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Abundance, marketing channel and export potentiality of freshwater Eel (*Monopterus cuchia*) in Bangladesh

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Abstract
The survey based study pursues production and marketing of Eel in order to explore the Eel trading and value chain involved. A part of the population especially land less people, widow and children are involved in Eel collection for their livelihoods earning. The market chain from collector to consumers passes through a number of intermediaries like local Bepary, Agents, Arotdars, Exporters and Buyers. Aluminum containers, plastic drums and bamboo baskets with polythene covers are commonly used for keeping fresh water Eel alive during the transport. Generally two grading system is involved for marketing of Eel in Bangladesh. Daily harvesting rate depends on season ranging from 2.0-3.5 kg/collector and local price ranges from 120 to 500Tk/kg. Annual harvest by Eel collectors from different division of Bangladesh were found as: Rajshahi: 3,60,645-4,21,580 kg; Khulna: 3,26,759-3,33,388 kg; Mymensingh: 73,050-77,700 kg; Sylhet: 93,790-96,000 kg; Barishal: 1,94,000-2,18,000 kg; Rangpur: 39,150-48,130 kg; and Chattogram: 4,93,585-6,54,410 kg respectively. Highest harvest were obtained from Chattogram division (4, 93,585-6,54,410 kg) and lowest harvest was from Rangpur division (39,150-48,130 kg). Eel of Bangladesh are exported to many countries of Europe, Asia and Middle East.

Keywords: *Monopterus cuchia*, nutritional value, distribution, harvest, marketing channel, export

1. Introduction
The fisheries sector of Bangladesh has great contribution in the agro-based economic development, poverty elevation, employment, supply of animal protein and earning foreign currency. Around 70% of exports in the primary commodity category and almost 9% of total exports come from this sector [3]. It has developed as a commercial sector with employment and income generating opportunities both in the rural and urban areas. Shrimp is the main aquatic export item in Bangladesh. However, Eels, a recent export item, has not yet been given any attention. Its culture and collection would be an alternative income source for poor people and an immerging trade for fishery product traders. Considering demand in the international markets, Eel fishery has been gaining popularity among the community of greater Khulna, Chattogram, Mymensingh as well as Sylhet and Comilla region.

Four species of Eels are available in Bangladesh, among them *Monopterus cuchia* [6] which is commonly known as Gangetic mud Eel, is commercially important, due to its high demand for export. The species commonly occurs in Bangladesh, Pakistan, Myanmar, Nepal and India. *Monopterus cuchia* is an obligate air-breathing mud Eel spends the greater part of its life out of water, wriggling along the muddy banks of river and ponds among the grassy vegetation. During dry season it burrows in the mud, where it lays eggs. Eel is found in almost every upazila of Bangladesh. But due to habitat degradation, overcrowding and the use of pesticides in agriculture, the abundance of the Eel is gradually decreasing and now it is vulnerable in Bangladesh [9].

Due to nutrition and medicinal value, Eel is in great demand in the world market. Nutritional consideration is richer than any other fish. The average protein content per 100g of Eel flesh is 14g and the caloric value of Eel flesh is as high as 303 Kcal/100g compared to 110 Kcal/100g in other average fishes [12]. On the other hand a study found that 100 grams of cooked raw meat contains 18.7 grams of protein, fat, carbohydrate and calcium density of 0.8 grams, 2.4 and 18.6 grams respectively. The amount of energy is 303 kilo calories / 100 grams. Currently Bangladesh is exporting Eel to countries such as China, Taiwan, Hong Kong, Malaysia, Indonesia and Korea.

Eel has a special reputation in the international market as an exportable product. The poor people of Bangladesh are earning livelihood through Eel collection, transport, maintenance and processing, resulting in employment generation which plays an important role in the socio-economic development of the people of Bangladesh. A significant commercial fishery for Eels exists in various developed countries like Australia, Thailand, Malaysia, Japan, Korea, USA, China, Italy, Greece, Egypt, Singapore, Cambodia and Taiwan [1, 2, 6] consisting a great available export market [5, 8, 10]. However, the Eel aquaculture industry in Bangladesh is completely absent, only capture based fishery practice are performed. Both freshwater and brackish water Eel of Bangladesh can be grown to international market size. Hence, Bangladesh has great opportunity to develop Eel farming industry and to enter those European and Asian markets, if proper attempt could be made. Present surveys considering the various socio-economic and trade factors have identified the potential for the foreign marketing and harvest of Eel as an alternative livelihood option. However, as with other aquatic products, the main problem of entrepreneurship development is vertical integration between the primary producers and the consumers in the marketing system, is yet to develop. In absence of proper policy orientation, the activities of a number of intermediaries having no stakes in the production and processing of the products often make such integration really difficult.

