

# 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 <sup>[1]</sup>.

Fish is often a fishing community's primary source of protein, fatty acids, and micronutrients <sup>[2]</sup>. 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 <sup>[3]</sup>. 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 <sup>[4]</sup>.

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 <sup>[5]</sup>. 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 <sup>[6]</sup>. 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 [7]. 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 [5]. 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	<ul style="list-style-type: none"> <li>Limited access to livelihood capital</li> <li>Disruption of strategies for securing livelihood</li> </ul>	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
	<ul style="list-style-type: none"> <li>Increased vulnerability of livelihoods</li> <li>Increased food and nutritional insecurity</li> </ul>	
Freshwater aquaculture	<ul style="list-style-type: none"> <li>Increased cost of inputs and transportation</li> <li>Hampered availability of seed stock</li> <li>Lower demand and price</li> <li>Increased burden of maintaining unsold stock</li> </ul>	Islam et al. <a href="#">[15]</a> Seshagiri et al. <a href="#">[16]</a> Cooke et al. <a href="#">[17]</a> Fiorella et al. <a href="#">[18]</a> Stokes et al. <a href="#">[10]</a>
Brackish water aquaculture	<ul style="list-style-type: none"> <li>Increased transportation cost</li> <li>Reduced sales and falling prices</li> </ul>	Kumaran et al. <a href="#">[14]</a> Islam et al. <a href="#">[15]</a> Manlosa et al. <a href="#">[19]</a>
River and naturally sourced fisheries	<ul style="list-style-type: none"> <li>Increased positive impact on natural sources</li> <li>Lower demand and price</li> <li>Expensive transportation</li> <li>Reduced regulatory enforcement</li> </ul>	Waibel et al. <a href="#">[20]</a> Newton et al. <a href="#">[21]</a> Islam et al. <a href="#">[15]</a> Stokes et al. <a href="#">[10]</a>
Offshore fisheries	<ul style="list-style-type: none"> <li>Positive ecological impact on stock</li> <li>Lower demand and price</li> </ul>	Andrews et al. <a href="#">[22]</a> Shenoy & Rajpathak <a href="#">[23]</a> Marschke et al. <a href="#">[24]</a> Asante, & Sabau <a href="#">[25]</a>

Major Domains of Fisheries and Aquaculture Production	Impacts of COVID-19	Sources
Industry	<ul style="list-style-type: none"> <li>Reduced storage facilities</li> <li>Higher transportation cost</li> </ul>	
	<ul style="list-style-type: none"> <li>Reduced production of processed food items</li> </ul>	
	<ul style="list-style-type: none"> <li>Increased price of raw materials</li> </ul>	Fernández-González, & Pérez-Vas <a href="#">[26]</a> Hasan et al. <a href="#">[27]</a> Kaewnuratchadasorn et al. <a href="#">[28]</a>
	<ul style="list-style-type: none"> <li>Need to limit sales</li> </ul>	Paradis et al. <a href="#">[29]</a>
	<ul style="list-style-type: none"> <li>Need to limit international trade</li> </ul>	

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### 3. COVID-19's Impacts on the Aquatic Food Supply Chain

The *Glob. Food Secur.* 2021, 12, 100526, the major impacts of COVID-19 on the aquatic food supply chain (Table 2).

2). The key domains that have been affected are fishing, aquaculture production, processors and cold storage. At the fishing level, farmers are facing limited access to capture fisheries, less time to catch the fish, expensive labor, and travel restrictions. Similarly, at the production level, stakeholders are experiencing the higher costs of inputs and transportation, less demand, reductions in the price of the product, and undesired stock. At the processor level, there are also several challenges such as expensive transportation, dropping demand and prices, expensive inputs and restrictions on transportation (Table 2). The aquatic food supply chain's stakeholders are also facing limited access to cold storage facilities and are therefore incurring losses due to the perishability of the product.

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Major Domains of Supply Chain	Impacts of COVID-19	Sources
Fishing	<ul style="list-style-type: none"> <li>Limited access to capture fisheries</li> </ul>	
	<ul style="list-style-type: none"> <li>Reduced duration of catching time</li> </ul>	Fiorella et al. <a href="#">[18]</a> Campbell et al. <a href="#">[30]</a> Ruiz-Salmón et al. <a href="#">[31]</a>
	<ul style="list-style-type: none"> <li>Increased labor cost</li> </ul>	Paradis et al. <a href="#">[29]</a>
	<ul style="list-style-type: none"> <li>Travel restrictions</li> </ul>	

