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Mud crab (*Scylla serrata* Forsskal 1775) value chain analysis in the Khulna region of Bangladesh

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ABSTRACT

A value chain analysis is a detailed description of all the activities and services needed to turn a raw product into a marketable good for delivery to final consumers. The mud crab business is considered by most marketing operators to be a profitable and viable business due to the high demand in the international market. Despite the importance of mud crab fishery, there is no structured marketing facilities in Bangladesh. This research aim to analyze the socioeconomic condition of actors, the profitability of farming, mapping the institutional and non-institutional barriers, and provide a better understanding of the possibility of technological interventions in the value chain. Qualitative and quantitative data were collected through participatory rural appraisal tools that include 200 individual interviews, 16 focus group discussions, and 24 key informant interviews conducted in south-west Bangladesh from July to December of 2019. The mud crab value chain analysis revealed that the chain started with crab collection (cultivated and wild harvest), before sale to local vendors, and ended with exporters through several intermediaries. Results noted that most ($\pm 95\%$) exportable crab came from natural sources, with rest ($\pm 5\%$) from aquaculture sector. The average price (USD/kg) ranged from \$10.59–14.12 and \$12.94–19.42 for male crabs (grade: XXL), followed by \$10.00–11.77 and \$11.77–17.06 for female (grade: FF1) in domestic and international markets, respectively. Despite the high profitability of these sectors, the livelihood of these stakeholders has remained relatively hard. Multi-pronged approaches, like a nursery or increasing farming and backyard seed production, and possible value addition at the farm level may help farmers.

1. Introduction

A value chain is the full range of activities, from the producer to the final consumer, that involve a combination of physical transformations and the input of various producer services (Kaplinsky, 2000). It focuses on market collaboration amongst various suppliers, producers, processors, and buyers who hold different degree of market power (Man-gubhai et al., 2017). The value chain identifies the parties involved in aquaculture and the distribution of seafood in other countries, reveals the actual market prices and how much a farmer earn. Crab farming is one of the most critical sectors of small-scale fisheries industry. It played a crucial role in exporting crab in the 2018–2019 fiscal year, earning approximately \$42.93 million (BBS, 2018). Bangladesh has experienced an increase in crabs' export as a source of foreign currency over the past

five years by developing hatchery-produced mud crab (BBS, 2018; Shamsuzzaman, Mozumder, Mitu, & Bhuiyan, 2020), recently exporting 11,000 tons of crab to countries such as Malaysia, Singapore, China, Japan, Hong Kong, and South Korea (Ahmad, 2019). In South-East Asia, *Scylla serrata*, known as mud crab is considered as one of the most popular and proliferates due to suitable agro-ecological conditions, high prices, and demand in international markets (Chandra et al., 2012; Pripanapong & Tongdee, 1998, pp. 7–10). These mud crabs are available across the whole coastal region of Bangladesh, particularly in the estuaries and, tidal rivers of the Sundarbans mangrove forest (Khan and Alam, 1992). Due to increasing demand of mud crabs in local and international markets, the fishery has been gaining popularity among the coastal communities of Khulna region with approximately 300,000 people directly or indirectly involved in mud crab cultivation activities

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(Begum et al., 2009; Rahman et al., 2017). Although fishers are the main actor in collecting the crab from Sundarbans, they are a most marginalized community in this region. Instead, the middlemen (locally called *Farias* or *Aratdars*) are the biggest beneficiaries in the current value chain (Ferdoushi, Zhang, & Hasan, 2010). The existing mud crab value chain is long and unstructured and crab fishers are exploited by middleman and hardly receive any government support (Sanoara, 2018). However, like other seafood, the main problem with low entrepreneurial development in Bangladesh is that vertical integration of primary producers and consumers in the marketing system has not yet been developed (Zafar and Ahsan, 2006). Without proper policy direction, the activities of many intermediaries who are not involved in the production and processing of products make this kind of integration difficult. There have been several studies were conducted on the marketing system and value chain analysis of crab fishery (Chandra et al., 2012, Zafar & Ahsan, 2006; Bain & Mandal, 2017). Efficient value chain research could be helpful for the sustainable livelihood of crab fishers and maintain natural resources sustainability. Several project have been carried out on larval culture and rearing techniques (Azra, 2015a); value-added product development (Ishtiaq, 2018), and the economic assessment of mud crab (Basu & Roy, 2018). However, sustainability perspectives depend on the knowledge of the mud crab fishery's value chain in southwest Bangladesh, which is often poorly studied. Therefore, this study aimed to analyze the value chain of mud crab (*S. serrata*) in the Khulna region, focusing on mapping the concurrent operations of mud crab fattening, culture, and harvesting from natural sources. This study also links the livelihood profile for actors involved in the marketing channel and suggests ways to increase stakeholder' and crab harvester' interests.