Materials and Methods

The survey was carried out covering the seven divisions of Bangladesh (Rajshahi, Barisal, Chattogram, Comilla, Khulna, Mymensingh, Rangpur). During the year of 2016-17, a questionnaire was prepared for survey and the questionnaire was filled on the basis of information from the collectors and depot owners of the various departments of the district and district officials of the Department of Fisheries. Information according to the questionnaire is discussed below:

Marketing channel of freshwater mud Eel

a. **Eel collector:** Collectors are those who collect Eel from wild sources and sell them to Bapari or Arotdar. Very often collectors collect Eel of different categories depending on size, species and season.
b. **Seller:** Seller buys Eel from Collector and sells to the Wholesaler in reasonable price.
c. **Whole seller:** Whole sellers buy Eel from Collector or Bapari and sell them to the Supplier. The function of the Whole seller is to store the fish.
d. **Supplier:** Supplier collects Eel from Wholesaler and Seller. They rent a packing center, where they packing and transport to airport near to Exporter. Suppliers are benefited from Whole seller and Exporter because only they know about the real market price of the fish. Market price fluctuates sometimes because of seasonal variation.
e. **Exporter:** Exporters are also Eel Retailers but they do not sell directly to the Consumers, they transport Eel to the other Buyers. Freshwater Eel has great demand in China, Japan, Hong Kong, Taiwan, Thailand, Singapore, Malaysia and USA. Exporter contact with other Buyer through email, telephone, internet or personal contact.

Data processing and analysis

By analyzing the information received from the questionnaire by the survey, the actual picture of the present situation of Freshwater Eel in Bangladesh came out. Preliminary data sheets (in computer) were compared with original questionnaire and result sheets to ensure the accuracy of the data entry. Processed data were finally analyzed by using Microsoft Excel and SPSS (Statistical Package for Social Science).

Results and Discussion

Eel collection and preservation system

The process of collecting method of Eel is different from any other fish collection and it is relatively complex. From this study it is revealed that, Eel are collected using baited traps, long lines, spears or shore seines, hook, bare hand, frog and handmade tools from every water systems including mangrove forest. Though Eels are available all the year, October to December is the peak breeding season. Due to undersized local market comprised of only non-Muslim communities, it's trading mostly export oriented.

Preservation of Eel is very important because live Eel is being exported. Recognized or acceptable methods of preserving Eel in our country have not yet been introduced.

Generally, plastic drums, silver sheets, buckets, clay etc. are being used for preservation of Eel. Nowadays, some traders stock Eel in concrete houses and use vermi-compost and frogs as food. Due to uneven bottom of the house a small red stains are shown in the body of the Eel which is decreases the market price of Eel. Besides, Eel is used as bait for catching crabs in some areas, especially in the north. Due to this, salted and dried Eels are processed after collecting the Eel. It is found that in almost every district Eel is collected throughout the year but it is more in the winter season.

Plate 1: Dry Eel

Plate 2: Salted Eel

Marketing system and marketing channel of mud Eel

From the survey, it is found that, Eel collection has not established as a recognized income generation source. Most of the collectors (74%) take it as a part-time occupation whereas only 26% treating it as a primary occupation and to be more, the Eel collectors are vulnerable to lose out in the marketing chain as they usually do not have access to any institutional credit source whatsoever [11]. In Eel marketing

systems, there are a number of people involved in the study areas. The market chain from collector to consumer passes through a number of intermediaries like local Bepary, Agents, Arotddar, Exporters and Buyers. Eel collectors never directly communicate with exporters, they normally connected via middlemen. The middle men usually buy Eel from the collectors but do not seem to have formal agreements with particular producer. Collector directly sells their Eel to wholesalers or through local agents. Until reaching the hands of the exporters, they have to pass a few steps.

