



COVID-19 Impact on the Ornamental Fish Market and Marketing Channel in Katabon, Dhaka, Bangladesh

Md. Fakhurul Islam¹, Tania Perven², Shayla Sultana Mely³, Smriti Chakraborty⁴,
Jewel Chandra Pall⁴, Md. Sohel Rana⁴, Shyamal Kumar Paul^{4*}

¹Department of Aquaculture, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh - 2202, Bangladesh

²Bangladesh Bank, Barishal-8200, Bangladesh

³Bangladesh Fisheries Research Institute, Mymensingh-2201, Bangladesh

⁴Department of Fisheries and Marine Science, Faculty of Science, Noakhali Science and Technology University, Noakhali, 3814, Bangladesh

*Corresponding Author: shyamal@nstu.edu.bd

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ABSTRACT

The burgeoning aquarium fish industry in Bangladesh has been significantly impacted by the COVID-19 pandemic. Therefore, the objective of this study was to evaluate the wholesale and retail Katabon aquarium fish market in Dhaka before (January to March 2020) and during (April 2020 to August 2020) the COVID period. A total of 69 aquarium stakeholders were selected before the COVID-19 outbreak, and 36 were selected during it. Both open-ended and closed-ended questionnaires were prepared and physically administered to the stakeholders to gather data on aquarium species sales, prices, availability, demand, and marketing channels. Compared to the period before the pandemic, daily sales dropped by wholesalers, retailers, importers, and hatchery owners by 44, 52, 80, and 42.2%, respectively. Additionally, the prices of different fish species increased during the COVID period compared to prior. The COVID-19 pandemic reduced the number of species in all aquarium stores by 2.4 to 37.9%. Before the COVID period, the most demanded species were goldfish (50%), guppy (20%), fighter fish (17%), and angelfish (13%), while during the COVID period, it shifted to goldfish (80%), guppy (10%), fighter fish (5%), and angelfish (5%). Furthermore, aquarium fish imports fell from 30 to 2%, while local sources, particularly hatchery owners, increased from 70 to 98%. The number of aquarium stakeholders declined during the COVID era due to lockdowns (70%), fish shortages (15%), low customer demand (5%), and high prices (10%). Transportation costs rose by 6.25– 33.33% compared to pre-COVID levels. The marketing channel was shorter during the COVID-19 period compared to that recorded before COVID, with roles such as commission agent and farmer lack involvement. Aquarium stakeholders' market shares fluctuated both during and before the COVID period. This study highlighted the vulnerability of the aquarium fish market during the COVID-19 outbreak

INTRODUCTION

The ornamental fish business is booming in Bangladesh, offering significant opportunities for rural, coastal, and island residents to earn a livelihood in the fish industry. Each year, numerous new aquarium fish hatcheries are opening due to the

expanding aquarium trade. Consequently, reducing the importation of aquarium fish would benefit Bangladesh. Although there is limited information available on the ornamental fish industry in Bangladesh, it is safe to assert that it has become a successful business in almost all of the country's main cities. Over the years, there has been a steady rise in the number of people in Bangladesh who wish to keep fish in tanks or use them as decorations (**Sunny *et al.*, 2021**). The majority of individuals who have a fondness for ornamental fish tend to maintain their aquatic tanks either within their residential or occupational settings, primarily to enhance the aesthetic value of their surroundings (**Nanayakkara *et al.*, 2021**). Aquarium fish importers are importing many exotic species and introducing some native fish species into the largest Katabon aquarium fish market (both wholesale and retail) in Bangladesh due to the market's expansion and increased consumer demand.

Bangladesh's aquarium fish market frequently imports several exotic species, such as goldfish, zebrafish, fighter fish, comet fish, and angelfish. Researchers have identified at least 25 distinct exotic aquarium species in the country (**Rahman, 2005**). Approximately 80% of the fish on the market are sourced locally, while about 20% are imported from abroad (**Faruk *et al.*, 2012**). Exotic fish species make up the majority of Bangladesh's most desirable aquarium inhabitants despite the beauty of a few native fish species. Some of the native ornamental fish species include *Botia dario*, *Botia lohachata*, *Lepidocephalichthys guntea* & *Colisa lalia*, among others (**Sunny *et al.*, 2021**; **Paul *et al.*, 2023**).

In Katabon, the hatchery serves as the exclusive source of aquarium fish, leading to the establishment of several distribution networks for the commercial sale of specific species. Different supply chains are identified within the fisheries sector based on location and area (**Lebel *et al.*, 2021**). In Bangladesh, four distinct supply chains exist in the ornamental fish market (**Paul *et al.*, 2016**; **Paul *et al.*, 2023**). In most cases, the trade chain begins with fish importers and local hatchery owners and concludes with aquarium store owners. The primary commodity of the aquarium business is fish, while additional items such as tanks, air pumps, food, medications, and other accessories are also available for purchase (**Cheong, 1996**). The commercial enterprise of breeding and selling ornamental fish for financial gain is experiencing rapid expansion (**Rosen, 2020**). The COVID-19 period halted or drastically reduced activities in manufacturing, marketing, processing, transportation, and elsewhere in the country (**Hasan *et al.*, 2021**). The quarantine measures implemented due to COVID-19 have significant ramifications for the fishing industry, as well as for the breeding, trading, and retailing of aquarium fish (**Belton *et al.*, 2021**).

Therefore, Bangladesh has severely curtailed the trade in aquarium fish, both in terms of export and import, as well as in domestic markets and distribution channels. Sadly, the unique human coronavirus (COVID-19) pandemic has expanded to threaten

some of the world's major businesses (Waiho *et al.*, 2020), including the ornamental fish industry in Bangladesh and the fisheries sector (Sunny *et al.*, 2021). The Katabon aquarium fish market stands as Bangladesh's premier wholesale and retail hub for aquarium fish and accessories. Here, a plethora of exotic and valuable species has found its way into the hands of enthusiasts, contributing to its reputation for a diverse selection. The market continues to expand steadily in response to growing consumer demand, with the most sought-after and vibrant species often making their way to district wholesale markets. However, during the COVID-19 period, the supply chain including Bangladesh's largest aquarium fish market experienced significant disruptions. Previously, no one had studied the aquarium fish trade in the Katabon region during the COVID-19 pandemic. Hence, the aim of this study was to collect data from both the COVID-19 and pre-COVID-19 periods to gain a deeper understanding of the status of aquarium stakeholders and the scenario of the marketing channels of the Katabon aquarium fish market in Dhaka, Bangladesh.

