

Chapter One

Introduction

1.1 Background

Bangladesh is located in Southeast Asia, between 20°34' and 26°38' N latitude and 88°01' to 92°42'E longitude, and has an area of 147,570 km². It is one of the world's top fish-producing countries. The fisheries sector in Bangladesh is one of the most productive and dynamic industries in the country, and it has become increasingly significant to the economy in recent decades. Bangladesh has made significant progress in the fisheries industry since its independence in 1971, contributing significantly to the promotion of food security and socioeconomic standing in the dependent people, both of which are highlighted in the United Nations' Sustainable Development Goals (SDGs). Approximately 12% of Bangladesh's total population is directly or indirectly involved in the fishing sector, which contributes 3.50% to the national GDP, 25.72% to agricultural GDP, and represents a significant share of animal proteins. In 2019–2020, inland capture, inland culture, and marine fisheries each provided around 29%, 57%, and 14% of the country's total fisheries production, respectively (DoF, 2020b).

Last few decades, Bangladesh achieved its target production by overcoming numerous natural disasters. The livelihood of fisher community is being affected by natural disasters. Recently, all over the world is facing a big humanitarian crisis caused by the Coronavirus-2019. People are suffering in every aspect of their daily life. Bangladesh is also facing the crisis of the corona virus. Many people died, many people lost their job and most of the total population of Bangladesh faced physical and mental shock because of the disastrous nature of the corona virus. Like other people fishermen also faced the impact of corona virus. The COVID-19 pandemic has impacted the livelihoods of approximately 1.8 million individuals working in Bangladesh's fisheries and aquaculture industries (Islam et al., 2021). Due to a lack of resources, Bangladesh is struggling to deal with COVID-19's negative effects. The country had confirmed 1,950,700 COVID-19 positive cases, 18,020,350 recovered cases, and a total death toll of 29,114 as of March 20th, 2022 (Worldometer, 2020). Bangladesh has implemented preventive measures such as social isolation, lockdowns, local and international travel limitations, and work-from-home opportunities. These initiatives

reduced household income, particularly for wage earners, and people are having difficulty managing their living expenses as a result. COVID-19 has also had an indirect impact on aquatic food production. The restrictions in movement, difficulties transporting fish and inputs, low consumer demand, unsold mature fish, low market prices, disruption in the new farming cycle, the labor crisis, limited-service provider attendance, debt cycle, ban period, and disease susceptibility have all had an impact on the livelihood of fish farmers, fishers, and associated stakeholders (Bennett et al., 2021). Because the COVID-19 pandemic is anticipated to affect the aquatic food chain and the resilience of Bangladesh's dependent communities, this aquaculture and fisheries axis needs to be examined through the lens of the pandemic.

Small-scale fishermen communities rely on expertise passed down from generations to generations (Rahman et al., 2017), and they are one of the most vulnerable groups in the fishing industry unless the organizational and legal framework allows for proper protection (Alam et al., 2021). Various sources of change, such as climate change, environmental adjustments, and national legislation, including regulations, have an impact on the lives of fishermen (Lazzari et al., 2021). At the moment, the COVID-19 challenge, as well as the fishing restriction period—a countrywide policy measure to replenish depleted fish stocks and livelihoods—have become the new drivers of change in poverty alleviation. The COVID-19 epidemic has impeded fishing, fish farming, and fish marketing, as well as damaged the livelihood of people that rely on fishing. The pandemic negatively impacted fish production, fishing activities, household food consumption, and income. Small-scale fisherfolk communities may be vulnerable to the COVID-19 pandemic due to social inequalities and political machinations. This issue also had a negative impact on the social capital of the Bangladeshi fishing community, as it was discovered that not all community members were included in the compensation package, resulting in not only suffering or financial loss for those who were excluded, but also a decrease in community cohesion. Short- and long-term recovery plans have the potential to solve the COVID-19 crisis in terms of urgent and long-term needs for the fishing sector's long-term recovery.

The current COVID-19 pandemic, which began in the first months of 2020, has produced severe societal disturbances. COVID-19 related economic system disturbances, such as business outages in numerous industries, supply-chain

disruptions, substantial declines in consumer demand, and labor shortages, caused chaos in economies all over the world. The fishing industry has been particularly heavily damaged by the COVID-19 epidemic (European Commission, 2020). Because of the reduction in seafood demand and the complexity of the supply chain (i.e., perishable products and labor-intensive activities), the sector's operations are losing money and may close down. Fishing, fish farming, and fish marketing have all been impeded by the pandemic, which has had a negative impact on the livelihood of populations that rely on fishing. The overall revenue of fish farmers, fishermen, and other important stakeholders was adversely impacted, influencing fisheries regulation violations. Many fishermen and fish laborers lost their jobs as a result of the COVID-19 shutdown and limitations. To make the fisheries and aquaculture sector more resilient, more focus should be placed on increasing the capacity of stakeholders through subsidies, incentives, interest-free loans, and alternate income-generating choices (Ahmed et al., 2021).

Due to border travel restrictions, overseas shellfish purchasers cancelled their orders during the lockdown, which was a concerning issue for the shrimp business. To reduce the possibility of such cancellations, greater initiatives from the fishing and transportation industries are needed to ensure the fast and safe transportation of fish products. A long-term management approach is required for the fisheries sector's long-term viability and to combat the COVID-19 pandemic threat. The fisheries sector's human resources and financial allotment (0.56% of the national budget) should both be expanded. At the grassroots level, a package of development and extension programs must be launched to give financial, technical, and moral support to fish farmers and fishermen (Shammi et al., 2021; Sunny et al., 2021a).

In terms of food security and nutrition, fisheries are essential to the macroeconomic and financial system. The COVID-19 pandemic adversely affected the fisheries and aquaculture sectors in many ways. Therefore, efficient and sustainable management of aquatic resources is essential for the continued and significant contribution to the country's health and economic sector. Despite the enormous prospects and potential, several reasons, such as climate change, onshore coal-based power plant installation, a lack of scientific information, skilled human resources, and poor implementation of acts and rules related to marine fisheries, limit the fisheries resources, production, and

performance. However, the supply of good quality seed, feed, and extension services could increase fisheries production in inland water bodies. To have a resilient coastal and marine aquaculture development, adopting appropriate technology is a prerequisite for Bangladesh. The development of communication and transportation systems for rapid access to information, coordination with the regional and international networks for updated technology, value chain, and proper utilization of marine resources is required to boost the total fisheries production of Bangladesh (Haque et al., 2021).

1.2 Significance of the study

A number of studies discussed the impact of the COVID-19 pandemic on the fisheries sector of Bangladesh have so far focused on the aquatic system and value chain, finfish aquaculture industry, shrimp aquaculture industry, seafood system, the resilience of the coastal fishing communities, fish consumption, and food security, and also on small-scale fishing communities. The overall impact of the pandemic on the fisheries sector in a particular coastal based area has, however, remained unrecognized. This study explores the pandemic's impact on the fisheries sector in the Chattogram district as a whole.

Chattogram is the second-largest city in Bangladesh that has an immense role in the regional connectivity across the Indian subcontinent. This port city, witnessed its first coronavirus positive case on April 2nd, 2020. Here, the study further applies the existing approach and project the COVID-19 spread for Chattogram city considering the similar restrictions. It has vast coastal areas where 10 coastal fishing landing centers are available in the district where fishermen and fishing sectors are completely affected by COVID-19 epidemic after Dhaka. Chattogram is the enriched coastal areas with fish diversity, all kinds of professional people like slum people to urban rich people are affected due to COVID as fish availability for consumption, selling, fish business purposes had declined. Therefore, the present study was undertaken through a fundamental survey to assess the economic impact of the current COVID-19 crisis on the fisheries sector of the Chattogram region, Bangladesh.

1.3 Objectives

- To investigate the overall impact of the COVID-19 pandemic on the small-scale fishing community of coastal regions of Chattogram at the individual and community levels.
- To find out shocks and stresses caused by the COVID-19 pandemic; and
- To obtain a general understanding of the resilience features perceived by stakeholders to withstand pandemic-associated threats.

Chapter Two

Review of Literature

2.1 Overview of fisheries before COVID-19

Fisheries is one of the mainstays of the Bangladesh economy. Bangladesh is blessed with productive substantial inland, coastal, and marine water resources. A total of 4.34 million hectares of the country are covered with water, including small ponds, bogs, reservoirs, canals, small and major rivers, and estuaries. Pond aquaculture, in particular the polyculture of indigenous and exotic species, is a part of freshwater aquaculture. A significant artisanal and marine fishing is supported by the nation's 2.30 million ha of shoreline and its 714 km of Bay of Bengal coastline. 3.52 % of the country's GDP and 26.37 % of all agricultural GDP are contributed by the fishing industry. Total export revenues are comprised of 1.39 percent of fish and fishery products (DoF, 2020b). The country obtains 398.52 million by exporting almost 70.95 thousand MT of fish and fishery products.

Bangladesh is one of the top fish producers in the world, with a total production of 45.03 lakh MT in FY 2019–20, including aquaculture accounting for 57.38 % of the total fish production. Achieving a total fish production of 45.03 lakh MT in 2019–20, which is nearly equal to the targeted fish production of 45.52 lakh MT in 2020–21, has been made possible by the steady growth performance in the fisheries sector over the previous 12 years, with fairly steady average fisheries growth of 4.82 percent and consistent average aquaculture growth of about 8.59 percent. The overall fish production in Bangladesh has expanded by approximately six times during the past three decades (7.54 lakh MT in 1983-84 to 45.03 lakh MT in 2019-20). With sovereignty over almost 118,813 sq km of the Bay of Bengal, Bangladesh has access to immense maritime water resources thriving with biodiversity. Only 14.90% of the nation's 6.71 lakh MT of fisheries production in 2019–20 comes from the marine fishing sector. Of the entire marine production, artisanal small-scale fishing accounts for 82.86 percent, or 5.56 lakh MT, and large industrial fishing for 17.14 percent, or 1.15 lakh MT (DoF, 2020b).

2.2 Impact of COVID-19 pandemic on aquaculture

Before COVID-19, the aquaculture industry of Bangladesh was experiencing rapid expansion, with an average yield of 5.26% during the preceding ten years (2008-2018). Every commercial sector in Bangladesh, including the growing aquaculture sector, has been shaken by the pandemic and the advent of a new normal. The government of Bangladesh imposed a countrywide closure on the 26th of March of 2020, when the outbreak was in its early stages. Production, processing, marketing, transportation, and all other sectors were compelled to shut down or lessen activities, resulting in a reduction in production across the country. Due to disruptions in national and international transportation, aquaculture has been challenged, making the inflow of inputs (seed, feed, water, and medications) and the outflow of harvests from aquaculture farms more expensive. The impact has been experienced by all stakeholders in the Bangladeshi aquaculture sector from aquaculture product sales to fish and shellfish markets to aquaculture feed and medicine sales.