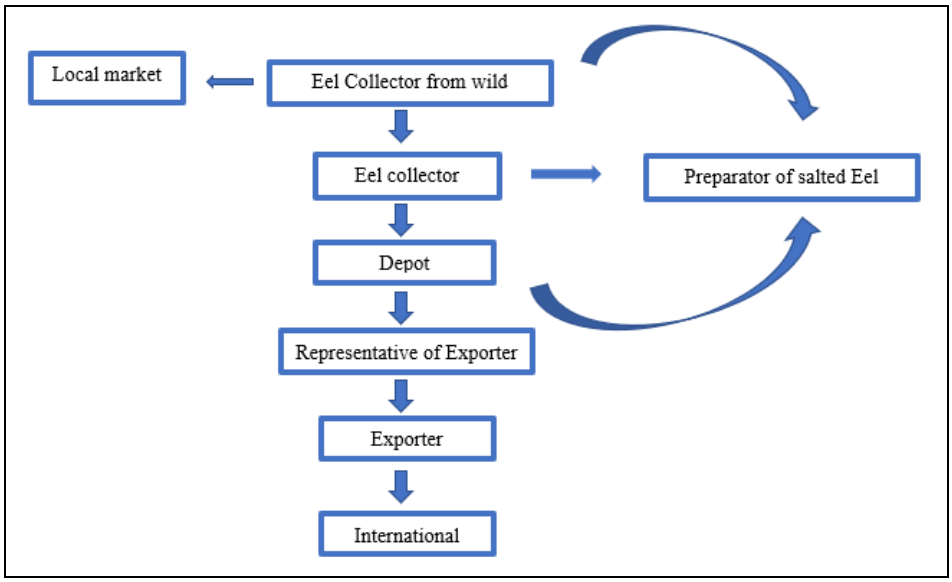

Fig 1: Eel Marketing Channel

Harvest and Export potentiality of freshwater mud Eel

Eel is found in all the district and upazilas of Bangladesh. From this it is revealed that both the weather and soil of this country are suitable for cultivation of Eel. Annual production by Eel collectors from different division of Bangladesh were found as: Rajshahi: 3,60,645-4,21,580 kg; Khulna: 3,26,759 - 3,33,388 kg; Mymensingh: 73,050-77,700 kg; Sylhet: 93,790-96,000 kg; Barishal: 1,94,000-2,18,000 kg; Rangpur: 39,150-48,130 kg; Chattogram: 4,93,585-6,54,410 kg respectively (Table-1).

Highest harvest were obtained from Chattogram Division (4,93,585 - 6,54,410 kg). Daily harvesting rate depends on season ranging from 2.0-3.5 kg/collector and local price ranges from 120 to 700Tk/kg. There are many factors affecting the price of freshwater Eel in local and international markets, particularly as the supply of freshwater Eel is mainly depending on wild source. Export potentiality of freshwater mud Eel in Bangladesh is vivid. It was showed that exports of freshwater Eel to different countries from Bangladesh were Japan (3.5%), Malaysia (3.5%), America (3%), Thailand (10%) and China (80%) [7].

Plate 3: Whole sell market

Table 1: At a Glance yearly collected Eel from different division and their local selling price

Name of the Division	Name of the District	Name of the Upazila	Amount of collected Eel (kg/) year	Weight of collected Eel (g)	Prices (Tk/kg)
Rajshahi	Chapai Nawabgonj	Nachol	1,600-1,700	200-1200	250- 300
	Natore	Singra	16,000-20,000	300-500	200-300
		Baraigram	12,000-18,000	100-500	150-300
	Naogaon	Patnitala	8,000-10,000	200-500	280-300
		Atrai	1,800-2,200	200-400	250-350
	Bogura	Sonatola	215-220	100-500	200-350
		Bogura Sadar	55,000-65,000	100-500	200-350
		Adamdighi	4,600-5,000	50-300	300-350
		Gabtali	1,800-2,000	150-300	250-300
	Pabna	Pabna Sadar	1,30,000-1,50,000	100-300	150-250
		Chatmohar	1,20,000-1,15,000	200-300	180-250
		Ishwardi	1,000-1,500	150-200	150-170
		Bhangura	6,000-7,000	250-500	150-160
		Suzanagar	1,000-12,000	400-600	160-250
	Rajshahi	Paba	670.00-675.00	400-500	250-300
		Puthia	1,200-1,260	250-500	250- 300