2. Materials and methods

2.1. Study area and fieldworks

The investigation was carried out in the crab farming areas of Paikgacha Upazila of Khulna region (one of the ecological hotspots for mud crab fattening and farming), situated in the southwestern Bangladesh. Data was collected during six months of fieldwork (from July 2019 to December 2019) in the study sites of Paikgacha in the Khulna district (Fig. 1).

2.2. Primary and secondary data collection

Semi-structured questionnaire-based individual interviews collected the primary empirical data, along with focus group discussions (FGD) with a checklist, and key informant interviews (KII). A total of 200 individual interviews using a semi-structured questionnaire were conducted with several stakeholders involved in the crab industry, including crab harvesters, farmers (crab fatteners), marketing intermediaries, local middle men (*Foria*), retailers, depot owners, and exporters in the study area (Table 1). The questionnaire focused on their primary and supplementary occupations, monthly income, household condition, crab harvester benefits, daily catch, mud crab price, and

Table 1
Source of primary of information, study sites sampled, tools used, and sample size implied in the study.

Coverage of the study area	Study sites	Data collection methods and sample size (n)		
		Individual Interviews	FGD with stakeholders	KII with experts
District Khulna	Paikgacha	200	16	24

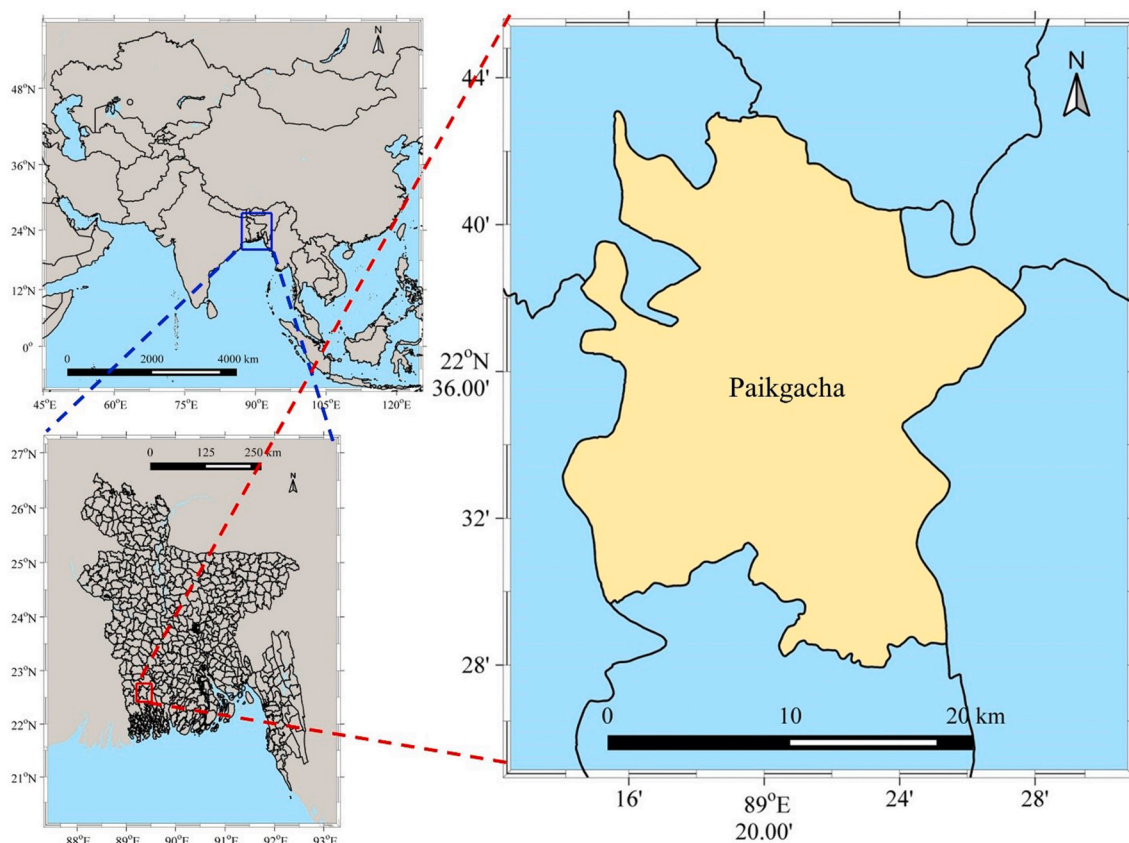


Fig. 1. Location of the study area of the Khulna district in southwest Bangladesh.

others factors involved in the mud crab marketing. FGDs were used effectively to collect and verify a significant amount of interactive information from the target group. In the study area total, 16 FGDs were conducted with checklists for 45 to 90 minutes involving 5 to 10 people purposively selected to achieve research goals (Table 1). A total of 24 KII were conducted with the individuals inside and outside the interviewed communities, government officials, NGOs, fisheries officers, teachers, and members of various forum, and other organizations were approached (Table 1). Secondary data were gathered from multiple scholarly articles and related literature through an online search.