Farmers are the most susceptible stakeholders in the value chain, as they have to endure a range of risks and make a large investment against several uncertainties in order to recoup their investment. COVID has triggered financial pressure for finfish farmers and has created disparities in the supply chain. A study on the finfish farmers in Mymensingh concluded that according to benefit-cost ratios derived from the farm's economic study, while carp and other catfish farming is still profitable, pangasius and tilapia cultivation may put the farmers in debt (Hasan et al., 2021). Consumers are paying higher prices for pangasius and carp, and slightly lower prices for tilapia and other catfish, while finfish producers are getting less money per kilogram for all of their products. The "middlemen" in the supply chain, on the other hand, have raised their selling prices to balance rising expenses and maintain profitability. Such a destabilized value chain is unsustainable in the long run and sets local and national food security at risk. There was also evidence that farmers were not receiving a fair price as a result of supply outpacing consumer demand and a gradual decline in farmgate prices caused by market instability. As a result, some farmers are holding onto supplies for an undetermined period of time, hoping that the market would recover to pre-crisis levels (Fry et al., 2019). Another study revealed COVID-19 has presented a number of challenges to fish supply chain actors, including a lack of inputs, a lack of technical assistance, an inability to sell the product, a lack of transportation for the fish supply,

export restrictions on fish and fisheries products, and a low fish price. These issues result in insufficient production, unintended stock retention, and a loss of profits (Alam et al., 2021). Fish farmers were unable to harvest their fish in order to begin a new production cycle, resulting in decreased fish availability and the loss of downstream and upstream employment options (Love et al., 2021). According to Waiho et al. (2020) the pandemic has lowered demand for fish and fishery goods, causing hatcheries to close, feed imports to halt, and many value chain companies to incur losses right from the start of the culture season.

Shrimp farming is significant to Bangladesh's national economy, notably in terms of foreign exchange earnings. This has become a fundamental income generating opportunity for coastal communities of Bangladesh, with the industry contributing USD 383 million through export earnings, 75.8% of the total fish and fish product exported in the financial year 2018-19 (DoF, 2019). From a thorough survey on shrimp farmers in south-west Bangladesh it was observed that farm incomes declined as national lockdowns restricted access to international markets and mobility inside the country, despite increased production costs. Farmers curtailed their labor to compensate, yet even with the sale of co-cultured finfish, they still faced significant revenue losses (average 42.8% reduction in profit) (Bashar et al., 2021). Supply chains have been disrupted as a result of export restrictions and limited cargo shipment of agricultural goods (FAO, 2020b), which has delayed goods transit both locally and internationally. International orders have been canceled, including a worth of USD 4.6 billion in a single month (Sarafat, 2020), forcing the business into a financial bind. Furthermore, the majority of shrimp farming products, such as feed, farm equipment, fertilizers, and chemicals, are imported from other countries. The limited international and national movement has resulted in input shortages and higher production prices; for example, the COVID-19 prohibition has reduced sea fishing by 34% (Coll et al., 2021), while limited maritime transport has increased the cost of fish meal by up to 47%. Farmers were hesitant to restock ponds due to potential drops in demand and price of shrimp, as well as increasing production expenses. They were somehow unable to hold onto their stock until better market circumstances arose due to potential disease outbreaks or environmental issues (Kabir et al., 2020; Talukder et al., 2021). Hasan et al. (2021) and Kumaran et al. (2021) observed price drops of 13% for carps and catfishes in

Bangladesh and 35% for shrimps in India, respectively, whilst Belton et al. (2021) reported a maximum fall of 35% in Asian and African countries.

2.3 Impact of COVID-19 pandemic on small-scale artisanal fisheries

The marine fishery sector is an important source of socioeconomic support for the people of the country. More over 17 million people work in this industry, accounting for roughly 11% of the country's entire population (DoF, 2016). Artisanal small-scale fishery provides the lions share in this total marine production. Small-scale fishermen, an important part of maritime fisheries, usually reside in coastal regions and capture fish using traditional methods and equipment. Due to movement restrictions imposed by COVID-19, artisanal and small-scale fishing on the Bay of Bengal was restricted, and the local market and supply channel distribution system was interrupted. It was observed that 88.5% of fishermen who relied solely on fishing were more vulnerable to the COVID-19 outbreak (Sunny et al., 2021b). Meanwhile, a major portion of the fishing work force in the harvesting, processing, and selling of fish was unemployed. The unemployment situation intensified disputes among several stakeholders, leading to social unrest. About 68% of respondents claimed government subsidies were insufficient to feed their families, urging them to fish illegally and overlook sanitary measures. Small-scale fishermen's ability to pursue their livelihoods has been further harmed by low demand and price collapse that has resulted from market disruptions. Export-oriented small-scale fisheries have seen a significant drop in demand (especially from Europe, the United States, and Asia), as well as port closures, loss of cold storage, and shipping and commercial shipping delays (Orlowski, 2020). Fishermen, sellers, and processors are also at risk of COVID-19 infection and spread, compelled them to choose between feeding their families and risking exposure. Because of the migratory character of fishermen and the frequency of international visitors, fishing villages and ports could become "hotspots" for fast infection (FAO, 2020). Small-scale fishermen have been particularly vulnerable, as many of them rely on their daily catch to feed and maintain their families. Many fishermen have gone further in debt by borrowing money from unofficial sources to maintain themselves and their families (Ferrer et al., 2021). Furthermore, due to the restrictions restaurants and hotels are required by law to shut their business. As a result, the demand for fish and fishery products has declined (Fiorella et al., 2021). COVID-19 exposes existing vulnerabilities in small-scale fisheries by disrupting fish distribution, fish supply and demand, production and labor,

putting small-scale farmers' livelihoods at jeopardy (Love et al., 2021). Marginal fish producers have also had to deal with a lack of inputs and technical help, as well as market difficulties, transportation concerns, and low prices. As a result of these issues, there has been food insecurity, unanticipated stock retention, lack of returns, and insufficient output (Alam et al., 2022).

2.4 COVID-19 and 65-days fishing ban regulation

In the midst of this pandemic crisis, a 65-day marine fishing restriction was issued from May 20 to July 23, 2020 (United News of Bangladesh, 2020). Bangladesh's Ministry of Fisheries and Livestock first imposed such a fishing ban in 2015 through a gazette notification to maintain proper fish breeding in the economic marine region as it was under threat from overexploitation (Hussain, 2019; Islam et al., 2020). The prohibition was initially only on industrial trawlers, but since 2019, it has been extended to other types of fishing in the Bay of Bengal in order to protect spawning fish and crustacean species (Rahman et al., 2017; Islam et al., 2020; Arafat et al., 2021). While the fishing ban appears to be benefiting Bangladesh in terms of increased fish output, it is also causing economic loss and threatening the resilience of coastal Bangladesh's small-scale fishing communities (Islam et al., 2020). The fishing ban was a regular event for the coastal fishers, but this time it was stressful because of the COVID19 pandemic restrictions which already deprived them of fishing from late March 2020 onward. The unexpected lockdown posed reduced income and debt as a shock. A study by Sultana et al. (2021) reported that most of the fisherfolk could not find alternative income sources due to their limited skill and some of them entered into daily labor work to earn a livelihood. However, the government normally gives assistance to fishermen who have a fishing identity card during the timeframe of the fishing restriction. But the level of bureaucracy in getting identity cards and unequal access to relief supplies puts fishers in severe conditions. It should also be highlighted that there was no monitoring or supervision of fishing activities during COVID-19's emergency situation, which could have increased the occurrences of Illegal, Unreported and Unregulated (IUU) fishing and incursions into areas used by small scale fishers (Thomson, 2020; CFFA, 2020).

2.5 Impact of COVID-19 pandemic on aquatic value chain

A fisheries or aquaculture value chain incorporates everything from fishing to aquaculture production to processing, input transit, distribution, wholesale, and retail

marketing. Each of these activities is vital to the supply chain's performance. COVID-19 and similar schemes have the ability to disrupt or interrupt the chain at any step. Fish farms have had issues collecting and marketing their goods due to a significant decline in market demand for fish and the limited transportation alternatives available during the lockdown (FAO, 2021). Farmers were unable to harvest their current crop, therefore they could not begin a new farming cycle. As a result, they had to try to sell their produce at a reduced price, putting their livelihoods in jeopardy (FAO, 2020; Sunny et al., 2021b). Producers had experienced challenges with production inputs (seed stock and fingerling shortages), as well as limited access to feed, labor, medicine, chemicals, vaccines, and consulting or engineering services, due to the strict movement restrictions. In aquaculture operations, a scarcity of essential products such as medicine had resulted in poor water quality management and a higher incidence of infection (Chanrachkij et al., 2020; Manlosa et al., 2021).

Fishing and farming activity reductions also altered demand for harvesting labour, transportation, and other services, resulting in major negative consequences for the numerous employees that rely on these industries. Because the COVID-19 pandemic adversely affected the entire value chain, curtailed fish seed and grow-out production systems, and constrained these value chain actors' sources of income and subsistence means (Hussain et al., 2020). Even though consumers were paying more than they had been before COVID, farmers were earning less, and the profit was shared by the middlemen, who keep blaming higher transport costs and lower customer needs. Moreover, the government's lack of institutional, monetary, and technical support for fish farmers was driving them to bankruptcy and massive debt. From the perspective of achieving food security, work opportunities, and revenue production, this probable collapse of aquaculture sustainability in Bangladesh may pose a more serious threat than COVID (Hasan et al., 2021).

2.6 Impact of COVID-19 pandemic on consumers

The COVID-19 pandemic had posed a detrimental influence on nutrition and food security throughout all levels, especially for lower to middle-income households and vulnerable communities in urban areas. A job loss during the pandemic might put a household under a lot of stress, depending on each person's income. The food supply chain was affected by the limitations placed on mobility during the lockdown, and low-

income people in large cities experienced their purchasing power dwindling (Mandal et al., 2021). Consumers of all income ranges had to suffer more or less income reduction with a few losing their job permanently. Additionally, now consumers have to spend for higher-priced pharmaceutical and personal hygiene items, expensive medical services, and the frequent purchasing and usage of surgical masks, which have increased in price by nearly six-fold (Bunis, 2020). The rising expense of living is forcing them to ration in other areas, such as food preferences, such as choosing low-cost eggs over higher-cost fish or cheaper fish over more expensive species.

2.7 Resilience of fishing community and stakeholders

The capability to prepare for and withstand shock and stress from a variety of risks, whether environmental, social, or economic, and sustain functionality is referred to as resilience (Keck and Sakdapolrak, 2013; Lei et al., 2014). Leite et al. (2019) evaluated resilience at the individual, household, and community levels as studying from a single level might discard the resilience of the other levels. Uncertainty, insecurity, concern, and panic emerged as a result of COVID-19's rapid spread and impact over the world (Ahorsu et al., 2020; Sultana and Alam, 2020). This unexpected event had a significant impact on lower-income people in developing nations such as Bangladesh (Shammi et al., 2020). Fishing was strictly prohibited in the Bay of Bengal during the COVID-19 lockdown, and the market and distribution system was interrupted due to transportation restrictions (Sunny et al., 2021b). The limited mobility posed as a great threat to the aquaculture supply chain and its actors.

A significant number of fishers and traders stated that low demand from traders was affecting the fish trade, implying that supply chain disruptions were caused by traders' inability to sell fish and, as a result, they were unable to support local fishing operations (FAO, 2020a; 2020b). Despite these obstacles, a greater part of fishermen and traders said that continuing to fish was their best coping technique, despite obtaining lower prices for catches. This trend is in contrast to small-scale fisheries in Mexico, where 48% said they had ceased fishing and 44% said they were unable to adjust and had discontinued selling their products owing to the lack of dealers or storage space (COBI, 2020).

