

# Impact of COVID-19 on Aquaculture and Fisheries Sectors

Subjects: Fisheries

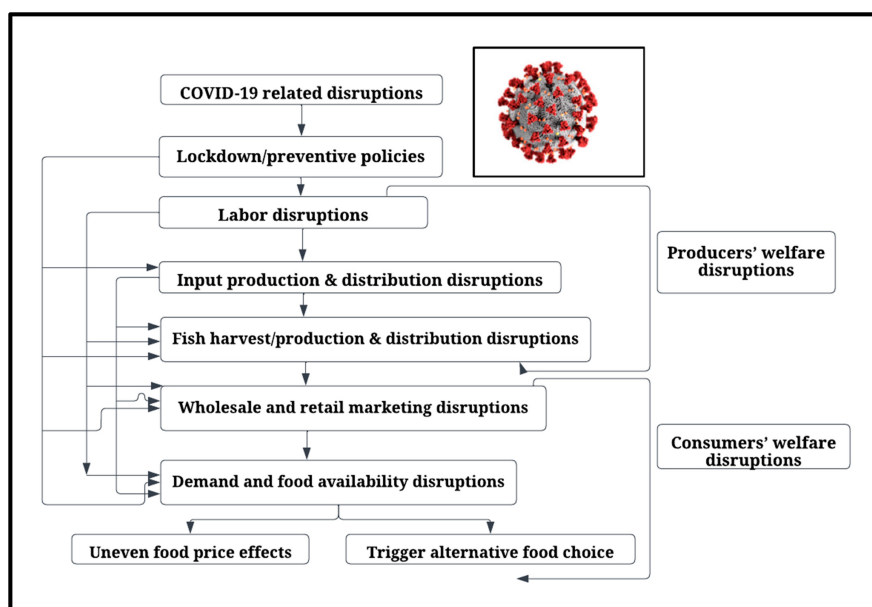
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The aquaculture and fisheries sectors are critical sources of nutrition and employment generation in many developed and developing countries. Hence, any disruptions to these sectors due to the COVID-19 pandemic have a far-reaching impact, leading to a cascading chain of disorder affecting people's food security and livelihoods.

Keywords: food security ; livelihood ; aquaculture ; COVID-19 ; economic impact model ; fisheries

## 1. Fish Supply Chain Disruption

Fish supply from capture fisheries was temporarily halted due to decreased seafood demand in the national and international markets <sup>[1]</sup>. Fishing fleets, which usually harvest at a bulk rate, targeting the export markets, were more highly impacted than those fleets serving only in domestic and small markets. Sanitary measures, such as physical distancing among crew members at sea and/or the lack of necessary equipment such as facial masks and gloves, sometimes caused fishing activity to cease. Therefore, a sharp drop in harvesting was observed globally (**Figure 1**), particularly during the first weeks of the pandemic crisis <sup>[1]</sup>. On the other hand, imposing movement restrictions for professional seafarers and marine fishing personnel created a human rights crisis during this pandemic because they were stuck at port/transit point/sea due to not having embarking permission from the concerned sheltering country/territory's authority <sup>[2]</sup>.



**Figure 1.** Impact of COVID-19 on producers' and consumers' economic welfare in the aquaculture and fisheries sectors (source: personal elaboration by the authors).

In the USA, fishers in certain states temporarily halted their fishing activities due to the decreased fish demand in the restaurant business during this pandemic. It should be noted that these restaurants sell approximately 75% of the seafood consumed in the entire USA, as reported before the pandemic <sup>[3]</sup>. Fish prices also temporarily fell by 34% due to a similar restaurant business shutdown, as written by the 'Portland Fish Exchange in Maine' in May 2020 <sup>[4]</sup>. In some instances, Maine's fishers received a low price at the docks and witnessed complex price volatility during this pandemic <sup>[4]</sup>. Therefore, Maine's wholesalers encouraged their fishers to temporarily refrain from fishing during the pandemic <sup>[4]</sup>. In the northeast USA, the fishers adopted multiple coping strategies during the pandemic, including temporarily stopping fishing,

direct sales of seafood, switching species, and supplementing their income with government payments or other sources of income [5].