2.3. Data analysis

Qualitative data analysis included three steps: preparing and organizing the data for analysis, reducing the data into themes; and finally representing the data in tables or as part of a discussion. Qualitative data were analyzed using Microsoft Excel. After transcription of qualitative data, contents were interpreted, and themes were developed and classified into variables for further explanation. For quantitative data analysis, data were stored, interpreted, and then digitized for analysis. Data were analyzed by using Excel and SPSS, and the result was presented in graphical or tabular form.

3. Results

3.1. General features of mud crab

Mud crab (genus *Scylla* De Haan 1833; Crustacea: Decapoda: Brachyura: Portunidae) are common in mangrove areas, brackish or coastal waters along the shorelines, ponds, and intertidal swamps (Rouf, Shahriar, Sarower, & Ahsan, 2016). There are four mangrove crab or mud crab species of the genus *Scylla*, namely; *S. serrata*, *S. olivacea*, *S. paramamosain* and *S. tranquebarica* (Ferdoushi, 2015; Rahman et al., 2017). Of the four, two mud crabs, *Scylla serrata* and *S. olivacea*, are available in Bangladesh. After a lengthy discussion on the taxonomic classification of the *Scylla* genus in Bangladesh, *S. olivacea* was identified as a common mud crab caught from the Sundarban Mangrove Forest, which many researchers mistakenly describe as *S. serrata* in previous literature (Shahriar & Rouf, 2018). Available mud crabs are harvested from wild sources, using bamboo traps, baited drop nets, and traditional hooks, especially in the Sundarbans mangrove forest channels, tidal rivers, and coastal creeks. The market price of *S. olivacea* in Bangladesh is almost the same as *S. serrata*. However, the international giant *S. serrata* has excellent prices since *S. olivacea* cannot grow as much as *S. serrata*.

The results showed that about 40% of the collectors had 5–7 members in their family, while 57% of them used tube wells, 25% used filtered pond water and 18% used pond water for drinking.

There were three types of houses: Wooden wall and mud floor with a tin shed roof, (9%), tin shed wall and mud floor with asbestos shed (78%); and brick wall and mud floor with a tin shed roof (13%) (Table 2). The income of crab farmers varied with the season. The results showed that 20% crab harvester earned \$118–177 per month, 27% earned \$188–236 per month, 26% earned \$247–295 per month, 11% earned \$306–354 per month and 16% earned more than \$354 per month (Table 2).

Approximately 40% of people involved in catching and distributing crabs said the current crab aquaculture situation was declining, 42% said that crab farming was on the rise. The rest, 18%, it was in stable condition (Fig. 2 and 3).

3.2. The natural habitat of crab fishery

The mud crab fishery in Bangladesh is entirely reliant on the wild catch from swamplands, tidal rivers, canals, and tidally fed and outdated shrimp ghers (rearing pond) for export and domestic consumption.

Table 2

Socio-economic condition of the actors involved in the mud crab (*S. serrata*) value chain.

Characteristics	Categories	No. of Respondents	Percentage (%)
Age group	<15	3	1.50
	16–25	24	12.00
	26–35	66	33.00
	36–45	51	25.50
	46–55	36	18.00
	56–65	16	8.00
Education	>66	4	2.00
	Illiterate	38	19.00
	Only sign	66	33.00
	Primary	64	32.00
	Secondary	22	11.00
Family size	Higher secondary	10	5.00
	2–4	70	35
	5–7	80	40
	8–10	40	20
	11–14	10	5
	2–4	70	35
Drinking water supply	5–7	80	40
	8–10	40	20
	Tube well water	114	57
	Filtered pond water	51	25
Sanitation facilities	Pond water	35	18
	Katcha	30	15
	Puccha	170	85
Use of electricity	Yes	146	73
	No	54	23
Housing condition	Wooden wall and mud floor with a tin shed	18	9
	Tin shed wall and mud floor with tin/asbestos shed	156	78
	Bricks wall and mud floor with tin shed	26	13
	Land ownership (Decimal)	0.1–10	62
Occupation	10.1–20	94	47
	20.1–30	26	13
	>30	18	9
	Agriculture	83	41
	Fishing	63	31.50
Monthly income (BDT)	Day Labor	7	3.50
	Majhi	5	2.50
	Business	33	16.50
	Driver	2	1
	Carpenters	2	1
	Others	5	2.50
	10–15000	40	20
Monthly income (BDT)	16–20000	54	27
	21–25000	53	27
	26–30000	21	11
	>30,000	32	16

About 90% of exported crabs come from natural sources, with the rest coming from crab fattening farms. The Sundarban mangrove swamps and tidal flats after the monsoon (October–January) and traditional shrimp ponds during the monsoon (May–September), are the primary sources of wild crab harvesting. Other mud crab sources available on the market come from the fattening ponds.