The most frequent responses to shocks and stresses were taken by households or individuals, while community responses had been the smallest. Nonetheless, the most

common community-level reactions were found to be communal income-generating activities and interaction with formal institutions. The majority of respondents from the literature studied by Sultana et al. (2021) favored for differentiated participation in response to the pandemic and modifications in the fishing restriction. For example, a group of fishermen who did not own a boat or individual fishing equipment worked for a Mohajan (boat owner) or a fishing company and were paid on a daily basis. Working as a Mohajan supported fishermen helped them in obtaining unsecured loans or receive necessary supplies, such as food for their homes, in exchange for a mortgage, before departing for fishing in the Bay of Bengal. This assistance aided them in overcoming the financial and food challenges in a shorter time. Fishermen, on the other hand, frequently failed to make enough money to return the assistance they had already received. As a result, they were obligated to work for that Mohajan until the debt was repaid, often for very little or no pay, and in some cases, they were manipulated and forced to engage in illegal fishing. This type of bonded labor may persist for generations.

Chapter Three

Materials and Methods

3.1 Study area

As the research solely concentrated on fisheries in the Chattogram district, a number of fish landing areas, fish markets, super markets, fish farms, and hatcheries were considered to collect information. The study was conducted for a period of 12 months from October 2020 to September 2021. To obtain the general idea of pandemic impact during and after the lockdown period, 7 landing areas, 7 fish farms located in Patenga, Mirsharai, Sitakunda, Banshkhali, and Anowara, 8 fish markets considering the urban and rural sites, and 3 supershops located in Chattogram city were selected. The sites were purposively chosen for this study due to their close proximity to fishing and landing sites. For a complete understanding of the effects of the pandemic, a survey was also carried out in a few different fishing communities along the coastal area of the district. These places were also purposefully chosen with the goal of reaching out to the communities and learning about their livelihoods, including problems and adaptive behavior during the COVID-19 pandemic.

3.2 Identification of target groups

The interviews were conducted with personnel who are actively and partially related to fishing and related livelihoods. The study also covered a wide range of consumers to draw a portrait of fish availability and a consumer-driven scenario in the fishery sector. The sample size of respondents was chosen carefully, so the information contains as insightful perspectives.

Table 1: List of participant category, name of the area and their location, and number of participants in a respective area

Category	Name of the Area	Name of the location	Number
Fish trader (Aratdar)	Fish Landing Areas	Fishery ghat	5
		Kattali	5
		Faillatali, Halishahar	5

		Guliyakhali, Sitakundo	5
		Kumira ghat	5
		Zorarganj, Mirsharai	5
	Fish Markets	Bahaddarhat	3
		Chawkbazar	2
		Patenga bazar	4
		Sitakundo Bazar	4
		Zorarganj Bazar	4
		Baraiyarhat Bazar, Mirsharai	4
Wholeseller	Fish Landing Areas	Fishery ghat	5
	Fish market	Kalurghat	5
		Sitakunda Bazar	2
		Zorarganj Bazar	2
		Baraiyarhat Bazar, Mirsharai	3
Fish Retailer	Fish Landing Areas	Kattali	5
		Guliyakhali, Sitakundo	3
		Kumira ghat	4
		Banshbaria	3
		Syedpur	5
	Fish market	Bahaddarhat	5
		Chawkbazar	3
		Patenga bazar	5

		Karnaphuli market, Agrabad	3
		Pahartali Bazar	3
		Sitakundo bazar	1
		Zorarganj Bazar	2
		Baraiyarhat Bazar	1
Seller	Supershop	Agora	1
		Shwapno	1
		Basket	1
Farmer	Fish farm	Patenga	5
		Patiya	3
		Sitakunda	9
		Mirsharai	3
		Gahira, Anwara	5
		Chanua, Banshkhali	5
Fishing laborer	Fish market	-	3
Ice vendor	Landing center	-	2
Transport worker	Fish market	-	4
Fisherman	-	-	125
Consumer	-	-	41
Total			319

3.3 Data collection

The information required for the study was gathered into two types: primary data and secondary data. One of the most widely used qualitative methods for primary data collection is interviewing. In this study, semi-structured interviewing was employed.

To gather diverse opinions from the target groups, the following phases were practiced thoroughly:

- a) Individual interviews
- b) Key informant interviews
- c) Focus group discussion

3.3.1 Individual interviews

The study was conducted mostly by face-to-face interviews with a semi-structured questionnaire. During the early year of the pandemic, considering the one-on-one interview was quite hazardous due to heavy transport loss and area restrictions. To collect at least some sample representatives from different sub-sectors of fisheries, a total of 20 in-depth face-to-face interviews were performed with the fishers, fish farmers, fish traders, wholesalers, retailers, and fish laborers to draw a proper view of the effect of the pandemic on fisheries sector and related livelihoods. A collective number of individual interviews were also held at the consumer level to get a better understanding of the value chain of fishery products.

3.3.2 Key informant interviews

A number of key informant interviews were conducted in every examined area possible to gather precise and actual information. Most of the key informants were fish auctioneers in landing areas, fishery personnel in markets and group leaders in fishing occupied communities. The questions were strategically chosen to get bias-free answers to stack up reliable information.

3.3.3 Focus group discussions (FGDs)

Five focus group discussions (FGDs) were held to synthesize the data from the in-depth interviews and to analyze the pandemic's comprehensive consequences and recovery alternatives in the industry. During the face-to-face interviews, a few issues that seemed controversial were also addressed with the FGD participants. FGDs were arranged in fishing communities and fish landing areas. Proper health guidelines and safety measures were maintained during the interviews.

3.3.4 Secondary data collection

A systematic review technique was used in this study, which includes developing an evaluation process and searching for the most relevant literature. Many related articles, along with recent papers on COVID-19's impact on fisheries and the food economy, were reviewed to collect reliable data and information to enrich the study. The relevance of papers to the field of fisheries and aquaculture, as well as the availability of references to the impact of COVID-19 or the fish food supply chain, were all considered. A number of published journals and official documents on the effects of the pandemic and lockdown in Bangladesh were contemplated as supporting material for this research.

3.4 Data analysis

Statistical tests were used to analyze quantitative data in the form of frequencies and percentages in MS Excel (Version 2016) and IBM SPSS (Version 25). The evaluation of qualitative data involved text analysis. After the qualitative input was transcribed, the contents were analyzed, and themes were created. The study uses graphs, charts, and tables to visually represent the data.

Chapter Four

Results

The findings of the research are presented in the following sections: 1) impacts on income and sales of different stakeholders (fish auctioneer, retailer, wholesaler and farmer), 2) impacts on small-scale artisanal fishing communities, 3) impacts on consumers.

4.1 Impact on stakeholders

4.1.1 Fish sale

The overall impact of the pandemic on stakeholders in the aquaculture and fishing sectors was mostly negative. The stakeholders included fish auctioneers, fishers, fish farmers, and fish traders (retailers and wholesalers). From the analyses, the total mean fish sale of a fish auctioneer was 359.7 ± 264.04 kg/day before the pandemic (Fig 1A). This daily sale significantly ($p < 0.05$) dropped to 190.7 ± 164.6 kg during the lockdown period. After lockdown, this situation improved a bit and the sale was raised to 268.9 ± 215.9 kg/day. The sale statistics show the change in sales during the pandemic period is more observed in rural areas than in urban areas, and the situation also improved more in urban areas than in rural areas after the lockdown period.

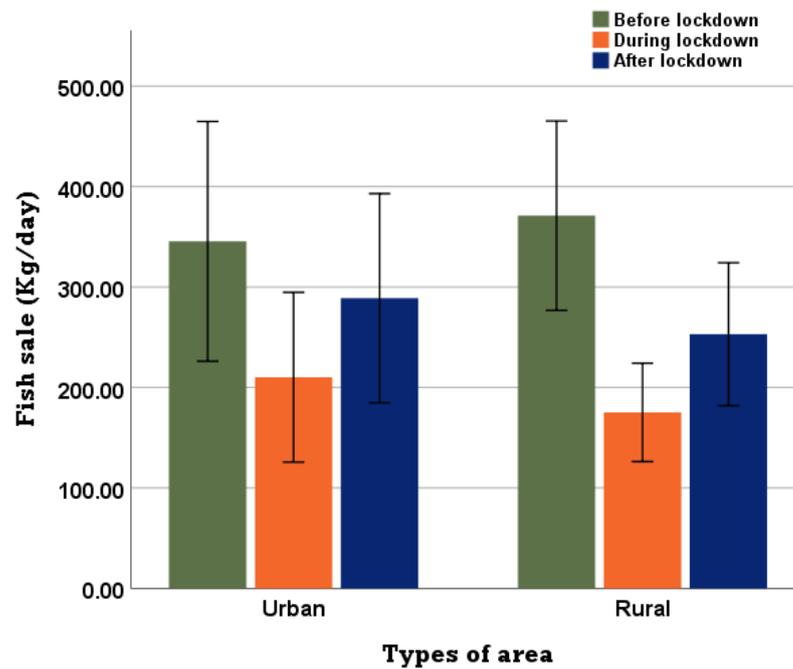
The survey collected data on sales from 30 farmers, with 83% from rural areas. Prior to the epidemic, the average weekly sale of a fish farmer was 691 ± 170.3 kg. The sale was reduced to 136.2 ± 64.3 kg/week during the lockdown period. The fish sale had not yet surpassed pre-COVID levels, and was recorded at 394.7 ± 145.9 kg/week (Fig 1B).

Participants, majorly the traders claimed that they faced the most negative consequences from movement restrictions. Both in urban and rural areas the sale steeply decreased. Before the pandemic, the mean sale of an urban fish trader was 25.9 ± 13.6 kg/day whereas the sale of a rural trader was 94.4 ± 91.8 kg/day (Fig 1C). This sale significantly declined during the pandemic, the recorded sale of the urban and rural trader was 14.2 ± 8.1 kg/day and 41.3 ± 43.9 kg/day, respectively. The sale volume was seen comparatively higher than lockdown times, in urban areas at 27.5 ± 14.2 kg/day and in rural areas at 74.3 ± 76.3 kg/day.

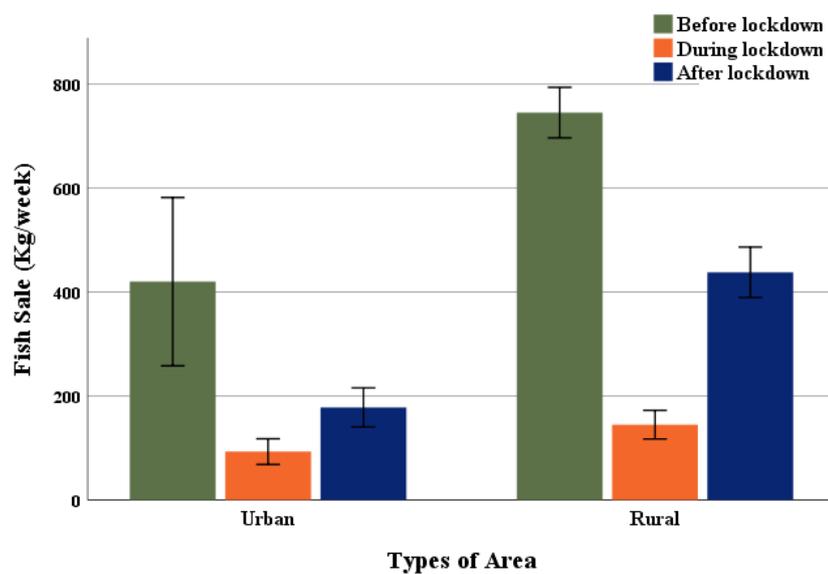
The sale of fish has decreased considerably during the pandemic, according to fish traders. Traders, primarily wholesalers, may not have delivered the required amount of

fish from fish auctioneers. As a result, their daily sale volume drastically dropped from 143.5 ± 77.4 kg to 63.3 ± 40.4 kg. Retailers' sales declined as well, though not as sharply as wholesalers' (Fig 1D).