MATERIALS AND METHODS

The study was conducted from January 2020 to September 2020 in the Katabon aquarium fish market in Dhaka, Bangladesh. This aquarium fish market, one of the biggest ornamental fish markets comprising wholesalers and retailers, was chosen for this survey. Prior to commencing data collection, a questionnaire was developed with the objective of obtaining both descriptive and specific information. The questionnaire aimed to gather data on various aspects, including sales status, fish prices, the availability of aquarium fish species and their names, consumer purchasing behavior, challenges encountered by stakeholders in the market, transportation systems for fish species, marketing channels, and the activities of aquarium stakeholders. To achieve this, a combination of open-ended and closed-ended questions was utilized. The questionnaire was tailored to address various stakeholders in the aquarium industry, including wholesalers, retailers, commission agents, hatchery owners, and farmers. Prior to the onset of COVID-19, a total of 69 aquarium stakeholders were selected, including 8 importers, 13 wholesalers, 5 commission agents, 39 retailers, 3 hatchery owners, and 1 farmer, while during the COVID-19 period, 36 stakeholders were included, comprising 3 importers, 6 wholesalers, 22 retailers, and 5 hatchery owners. Primary data were collected by physically visiting aquarium stakeholders for face-to-face interviews, both during and before the COVID-19 period (Table 1). In this study, the sale status of stakeholders, the number of aquarium fish species and their price, demandable species, sources of fish and aquarium products, problems in the existing market, the number of stakeholders and their status, transportation costs, and marketing channels were analyzed before and during the COVID-19 period. All primary data were noted on it upon interviewing every aquarium shop owner, manager, and worker. All relevant secondary data were collected from

various reliable journals, books, newspapers, electronic media in addition to government and non-government organizations.

Table 1. Sample size of this study

Period	Aquarium fish trader			Fish producer		
	Importers	Wholesaler	Commission agent (Bepari)	Retailer	Hatchery owner / representative	Wild catcher / farmer
Before COVID	8	13	5	39	3	1
In COVID	3	6	-	22	5	-
Total	11	19	5	61	08	1

Before being documented, all the survey's data were meticulously assembled, reviewed, and completed. Lastly, tables and graphs created using MS-Excel were utilized to describe the study's purpose.

RESULTS

Sale status of aquarium stakeholder

The sales status of aquarium fish stakeholders, including wholesalers, retailers, importers, and hatchery owners, is depicted in Fig. (1). It's evident that sales significantly declined during the COVID-19 period compared to the pre-COVID-19 situation. Before COVID-19, wholesalers had daily sales of 50000 BDT, which dropped to 28000 BDT/day during the pandemic (a decrease of 44% BDT/ day). Similarly, retailers experienced a decrease from 10000 BDT to 4800 BDT/ day (a decrease of 52% BDT/ day); importers saw their sales decrease from 35000 BDT to 7000 BDT/ day (a decrease of 80% BDT/ day), and hatchery owners' sales decreased from 90000 BDT to 52000 BDT/ day (a decrease of 42.2% BDT/ day).

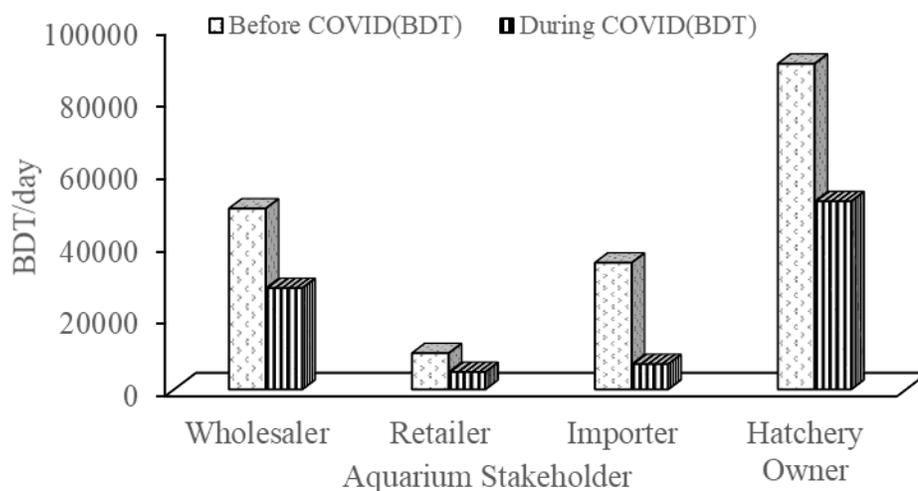


Fig.1. Sale status of retailers, wholesalers and importers

Market price of ornamental fish

Species are categorized in Table (2) based on the percentage increase in retail prices. Out of 42 aquarium species, 11 species price increased ranging from 70 to 92%, followed by 20 species with increases of 50 to 69%, 6 species with increases of 21 to 49%, and 5 species with increases of 10 to 20% (Table 2). Overall, in the retail market, the prices of ornamental fish species increased during the COVID-19 period compared to the pre-COVID-19 period, with increases ranging from 13.93 to 91.11%. The highest price increase was observed for black moor, at 91.11%, while the lowest was for blue spotted angelfish, at 13.93%. Before and during the COVID-19 period, the lowest observed price was 35 ± 10.02 BDT/ fish for tigerfish (local), while the highest was 6200 ± 390.32 BDT/ fish for golden arowana. Additionally, red parrots and flower-horned cichlids were completely out of stock during the COVID-19 period. Price increases were observed in the wholesale, import, and hatchery owner markets for the following species: from $5.80 \pm 0.59\%$ (Bluespotted angelfish) to $51.35 \pm 11.27\%$ (Black Moor), from $3.25 \pm 0.41\%$ (Bluespotted angelfish) to $54.55 \pm 12.13\%$ (Black Moor), and from $5.00 \pm 0.48\%$ (Chinese sucker) to $51.43 \pm 9.37\%$ (Black Moor) compared to the status before the start of COVID-19. Meanwhile, the prices of eight species, including yellowtail damselfish, discus fish, golden arowana, bluespotted angelfish, chinese sucker, and silver shark, increased by less than 10% (Table 2). With the exception of koi carp, the cost of seven species of aquarium fish (parrot, pacu, yellowtail damselfish, discus fish, golden arowana, and bluespotted angelfish) was notably high (exceeding 1000 BDT per fish) due to their imported nature. This study revealed that the price increase was the highest in the retail market, followed by wholesalers, importers, and producers (hatcheries).

