Impacts of COVID-19 on Fisheries and Aquaculture Sector

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Fish is a major source of food and nutritional security for subsistence communities in developing countries, it also has linkages with the economic and supply-chain dimensions of these countries. It is revealed that COVID-19 has posed numerous challenges to fish supply chain actors, including a shortage 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 challenges lead to inadequate production, unanticipated stock retention, and a loss in returns. COVID-19 has also resulted in food insecurity for many small-scale fish growers. Fish farmers are becoming less motivated to raise fish and related products as a result of these cumulative consequences. Because of COVID-19's different restriction measures, the demand and supply sides of the fish food chain have been disrupted, resulting in reduced livelihoods and economic vulnerability.

aquaculture small-scale fisheries fish-based industry fish-food supply chain

agri-food system fish farming agricultural vulnerability

1. Introduction

COVID-19 has had an influence on all sectors of the economy; the fisheries and aquaculture sector in particular has faced great difficulty, mainly due to the perishability of the product [1].

Fish is often a fishing community's primary source of protein, fatty acids, and micronutrients [2]. Fish do not play a role in the transfer of COVID-19 to humans in terms of epidemiology. However, false perceptions about fish and the spread of COVID-19 have contributed to a decrease in the consumption of fish in some cases, such as in Bangladesh and China [3]. Because fish is an important food source for a large portion of the world's population, the business of fishing requires changes, especially now during the current pandemic. Many of the governmental measures that have been introduced to limit the spread of COVID-19 have caused significant disruptions to human movement, physical business contact and the transport of goods [4].

By disrupting fish supply and demand, fish distribution, labor, and production, COVID-19 exposes the existing vulnerabilities in small-scale fisheries, putting small-scale farmers' livelihoods at risk ^[5]. The many value chains within the fisheries and aquaculture sector were also subject to the inevitable disruptions to international and domestic transportation; these disruptions have affected the supply of raw materials for processing, the supply of production inputs, and the shipping of the finished products for both export and domestic consumption ^[6]. Farm-

made inputs, such as seed stock and feed, have become unavailable due to the stringent restrictions that have been placed on the movement of materials and persons, including workers [Z]. Small-scale fish farmers have lost money because they either had to sell off their fish or couldn't sell their fish at all. Fish farmers could not harvest their fish in order to be able to begin a new production cycle, leading to a reduction in fish availability and the loss of downstream and upstream employment opportunities [S]. According to Waiho et al. [8], COVID-19 has depressed the demand for fish and fishery products and negatively impacted the supply chain, forcing hatcheries to close, feed imports to halt, and many value chain entities to lose money right from the start of the culture season. Medium and small businesses and seafood producers have been hit particularly hard, many of them are still unable to resume their normal operations [9]. COVID-19, in fact, has posed complex and long-term challenges for the aquaculture value chains' continued operations and the livelihoods of the millions of people who rely on them [10]. However, the major impact on supply chains and demand is not from COVID-19 itself, but instead from the measures that have been introduced in order to control it.

2. Summary of the Impacts of COVID-19 on the Fisheries Sector

The effects of COVID-19 on the fisheries and aquaculture sector are manifold (**Table 1**). The entry has identified the key affected domains of the fisheries sector, these are the stakeholders, freshwater aquaculture, brackish water aquaculture, river and naturally sourced fisheries, offshore fisheries, and industry. Fishermen, farmers, auctioneers, and traders are the main stakeholders. The major impacts felt at the stakeholder level are the limited access to livelihood capital, disruption of strategies for securing a livelihood, increased vulnerability of livelihoods, and increase in food and nutritional insecurity [3][11][12]. At the freshwater aquaculture level, the restriction measures that have been put in place to stop the spread of COVID-19 are responsible for increasing the cost of inputs and transportation, hampering the availability of seed stock, reducing demand and price, and increasing the burden of maintaining unsold stock. Brackish water aquaculture and river and naturally sourced fisheries are facing the same challenges, along with less regulatory enforcement. From an ecological perspective, only offshore aquaculture has received a positive impact from COVID-19. Aquaculture at the industry level has also faced many challenges, such as the need to reduce the production of processed food items, increase the price of raw materials, limit sales, and restrain international trade (**Table 1**).