		Bagha	2,500-2,575	50-400	250-300
		Tanore	4,560-4,600	100-400	200-280
		Godagari	2,500-2,600	350- 1500	160-200
		Mohanpur	200-250	250 -1500	250-300
	Total=		3,60,645-4,21,580		

Name of the Division	Name of the District	Name of the Upazila	Amount of collected Eel (kg/)year	Weight of collected Eel (g)	Selling prices (Tk/kg)
Khulna	Chuadanga	Damurhuda	18,000-19,000	100-200	150-200
	Jessore	Abhaynagar, Bagherpara, Chougacha, Jhikargacha, Keshabpur, Jessore Sadar, Manirampur, Sharsha	2000-2100	500-600	250-300
	Bagerhat	Rampal	1,09,000-1,09,500	80-500	200-210
		Mongla	8,000-9,000	30-400	70-160
		Mollahat	3,600-3,700	400-500	160-320
	Jhenaidah	Jhenaidah Sadar	3,600-3,650	200-300	200-250
		Shailkupa	9,500-9,600	400-800	200-300
		Kaliganj	1,09,000-1,09,500	300-800	200-300
		Maheshpur	1,500-1,600	500-700	200-300
	Magura	Shalika	1,500-1,600	150-250	190-220
		Magura Sadar	80-85	150-200	150-160
		Sripur	450-460	300-400	145-140
		Mohammedpur	500-550	250-500	100 - 120
	Khulna	Dumuria	20,000-21,000	200-400	200-400
		Paikgacha	40,000-42,000	20-200	70-100
		Khulna Sadar	4.00-6.00	300-400	200-300
	Kushtia	Kumarkhali	2.00-2.50	250-500	200-400
		Bheramara	5.00-7.00	200-400	200-400
		Khoksa	7.00-12.00	200-300	200-250
		Mirpur	4.00-6.00	250-500	200-400
		Daulatpur	7.00-10.00	200-400	200-300
	Total=	3, 26, 759. 00-3, 33, 388			

Name of the Division	Name of the District	Name of the Upazila	Amount of collected Eel (kg/)year	Weight of collected Eel (g)	Selling prices (Tk/kg)
Mymensingh	Mymensingh	Trishal	2,400-2,500	400-500	200-250
		Dhobaura	3,500-3,600	200-400	200-250
		Mymensingh Sadar	1,800-1,900	300-400	200-250
		Bhaluka	1,450-1,500	300-350	200-250
		Ishwargani	1,800-1,850	200-250	200-250
		Gauripur	1,800-1,900	300-400	200-300
		Haluaghat	3,700-3,800	300-400	200-300
		Muktagachha	2,600-2,650	200-300	200-300
		Tarakanda	1,000-1,100	300-400	200-250
		Nandail	14,500-15,000	200-300	150-200
		Fulpur	2900-3,000	300-400	200-250
	Netrokona	Netrokona Sadar	3,600-3,700	150-200	200-250
		Mohanganj	9,000-10,000	200-300	200-250
		Barhatta	2000-2,150	120-400	200-300
		Kendua	2,500-2,600	100-500	200-250
		Purbadhala	10,000-11,000	250-500	200-250
		Kalmakanda	500-600	100-150	250-320
		Atpara	3,000-3,500	100-400	250-320
		Durgapur	1,800-2,000	100-400	250-330
		Madan	2,500-2,600	150-300	200-250
	Jamalpur	Baksiganj	700-750	190-200	70-100
	Total=		73,050-77,700		
Sylhet	Moulvibazar	Sreemangal	21,000-22,000	100-350	280-350
	Sunamganj	Sunamganj Sadar	72,000-73,000	150-700	220-310
		Dharmapasha	90-100	300-1000	250- 300
	Habiganj	Madhabpur	700-900	500-900	150-200
	Total=		93,790 -96,000		
Barisal	Pirojpur	Kawkhali,Nazirpur, Nesarabad, Sadar, Mathbaria	1,800-2,000	200-500	200-400
	Patuakhali	Galachipa	40,000-50,000	250-1000	170-250
		Kalpara	84,000-85,000	200-100	160-260
		Rangabali	50,000-60,000	150-700	150-200
	Barguna	Amtali	4,000-5,000	250-300	240-270