Similar COVID-19-related impacts were reported in France, Italy, and Spain, where fresh fish sales declined by 30% due to the sudden shutdown of restaurant businesses [6]. In Bangladesh, the fishers temporarily reduced their fishing trips to the Bay of Bengal following the pandemic-related preventive strategies, significantly affecting their livelihoods and income [7][8]. In such situations, non-governmental/governmental organizations in Bangladesh provided little to no support, further increasing the country's vulnerability to food insecurity [9]. However, certain fishers in Bangladesh adopted multilevel resilience strategies at the individual and household levels to cope with such situations, including diversifying their livelihood, creating more friendships, and networking among supporters [10].

The COVID-19 pandemic also severely affected the global aquaculture supply chain by creating extended production delays (**Figure 1**) [11][12]. Additional problems faced in this sector included dilemmas regarding the transportation and selling of the final products at the market, shortage in production inputs, and difficulties obtaining credit from banks and other financial institutions, as reported for China [12]. Being the world's largest fish producer and exporter and third largest importer, China was one of the countries that suffered the most from this COVID-19 pandemic, which could be viewed in several phases [11]: First, the nationwide lockdown in China inevitably cut off their logistics and domestic distribution channels, which created a fish overstocking scenario at their farms resulting from the temporary fish feed shortage, inadequate transportation, and low consumer demand. Second, the closure of wholesale markets, supermarkets, and restaurants resulted in low consumer demand, putting more pressure on the farmers. Third, fish exportation was temporarily halted, particularly tilapia, catfish, and whitefish exportation, due to the stagnant fish demand in the international market [11].

COVID-19-related disruptions in the US aquaculture sector included loss of revenue, farm labor shortages, difficulty securing production inputs and services, and management challenges relating to the on-farm inventory of unsold fish and shellfish [13]. Similar challenges were faced by the aquaculture value chain actors in India and Bangladesh after experiencing lockdown and other preventive strategies [8][9][11][14][15][16][17][18]. In Bangladesh, fish feed input prices increased considerably [19]. One example of a required raw material for fish feed is monosodium glutamate, the price of which increased by 16% from 2019 to 2021 [15]. On the other hand, Bangladesh's demand for hatchery fish fry was reduced by 40% from 2019 to 2021 [15]. Likewise, fish fry prices decreased by 20–25% from 2019 to 2021 [15]. One example was tilapia fry, the sales of which were reduced from 10 million in 2019 to 2.5 million in 2021 [15]. There are two potential reasons behind this: (1) farmers from neighboring districts were unable to come to fish hatcheries during to lockdown period, particularly in April when the peak season for fry selling begins; (2) some nursery owners were reluctant to stock hatchlings in 2021 because of the leftover fish available from the previous year [15].

However, the fishermen/fishers' situation improved after adopting COVID-19-related prevention guidelines [11]. In some instances, the temporary pause in fishing/fishing fleet operation created a new opportunity for recovering the depleted fishing grounds, which resulted from decade-long overfishing attempts [20]. Moreover, fossil fuel usage in the commercial fishing fleet declined during this pandemic, which potentially helped to reduce greenhouse gas emissions, consistent with climate change adaptation and mitigation strategies [21].

## **2. Fish Demand and Price Disruptions**

As noted before, fish demand fluctuated due to pandemic-related public health safety measures (**Figure 1**) [11][22]. Similar cases were reported for expensive fish, such as lobsters, oysters, bluefin tuna, and mahi-mahi, as demand for them declined due to the closure of public restaurants and cessation of public/private events [23][24]. Hence, fish price volatility was observed [11]. The European market observatory data for fisheries and aquaculture also reported the same after highlighting that the price had declined by 20–70% for their Mediterranean fisheries [25]. Other European fisheries also observed high weekly price volatility, with price paths varying significantly across products and countries [25]. Likewise, the price of Hilsa fish (*Tenualosa ilisha*), harvested from the captured fisheries in Bangladesh, decreased by 6–13% [15]. The main reason behind such an outcome was the lockdown restriction and high transportation costs [15]. Hilsa fish distributors faced a substantial economic loss from such instances, but it allowed the local people to consume more, leading to improved consumer welfare (**Figure 1**).

However, most survey respondents (74%) in Senegal experienced a soaring price for their essential food products during the COVID-19 pandemic [26]. Similar instances were reported in Bangladesh, India, Myanmar, Egypt, and Nigeria, where the retail fish price peaked during the initial lockdown but dropped later due to declining demand [27][28]. Such significant

price drops and uncertainties are challenging as they reduce fish producers' welfare but sometimes improve consumer welfare by giving them a substantial chance to consume more <sup>[25]</sup>.