Availability of fish species in shops before and during the COVID-19 period

During the research period, nineteen wholesalers were surveyed to gather information on the species, as the wholesale market supplied aquarium fish to the retail market. Before the COVID-19 period, the range of available fish species varied from 23 to 40 among different wholesalers in the aquarium fish market, while during the COVID-19 period, this range narrowed slightly to 18 to 40 species per wholesaler (Fig. 2). Aquatica-2 had the maximum number of species (40 species) throughout the COVID-19 period, while Ocean World, Singapur Aquarium, Water Zoo BD, and Rima Aquarium had the lowest number of species (23 before the COVID-19 began) (Fig. 2). The number of species in all aquarium stores decreased during the COVID-19 era, with drop rates ranging from 2.4% (Popular Aquarium) to 37.9% (Al-Noor Aquarium) (Fig. 2).

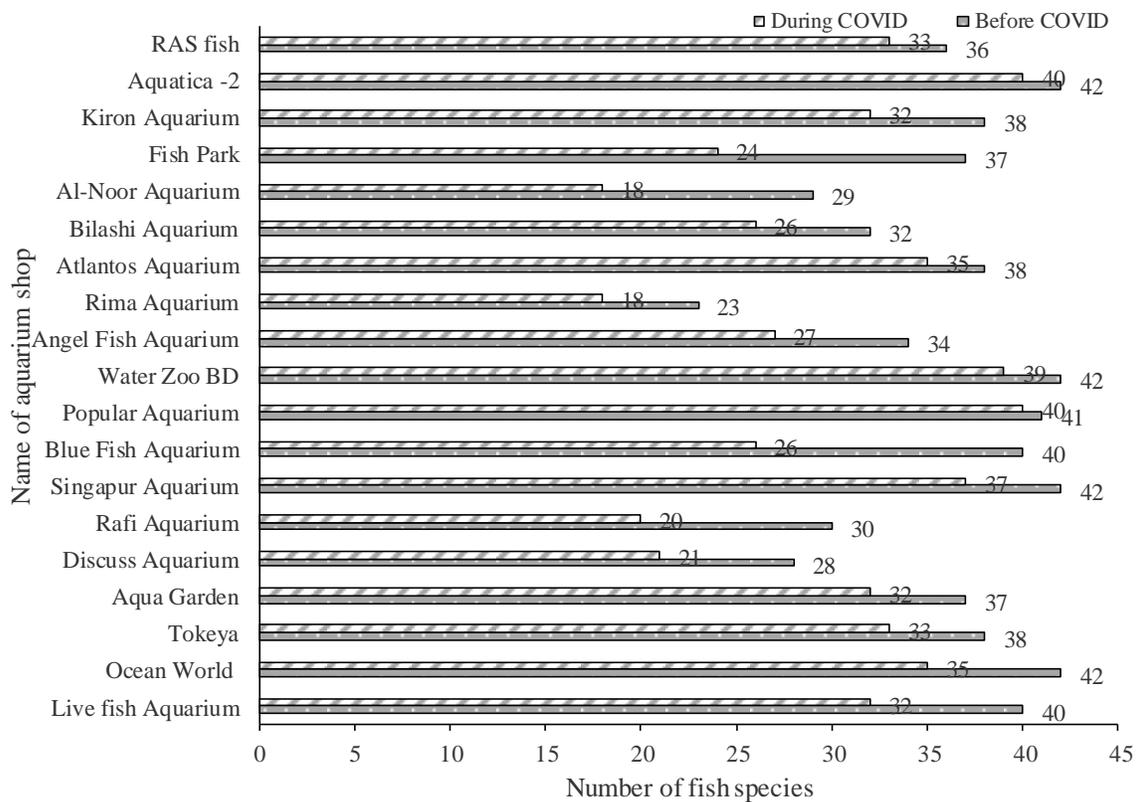


Fig. 2. Number of available species during COVID-19 and before COVID-19 situation

153 **Table 2.** Details market price of aquarium fish during and before COVID-19 period