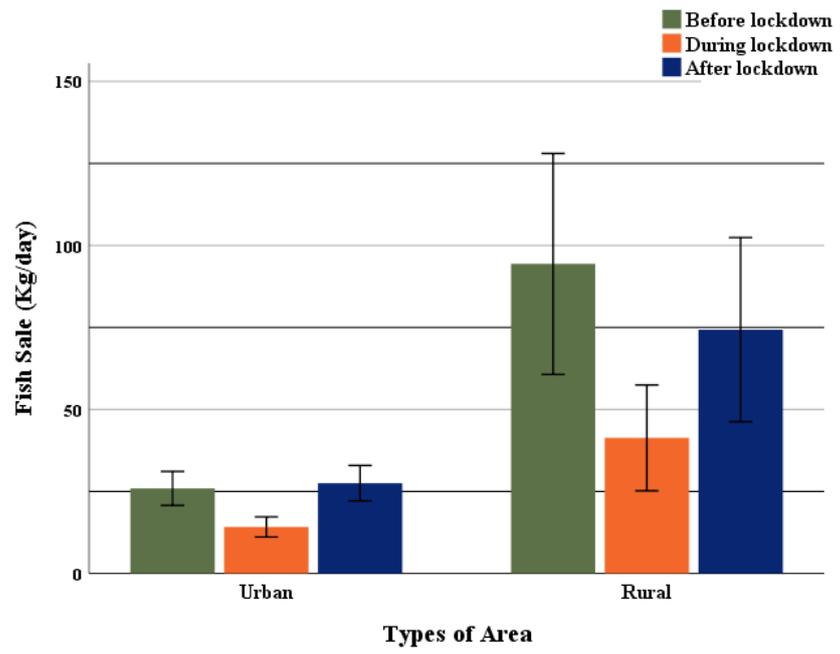
The study also looked for a pattern in fish sales in three different supermarkets. The sale of fish during the pandemic was lower than in pre-COVID days (Fig 1E). They began selling online and offering home delivery as an option, and sales increased after the lockdown.



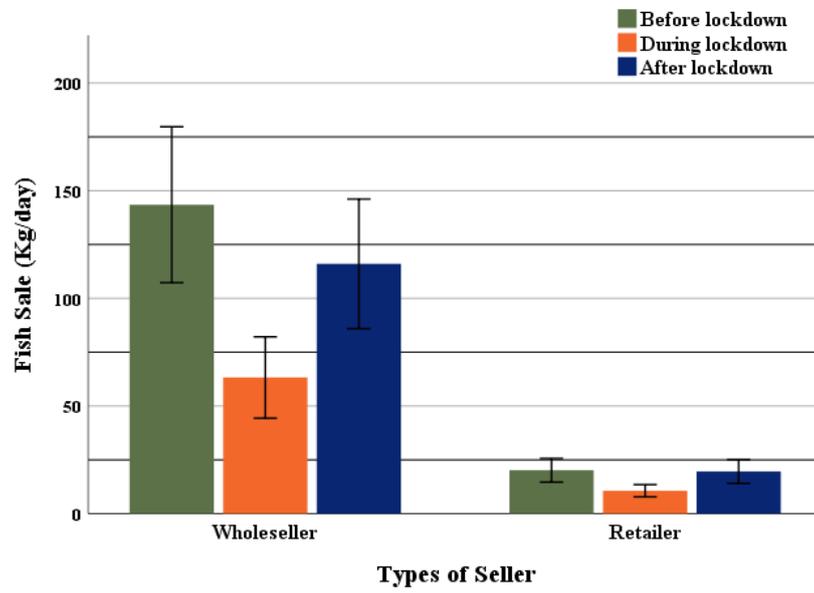
1(A)



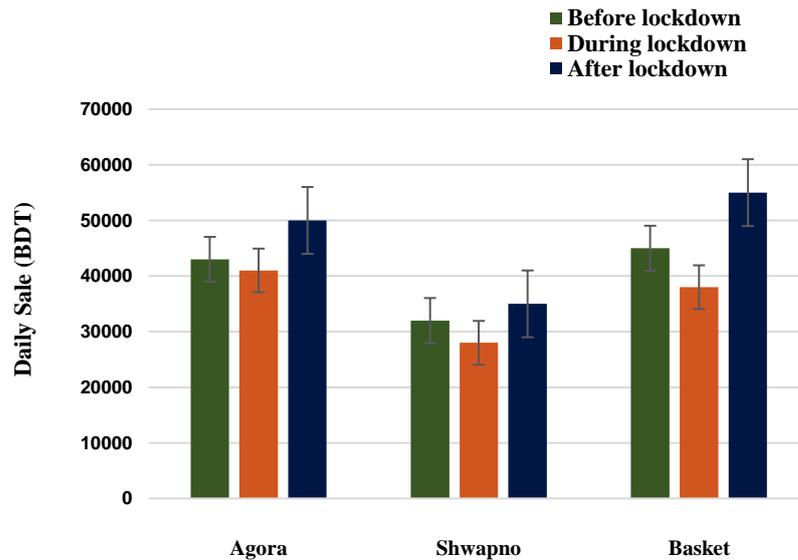
1(B)



1(C)



1(D)



1(E)

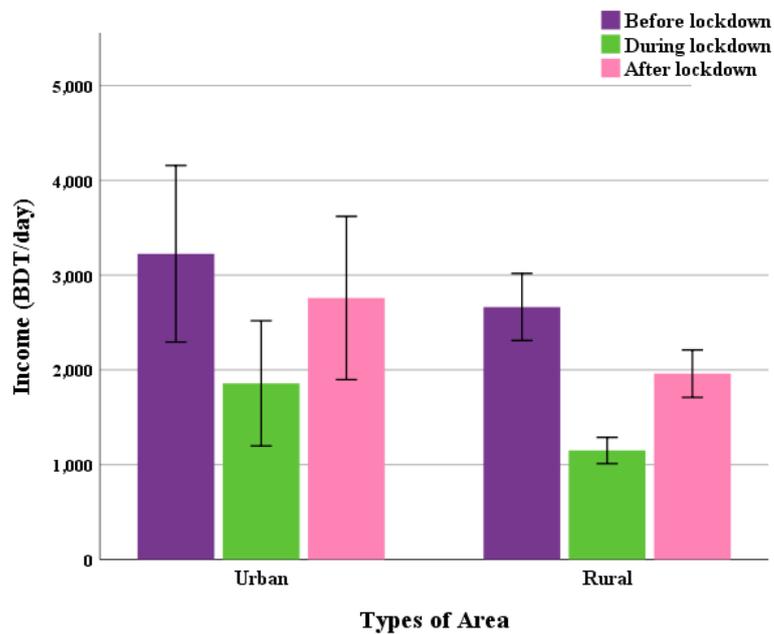
Fig 1: Fish sale statistics of different stakeholders (Mean±SD) before lockdown, during lockdown and after lockdown; A: Fish auctioneers, B: Fish Farmers, C: Fish traders (based on area type), D: Fish traders (based on seller type), E: Supershops

4.1.2 Income

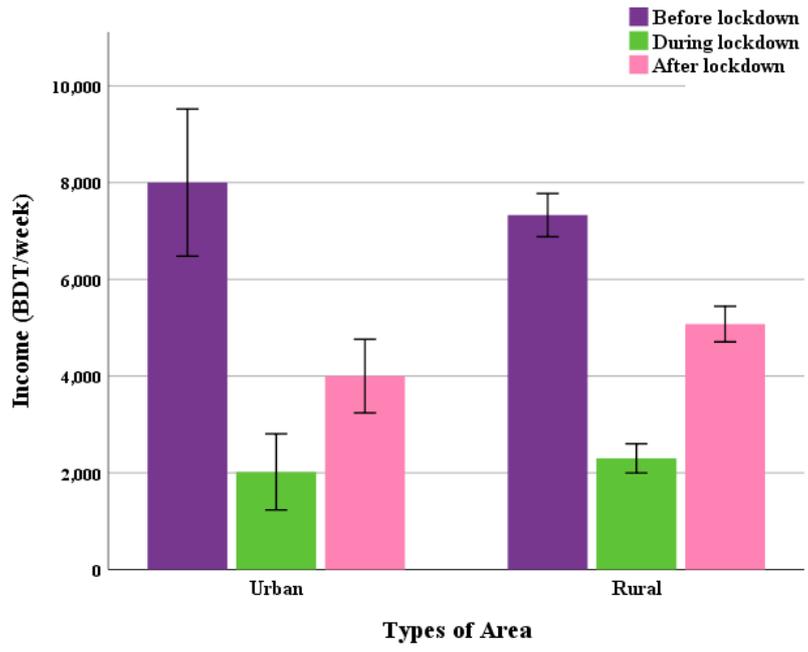
In both urban and rural areas, almost every one of the 278 stakeholders interviewed believed that their income was highly impacted by the pandemic. The daily average income of a fish auctioneer was 2912.9±1637.5 BDT, which declined to 1464.8±1123.5 BDT during the lockdown period. According to the respondents, fish supply was normal but a lack of regular buyers and traders caused this decrease in daily income. They could not transport the fish to outer districts, and the fish volume that they received from farmers of remote sites was also reduced due to movement restrictions. The situation improved following the lockdown, however due to the ongoing pandemic, their average daily income was analyzed at 2314.8±1486.9 BDT (Fig 2A).

In Bangladesh, March and April are the peak season for fish stocking, which coincided with the onset of the COVID19 crisis that began in March 2020. The prices and demand for fish decreased gradually and with transportation broke down, the farmers were put in a stake. Their sale was reduced and average income fell from 7440±1114 BDT/week to 2253.3±712.3 BDT/week. After the lockdown restriction, the income gradually increased to 4896.7±935.7 BDT/week (Fig 2B).

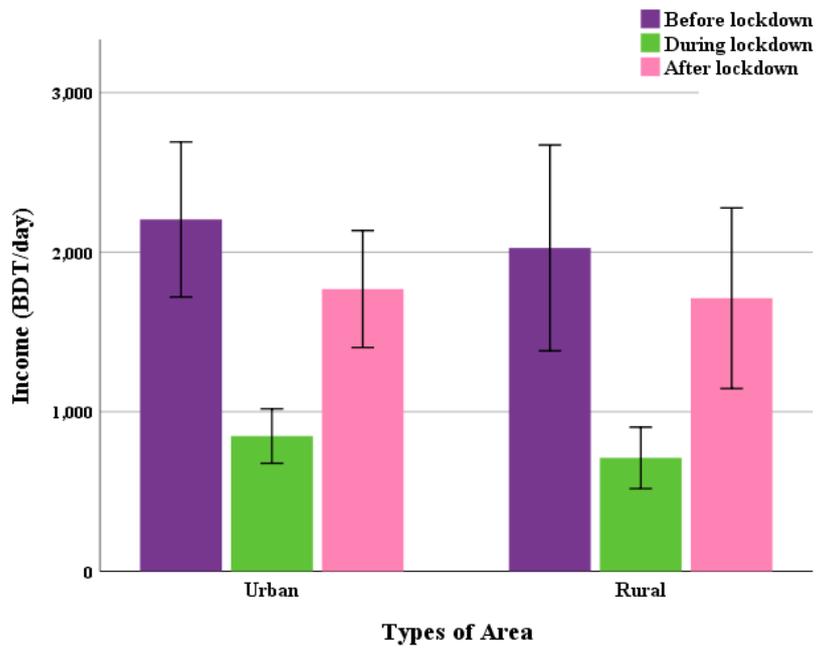
Among the 60 fish traders, 33% were wholesalers and 67% were retailers from different markets and fish landing centers. Some of the retailers were mobile vendors in various local market places. Both in urban and rural areas, a steep reduction in income was observed (Fig 2C). The income of wholesalers and retailers was also analyzed separately. During normal times, the income of wholesalers and retailers was 3325 ± 1039 BDT/day and 1507 ± 1380 BDT/day, respectively (Fig 2D). During the lockdown, some retailers suspended their operations because of the higher cost of fish. Some tried to survive on loans from NGOs and Mahajon, while some took alternative work to earn their daily livelihood. At that time, the daily average income for wholesalers was recorded at 1195 ± 395.3 BDT, while the average income of retailers was 567.8 ± 391 BDT/day. After the lockdown period, the income of wholesalers was observed at 2835 ± 918.4 BDT/day and the income of retailers was at 1191.5 ± 1079.6 BDT/day.