Decreased demand for fresh fish products increased demand for canned, frozen, and processed fish (**Figure 1**). Retail sales of these kinds of shelf-stable fish products rose in supermarkets, notably during the early pandemic when consumers started stockpiling due to the panic and speculation relating to future shortage or consumption (**Figure 1**) <sup>[1][2]</sup>. Therefore, the processing industry for salmon and whitefish experienced positive sales trends compared to last year, particularly in areas where the fish supply chain was disrupted <sup>[29]</sup>. In certain instances, COVID-19 triggered increased demand and a price rise for locally sourced fish products. For example, small-scale fishers from Lake Victoria, Kenya, experienced a price rise for their catch as the import of frozen fish fillet supplies from China declined <sup>[29]</sup>. Organizations, which providing direct delivery services, connecting fishers and consumers in several OECD (Organization for Economic Co-operation and Development) countries, experienced expansion, particularly in COVID-affected areas <sup>[25][29]</sup>. However, the economic contraction caused by the pandemic and resulting reductions in consumers' spending power could impact demand in the medium and longer term <sup>[25][29]</sup>. Under these circumstances, the market's recovery is likely slow and difficult to predict <sup>[25][29]</sup>.

### **3. Trade (Imports and Exports)**

Trade was affected by border closings, input availability declining, and increasing in global air-freight costs as passenger flights were canceled (**Figure 1**) <sup>[30]</sup>. These impacts created further challenges for selling fresh fish products, even though the demand for fish existed domestically and internationally <sup>[25]</sup>. For example, shrimp farmers in Peru faced obstacles while importing their post-larvae (PL) due to pandemic-related biosecurity restrictions. Such preventive measurements affected both their current and future shrimp production efforts. Before the pandemic, Peru imported more than 70 percent of its PL from overseas <sup>[22]</sup>.

In certain instances, increasing the screening incidences for COVID-19 at the border and obtaining a positive COVID-19 result for certain products exacerbated the trade disruptions further (**Figure 1**). For example, China temporarily halted its seafood trading with Brazil, Chile, Ecuador, Indonesia, India, the Netherlands, and Russia after finding COVID-19 strains on the packaging materials at the border while screening. This risk-averse approach to food safety results in overly cautious rejection of suspected seafood products <sup>[23]</sup>, even though the likelihood of virus transmission through food to humans is very low <sup>[31]</sup>. Often, this kind of news creates fear and panic among consumers, possibly resulting in the local food prices of essential commodities soaring or products being out of stock.

A collapse further compounded the loss of domestic demand in export markets. For instance, the cancellation of the Chinese lunar new year celebration devastated exporting countries' lobster fisheries, including Australia, Kenya, New Zealand, the United Kingdom, and the United States, which export to China <sup>[25]</sup>. Indeed, the Chinese lunar year celebration is one of their biggest festivals, during which the Chinese people prefer to consume high-valued seafood items <sup>[29]</sup>.

In Bangladesh, carp fish hatcheries were severely affected due to the Indian border closure. Local vendors often imported a large amount of pituitary gland (PG) hormone from India for conducting artificial breeding programs during the pre-COVID-19 period. Due to COVID-19 movement restrictions, the availability of such PG hormone was reduced, resulting in a per-PG-hormone-bottle price hike of 180% between 2019 and 2021 <sup>[15]</sup>. Similar instances were evidenced for fish inputs (e.g., mustard oil cake and dry fish) and prawn PL importation from India as their availability/accessibility was significantly reduced, resulting in a price hike in the Bangladesh local market <sup>[15]</sup>. A review study showed that the supply of Indian prawn PL to Bangladesh was reduced by 50% in volume in 2021 compared to 40% in 2020. In the meantime, local prawn PL supply from local hatcheries and the wild in Bangladesh was significantly reduced during this pandemic, resulting in a fluctuating PL supply and price volatility in the local PL market <sup>[15]</sup>.