Name of species	Retailer			Wholesaler			Importer			Hatchery owner in Bangladesh (Producer)		
	Price (BDT/fish) (Before COVID)	Price (BDT/fish) (During COVID)	Price increase (%)	Price (BDT/fish) (Before COVID)	Price (BDT/fish) (During COVID)	Price increase (%)	Price (BDT/fish) (Before COVID)	Price (BDT/fish) (During COVID)	Price increase (%)	Price (BDT/fish) (Before COVID)	Price (BDT/fish) (During COVID)	Price increase (%)
Black moor	450±60.25	860±90.13	91.11±18.37	370±35.18	560±70.44	51.35±11.27	330±45.79	510±70.26	54.55±12.13	350±22.65	530±58.86	51.43±9.37
Pangus	50±4.28	95±8.41	90.00±2.42	40±3.25	45±2.86	12.50±1.86	35±2.17	40±2.75	14.29±1.86	30±1.78	40±2.76	33.33±1.54
Zebra danio	35±2.32	65±4.15	85.71±2.71	32±3.15	40±2.82	25.00±1.85	25±1.62	30±2.05	20.00±1.42	25±2.17	30±2.91	20.00±1.04
Rainbow shark	110±9.17	200±12.84	81.82±7.52	95±5.62	130±13.74	36.84±5.96	85±7.22	110± 9.23	29.41±4.11			
Orenda	300±25.16	540±40.93	80.00±6.86	260±17.15	330±12.54	26.92±4.86	220±10.56	280±12.64	27.27±3.54	240±15.71	270±12.83	12.50±1.83
Bala shark	120±7.54	210±17.13	75.00±6.86	100±5.37	150±9.117	50.00±3.53	90±6.86	110±7.47	22.22±2.96	92±8.34	108±10.43	17.39±2.54
Koi carp	600±40.73	1050±60.73	75.00±16.38	530±30.43	670±41.73	26.42±8.34	490±30.04	610±47.19	24.49±9.10	510±20.91	640±27.88	25.49±7.92
Molly	60±3.17	105±6.32	75.00±2.43	50±5.01	65±3.03	30.00±2.93	43±2.17	58±3.19	34.88±2.34	40±2.11	55±3.91	37.50±2.81
Sword tail	40±1.09	70±3.56	75.00±2.21	30±1.91	35±2.45	16.67±1.05	25±2.13	32±1.85	28.00±2.04	25±2.75	30±1.04	20.00±1.60
Angel fish	55±3.19	95±4.93	72.73±3.17	45±2.12	55±3.92	22.22±1.87	40±2.65	47±4.02	17.50±2.19	40±3.37	45±2.96	12.50±1.74
Parrot	1000±70.63	1700±150.93	70.00±17.73	920±55.92	1120±150.62	21.74±4.92	870±50.36	1070±80.36	22.99±4.93			
Comet	150±8.74	250±16.82	66.67±4.48	110±9.04	150±10.25	36.36±4.16	100±5.84	140±11.32	40.00±3.19	95±4.91	130±8.26	36.84±5.19
Silver ruji (Punti)	45±2.08	75±4.65	66.67±3.76	40±2.76	47±3.65	17.50±2.06	35±3.16	42±2.12	20.00±1.98	35±3.65	40±2.98	14.29±2.06
Pacu	650±65.98	1080±100.07	66.15±18.22	600±54.25	740±70.77	23.33±4.09	530±45.76	650±66.09	22.64±3.76			
Tiger fish (Outer)	110±7.98	180±17.51	63.64±9.55	95±4.44	110±6.38	15.79±1.87	75±3.67	90±4.35	20.00±1.23	80±4.54	95±5.31	18.75±1.02
Tiger shark	55±2.43	90±5.88	63.64±2.87	40±2.54	50±1.06	25.00±0.97	35±1.56	45±2.21	28.57±1.33	30±2.44	40±1.38	33.33±2.33
Albino	160±12.32	260±17.58	62.50±4.43	130±9.55	170±12.62	30.77±2.87	110±7.05	145±10.32	31.82±3.64	115±5.37	155±10.28	34.78±2.97

Fighting fish	680±60.76	1090±81.43	60.29±5.54	610±54.24	870±70.09	42.62±3.56	580±54.29	840±77.56	44.83±5.65			
Knife fish	320±24.51	510±43.65	59.38±4.76	280±18.53	370±23.73	32.14±2.34	250±9.53	330±13.78	32.00±2.06	250±11.45	350±20.09	40.00±2.65
Gourami(Gold)	120±7.09	190±12.87	58.33±4.11	100±5.04	150±7.28	50.00±4.01	100±4.45	130±7.54	30.00±2.43			
Platy	60±3.87	95±4.11	58.33±3.01	50±2.99	65±3.18	30.00±2.43	42±2.01	60±1.07	42.86±3.25	42±2.08	60±3.05	42.86±1.03
Amur koi carp	140±7.46	220±15.26	57.14±2.98	110±5.28	150±9.57	36.36±2.64	100±4.08	135±8.45	35.00±2.77	94±5.01	131±11.87	39.36±2.83
Tiger fish (Local)	35±2.83	55±4.18	57.14±2.01	30±2.12	42±1.81	40.00±0.92	25±2.10	32±1.78	28.00±1.07	25±1.61	35±2.24	40.00±0.82
Algae sucker	55±3.56	85±4.02	54.55±2.76	45±3.08	55±4.01	22.22±1.87	38±2.99	45±2.98	18.42±1.02	40±2.05	47±3.42	17.50±2.01
Chinese sucker	55±3.09	85±3.83	54.55±2.17	45±3.37	55±2.38	22.22±1.58	42±2.27	48±2.63	14.29±1.48	40±2.19	42±2.07	5.00±0.48
Sucker	110±9.08	170±12.35	54.55±3.01	90±6.52	110±7.31	22.22±2.65	80±4.64	100±7.02	25.00±3.18	75±4.11	90±5.27	20.00±2.01
Black angel	100±3.72	150±8.17	50.00±2.91	90±4.16	120±10.08	33.33±2.88	70±3.19	90±2.92	28.57±1.87	75±3.17	92±4.21	22.67±1.73
Cichlid	120±7.61	180±9.74	50.00±3.72	110±6.22	145±11.08	31.82±4.01	100±4.17	130±7.25	30.00±2.87	103±5.53	122±7.27	18.45±2.56
Gold fish	120±7.27	180±9.22	50.00±3.28	110±5.27	150±8.46	36.36±3.16	100±4.11	125±9.16	25.00±3.53	101±3.77	128±5.69	26.73±2.71
Guppy	80±3.88	120±5.15	50.00±2.76	65±2.66	75±2.71	15.38±1.06	55±2.31	70±3.28	27.27±1.72	50±2.01	60±3.02	20.00±1.14
Ticto barb	120±5.42	180±6.58	50.00±2.54	105±2.87	140±3.22	33.33±1.86	105±3.17	135±6.27	28.57±2.58	100±4.22	128±8.16	28.00±3.04
Black molly	90±2.94	130±9.18	44.44±3.18	75±2.09	95±3.11	26.67±0.65	65±3.13	75±2.86	15.38±0.91	65±1.93	72±2.72	10.77±0.68
Gourami (Blue)	90±3.46	130±7.29	44.44±3.13	75±2.91	90±2.87	20.00±1.09	65±2.61	80±3.05	23.08±1.04	65±3.10	77±2.87	18.46±1.43
Oscar	500±70.18	700±65.29	40.00±5.10	450±35.91	520±42.64	15.56±4.92	410±55.23	460±3.62	12.20±2.11	430±40.26	490±38.27	13.95±2.01
Silver shark	130±4.67	180±7.53	38.46±2.03	105±5.19	125±9.26	19.05±2.16	90±4.19	105±7.11	16.67±1.08			
Red gourami	210±16.37	280±21.53	33.33±5.19	185±11.03	210±15.38	13.51±2.19	150±12.08	180±14.34	20.00±3.01	170±5.09	190±9.24	11.76±1.26
Chinese carp	130±8.45	170±11.42	30.77±2.73	110±5.19	140±10.04	27.27±2.38	100±3.91	125±6.93	25.00±2.37	92±4.28	120±6.22	30.43±2.01
Yellowtail damselfish	3300±180.22	3900±280.17	18.18±4.19	3150±130.12	3450±100.23	9.52±1.93	3050±160.42	3600±98.47	18.03±1.93			
Discus fish	4100±230.87	4800±320.37	17.07±3.89	3950±200.26	4200±300.27	6.33±0.87	3590±180.76	4000±287.65	11.42±1.65			
Tiger bulb	60±3.74	70±2.84	16.67±0.56	50±2.04	65±3.03	30.00±1.02	40±2.19	55±3.23	37.50±1.83	40±2.12	50±2.83	25.00±1.73
Golden Arowana	6200±290.27	7180±320.74	15.81±2.52	4700±278.23	5050±260.76	7.45±0.93	4550±230.36	4820±220.63	5.93±0.64			
Bluespotted angelfish	3590±249.73	4090±210.54	13.93±1.04	3450±201.32	3650±190.63	5.80±0.59	3380±167.73	3490±154.54	3.25±0.41			