Table 1. Summary of the impacts of COVID-19 on fisheries and aquaculture production based on literature review.

Major Domains of Fisheries and Aquaculture Production	Impacts of COVID-19	Sources
Stakeholders	 Limited access to livelihood capital Disruption of strategies for securing livelihood 	Belton [13] Stokes et al. [10] Ferrer et al. [7] Kumaran et al. [14]

Major Domains of Fisheries and Aquaculture Production	Impacts of COVID-19	Sources
	 Increased vulnerability of livelihoods Increased food and nutritional insecurity 	
Freshwater aquaculture	 Increased cost of inputs and transportation Hampered availability of seed stock Lower demand and price Increased burden of maintaining unsold stock 	Islam et al. [15] Seshagiri et al. [16] Cooke et al. [17] Fiorella et al. [18] Stokes et al. [10]
Brackish water aquaculture	 Increased transportation cost Reduced sales and falling prices 	Kumaran et al. ^[14] Islam et al. ^[15] Manlosa et al. ^[19]
River and naturally sourced fisheries	 Increased positive impact on natural sources Lower demand and price Expensive transportation Reduced regulatory enforcement 	Waibel et al. ^[20] Newton et al. ^[21] Islam et al. ^[15] Stokes et al. ^[10]
Offshore fisheries	Positive ecological impact on stockLower demand and price	Andrews et al. [22] Shenoy & Rajpathak [23] Marschke et al. [24] Asante, & Sabau [25]

Aquaculture Production	Impacts of COVID-19	Sources
	Reduced storage facilities	
	Higher transportation cost	
Industry	 Reduced production of 	
	processed food items	
	Increased price of raw	Fernández-González, &
	materials	Pérez-Vas ^[26] Hasan et al. ^[27]
	Need to limit sales	Kaewnuratchadasorn et al. [28]
		Paradis et al. [29]
	 Need to limit international 	
	trade	

2. FAO. Summary of the Impacts of the COVID-19 Pandemic on the Fisheries and Acquaculture Sector; FAO: Rome, Italy, 2020; ISBN 978-92-5-132789-0.

B.3!aCOVID-PP9's, Impacts on the Aquatics Food Supply Chain the COVID-19 pandemic on fish consumption and household food security in Dhaka city, Bangladesh.

The Clods e Front do Seas 2021 if i 29 s 4005 26 the major impacts of COVID-19 on the aquatic food supply chain (Table

2). The key domains that have been affected are fishing, aquaculture production, processors and cold storage. At 4. Farrell, P.; Thow, A.M.; Wate, J.T.; Nonga, N.; Vatucawaga, P.; Brewer, T.; Sharp, M.K.; Farmery, the fishing level, farmers are facing limited access to capture fisheries, less time to catch the fish, expensive labor, A.; Trevena, H.; Reeve, E.; et al. COVID-19 and Pacific food system resilience: Opportunities to and travel restrictions. Similarly, at the production level, stakeholders are experiencing the higher costs of inputs build a robust response. Food Secur. 2020, 12, 783–791. and transportation, less demand, reductions in the price of the product, and undesired stock. At the processor level, the level also sellianthated selli

6. Giannakis, E.; Hadjioannou, L.; Jimenez, C.; Papageorgiou, M.; Karonias, A.; Petrou, A. **Table 2.** Summary of the impacts of COVID-19 on the aquatic food supply chain. Economic consequences of coronavirus disease (COVID-19) on fisheries in the eastern

Major Domains of Supply Chain	Impacts of COVID-19	Sources	i DC
	Limited access to capture fisheries		i, P.G.;
	Reduced duration of catching time	Fiorella et al. ^[18] Campbell et al. ^[30]	4
Fishing	Increased labor cost	Ruiz-Salmón et al. ^[31] Paradis et al. ^[29]	Л. gies.
	Travel restrictions		
			T.;

Blamey, L.; Dutra, L. Indirect impacts of COVID-19 on a tropical lobster fishery's harvest strategy

