between 0.2 acre to 2 acres and the stocking density was 15000 to 25000 individuals/acre. The average size of mud crab fattening ponds in Thailand was around 270 m^2 and the stocking density is 2-4 individuals/m^2 [15]. In Taiwan, the stocking density was 2-4 individuals/m^2 [16]. In Myanmar, crabs were fed with chopped trash fish, ascetes and agricultural-by products [17]. In Bangladesh, farmers used small fish, snail meat, and offal of chicken and cattle as Thailand [15].

Medium and large crab of more than 14 cm carapace width and weighing more than 400 g were collected exclusively for export in India [18]. The grades of the mud crabs depended on the sex, size, body-weight and gonadal maturation. The grading system was almost similar in all districts of the SW region. The females crab with mature ovaries were particularly expensive in the Philippines [19]. Experienced farmers could tell whether the ovaries were full examining against the light.

The peak harvesting season of mud crab in Bangladesh was from mid to late monsoon (June-August) [20]. Late pre-monsoon, early monsoon (April-May) and early post monsoon (September-October) was the season of modest harvest. During the present investigation the average production was found to be 6,945.62 t in Khulna, Satkhira and Bagerhat district. The production of mud crab from Cox's Bazar, Khulna, Bagerhat, Satkhira and Barisal-Patuakhali were 976 - 992 t, 345.10 - 439.40 t, 535.60 - 605.80 t. 31.30 - 45.00 t and 34.80 t respectively [21].

The total mud crabs production was higher in Bagherhat districts than other two districts. The reason behind for such higher production was the close proximity to the Sundarhan mangrove swamps and numerous cris-crossed rivers and canals with the mud crab supply from numerous shrimp ghers in this district. The mortality rate varied from season to season which was low in winter and high during summer. Mortality in transportation affected the production of mud crabs. The transportation mortality rate was 5-9 % in Philippines [19]. Higher mortality occurred due to stress during the long transportation [22]. In SW region of Bangladesh the transportation mortality was 4-6 % but during packing and handling mortality was high (9-14%). Necessary care should be taken during packaging and handling.

Practically the price of crab was entirely dependent on the demand in foreign market. If foreign demand went high and the availability of crab went low, then the price of mud crab increased significantly. The price of different grades varied in different seasons [1].

The marketing channels were mostly uniform in all districts of the SW region. Sometimes, the exporters employ agents to purchase crabs directly from the crab catchers or middlemen. As a result, conflicts arose sometimes between the depot owners, suppliers and exporters. Two types of markets existed for crab in Bangladesh: (a) local markets in the vicinity of fishing villages and (b) consumer markets away from the fishing areas [20]. The non- Muslims and the tribal people were the major consumers of crab. Direct sell by fishermen in the local markets or in the consumer markets was the general mode of marketing. Previously, there were no middlemen in this trade. Each pair of medium sized crab was sold at Tk. 8-12 in the local market. Female crab fetched a better price than males. The development of an export market was a recent phenomenon in Bangladesh [21]. The meat of mud crab was very delicious and contained high nutritive value [23]. So, it had high market value in developed countries. But after 1995-96 mud crab export decreased because the availability was reduced [12].

4. Conclusion

The harvesting of mud crab completely depended on the natural sources in Bangladesh. Over fishing was the main reason for decreasing the stock. Besides these, there were no standard culture techniques for mud crab. Although the mud crab business had developed since mid 80s, the livelihood, of the crab fishermen remained unchanged. The major portion of the profit of crab business was going to the crab traders and exporters than the harvesters.

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