Demandable species before COVID-19 and during COVID-19 situation

Before the COVID-19 period, in the Katabon aquarium fish market of Dhaka, the distribution of demand among the four most demanded species was as follows: 50% for *Carassius auratus* (Gold Fish), 20% for *Poecilia reticulata* (Guppy), 17% for *Betta splendens* (Fighter fish), and 13% for *Pterophyllum altum* (Angel fish) (Fig. 3). Conversely, during the COVID-19 period, the distribution shifted, with 80% of the demand being for *Carassius auratus* (Gold fish), 10% for *Poecilia reticulata* (Guppy), 5% for *Betta splendens*, and 5% for *Pterophyllum altum* (Angel fish) contributing to the aquarium retail market (Fig. 4). According to this study, the demand for goldfish increased by 30% during the COVID-19 period, while the demand for other species decreased.

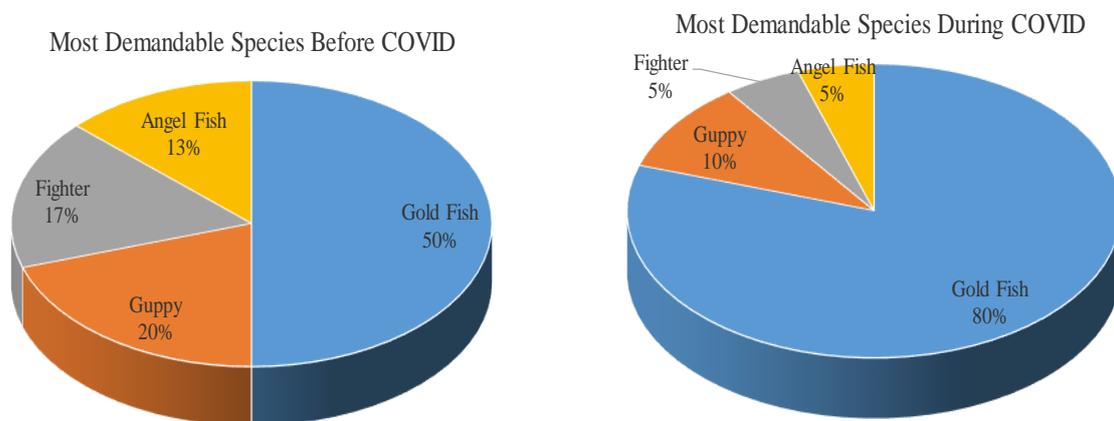


Fig. 3. Demandable species before COVID-19 **Fig. 4.** Demandable species during COVID-19

Market share of producer

The COVID-19 pandemic had a severe impact on the supply chain. Before the COVID-19 pandemic, the Katabon aquarium fish market imported 10% of its fish species and sourced 90% from local hatcheries. Rokomari Fish Hatchery in Feni dominated with a 50% market share, followed by 25% from Gazipur and 15% from Mymensingh (Fig. 5). The most commonly imported aquarium species included the rainbow shark, yellow-tail damselfish, blue-spotted angelfish, golden arowana, and red gourami. Only 2% of the fish sold at the Katabon wholesale market during the COVID-19 period came from abroad. Domestic sources accounted for the remaining 98%, with Feni contributing 57%, Gazipur 33%, and Mymensingh 8% (Fig. 6).

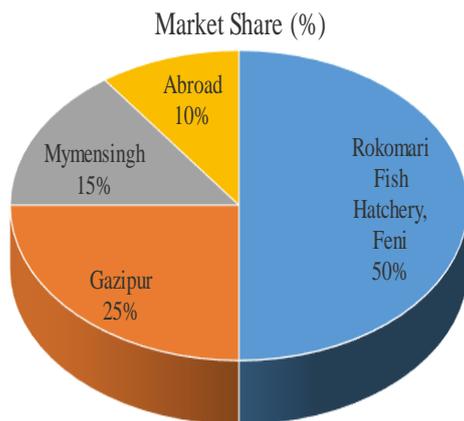


Fig. 5. Market share of producer prior to COVID-19

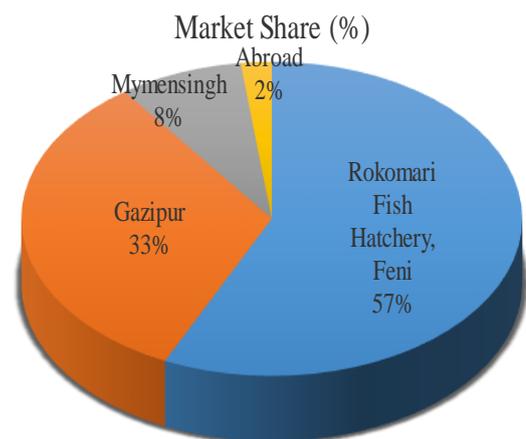


Fig. 6. Market share of producer during COVID-19

Consumer demand of aquarium fish and their accessories

During the COVID-19 pandemic, consumer spending significantly decreased, resulting in a decline in demand for various products including ornamental fish. The demand for aquarium fish species decreased from 90 to 60% during COVID-19, while fish medication needs dropped from 60 to 20%; fish food demand decreased from 80 to 30%, and demand for other aquarium supplies declined from 50 to 20% (Fig. 7).