Reduced demand and price Islam et al. 15 Increased burden of maintaining unsold stock Transportation cost increased Decline of rates of sale and price Decline of rates of sale and price Expensive inputs Expensive inputs Limited transportation due to restrictions Processors Less access to cold storage facilities Fahlevi et al. 18 Kumaran et al. 14 Kumaran et al. 14 Kumaran et al. 14 Fahlevi et al. 18 Kumaran et al. 14	Major Domains of Supply Chain	Impacts of COVID-19	Sources
Aquaculture production Reduced demand and price Reduced demand and price Increased burden of maintaining unsold stock Transportation cost increased Decline of rates of sale and price Expensive inputs Limited transportation due to restrictions Processors Less access to cold storage facilities Less access to cold storage facilities Unexpected loss due to the perishable nature Manlosa et al. [19] Sarà et al. [32] Islam et al. [33] Bennett et al. [34] Fiorella et al. [18] Kumaran et al. [14] Kaewnuratchadasorn et al.	Aquaculture production	Increased cost of inputs and transportation	
Processors Reduced demand and price Reduced demand and price Increased burden of maintaining unsold stock Transportation cost increased Decline of rates of sale and price Expensive inputs Expensive inputs Limited transportation due to restrictions Processors Less access to cold storage facilities Unexpected loss due to the perishable nature of the product Transportation cost increased White et al. [33] Bennett et al. [34] Fiorella et al. [18] Kumaran et al. [14] Kaewnuratchadasorn et al. [24]		Undesired seed stock	
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Decline of rates of sale and price		Increased burden of maintaining unsold stock	
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Fahlevi et al. [35] Cold storage facilities • Unexpected loss due to the perishable nature of the product Fahlevi et al. [14] Kaewnuratchadasorn et al. [28]		Limited transportation due to restrictions	
Cold storage facilities • Unexpected loss due to the perishable nature of the product Kumaran et al. [14] Kaewnuratchadasorn et al. [28]		Less access to cold storage facilities	roci
of the product [28]	Cold storage facilities	Unexpected loss due to the perishable nature	Kumaran et al. ^[14]
		of the product	

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Impacts on aquaculture farms

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Assessment from the Perspective of Regional Fishery Bodies; FAO: Rome, Italy, 2020; ISBN 978-Maggingl_fish_faggers often raise fish primarily for personal consumption and then sell the surplus to supplement their income. During lockdown, they could not collect their inputs on time and did not receive the customary level of 24. Marschke, M.: Vandergeest, P.: Havice, E.: Kadfak, A.: Duker, P.: Isopescu, I.: MacDonnell, M. support from technical experts. The biggest problem faced by fish farmers and business people in the fisheries COVID-19, instability and migrant fish workers in Asia. Marit setup. Stud. 2021, 20, 87–99.

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6. Policy Recommendations

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- should be tailored to local needs, with recovery actions prioritized for the short medium, and long terms [37]. 34. Bennett, N.J.; Finkbeiner, E.M.; Ban, N.C.; Belhabib, D.; Jupiter, S.D.; Kittinger, J.N.; Mangubhai, Particular priority should be given to the households in which someone has fallen sick to COVID-19, as these were S.; Scholtens, J.; Gill, D.; Christie, P. The COVID-19 pandemic, small-scale fisheries and coastal often severely affected by issues surrounding agricultural production, whereas households that were affected by fishing communities. Coast. Manag. 2020, 48, 336–347. travel restrictions, market closures, etc. suffered relatively less-severe impacts [38]. The design of the rescue policy 35ackagles in Unit Changes in Uni
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- their survival and continued production. Loan forgiveness or new loans at subsidized rates for small-scale lese, V.; Wairiu, M.; Hickey, G.M.; Ugalde, D., Hinge Salill, D.; Walenenea, J.; Tabe, T.; fishers and farmers could be included in the provision. Keremama, M.; Teva, C.; Navunicagi, O.; et al. Impacts of COVID-19 on agriculture and food
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- f. Development organization can help with the re-orientation and flexibility of financing programs and the targeting Retrieved from https://encyclopedia.pub/entry/history/show/45590 of support to smallholders and rural fishing communities.
- g. The fishing season could be extended on a conditional basis.