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Major Domains of Supply Chain	Impacts of COVID-19	Sources
1 Aquaculture production	<ul style="list-style-type: none"> <li>Increased cost of inputs and transportation</li> <li>Undesired seed stock</li> <li>Reduced demand and price</li> <li>Increased burden of maintaining unsold stock</li> </ul>	Cooke et al. <sup>[17]</sup> Manlosa et al. <sup>[19]</sup> Sarà et al. <sup>[32]</sup> Islam et al. <sup>[15]</sup>
1 Processors	<ul style="list-style-type: none"> <li>Transportation cost increased</li> <li>Decline of rates of sale and price</li> <li>Expensive inputs</li> <li>Limited transportation due to restrictions</li> </ul>	White et al. <sup>[33]</sup> Bennett et al. <sup>[34]</sup> Fiorella et al. <sup>[18]</sup> Kumaran et al. <sup>[14]</sup>
1 Cold storage facilities	<ul style="list-style-type: none"> <li>Less access to cold storage facilities</li> <li>Unexpected loss due to the perishable nature of the product</li> </ul>	Fahlevi et al. <sup>[35]</sup> Kumaran et al. <sup>[14]</sup> Kaewnuratchadasorn et al. <sup>[28]</sup>

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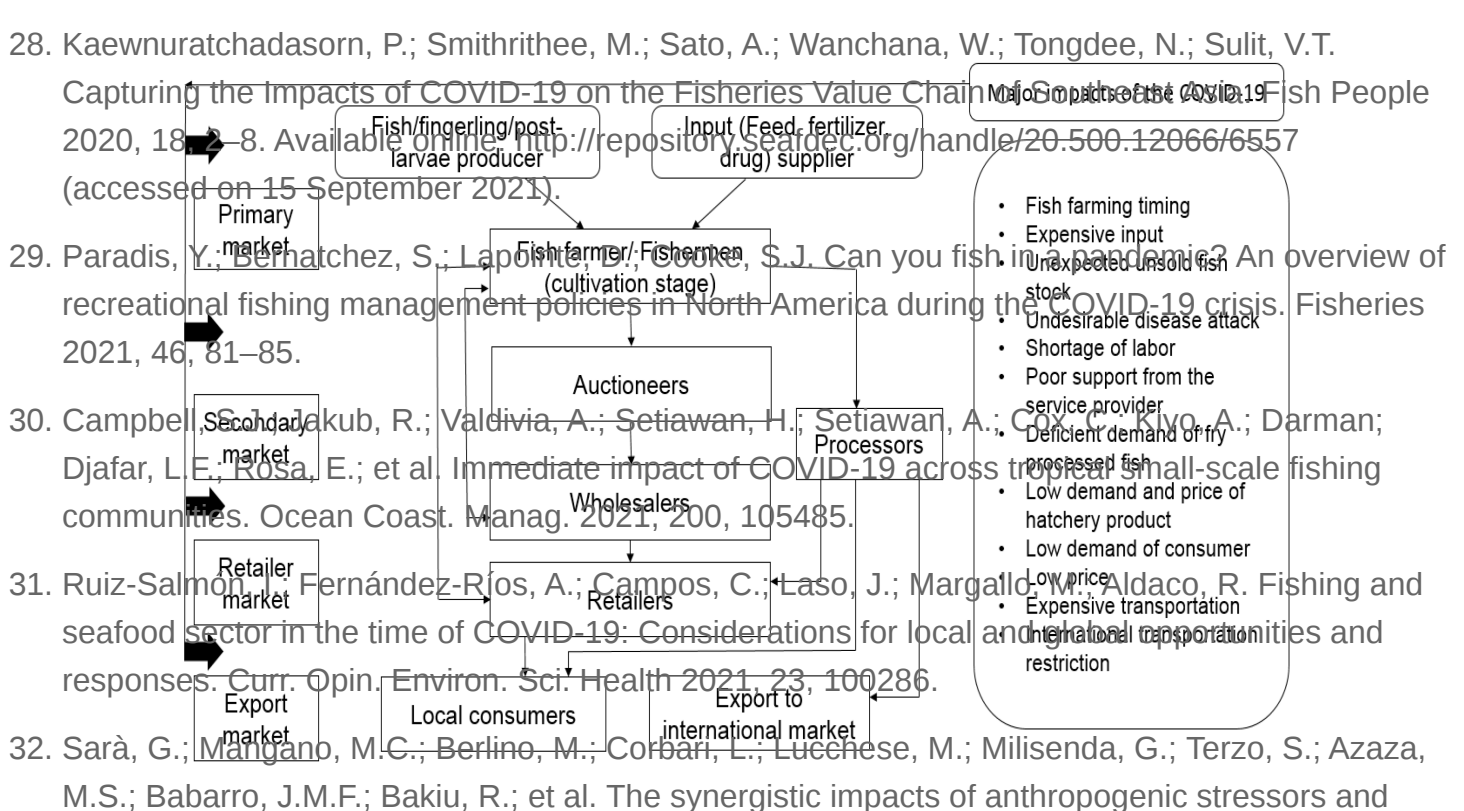


Figure 1. Disruption of aquatic food supply chain. Source: from existing literature.

## 6. Policy Recommendations



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