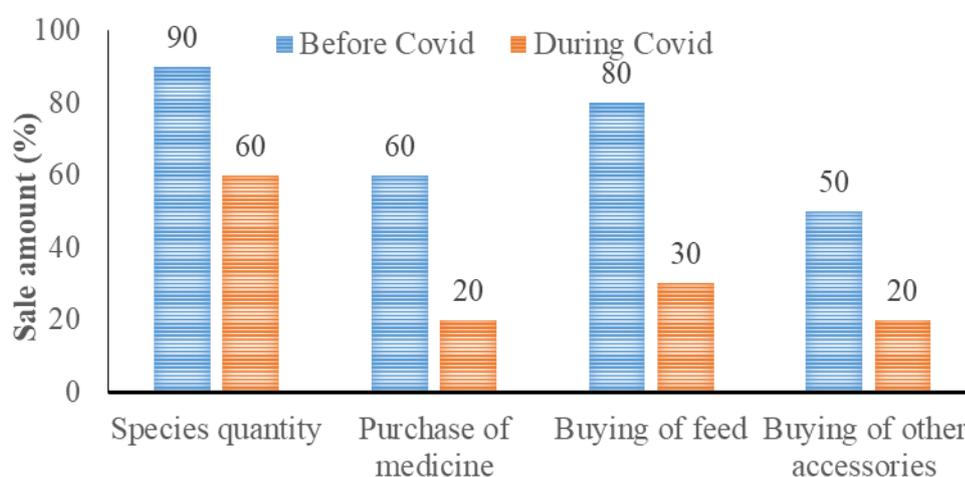


Fig. 7. Status of purchasing ornamental fish and accessories by consumer

Major problems faced by the aquarium stakeholders in COVID situation

Under the conditions of the COVID-19 pandemic, aquarium stakeholders identified four primary limitations during the COVID-19 pandemic. These included issues related to lockdown (70%), supply shortages (15%), limited customer demand (5%), and high price ranges (10%) within the aquarium fish industry (Fig. 8).

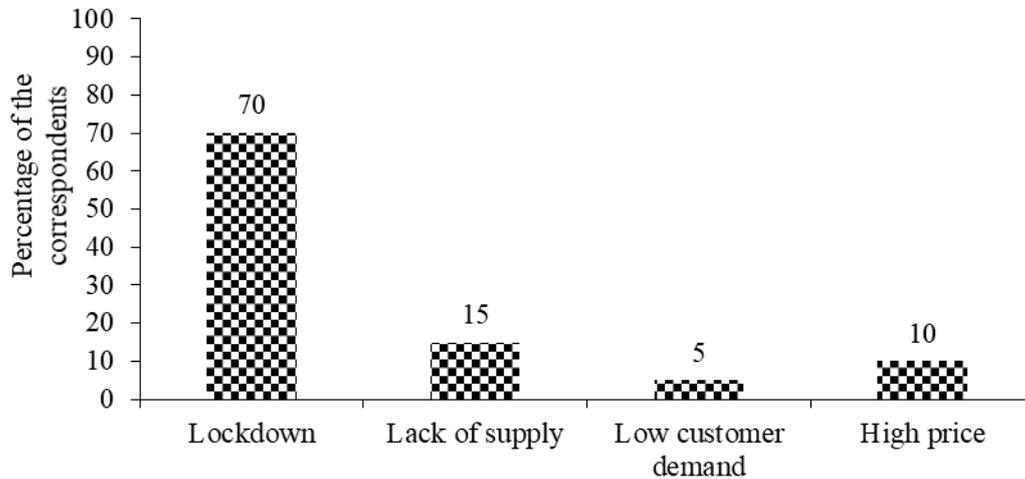


Fig. 8. Major problems faced by aquarium stakeholder during COVID-19

Transportation cost during COVID-19 and before COVID-19 situation

Transportation restrictions significantly impacted the cost of transporting aquarium fish during the COVID-19 crisis. The price range of transportation increased by 6.25 to 33.33% compared to the onset of the COVID-19 period and varied depending on the distance. Detailed cost comparisons are provided in Table (3).

Table 3. Transportation cost during COVID-19 and before COVID-19 situations

From	Destination	Rent of truck (BDT)		Percentage increase (%)
		Before COVID	During COVID	
Feni		8000	8500	6.25
Gazipur		3000	4000	33.33
Savar	Katabon aquarium market	3500	4000	14.29
Mymensingh		7000	7500	7.14

Effect of COVID -19 on supplier in ornamental fish market

Suppliers to the ornamental fish industry suffered significant losses due to COVID-19. Compared to the pre-COVID-19 environment, the number of importers, wholesalers, retailers, commission agents (Bepari), hatchery owners, and farmers decreased from 9 to 6, 14 to 9, 42 to 31, 4 to 2, 7 to 4, and 4 to 1, respectively (Fig. 9).