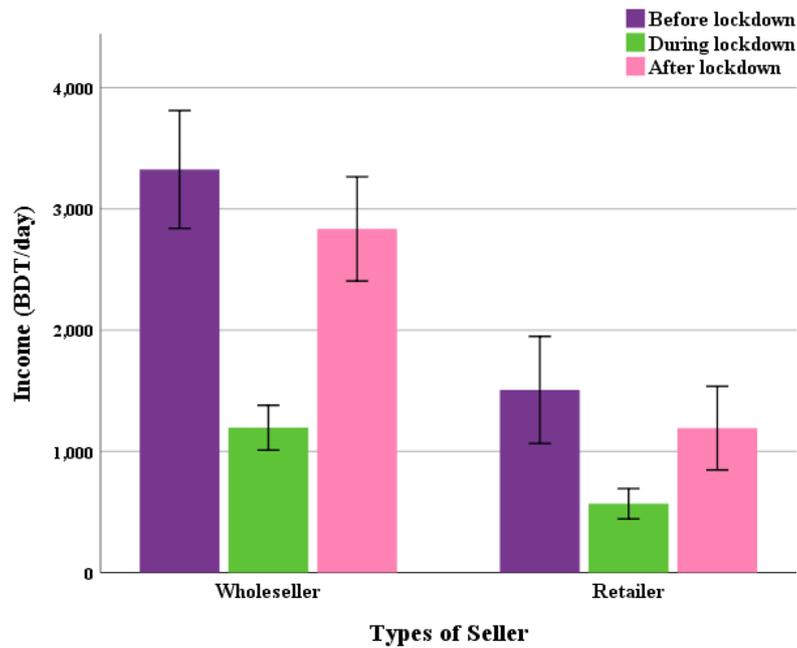
2(A)



2(B)



2(C)



2(D)

Fig 2: Income statistics of different stakeholders (Mean±SD) before lockdown, during lockdown and after lockdown; A: Fish auctioneers, B: Fish Farmers, C: Fish traders (based on area type), D: Fish traders (based on seller type).

4.2 Impact on fishermen

4.2.1 Income

The small-scale fishers and communities are the most vulnerable part of the fishing sector. They were negatively impacted by the COVID-19 pandemic and associated restrictions.

The income was set in 5 different ranges. According to the survey respondents their income was average of 300-400 BDT per day before the pandemic (Fig 3). Around 27% of the fisher earned more than 400 BDT per day and 24% earned around 200 BDT per day. When the lockdown hit, the one who had their own boat and net, continued fishing but at a minimum rate. Those who generally worked as labor on others boat mostly lost their jobs and earning. The trend of their income steeply declined to the minimum range. At that time 44% of the fisher responded that they barely managed to earn 200 BDT/day.

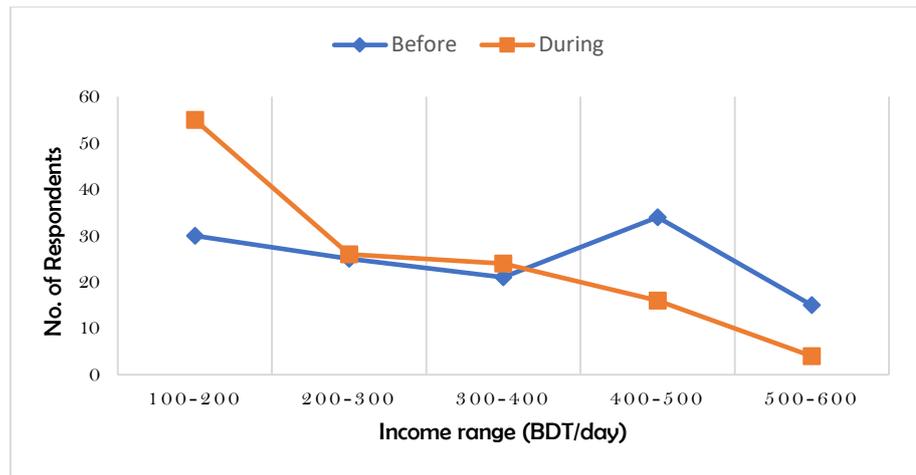


Fig 3: Income trends of fishermen before and during lockdown

4.2.2 Alternative sources of income

Fishers of the survey areas encountered many problems due to the COVID-19 pandemic. One of the most highlighted ones was unemployment. Approximately 44% of the fishermen had to turn to alternate sources of income to cover their living expenditures. 70 fishermen continued fishing despite of the restrictions. Because the market value was unpredictable and there was a possibility of remaining unsold fish, they had to restrict their fishing time and capture amount. 16% of fishermen began working as fish processors in markets, while 8% began selling their harvest directly.

Though the market price of fish increased, the fishers were not paid more than the farmgate price. Total 8 out of 125 survey respondents mentioned that they had started small homestead agriculture to sustain their food demand. 13% of the fishers had turned to different livelihood options in order to survive (Fig 4).

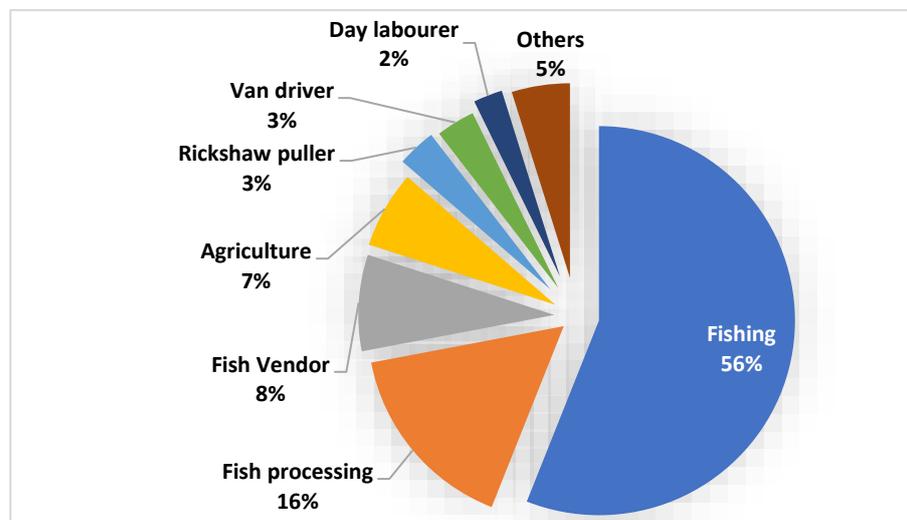


Fig 4: Alternate sources of income of fishers during lockdown

4.3 Problems faced by different stakeholders

Among the survey participants, 83% of them indicated that they could not sell fish due to transportation complexity. At the beginning of the lockdown, the fish prices fell in alignment with lower demand, which was mentioned by 53 respondents. Farmers held the mature fish without harvesting when consumer demand reduced as a result of transportation restrictions and health security concerns. Fishers were also constrained to their homes and were unable to supply fish to traders. Total 9% of the stakeholders claimed this lower supply was a problem for the market system (Fig 5).

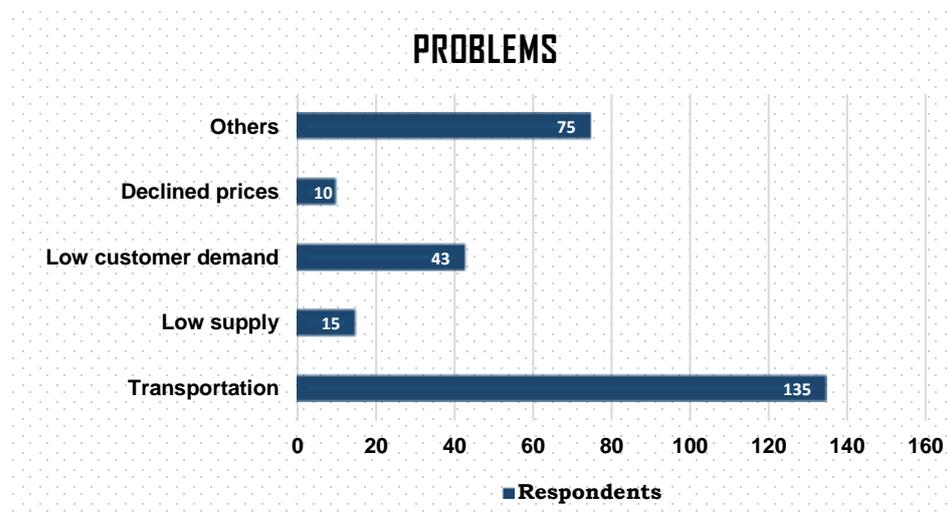


Fig 5: Major Problems highlighted by different stakeholders

Among the 278 stakeholders interviewed, 75 of the participants stated some other problems that are also caused by the COVID-19 pandemic and related protocols (Fig 6). Various stakeholders in the aquatic value chain have lost their jobs, had their income reduced, and a few have been cut off from labor by factory and farm owners. Since the onset of the pandemic in March, 2020, economic activities were halted for a few months, which caused a decline in alternative income sources.

Reduced transportation almost ceased the inflow and outflow of necessities, driving up commodity prices. As fishery-dependent households are mostly poor, rising prices of food items reduce their purchasing ability. The respondents said that they switched to lower priced food or bought fewer groceries, and some expressed grief that they could not manage the three regular meals daily. Due to insufficient income from fishing, the fishers barely manage their households in terms of financial capital. Some fishermen and traders managed to work as laborers while others remained jobless due to their limited skill at fishing.