3.3. Harvesting methods

In the study area, most of the crab harvester (54%) used traditional hook made with an iron stick, chimni and chai made of bamboo stick for collecting crab whereas 21% used scrap net and 13% used hand catching for crab harvesting. Dingi boats are exclusively used for harvesting crab from the river. The common traps used for crab collection were bamboo

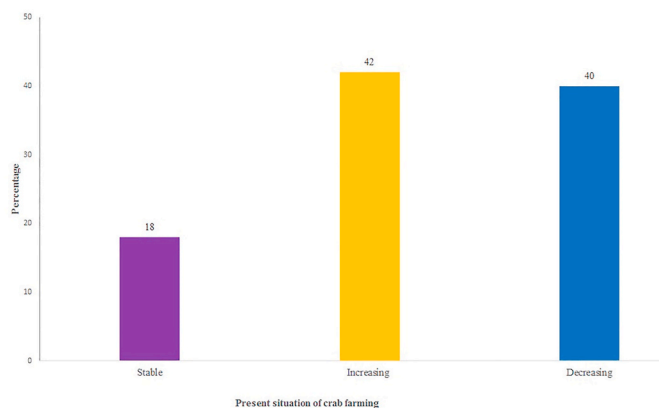


Fig. 2. The present condition of crab production.

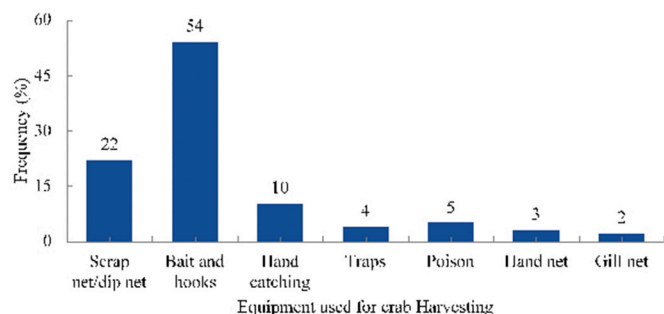


Fig. 3. Equipment used for mud crab (*S. serrata*) harvesting.

trap (locally chai or tonga); rope line or “don” (rope with the stick, angling with hook); long metal hook and nets (bag net).

3.4. Seasonality in catch and price

The crab growing season usually starts in September and ends in February, while the trading season begins at the end of June and March. The crab harvester stated that nearly 90% of crabs were caught during peak season (August, September, and October) and 10% during off-peak season (February, March, and April). An individual harvester could gather a daily average of 3 kg of crab in summer, 7 kg in the rainy season and 4 kg in winter from the rivers and other sources (Fig. 4a). On the other hand, groups comprising 5–6 (sometimes 12–14) harvesters usually harvested 35 kg in summer, 165 kg in the rainy season and 81 kg on a single trip of 7–8 days in winter (Fig. 4b).

3.5. Transportation

Crab harvesters, collectors or intermediaries keep the collected mud crab in plastic bags during transport or in bamboo baskets covered with

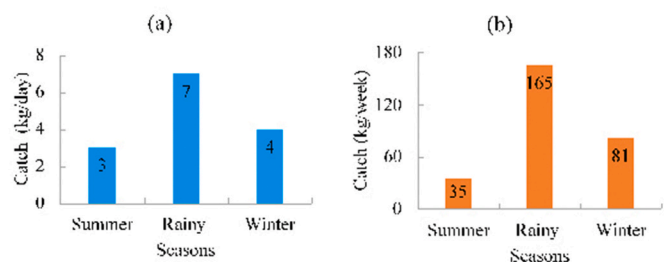


Fig. 4. Seasonal variation in *S. serrata* in the study area (a) individual catch and (b) weekly group catch by 5–14 harvesters.

gunny bags. From the country, only live crabs are exported. To avoid mortality, crabs are kept moist by spraying water on them and therefore, require no cooling or other cultural facilities during transportation. The survey revealed that the live mud crab was transported to the local depot by wooden boats, bicycles or vans, and sometimes a betel-nut leaf was placed at the bottom to prevent dampness and keep the temperature low. For export various containers were used, usually specified by importers such as plastic baskets, Styron foam cartons, and bamboo baskets. The exporters stated that it would take 1–3 h (43%), 4–6 h (14%), 7–9 h (34%) and 10–12 h or more (9%), to send processed crab to Dhaka (Fig. 5).