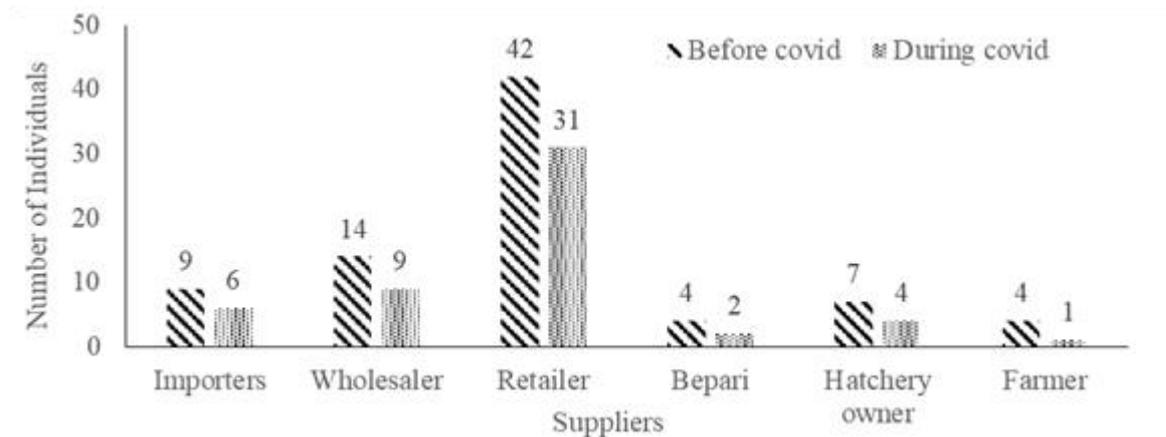


Fig. 9. Effect of COVID on aquarium fish supplier in Katabon, Dhaka, Bangladesh

Aquarium fish marketing channel

Before the onset of the COVID-19 era, the market relied on three primary sources: hatchery owners/ local producers, importers, and fishermen, comprising 69, 30, and 1% of the total market share, respectively. Wholesalers held control over 99% of aquarium fish sales, with 60% distributed to merchants in the Katabon aquarium fish market in Bangladesh, 19% to third parties, and the remaining 21% to shops outside of Dhaka (Fig. 10). The natural fish species caught by fishermen in ponds, rivers, lakes, and floodplains were sold through this marketing channel. During the COVID-19 period, the aquarium fish marketing channel experienced significant changes, with fishermen and third-party agents (Bepary) no longer involved. In this adjusted channel, hatcheries and imported fish accounted for 98 and 2%, respectively, of the total market share in the aquarium fish market. Hatchery owners and local producers primarily sold their products to the wholesale market in Dhaka (45%) and retailers in Dhaka (53%). Subsequently, wholesalers in Dhaka distributed these products to shops in Chittagong (9%), Dhaka (68%), and other districts of Bangladesh (23%) (Fig. 11). Each marketing strategy originated from the initial source of ornamental fish and continued until reaching aquarium keepers.