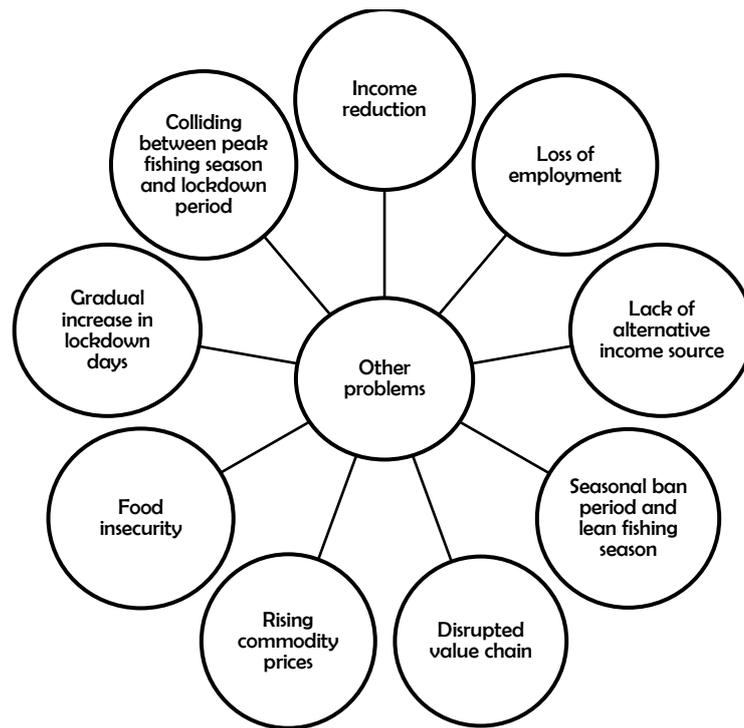


Fig 6: COVID-19 caused problems faced by fishermen and stakeholders

4.4 Impact on Consumer

4.4.1 Purchase of fish

The COVID-19 pandemic also had an impression on consumer demand and preference. The study interviewed 40 consumers to understand the impact on the people who prefer fish as a regular food item. Almost all of the respondents agreed that the supply of fish was disrupted during lockdown. Due to the movement restrictions consumers did not have access to regular market places so they had to cut down their monthly fish requirement. It was found that before lockdown 35% of the consumer used to buy 11-15kg of fish monthly where 33% were buying 16-20 kg of fish per month. During lockdown, this percentage dropped to 20% and 23% respectively. 12 respondents mentioned that their buying capacity reduced to 5-10 kg/month (Fig 7). This was the result of pandemic related issues like limited accessibility, higher price of fish, income reduction, unemployment etc.

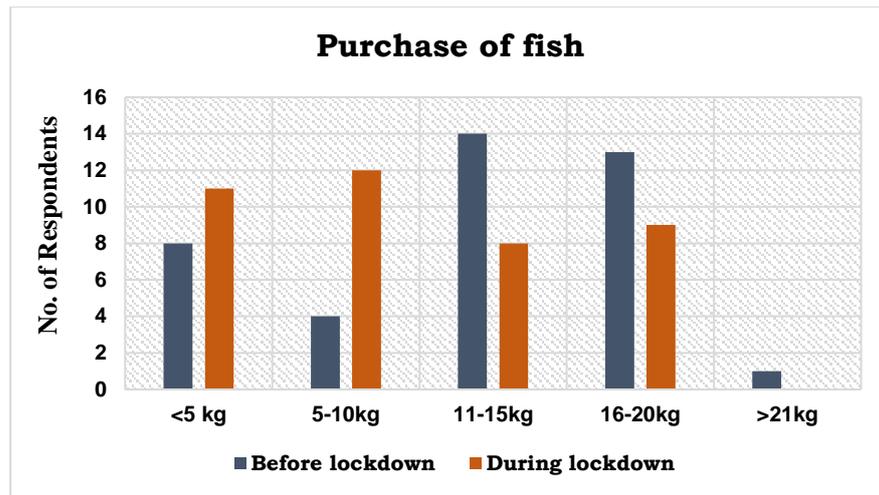


Fig 7: Amount of fish purchased before and during the lockdown period

4.4.2 Changes in fish consumption

During the pandemic, households made some adjustments to their daily diets. Total 24 respondents mentioned that they had changed their consumption of fish during lockdown (Fig 8). This was triggered by mainly less diversity of fish and availability in the market. A primary school teacher said he mostly purchases cultured freshwater fish for lower price but farmed fish was scarce during lockdown. Some of the interviewed consumer stated that they hardly bought fish during lockdown because the price was so high. 16 of the participants said they did not change their fish diet as it is more nutritious food than any other meat items. They preferred their health security rather than the rising price of fish and other aquatic food items.

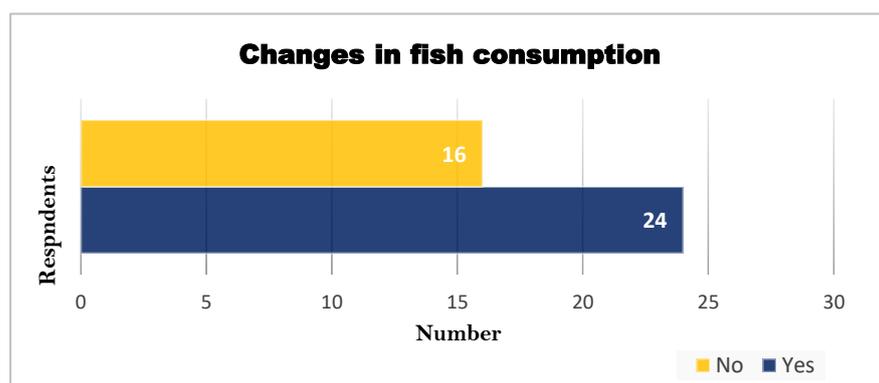


Fig 8: Changes in the consumption of fish by consumers

4.4.3 Place of fish purchase

Before lockdown, according to most consumers fish was mostly purchased from kitchen market, local market and street vendor. Online sale of fish was rarely practiced before lockdown but some of the consumers with higher income bought fish from supershops. Consumers were limited to local markets and certain mobile and street vendors during the closure (Fig 9). Online purchase of wet food item became popular due to easy collection and people with higher income continued to buy fish from super shops for convenience.

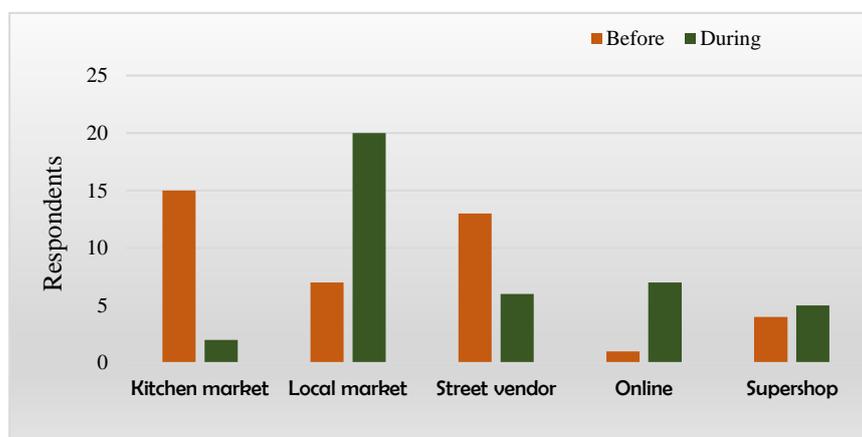


Fig 9: Place of fish purchase before and during lockdown

4.5 Resilience of fishing community and stakeholders

4.5.1 Alternative approaches

The stakeholders obtained a number of alternative approaches to deal with the pandemic situation. These approaches involved adaptive measures to withstand the problems. Total 28% of the respondents, mostly the fishers, said that they started to sell their catch directly due to the complexity of reaching the traders. A few fish auctioneers and farmers began to sell online and introduced home delivery of fresh and processed fish. Most of the farmers retained the mature stock without starting a new cycle with a hope to obtain proper price of the harvest. Total 4% of the participants were relying on loans from NGOs and GOs that are working for their welfare. Some received a little government subsidy which was sustaining them for a few weeks. Among the respondents, 35 persons stated that they did not take any measures to cope with the pandemic situation (Fig 10). Despite the restrictions, they continued to labor and lived in poverty.

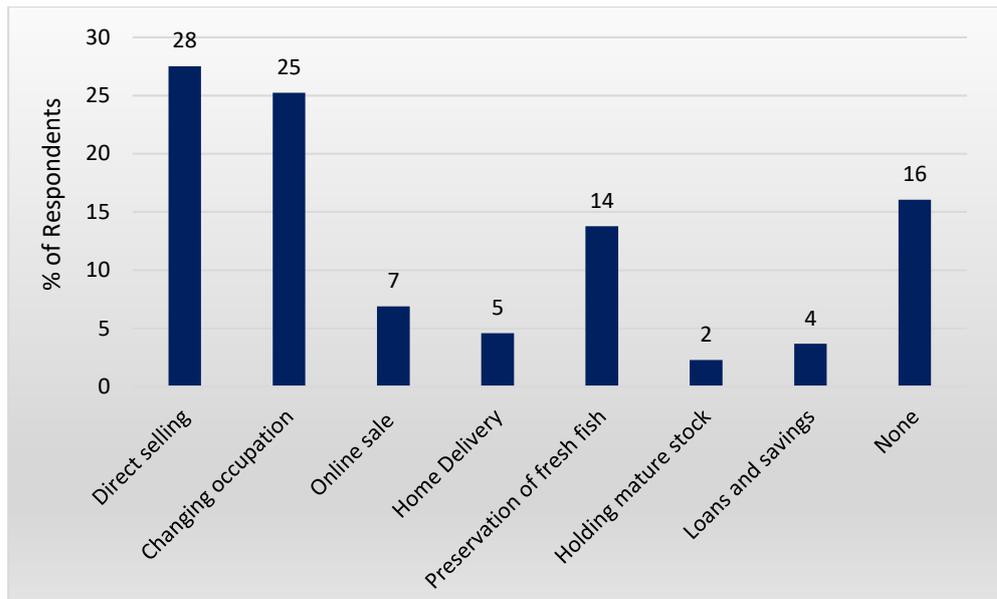


Fig 10: Coping strategies in response to COVID-19 pandemic

4.5.2 Government and NGO Aid

The government provides subsidy to fishers and other stakeholders to sustain during the ban period. During lockdown Bangladesh government provided the vulnerable communities with assistance. But the share of respondents receiving assistance was very low (11%) (Fig 11). They claimed that the support they received, was not sufficient to survive the lockdown period. Among the 89% participants, most of them were taking loan from different NGOs or middleman.



Fig 11: Response to receiving aid from Govt./NGOs

Chapter Five

Discussion

5.1 Impact on fish sale and income of stakeholders

The government of Bangladesh imposed mobility restrictions to avoid the spread of corona virus, which caused panic among the poor, as well as other constraints on the availability of aquatic food and other basic necessities, resulting in a crisis. The pandemic has already had mostly negative consequences for the aquaculture industry. The study revealed that the income and sales of the farmers from both rural and urban areas decreased considerably. The movement restriction limited the flow of inputs in the farms and the supply of fish to traders which resulted in remaining unsold fish. This caused a problem in harvesting mature fish and starting a new farming cycle. All of the fish farmers indicated that the price of cultured fish had declined owing to poor demand in the market places. This is evident by the fact that, since the beginning of the epidemic, most consumers' income had decreased due to job losses and, in some cases, cash flow interruption. In Indonesia, there was substantial drop in the number of active fishers and fish traders as well as a drop in the average price of fish (Campbell et al., 2021).

Fish storage and marketing challenges have had a significant impact on the livelihood of the fishing community worldwide (Purkait et al., 2020). Similar observations were recorded in another study by Islam et al. (2021). According to the study the negative effects were attributed to an increase in input and transportation expenses as well as a decrease in demand due to price hike of fish. Fish feed companies had integrated a 10%–12% rise in feed price due to transportation restrictions and a lack of labor as well as difficulties in production operations. Increased production costs due to feed price increase along with increased transportation costs due to the lower availability of the normal transport, and declining selling prices of fish had also prompted fish farmers to refrain from catching fish. In addition, ready feed and feed supplements were in low supply on the market. Farmers had been forced to use less feed in their ponds due to feed shortages and increased prices, resulting in slower fish development. Fish fry/fingerling stocking had also decreased as a result of the pandemic. By reducing the supply of fry and fingerlings transport limitations had hindered aquaculture productivity in the Philippines (Manlosa et al., 2021). Fish transportation was a big issue in supershops as well. Due to limited transportation, they could not collect fish

from different districts but had to rely on landing centers located in Chattogram district. Their sale was reduced during lockdown period, after obtaining several sale strategies their sale increased more than before COVID situation.