### **4. Labor Supplies in Aquaculture and Fisheries Sectors**

The unemployment rate in the fish supply chain increased due to partial and complete confinement measurements (**Figure 1**). Belton et al. (2021), who surveyed the aquatic value chain in India, Egypt, Nigeria, Bangladesh, and Myanmar, reported that the average share of male casual workers shrunk from 51% in February 2020 to 34% in April 2020 and then climbed again gradually to 45% in October 2020 <sup>[27]</sup>. Twelve percent of surveyed business owners reported hiring female casual workers in February 2020 <sup>[27]</sup>. This share shrank to 5% in May 2020 and remained static before climbing to 10% in October 2020 <sup>[27]</sup>. Travel barriers for seasonal or migrant workers added an obstacle that exacerbated this issue as many were temporarily trapped inside fishing boats, ports, and fishing vessels (**Figure 1**), as seen in multiple incidents that

occurred in India, Thailand, and the South Pacific ocean (an Ecuadorian vessel), respectively <sup>[4]</sup>. India's nationwide lockdown forced hatchery owners to close their hatcheries, feed mills, and processing plants <sup>[46]</sup>. Similar impacts were reported in Bangladesh and Myanmar <sup>[32]</sup>. Moreover, financial or cash-flow issues also forced the owners to lay off their labor temporarily or permanently from their farms <sup>[4]</sup>. COVID-19-related outbreaks also occurred among seafood process workers in Ghana, the US, and elsewhere <sup>[33]</sup>.

In Bangladesh, the profit margin of finfish farmers was squeezed during the pandemic due to the input price hike and low fish demand <sup>[34]</sup>. Although the net return from carp and other catfish farming remained close to the break-even level, pangasius and tilapia farming potentially put farmers in debt in Bangladesh <sup>[34]</sup>. To compensate for rising operational costs and reduced income, fish farm owners were forced to lay off their staff and cut wages to balance the costs <sup>[34]</sup>. However, this compensation tool risks frustrating working-class people in rural areas and creates huge socio-economic burdens <sup>[34]</sup>. Similar instances were adopted for workforce reduction in the shrimp industry in Bangladesh when shrimp selling was reduced domestically and internationally <sup>[35]</sup>. Even though the Bangladeshi government has already withdrawn the COVID-19-related preventive measures from the entire country, the aquatic value chain actors are still adapting to the negative COVID-19 impacts previously affecting their operations, income, and livelihoods <sup>[15][36]</sup>.

## **5. Food Security**

The impacts of the COVID-19 pandemic shocked the national food systems <sup>[37]</sup>, likely due to the lack of accurate data on pandemic handling and inadequate preventive measures and concerns relating to how residents would respond to the crisis after preventive restrictions were imposed <sup>[38]</sup>. Food system management was also affected due to limitations such as those noted above and the partial deficiency of timely government advisement for food supply chain actors. Thus, the market food stock decreased dramatically with a noticeable, sharp food price rise (**Figure 1**). In addition, it revealed that our current food systems are quite fragile <sup>[39]</sup>. As the pandemic worsened, peoples' purchasing power, production capability, and food-dispensing mechanism deteriorated, resulting in an acute burden, mainly carried by the vulnerable communities <sup>[4]</sup>. However, the delay in government advisement, particularly in developing/low-income countries, was quite logical for reducing panic among the residents. Otherwise, certain opportunist, unscrupulous, syndicated entrepreneurs might have exploited the situation by creating artificial scarcity for essential commodities in the market to gain a gigantic profit.

Global malnutrition issues were significantly affected after the reduction in fish consumption patterns during the pandemic. The case of the 'triple burden of malnutrition', which already existed globally, as reported before the advent of the pandemic, is likely to be worsened due to the current food insecurity crisis resulting from it <sup>[40]</sup>. Survey studies from Nigeria, Bangladesh, and Myanmar showed that food insecurity worsened as the surveyed respondents purchased less-than-usual food per month during the pandemic. Myanmar was notable because its share trended over time, reflecting the late onset of widespread COVID-19 infections <sup>[23]</sup>. Survey respondents from Senegal reported that COVID-19 created significant concern in multifaceted ways, including through reduced access to agricultural inputs, low ability to carry out planting (cropping, horticulture), yield reduction (cropping, horticulture), and little ability to feed and sell livestock and to hire labor (horticulture) <sup>[26]</sup>. Most survey respondents also indicated that COVID-19 made it difficult to purchase or sell their products at the market due to foreclosure or disruptions <sup>[26]</sup>.