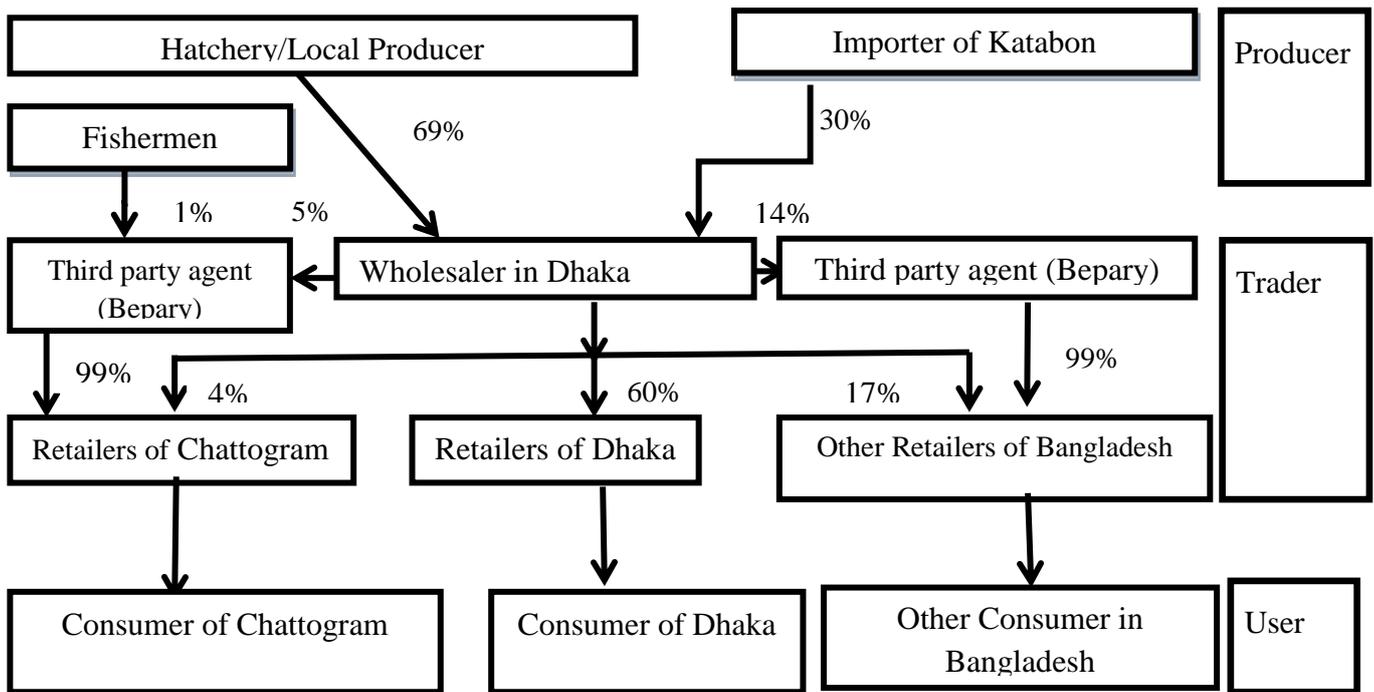


Fig. 10. Overall marketing channel of Katabon Market, Dhaka before COVID period

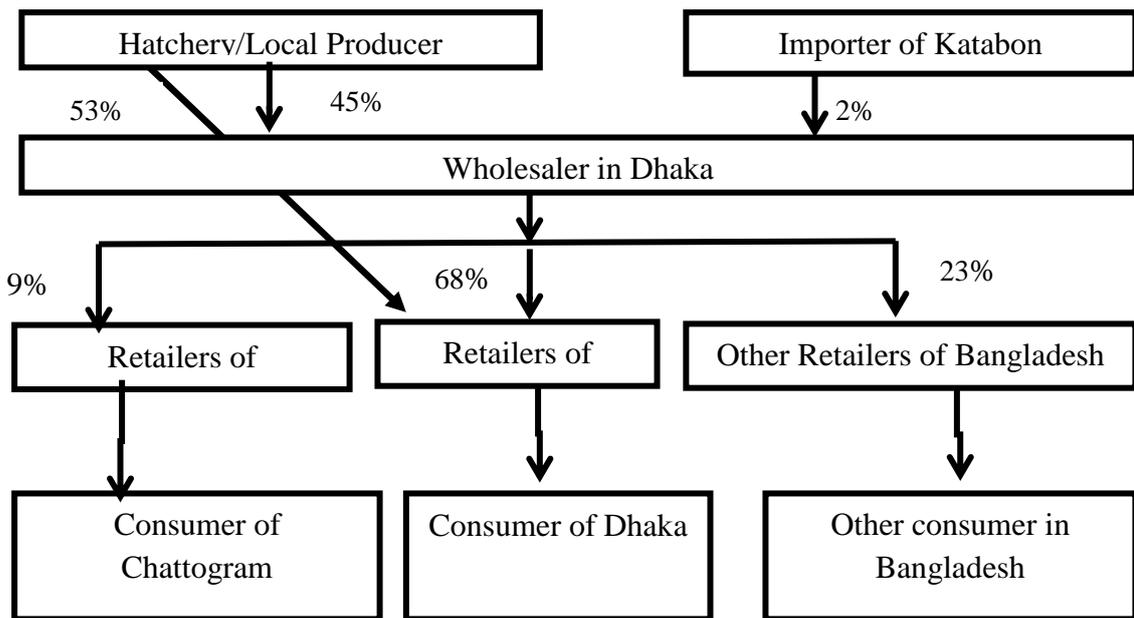


Fig. 11. Overall marketing channel of Katabon aquarium market, Dhaka in COVID period

DISCUSSION

The ornamental fish industry relies on the sale of aquarium fish and accessories for stakeholders to earn their livelihood. Before the onset of COVID-19, stakeholders were content with their sales, anticipating business growth. However, during the COVID-19 pandemic, stakeholders experienced a gradual decrease in sales (Sunny *et al.*, 2021), leading

to reduced revenues and some businesses shutting down in the aquarium market (**Purkait *et al.*, 2022**), similar to the findings of the present study. Apart from the impact of the COVID pandemic, it is widely recognized that an increase in the price of a commodity typically results in a corresponding drop in sales (**Campbell *et al.*, 2021**). The price of aquarium fish fluctuates depending on factors, such as availability, demand, season, size, & color, among others (**Nanayakkara *et al.*, 2021; Paul *et al.*, 2023**). Smaller fish of particular varieties are generally less expensive than larger ones in the case of aquarium fish (**Alam *et al.*, 2016**). During the COVID-19 pandemic, prices for aquarium fish were higher than before the onset of the COVID period due to a decrease in imports, high transportation costs, the weak value chain, feed costs, and equipment costs (**BdFish, 2021; Sunny *et al.*, 2021**), which prompted the present study and justified its conclusion. The findings revealed that the prices of all ornamental species were notably high during the COVID situation. Lockdown measures throughout most of the COVID period, reduced supply, and a broader price range all contributed to this increase.

Previous studies (**Mohsin *et al.*, 2009; Nanayakkara *et al.*, 2021; Sunny *et al.*, 2021; Paul *et al.*, 2023**) have consistently found that Cypriniformes fish are the most common and dominant fish order in the aquarium fish market. Similarly, our study yielded comparable results during both the COVID and pre-COVID periods. The statewide lockdown during the COVID scenario led to fewer fish species being available in aquarium fish markets compared to before the onset of the COVID period. Consequently, retailers were less able to maintain aquarium fish due to challenges in managing feed, water, and aerators. During the COVID period, retailers prioritized keeping the most popular species, with goldfish being a major demandable species both before and during the COVID period. However, our study observed an increased demand for goldfish during the COVID period owing to factors such as color and price. Goldfish emerged as the species with the highest demand, consistent with findings reported in previous studies covering Bangladesh (**Hossain & Mohsin, 2022; Paul *et al.*, 2023**).

Due to the global lockdown during the COVID era, importers of aquarium fish experienced a decline in market share compared to pre-COVID times. Conversely, the contribution of local aquarium fish hatcheries increased. The decline in exports of aquarium fish from Indonesia throughout the COVID era, as observed in **Peggy *et al.* (2022)**, is consistent with the findings of the present study. The COVID-19 pandemic has significantly impacted the global fisheries commodities market (**Peggy *et al.*, 2022**), affecting the aquarium fish market in Bangladesh as well. Reduced purchasing power among consumers, stemming from income declines and irregular salaries led to a downturn in sales of commodities, viz. aquarium fish and aquarium accessories during the COVID period, exacerbated by nationwide lockdowns.

In the present study, a majority of aquarium stakeholders reported business downturns during the COVID period due to unsold fish, high prices, lockdown measures, reduced consumer demand, traffic restrictions, shop rent, high credit rates, low production of aquarium fish, and supply chain disruptions, coinciding with the findings of **Sunny *et al.***

(2021). The sudden nationwide shutdown to curb the spread of the coronavirus resulted in reduced traffic & driving up prices. On the other hand, some truck and bus drivers proposed a 60% increase in transportation costs, further challenging entrepreneurs involved in fish marketing (**BdFish, 2021**). With a 20.6% probability of fish remaining unsold, both fishermen and fishmongers have been facing financial hardships (**BdFish, 2021**).

The marketing channel for a product can vary in length depending on factors, such as product quality, target customer base, and producer characteristics (**Paul et al., 2016**). Various intermediaries, such as hatchery owners, wholesalers, commission agents (Bepari), retailers, and aquarium owners, typically handle marketing tasks in ornamental fish trading (**Kohls & Uhl, 1990**). Lockdown measures, price fluctuations, and reduced consumer demand during the COVID period shortened the marketing channel for ornamental fish, a trend our present study corroborates (**BdFish, 2021; Loison et al., 2021; Siddiqua et al., 2022**). Different distribution channels were present throughout the COVID era and prior, but **Lecchini et al. (2006)** outlined seven different distribution channels for the marketing of fish seeds. In Dhaka, retailers preferred to purchase species directly from hatchery owners or the Katabon wholesale market during the COVID period rather than relying on intermediaries. However, the ornamental fish marketing channel in the Dhaka district faces numerous limitations and challenges that have persisted over time. The pandemic's effects have exacerbated issues related to supply chain disruptions, logistics challenges, marketing difficulties, and production constraints. Additionally, entry into the export market has become increasingly challenging.

CONCLUSION

Ornamental fish hold more than just aesthetic value for aquarium enthusiasts; they also play a crucial economic role, providing livelihoods for importers, retailers, intermediaries, and breeders. The COVID-19 pandemic has significantly impacted the aquarium industry, often associated with prosperity and luxury, thereby putting this sector of the economy at risk. Additional attention and support measures, such as duty exemptions, credit facilities, subsidies, and other forms of assistance, are necessary to sustain and support the growth of this industry.

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