3.6. Grading system

All crabs, no matter the source, were first washed with saline water in Arat (business place of Aratdar) and then weighed and examined. Different grading for domestic and international markets was then assigned (Table 3). Both males and females weighing more than 120 g were considered for export. Usually, hard shell and meat-filled male crab and meat-filled female crab with hard carapace and the entire gonad were considered for shipping.

3.7. The primary role of value chain stakeholders

3.7.1. Crab harvesters

The crab harvesters typically collect crabs from natural waters such as the shrimp gher, canals, rivers, and the Sundarban mangrove forests, and then sell the collected crabs to Faria or brokers, depot owners, and suppliers (Fig. 6). Wild crab collectors argued that in most cases, due to broker intervention and loan burden, they did not get the actual price of their product. Wild collectors were obliged to sell crabs at low prices to individual brokers or traders who offered loans in a lean period.

3.7.2. Middleman (Faria)

The second contributor to the supply chain is the middlemen or faria, who provides the main link between wild mud crabs catchers and markets. They purchased crabs from the collectors sometimes also from the fatteners and sold their products to individual depot owners or suppliers. Majority of them had a verbal agreement with the.

3.7.3. Fatteners

Crab fattening is an alternative source of income for the coastal peoples and the persons who are involved in the crab fattening known as fatteners. They purchased soft-shell or eggless crab from collectors or

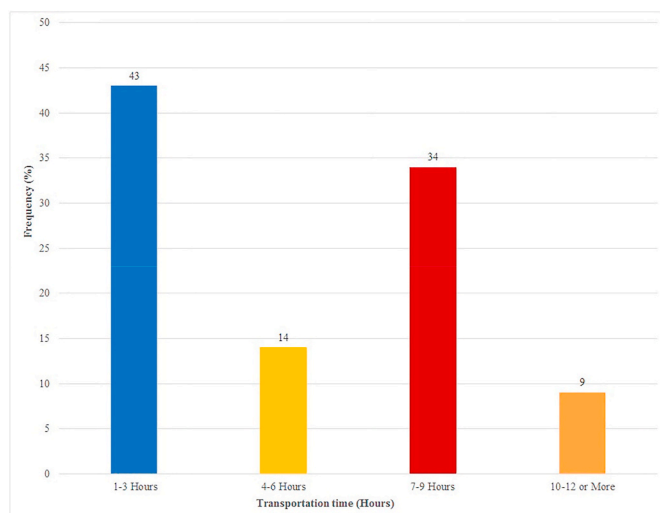


Fig. 5. The time required to export the processed mud crab in Dhaka.

Table 3

Grading of mud crab (*S. serrate*) basis on their weight (W), development of claw (male) and gonad (female), shell condition and price range for the domestic and international markets.

Male			Domestic market			Price range/(BDT/kg)		Male			International market		Price range (BDT/kg)	
Grade	W (g)	Claw	Shell	Collectors	Aratdar	Grade	W (g)	Claw	Shell	Export center				
XXL	>800	Full meat	Hard	600–850	850–1000	XXL	>500	Full meat	Hard	1000–1450				
XL	>400	Full meat	Hard	350–600	650–850	XL	>400	Full meat	Hard	750–1050				
L	>300	Full meat	Hard	250–350	550–650	L	>300	Full meat	Hard	650–900				
M	>250	Full meat	Hard	150–250	450–550	M	>250	Full meat	Hard	550–850				
SM	>200	Partially develop	Soft	100–150	350–450	SM	>200	Partially develop	Hard	550–800				
SSM	>150	Partially develop	Soft	80–100	300–350									

Female			Domestic market			Price (BDT)		Female			International market		Price (BDT)	
Grade	W (g)	Gonad	Shell	Collectors	Aratdar	Grade	W (g)	Gonad	Shell	Export center				
FF1	400+	Full gonad	Hard	800–1000	900–1200	FF1	>200	Full gonad	Hard	1100–1650				
F1	200+	Full gonad	Hard	500–800	800–1000	F1	>180	Full gonad	Hard	1000–1500				
F2	180+	Partial gonad	Hard	450–500	700–900	F2	>180	Full gonad	Hard	950–1300				
F3	150+	Partial gonad	Hard	350–450	600–700	F3	>150	Full gonad	Hard	850–1200				
KS1	180+	Immature gonad	Soft	250–350	500–650	KS1	>120	Partial gonad	Hard	750–1100				
KS2	150+	Immature gonad	Soft	150–250	400–600									