	Barisal Sadar	Uralish, Agailjara	15,000-16,000	100-350	280-350
	Total=		1, 94, 000-2, 18, 000		

Name of the Division	Name of the District	Name of the Upazila	Amount of collected Eel (kg/)year	Weight of collected Eel (g)	Selling prices (Tk/kg)
Chittagong	Noakhali	Noakhali Sadar	4,380-4,745	100-300	600-650
		Chatkhil	1825-2555	200-400	500-600
	Brahmanbaria	Nasirnagar	12500-13000	50-400	100-300
	Cox's Bazar	Chakaria, Pekua	3300-3400	250-1000	500-700
	Khagrachari	Khagrachari Sadar	5000-5500	250-600	250-300
		Dighinala	500-560	250-500	250-300
		Panchari	1800-1850	50-150	50-100
	Bandarban	Bandarban Sadar	1400-1500	200-250	150-200
		Roangchari	2,25,000-2,75,000	150-500	100-350
		Lama	150,000-250,000	200-500	120-350
	Chittagong	Anwara	20000-22700	100-400	200-250
	Comilla Sadar	Comilla Sadar	200-250	100-250	100-150
		Nangakot	800-900	150-250	100-150
		Deidwar	400-500	150-350	200-250
		Laksham	60000-65000	200-350	250-300
		Barura	450-500	150-300	200-250
		Murad Nagar	480-500	150-500	200-300
		Chandina	600-700	150-450	200-300
		Daudkandi	600-650	200-250	150-200
		Titas	4,000-4,200	150-250	170-200
		Monoharganj	350-400	200-350	150-250
	Total=		4, 93, 585-6, 54, 410		
Rangpur	Dinajpur	Birganj	100-120	150-300	100-300
		Fulbari	500-600	180-320	150-200
		Bochaganj	1,000-1,200	120-200	100-200
		Biral	400-500	150-300	100-250
		Nawabganj	700-800	180-250	150-200
		Birampur	900-980	200-400	200-300
		Khanshama	350-400	250-1000	300-600
	Kurigram	Sadar, Ulipur, Nagashweri, Razarhat Bhurungamari Phulbari, Chilmari	8,000-8,500	150-350	180-250
	Gaibandha	Sadar upazila Palashbari Gobandaganj Saghata, Fhulchhari Sundarganj	10,000-11,000	150-320	200-250
	Thakurgaon	Chankargaon Ranisankail	1,080-1,100	100-220	150-200
	Panchagarh	Panchagarh Sadar	60-70	500-700	400-500
		Atomari	200-250	300-400	350-400
	Rangpur	Piragachha	10,000-15,000	200-1500	150-240
		Mithapukur	5,000-6,500	150-600	120-250
		Pirganj	400-500	200-750	120-200
	Lalmonirhat	Sadar	120-150	200-300	120-200
		Aditmari	70-80	100-200	170-200
		Patgram	80-100	100-200	100-150
		Kaliganj	100-180	100-200	120-150
		Hatabanda	90-100	150-250	130-180
	Total=		39,150-48,130		

Conclusion

In Bangladesh *Monopterus cuchia* is commonly found throughout the country. Both freshwater and brackish water Eels are an export fishery that playing an important role in international markets in Bangladesh. Hence, Bangladesh has great opportunity to develop Eel farming industry. Though Eels have very few not yet been given any attention, its culture and collection could be considered as an alternative option for poor peoples and an immerging trade for fishery product traders. Freshwater mud Eel is presently exported to Japan, Korea, Hong Kong, Thailand, China and Taiwan. So it can be a profitable export item to earn foreign currency. From this study it was found that marketing system of freshwater mud Eel affects by various factors.

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