With the exception of the high retail prices seen in urban areas, several studies (Kibria et al., 2020; FAO, 2020) conducted at the rural level in Bangladesh found that a disruption in market demand results in a drop in farmgate prices of 17–70%. Farmers also claimed that they were having issues selling and transporting their products, citing a 20% increase in transportation expenses, a labor scarcity, and a shortage of inputs such as feed, seed, and medications at the production level (FAO, 2020c). Higher input prices, along with lower farmgate prices, indicated that farm incomes were squeezed more in 2020. Farming and fishing activity reduction lowered demand for harvesting labor, transportation, and other services, resulting in major negative consequences for the numerous employees who rely on these operations (Belton et al., 2021). An interesting reality is that fish demand in city markets has recently been reduced, with demand in rural fish markets set to improve. People have returned to their families since jobs have been lost in cities and numerous offices have closed, raising the demand for fish in rural areas (Anwar et al., 2020). This fact was seen in the sale value of farmers in the study, where weekly sale of the farmers in rural area were estimated at 144.8 ± 66.8 kg while sale of the farmers in urban area was recorded 93 ± 19.9 kg/week.

5.2 Impact on fishermen

From the results of the study, this can be concluded that already vulnerable fishing communities were negatively affected by the COVID-19 pandemic. Their income reduction made them susceptible to many other socio-economic stresses. According to FAO 2020a, fishers' income and well-being had been significantly influenced by declining demand for fish and related goods and services, and this is expected to continue for a certain period of time. Fishermen had lost their livelihoods due to the limitation on mobility, delays or lack of transportation, and frequent cancellation of orders, since they had been unable to sell their captured fish for the expected price and had instead been forced to sell at a low price (Hossain et al., 2022).

Furthermore, many fishermen had lost their businesses or professions, forcing them to work as day laborers or shift their century-old generational occupation and this has had a significant impact on household economics (Sunny et al., 2021b; Lima et al., 2021).

However, another study on impact of COVID-19 across tropical small-scale fishing communities by Campbell et al. (2021) observed that despite decreasing demand and low prices for catches, most fishermen and dealers continued in their current activity of fishing and dealing was their primary approach for adapting to these disruptions.

In this study, it was observed that fishers had to obtain a number of alternative livelihoods to sustain their family and to at least survive during the pandemic. The participants had no risk reduction investments or emergency preparations in place to prepare for disruptions. They also lacked assets that could be transformed into resources in the event of a disaster. Because they lacked financial and other assets, the fishermen were unable to reduce pandemic effects and implement alternative livelihood methods to attain desired livelihood outcomes. Moreover, along with the government enforced lockdown, fishers had to confront the fishing ban period. This was developed to enhance the conservation and management of marine fisheries. During this time, the government distributes 40 kg of rice per month to each registered fisherman's family as part of the Vulnerable Group Feeding (VGF) and food security support program (DoF, 2020a). Given the limited movement during the lockdown, these support activities were also interrupted, and VGF delivery was delayed. The combined effect has increased food insecurity among fishermen, prompting some to resort to illegal, unreported, and unregulated (IUU) fishing. Due to the difficulty in supplying VGF support during the pandemic, the FAO (2020) and Bennett et al. (2020) had observed an increase in IUU since the start of the lockdown. Interviewers from the study said that the relief from government was really insufficient to maintain a family and unevenly distributed among the fisherfolks. They were bound to borrow money from lenders and different sources like NGOs. They were also unable to take a loan from the concerned bank since they lacked sufficient resources to mortgage (Sunny et al., 2019).

Several fisheries faced complete breakdowns when social distancing rules came into force. Such new restrictions on fishing operations show a inclination to minimize the importance of fish in food systems (Béné et al., 2015). Even though fishing is considered a necessary service, social distancing measures had prevented many small-scale fishermen from going fishing or dealing in local marketplaces (Orlowski, 2020). It was observed that fishing activity had also declined as prices have fallen due to lower demand for seafood from local markets, restaurants, and hotels. Input providers, merchants, processors, transporters, lenders, and others in small-scale fisheries value

chain had suffered a reduction in business. Owing to reduced fishing activity, access to ice, fuel, and fishing gear had also been constrained (Ferrer et al., 2021). In summary, the ban period, low fishing rate, lack of alternative income generating activities, low consumer demand, low income, weak value chain, gradual increase in lockdown days, and constraint of dadon were the major problems faced by fishers during lockdown periods.

5.3 Problems faced by different stakeholders

Restrictions on movement and accessibility to businesses imposed by the COVID-19 outbreak, Bangladesh's supply chains have been severely disrupted, resulting in unprecedented economic losses. The lockdown had an adverse effect on the lives and income of fish farmers, fish laborers, fish feed/ post-harvest sector workers and individual fishermen. The impact of lockdown was first experienced by fish farmers and fishermen, who are considered producers in the value chain. Due to limited mobility, fishing activity was reduced. They eventually ran out of money due to a low profit margin. Many fishers have suspended or reduced operations as a result of the drop in demand, which has led to lower prices for fish and fish products in some circumstances. As to the lower demand and transportation complexity, fish farmers reported that they had been unable to sell mature fish. They were unable to begin a new farming cycle because of unsold fish, which lowered the selling price of fish.

The supply chain was being disrupted by the fish sales issue since local vehicles such as trucks and pickup trucks were hesitant to deliver fish, fingerlings, feed, and other items. Similar findings were concluded in another study conducted by Sunny et al. (2021b). Aquaculture farmers are by far the most susceptible since they build farms on their own property, invest their own money, and need constant cash flow for stocking, feeding, and maintaining health, all while struggling with fish mortality and market price fluctuations. Because of the COVID-19 epidemic, all of these things got more intense for Bangladeshi fish farmers (Haque, 2020).

Another study on the pandemic's impact on the aquaculture industry by Islam et al., 2021 reported that the pandemic has had a significant impact on the fish feed industries due to a shortage of raw materials and labor, lower feed sales, higher transportation costs (20–60%), higher operating costs to maintain health guidelines and social distancing, all of which have forced the factories to raise feed prices. The complexity

in transporting feed in the market had also increased the feed's unit price. This feed price inflation impacted not just fish farmers but also hatchery operators. From the statement of a hatchery owner, it was reported that they had to buy the same amount of food at a higher price during the lockdown.

The pandemic had an impact on fish hatcheries due to a drop in the sale price of fry and labor shortages, as well as an increase in transportation costs and the expense of maintenance to comply with health guidelines and social distance. The transportation of fish fry around the country, like other sectors, had been severely hampered by the pandemic. The hatchery managers indicated that a lack of regular labor has caused a crisis in the hatcheries, forcing them to hire temporary labor on a daily basis. This increased labor costs despite of lower sale of the fish fries even in the peak farming season created economic instability in the hatcheries. In response to the economic uncertainty, finfish farmers and hatchery owners have taken a number of steps to prepare for the future. Among these approaches, margining labor costs by lowering the number of permanent and non-technical employees, as well as some substitution of permanent and non-technical employees with seasonal workers were prominent (Rosen, 2020).

Since frequent transportation constraints have reduced access for agricultural items to be transited between cities (Anwar et al., 2020; Ramachandran, 2020), many of the larger middlemen had been hesitant to continue purchasing fish from local farmers on a regular basis. The intricate and extensive supply chain that characterized the pre-pandemic aquaculture supply chain, with the involvement of multiple middlemen, appears to be minimized, and local mask-middlemen had taken its place. Farmers were being forced to sell their crops at an unjust and insufficient price due to the unstable supply chain and market environment (Hasan, 2020). According to Sar`a et al. (2021), COVID-19 affects the beginning and end of the aquaculture supply chain (raw material input and product transport and sale), and can intensify existing financial losses and food security concerns.

5.4 Impact on consumers

There were several effects on customers as a result of the COVID-19 crisis. Consumer preferences have shifted when it came to purchasing items. They have had difficulty keeping their jobs and have had their wages deducted. Most consumers reduced the

amount of fish purchase as retail prices were high. A few customers of lower income ranges responded they hardly bought fish during lockdown. Hasan et al. (2021) conducted a consumer-based study before and after the outbreak of COVID-19 to better assess true market demand for fishes. Fish consumption was shown to be much lower post-COVID, with more consumers opting for egg as their primary protein source. This might be exacerbated by a 13% increase in unemployment, a 60% drop in urban income (Amin et al., 2020) and an 80% reduction in rural income (Kibria et al., 2020), and the potential emergence of a "new poor" as a result of the COVID-19 epidemic (Said et al., 2020).

The rise in the cost of living is compelling individuals to ration in other areas, such as food preferences, such as choosing eggs over high-priced fish or cheaper fish produce over expensive species. According to Akhtar et al. (2018), the consumption of eggs has increased the most, followed by chicken and fish. However, many consumers in the study reported lowering their fish portion sizes and eliminating costly animal products from their diets as a result of the epidemic. This is in accordance with the findings from Ethiopia's Addis Ababa (Abate et al., 2020).

A variation in the number of fish people buy each week was also found, with a moderate drop. Following COVID, several consumers adjusted their species preferences, choosing species based on price rather than nutritive value. During the pandemic, most households significantly reduced their grocery shopping frequency (Mandal et al., 2021). The majority of people were aware of the pandemic and believed that the virus might be passed from person to person. People were unable to leave their houses due to extensive media coverage and government restrictions, which resulted in fewer actual transactions to the shop for food. The study also observed similar scenario of limited mobility of consumers regarding fish purchases.

5.5 Resilience of fishing community and stakeholders

During the COVID-19 circumstance, a few studies explained the fishing community's and stakeholders' resilience on three levels. Individual, household, and communal levels are a few examples (Sultana et al., 2021). Various types of shocks and stresses had diverse impact on these resilience features. At the individual level, fishers mostly faced fishing restrictions and scarcity of fish. Most of the respondents among the farmers and stakeholders faced problems in earning livelihoods. Members of the fishing

community had minimum access to any other income-generating occupations than fishing, and frequently noted their lack of skill in that area. While some fishers worked in the study areas as laborers, they also faced reduced pay and fewer work opportunities during the pandemic.

A significant number of fishers and traders stated low demand from traders was affecting the fish trade, implying that supply chain was disrupted by traders' inability to sell fish and, as a result, they were not able to support local fishing operations (FAO, 2020a; 2020b). Even with these obstacles, a greater part of fishermen and traders said continuing to fish was their best coping technique, despite obtaining lower prices for catches. This trend is in contrast to small-scale fisheries in Mexico, where 48% said they had ceased fishing and 44% said they were unable to adjust and had discontinued selling their products owing to the lack of dealers or storage space (COBI, 2020). Because of the unemployment and limited job opportunities, the fishermen have had to rely on local moneylenders for cash at a higher interest rate in order to survive.

In this study several responses were found that helped to lessen the stresses at the household level, such as: obtaining help from neighbors or relatives, accepting government incentives designated for fishermen, using alternative income sources during the fishing ban, borrowing fixed interest loans from NGOs (micro-credit), selling household assets, and migrating to nearby towns and cities. Traders and stakeholders obtained adaptations that focus on cost reduction or input replacement as a response to low product demand and limited input availability. Smaller businesses with limited resources are more prone to make reactive adjustments. Regardless of the fact that these measures are frequently necessary for minimizing losses, avoiding risks, or overcoming obstacles, they tend to reduce production and profitability. In the study of Belton et al. (2021), respondents from Bangladesh and Africa indicated the following reactive adjustments as the most common like temporarily reducing the duration of operations; minimizing operating costs; procuring alternatives to inaccessible inputs; selling products at reduced prices; bribing people in order to maintain the business running.