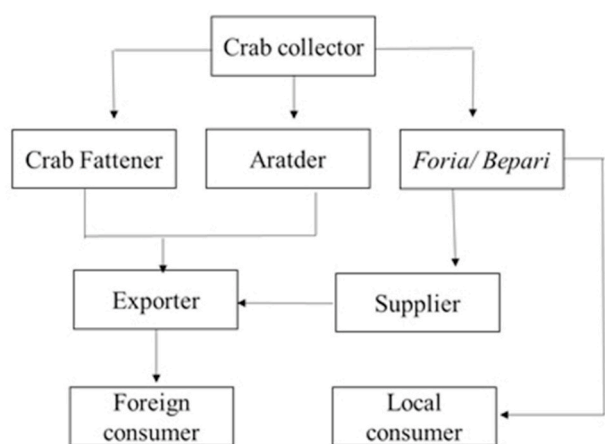


Fig. 6. Distribution pattern and supply chain of mud crab (*S. serrata*).

faria at low prices and then sold the products at high prices to depot owners, suppliers, and commission agents.

3.7.4. Suppliers/aratdar

Suppliers are licensed traders and relatively large traders, and these stakeholders play a vital role in the value chain by providing product value and transporting products from the root level to Dhaka and international markets. They purchase a large volume of crabs from large depot owners, small depot owners, faria, farmers, fatteners, and collectors and sell them to Dhaka exporters.

3.7.5. Retailers

In general, retailers collect the low grade and rejected mud crab (rejected for export) from various depots and sell in the local market for

domestic consumption.

3.7.6. Exporter

In the mud crab value chain, exporters, were the ultimate target group for domestic and international marketing channels. They transport the live crab to Dhaka and then to global markets such as Singapore, China, Japan, Taiwan, the Philippines, Malaysia, Hong Kong, the United States, and Canada.

3.8. Supply chain analysis of mud crab

The marketing channel of mud crab (*S. serrate*) in Bangladesh starts with the wild harvesters. It then goes through several intermediaries such as, aratdars, fatteners, suppliers, local agents, exporting agents and finally from exporter to the foreign countries.

The crab harvesters was the main actors of the mud crab value chain, as they were the only source of harvest from wild sources and supply seed crab to farmers as well as a mature crab to export market. Aratdar sold crabs to exporters through verbal agreements with collectors and fatteners, and then from exporters to foreign consumers. After collecting collectors’ crabs, some of the Faria/Beparies sold their catch directly to consumers (Fig. 6).

Fig. 7 shows the overall distribution of mud crabs, consisting of several series (local, domestic and international), starting with a local level crab harvester and ending with foreign consumers. The value chain starts with crab harvesters, who collect mud crabs from wild sources and then sell them to aratders, fatteners, or directly to consumers. The majority of the mud crabs supplied to collectors are first traded in the local market and then distributed from the local market to other market operators (aratders, exporters) who make a 15±5 BDT/kg profit. In local markets, aratdar is one of the dominant and profitable groups with little intervention. They control the collection and marketing of crab and

- Chain-1:** Crab Collector ➡ Aratdar ➡ Exporter ➡ Foreign Consumer= 67.3%
- Chain-2:** Crab Collector ➡ Fattener ➡ Exporter ➡ Foreign Consumer=25.4%
- Chain-3:** Crab Collector ➡ Faria/ Bepari ➡ Supplier ➡ Exporter ➡ Foreign Consumer=4.3%
- Chain-4:** Crab Collector ➡ Faria/ Bepari ➡ Local Consumer=1 %
- Chain-5:** Crab Collector ➡ Crab fattener ➡ Faria/ Bepari ➡ Supplier ➡ Exporter ➡ Foreign Consumer=2%

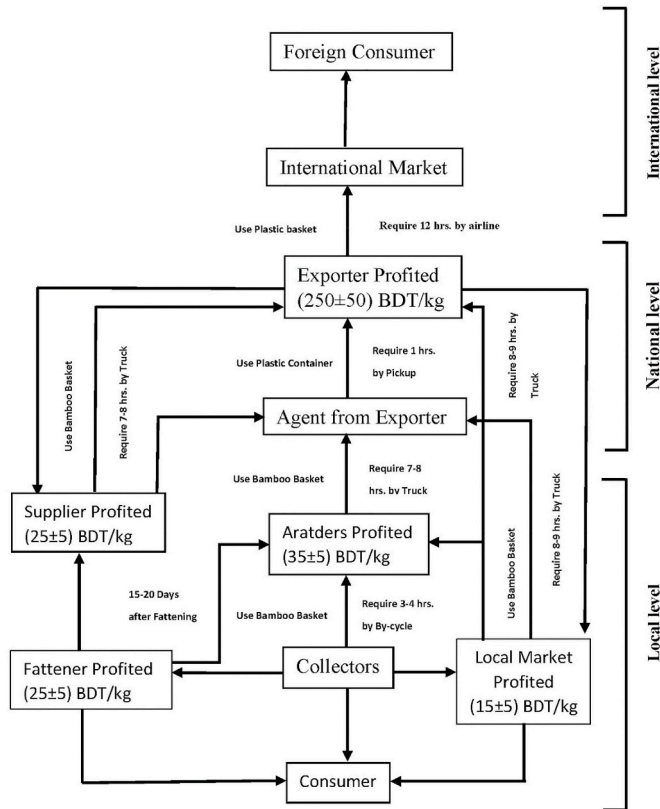
Value Chain of Mud Crab (*Scylla serrata*) in Khulna Region