A review study for Bangladesh indicated that the fish consumption rate per household was significantly reduced during the pandemic period <sup>[41]</sup>. This was due to the reduced income and job loss occurrence reported by multiple survey studies conducted there <sup>[15][19][42]</sup>. This was also evident in affluent segments of the community there <sup>[41]</sup>. Hence, the surveyed people adopted different coping strategies, including decreasing the frequency of grocery shopping, shifting to online shopping, reducing consumption of high-price commodities, reducing junk food consumption, cleaning fish and meat with hot water and vinegar, and increasing the consumption of protein- and vitamin-C-rich food items <sup>[41]</sup>.

## **6. Livelihoods**

The aquaculture and fisheries sectors are an essential source of food nutrition and employment generation for millions worldwide. After the COVID-19 outbreak, the health status of these dependent communities was severely imperiled. For example, the informal sector in India was hit hard by the lockdown restrictions that blocked many aquatic fish actors from engaging in production and other value-addition activities <sup>[43]</sup>. Hence, they received less household income, which increased their susceptibility to food insecurity <sup>[23]</sup>. Moreover, these vulnerable people often worked in crowded areas, preventing them from following social distancing guidelines and making them vulnerable to COVID-19 transmission. In contrast, these people could not stay indoors as they needed money for daily subsistence <sup>[38]</sup>.

The reduction in fishing and fish farming activities also affected women's income and livelihoods as they have been traditionally and predominantly involved in this post-fish harvesting sector since times immemorial. Approximately 8.33 million women were engaged worldwide in fish sector, as reported in 2018 <sup>[41]</sup>. Therefore, imposing pandemic-related preventive restrictions on mobility affected this segment of women and further prevented them from processing and, thereafter, selling their fish. Additionally, they may have faced an increased risk of food loss and waste if appropriate storage and cold chain systems were located far away from their premises during the lockdown period <sup>[41]</sup>. In some instances, some rotational guidelines in accessing the port to ensure physical distancing also constrained this segment of women from accessing the resources/raw materials needed to process their fish <sup>[44]</sup>. To curb the effect of such unforeseen events, an all-inclusive and organized plan is essential, especially for the vulnerable population, with a view to the fulfillment of Sustainable Development Goal (SDG).

Islam et al. (2021) reported that, for Bangladesh, the COVID-19 pandemic severely disrupted fishers' livelihoods due to the reduction of fish market price and cancellation of foreign fish orders <sup>[18]</sup>. Transportation costs, which increased by 20–60% during the lockdown, worsened this issue further, resulting in increased input and maintenance costs <sup>[18]</sup>. Although the number of fish stocks increased due to reduced disturbance in fishing grounds, the pandemic could not bring societal benefits as all fisheries sub-sectors were affected differently <sup>[18]</sup>. FAO (2020) and Ben et al. (2021) almost said the same for Bangladeshi fishers, as noted above <sup>[41][44]</sup>. In another study, Sunny et al. (2021) indicated that this pandemic affected the Bangladeshi fishers' livelihoods in multiple ways, with sudden illness, reduced income, complications for starting production and input collection, labor crises, transportation abstraction, complexity in the food supply, a weak value chain, low consumer demand, rising commodity prices, and creditor pressure being the primary drivers <sup>[47]</sup>.

## **7. External Factors and Post-Pandemic Scenarios**

The pre-COVID-19-pandemic data showed that certain global people were already facing chronic food-insecure conditions due to pre-existing reasons such as lack of food availability, access, and utilization. The United Nations also stated that approximately 55% of the global population, mainly in developing countries, would lose access to social protection due to this pandemic <sup>[45]</sup>. This vulnerability further aggravates socio-economic losses, which could spill into the human rights and educational sectors and affect the marginalized poor owing to their losing access to food and nutrition <sup>[45]</sup>. In some cases, this food insecurity impact may force vulnerable people to sell their assets such as fish, farming equipment, and boats in exchange for money to feed their families. A study indicated that these fish farmers might consume most of their produced fish instead of selling them to the market <sup>[38]</sup>. Such situations are quite challenging for low-income families who reside mainly in rural areas <sup>[38]</sup>. In extreme cases, some victims may abandon their homes and businesses and even be subjected to trafficking, searching for subsistence and livelihoods elsewhere <sup>[46]</sup>. One potential solution is to transform the current pandemic crisis into an opportunity for global structural change. Another possible solution is to urge the world's electronic and print media to move forward and vividly highlight the above-noted distress to the concerned authority before this pandemic becomes out of control <sup>[47]</sup>.

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