The low percentage of respondents who used savings, loans, or other work options implies that initiatives to promote livelihood opportunities, access to financial services, and control of their natural fishery are urgently needed. Along with the pandemic,

fishers and stakeholders had to confront with seasonal ban period. The VGF is the sole system available to registered coastal fishermen to help them survive during the fishing ban. Fishermen had no other means of obtaining social assistance. Coastal small-scale fishermen had received no specific incentives to compromise for their economic and livelihood losses. During the second lockdown, the government planned to make it easier to transport fish as an emergency food supply and to enroll 5 million fishermen in a social safety program as part of the Sustainable Development Goals (DOF, 2020a).

Within the context of Bangladesh, the aquaculture and fisheries sectors provide fundamental services to the society and have strong ties to the achievement of various SDGs. The current COVID-19 situation may have a negative impact on the fisheries sector, hindering the accomplishment of development goals. Adoption of proper technology is a must for Bangladesh's coastal and marine aquaculture development to be resilient. Therefore, comprehensive and long-term management of aquatic resources is crucial to the country's persistent and significant contribution to its health and economic sectors.

Chapter Six

Conclusion and Recommendations

The COVID-19 pandemic has had severe effects on human behavior and activities, including the aquatic food sector and small-scale fishing. Most countries' economies have steadily declined as a result of the global pandemic, which has had a notably negative impact on developing countries. Fishermen and other supply chain actors have encountered several challenges as a result of COVID-19, including limited input supplies, a lack of technical support, an inability to market their products, a lack of transportation to market, export restrictions on fish and fishery products, and low fish prices. By altering fish availability and demand, fish distribution, labor, and production, the pandemic has exposed pre-existing vulnerabilities and limited resilience, posing a threat to the well-being of small-scale fishing households. Fish producers have also had to deal with a lack of inputs and technical support, as well as market constraints, transportation challenges, and low prices. As a result of these issues, there has been insufficient output, unintended stock retention, loss of returns, and food scarcity. This study concludes the overall impact of the pandemic on the fisheries sector of the Chattogram district for a given period. An in-depth investigation of each of the sub-sectors of fisheries was beyond the scope of this study, but this study will be provided as a review in order to establish a thorough recovery plan. Understanding the resilience conditions of fishers and stakeholders is also necessary, as is recognizing the ways of adaptation in relation to their livelihood capitals and resilience qualities in order to address shocks and stresses and recuperate from these uncertainties. Nonetheless, the findings and recommendations of the study may have significant consequences for prioritizing, planning, and implementing attempts to assist Bangladesh's aquaculture and fisheries sector recover from the pandemic.

Short and long-term recovery strategies can ultimately address the COVID-19 induced problems in an attempt to meet immediate needs and long-term requirements for the fisheries sector's sustainable recovery. A number of recovery plans derived from the community and individual perception are summarized below:

- ✓ An immediate action plan must be formulated and implemented to save the livelihoods of fishers, hatcheries, feed manufacturers, and other stakeholders.

- ✓ Incentives, subsidies, interest-free loans, and alternative income-generating opportunities should all be included to help the fisheries and aquaculture sectors to become more resilient.
- ✓ Appropriate technology and management methods should be developed for resilient inland and marine fisheries, incorporating climate change and COVID-19.
- ✓ Small-scale fishers, who have been severely harmed by COVID-19, require food and cash to survive and begin producing. The provision could include additional loans at reduced rates for small-scale fishermen and farmers.
- ✓ Stakeholders' protection against COVID-19 should be strictly enforced as early as possible. The governmental and non-governmental organizations must collaborate to help producers gain access to the market.
- ✓ The difficulty of subsistence farmers to sell their produce during the COVID-19 pandemic necessitates the renovation of value chains, including market infrastructure, transportation systems, cold storage facilities, farmer-to-market links, and greater market information flow. Policies and programs that encourage the use of digital tools could help fisheries and aquaculture systems to be more adaptive.
- ✓ Market surveillance and regulation should be conducted in collaboration between the UFO and the farmer's association. This approach would help to provide a strategy for the industry's long-term success, ensuring the proper balance of fish species for both consumption and production markets.
- ✓ The development of local processing enterprises should be facilitated by the local government. This may be done through financial incentives or public-private partnerships, and it would add value to the product while also reducing the challenges that come with perishable goods and variable supply and demand. Furthermore, it would create employment opportunities for local people.
- ✓ The process of acquiring knowledge about the damages must be supported by all relevant sectors. This knowledge integration must encourage and allow fishing communities and community-based organizations (CBOs) that have experienced and overcome challenges and crisis to participate.

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Worldometers, 2020. Coronavirus Pandemic Live Cases.

Photo Gallery



Plate: Interview with different stakeholders

APPENDICES

Appendix-1

Effects of lockdown on fish sales and income of fish auctioneers (based on area):

Types of Area		Kg/day(avg)			BDT/day(avg)		
Urban	Mean	345.50	210.12	288.87	3225.00	1858.33	2758.33
	N	24	24	24	24	24	24
	Std. Deviation	282.542	200.196	246.614	2205.970	1563.418	2039.590
Rural	Mean	371.00	175.17	253.00	2663.33	1150.00	1960.00
	N	30	30	30	30	30	30
	Std. Deviation	252.595	131.099	190.678	946.676	371.158	669.843
Total	Mean	359.67	190.70	268.94	2912.96	1464.81	2314.81
	N	54	54	54	54	54	54
	Std. Deviation	264.043	164.634	215.895	1637.537	1123.532	1486.976

Appendix-2

Effects of lockdown on fish sales and income of fish farmers (based on area):

Area		Kg/week(avg)			BDT/week(avg)		
Urban	Mean	420.00	93.00	178.00	8000.00	2020.00	4000.00
	N	5	5	5	5	5	5
	Std. Deviation	130.384	19.875	30.332	1224.745	634.035	612.372
Rural	Mean	745.20	144.80	438.00	7328.00	2300.00	5076.00
	N	25	25	25	25	25	25
	Std. Deviation	117.761	66.841	117.580	1082.251	729.726	891.291
Total	Mean	691.00	136.17	394.67	7440.00	2253.33	4896.67
	N	30	30	30	30	30	30
	Std. Deviation	170.341	64.323	145.880	1114.048	712.322	935.685

Appendix-3

Effects of lockdown on fish sales and income of fish traders (based on area):

Types of Area		Kg/day(avg)			BDT/day(avg)		
Urban	Mean	25.90	14.17	27.52	2205.17	847.59	1768.97
	N	29	29	29	29	29	29
	Std. Deviation	13.610	8.085	14.174	1276.820	448.359	963.251
Rural	Mean	94.35	41.32	74.32	2026.77	710.65	1711.61
	N	31	31	31	31	31	31
	Std. Deviation	91.814	43.984	76.535	1758.178	524.982	1543.490
Total	Mean	61.27	28.20	51.70	2113.00	776.83	1739.33
	N	60	60	60	60	60	60
	Std. Deviation	74.595	34.669	60.250	1534.132	490.207	1285.512

Appendix-4

Effects of lockdown on fish sales and income of fish traders (based on seller types):

Types of Sellers		Kg/day(avg)			BDT/day(avg)		
Wholesaler	Mean	143.50	63.25	116.00	3325.00	1195.00	2835.00
	N	20	20	20	20	20	20
	Std. Deviation	77.405	40.381	64.304	1039.167	395.335	918.394
Retailer	Mean	20.15	10.67	19.55	1507.00	567.75	1191.50
	N	40	40	40	40	40	40
	Std. Deviation	17.241	8.882	17.230	1380.025	391.005	1079.647
Total	Mean	61.27	28.20	51.70	2113.00	776.83	1739.33
	N	60	60	60	60	60	60
	Std. Deviation	74.595	34.669	60.250	1534.132	490.207	1285.512

Appendix-5

Questionnaire for field survey:

Covid-19 and Its Effect on Fisheries Sector

Interview Location -----

Date-----

Introduction to the Interviewer/ Occupation / Institution: -----

Fishermen:

Question-01: What is the effect of lockdown on your life? Yes / No

Question-02: What was the average amount of fish delivered to the aratdar before the announced lockdown due to Corona?

Question-03: Did the lockdown announced in 2020 have any effect on the supply of fish to the aratdar? Yes/No

Question-04: If yes, how much did your fish supply decrease and what were the effects?

Question-05: Did the supply of fish after the lockdown return to the previous rate? Yes/No

Question-06: What impact did this year's lockdown and previous year's lockdown have on your fish supply? How the two lockdowns cost you financially, family and socially?

Question-07: How did you cover the loss of the lockdown?

Question-08: Have you received any kind of government / private financial / food assistance? If so, what support did you get?

Aratdar

Question-09: How much fish do you buy daily/ weekly from fishermen in normal time?

Question-10: Did you manage to keep the business open during the lockdown? Yes/No

Question-11: If closed, how did you collect the fish and deliver it to the city?

Question-12: What kind of losses did you face during the lockdown? What is the amount of damage?

Question-13: Has there been any difference in your life during the lockdown and in the past?

Question-14: In which year's lockdown did you face the most losses? What was the loss rate?

Question-15: What kind of problems did you face in your fish supply during the lockdown?

Question-16: What were your steps to cover financial or other losses?

Question-17: Have you received any kind of government/ private aid in this lockdown?

Question-18: Have you had any professional changes since the lockdown? Has the previous business situation returned to normal?

Fish seller

Question-19: How much fish do you sell each day and how much did you earn before the lockdown?

Question-20: Did your fish sales and collection have any impact during last year's and this year's lockdown? Yes/No

Question-21: If affected, how much loss did you incur in fish sales and what was the daily or weekly loss rate?

Question-22: Did you get your required amount of fish supply as before lockdown? Yes/No

Question-23: If there was less supply, how much fish supply was reduced? What was the price increase with the supply of fish and what was the impact on your sales?

Market

Question-24: How many and for how much fish was sold at your multipurpose shopping mall before the lockdown?

Question-25: During the lockdown, was there any effect on fish sales and fish collection in your organization? What kind of effect was there?

Question-26: If sales and collections differ, what is the impact?

Question-27: How much or what kind of fish did you buy weekly before the lockdown?

Question-28: Did you have any problems purchasing and getting fish during the lockdown?

Consumer

Question-29: How much was your weekly fish meal before the lockdown?

Question-30: From where did you buy fish back then?

Question-31: Did you reduce the amount of your fish meal during the lockdown? What kind of change did bring to your habit?

Question-32: Where did you buy the fish in lockdown?

Question-33: How lockdown has affected in fish purchases and your food habit?

Fish Farmer

Question-34: How much fish did you sell daily or weekly from the farm before the lockdown?

Question-35: During lockdown, have you been able to deliver fish to the fish market or other places on time?

Question-36: Have you had any difficulty purchasing fish feed during the lockdown?
What were your initiatives to solve the problem?

Question-37: How much did you lose by not being able to sell the fish?

Question-38: How much has your fish sales changed before and after the lockdown?

Question-39: Have you sold fish through online or any other means? Is there any challenge in this case? If yes how did you deal with the challenges?

Question-40: have you been able to deliver fish to the fish market or other places on demand?

Question-41: Has there been any difficulty in releasing the fish fry in time due to the lockdown?

Question-42: What have you done to compensate for the financial loss caused by the lockdown?

Question-43: What are your future plans to deal with the effects of multiple lockdowns over the years?

Brief Biography of the Author

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