Fig. 7. Value Chain of mud crab (*Scylla serrata*) in Khulna region of Bangladesh (Adapted and contextually modified after Hossain, 2018).

make a profit of 35 ± 5 BDT/kg. Moreover, the fatteners invest money to collectors and local agents through a loan scheme with an oral contract sold to them by the raised crabs. At the national level, exporters have agents who collect crabs from different intermediaries and then transport them to the capital (Dhaka) via plastic bags for export. Exporters further process the crabs to meet foreign buyers' requirements and export them to the international market by airline using plastic baskets. In addition to intermediaries, the most influential exporters and exporting agents play a significant role in raising prices and creating an artificial crisis by paying money in advance to *aratdars*, thus becoming the highest profit group (250 ± 5 BDT/kg). Value chain analysis reveals that adding value in fattening/farming can significantly differ in quality (food safety issues), profitability, and sustainability.

4. Discussion

Value chain analysis describes all the activities required to bring a product or service to different stages of production, where to overcome various weaknesses across different stages of the value chain and, and determines the scope for further improvement of the existing value chain by focusing on the performance and cost involved at each stage. Mapping the distribution processes and activities that bring products to consumers is widely applicable in different industries in different countries. Therefore, the value chain of mud crab (*S. serrata*) in Khulna region has been studied to make the whole chain more efficient by transferring information across the chain and improving relationships between the actors of the chain of the, including crab collectors, farmers, *aratdars*, exporters and other intermediaries.

Many of the crab farmers were marginalized poor and often exploited by the *artader*, crab traders and exporters. The results showed that more one-third of the harvesters (33%) were 26–35 years' old, while over 35%

of crab harvesters could only sign, and about 19% of collectors were illiterate. A similar observation was made by Zafar and Ahsan (2006) and Mahmud and Mamun (2013).

The majority (40%) of crab harvesters had above 5–7 members in family size, followed by 31.66% had family with 2–4 members. These results coincide with the findings of Fabusoro et al. (2007), who reported the average household size in Africa was about 9 persons. Approximately 57% of crab harvesters used tube well water for drinking, while nearby 30% of them did not have tube wells, similar to Hossain (2018), Zafar and Ahsan (2006).

In the study area, about 76% of the crab harvesters use electricity, and 24% of the crab harvesters had no electricity in their house because they did not have enough money to pay for the electricity bill. These findings differed significantly from Hossain (2018), who reported that only 18% of the crab harvesters in Khulna and Satkhira districts had electrical equipment.

It has been observed that most of the harvesters live in the tin-shed wall and muddy ground or tin/asbestos shed and use the metal sheet as a roofing material. Some harvesters use bricks as wall material; some used a metal sheet as wall and roof material, whereas some used cement on the ground. Zafar and Ahsan (2006) reported that the crab harvesters lived in four types of houses viz. wooden wall with tin shed (2%), mud wall with tin/asbestos shed (6%), mud wall with golpata shed (31%) and mud wall with straw shed (61%). These findings were different from the present result.

Most crab harvesters use their land to live and agricultural activities, an average of 10.1–20 decimal landowners among the harvesters. A similar observation was made by Hossain (2018) where (40%), (20%), (11.66%), 20% and (6.66%) of them had <10, 11–15, 16–20, 21–25 and above >26 decimal of lands, respectively.

Crab harvesters' average monthly income was significantly lower than other incomes associated with various economic activities. The annual income earned by harvesters, retailers, suppliers, and exporters from mud crab transactions is the same throughout the year, and almost all do not report peak selling prices. They stated that their income was higher (above \$354/month) when the demand and prices of mud crab around the Chinese New Year and Christmas were high. Bain and Mandal (2017) reported the monthly income of the most (50%) of the crab harvesters was \$17–23 respectively whereas only 5% of them earned above \$35 both in Khulna and Satkhira district.

The value chain of mud crab primarily focuses on the foreign export earning of Bangladesh. The main contributors involved in the live crab value chain are the crab harvesters, fatteners, *Aratdars*, suppliers and exporters. Analysis of the value chain revealed that the added value at the fattener and farmer level was the highest among all other intermediaries. Wild crab harvesters argued that in most cases, due to broker intervention and loan burden, they did not get their product's actual price. In Fiji, there are five similar types of players involved in selling mud crabs include fishers, traders, seafood retail shops, restaurants, and exporters (Mangubhai et al., 2017). Following this, all collected crabs from different small and local depots are transported to Dhaka to the exporters by truck or launch usually at night. After reaching in Dhaka, the crabs were again graded according to the international grades every stage they profited by adding value to the value chain.

The mud crab grading may vary for gender, size, bodyweight, gonadal ripening, the hardness of the carapace, and domestic and foreign markets (Ferdousi et al., 2010; Jahan & Islam, 2016). Mud crab collection and marketing is considered as a profitable and feasible business by most of the marketing operators. The price and demand of crab were higher in the winter season when the catch was minimal. The cost of the female crab was higher than that of the male. In the study area, there were seven grades for the male crabs namely XXL, XL, L, M, and SM, SSM whereas six categories for females namely FF1, F1, F2, F3, KS1 and KS2 both in descending order of live gross weight. The average highest range and the lowest range of value-added in the marketing

network were found to be BDT 1000–1450/kg for XXL male crab, and BDT 550–800/kg for SSM grade crab in international markets followed by 1100–1650 BDT/kg for female FF1 grade and BDT 850–1200 BDT/kg for KS1 grade. Huq (2010), Jahan and Islam (2016) also found similar findings.

In recent years, farming, fattening, and trading of mud crabs in coastal areas of Bangladesh has expanded significantly, improving food security, nutrition and livelihood options for coastal populations. The final price of the mud crab, *S. serrata*, depended on the total marketing network, where the larger number of intermediaries, the higher the crab price. The demand-driven marketing system often leads to price exploitation (Hossain, 2018). Many countries import crabs from Bangladesh, indicating greater international market opportunities for Bangladesh. Despite the great demand for mud crab (*S. serrata*) in the global market, the coastal crab industry for harvesting wild crabs has not expanded sufficiently to seize this opportunity. The industry has yet to achieve sustainability due to a heavy reliance on wild. The price gap between collectors and exporters is far from intermediate added value, which differs from other export-oriented seafood, including the shrimp. Most of the added value is captured by the exporter. The lack of a proper value chain system makes many potential farmers less attracted to this sector. In Bangladesh, social and religious restrictions on crab consumption have hampered businesses and prevent operators from achieving affordable domestic and international market prices. A similar observation was also made by Chandra et al. (2012).

In addition to this, weak communication, reduced bargaining power of fishers, lack of access to institutional credits, improper handling, and transport of live crabs, inadequate space and frequency of air flights, lead to large post-harvest economic losses. Lowering the marketing chain length, proper transport facilities, technical assistance, institutional intervention, micro credits facilities, and artificial breeding of mud crab can enhance the socioeconomic status and maximize foreign currency earning. We suggest that further technological advancement in the fattening of undersized or soft-shell crabs could provide momentum for the mud crab business.

In practical terms, the research's findings provide a better understanding of the drawbacks of the existing mud crab value chain and show the need to revise the current value chain to ensure a sustainable livelihood for crab fishers. Creating a new cooperative-based mud crab value chain requires cooperation and support from all value chain members, government, and related rural NGOs. Governments need to invest a portion of their export revenues from crab trades in developing market infrastructure to minimize post-harvest losses. Therefore, a pro-strategy should be applied to establish links between sustainable livelihoods at the community level and foreign (even domestic) trade.

5. Conclusion

Mud crabs are a valuable and expensive seafood. Despite this crab farming's high profitability, the marginalized actors' livelihood engaged in the marketing channel is poorly understood. Crab farming and trading have not yet gained momentum due to many restrictions. Multi-pronged approaches such as nursery or grow out farming and backyard seed production can take the sector to a higher level. Possible intervention and value-addition at the farm level may benefit farmers, targeting the domestic market with minimal interference from intermediaries. Government must take initiatives to reassure crab fishers and look after their socio-economic growth by helping them to develop production and trade at a sustainable level. It is anticipated that this finding will be available to stakeholders, such as harvesters, intermediaries, depots, exporters, and managers for the purpose of, formulating policies to achieve sustainability.

CRedit authorship contribution statement

Md. Sumon Bhuiyan: Conceptualization, Methodology, Software.
Md. Mostafa Shamsuzzaman: Data curation, Writing - original draft.
Mohammad Mosarof Hossain: Visualization, Investigation. **Sabrina Jannat Mitu:** Supervision, Software, Validation. **Mohammad Mojibul Hoque Mozumder:** Writing - review & editing.

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