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Impacts of the COVID-19 pandemic on fish trade and the coping strategies: An initial assessment from China’s perspective

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ABSTRACT

The outbreak of the COVID-19 pandemic in 2020 has posed unprecedented challenges for fish trade worldwide. This study examines these challenges through an observation of China’s fish import and export activities and a qualitative study on evolving policies in the first nine months of 2020. The results indicate that control measures responding to uncertainty regarding the source of the disease and transmission path, the pressing need for restriction of the movement of people and goods, and fear of a second wave of outbreaks have substantially disrupted fish trade. To meet these challenges, certain coping measures are adopted to offset negative effects in the short term. These measures indicate the government’s pivotal role in stabilizing the supply chain and striking a balance between control requirements and efficiency required in trading activities, as well as the importance to find alternative markets to mitigate risks brought by the delayed supply and the plummeting consumption market. It concludes with some suggestions on improving international cooperation and domestic regulation for building resilience in long run.

1. Introduction

Fish is among the most highly traded commodities in the world. Almost 38% of fish and fish products entered the international market in 2018 [1]. By supplying diversified animal protein, fish and fish products significantly contribute to global food security [2].

The year 2020 was very difficult for the fish sector. The outbreak of the COVID-19 pandemic has had a serious global impact [3]. The volume of global merchandise trade dropped by 5.3% [4]. Both supply and demand were under pressure, and trade costs have sharply increased [5]. For the fish market, some initial assessments have revealed short-to-medium term problems, including delayed production, import restriction and tightened inspection, paralyzed transportation, dropped price and slashed consumption [6–9].

As the situation is still unfolding at the time of writing, the full impact of the pandemic on fish sector cannot yet be determined. Its high dependency on international trade has given rise to great interest in exploring the impacts of the COVID-19 pandemic on the trade network and supply chain [10,11]. In this aspect, it finds that different countries may be disrupted at different levels. While the types of fish products, distance, seriousness of outbreak, and a country’s role in the global market matter, different coping strategies and capacities for building resilience may mitigate risk or aggravate the situation [12]. The COVID-19 pandemic is primarily a public health crisis. Under a conceptual framework of resilience, pressures may be transmitted to different parts of the market and cause disruptions. Reactive and adaptive actions may be taken to recover from the shock, or transform to new “normal” [13,14]. These actions have significant bearings on the trade activities. For example, when no consensus is reached at the international level, countries may adopt import policies based on their own contingency plan [15].

1.1. Research overview

Based on an understanding that a country’s initiative may substantially affect its trade activities and supply chain, an investigation at the national level is significant to provide insights into the dynamics of the COVID-19 pandemic on trade network and supply chain. Some reports have already revealed the effects of certain coping measures. For instance, the closure of the distribution channel in the food service industry (HORECA sector) in Spain has caused the fall of market price and increased costs for transportation [16]. The inclusion of aquaculture...
sector into critical manufacturing sector allowed it to operate during the implementation of Movement Control Order, which facilitated the recovery of trade activities in Malaysia [17]. Promotion of alternative marketing or distribution programs for those goods relied heavily on exports in the US allowed the fishers to weather the early stages of the pandemic [18].

In this regard, an investigation on China’s performance is valuable. As the dominant fish market for both imports and exports and the first country to be severely affected by and then recover from the COVID-19 pandemic, its experience has well reflected challenges upon trade under different scenarios along with the good and bad practices in tackling these challenges [19]. Three important questions are addressed: (a) what are the impacts of the COVID-19 pandemic on fish trade and supply chain as shown through China’s import and export activities? (b) what are the coping strategies that China has adopted to deal with the disruptions caused by the COVID-19 pandemic? (c) what lessons can be drawn for building resilience in long run? This study attempts to make a timely initial assessment to guide decision-making and allow a more in-depth analysis with a greater amount of information available at later stage [20].

1.2. The fish trade and supply chain in China

China is a major player in the international fish market, with a trade value of $39.36 billion in 2019 [21]. China’s imports and exports accounted for 9% and 14% of world fish trade respectively in terms of value [1]. Imports have experienced rapid growth since 2015, and exports have remained at a high level with more than $20 billion since 2013. The trade war with the US and the high tariffs imposed on certain products such as tilapia and shrimp substantially influenced China’s exports in 2019 (Fig. 1) [22].

The domestic market is highly intertwined with the international market (Fig. 2). Three general trading modes are identified. First, fish may be exported to foreign markets after processing. Tilapia, yellow croaker, shrimp, hairtail and sea eel are good examples. The proportion of secondary processed products is slightly lower than that of primary processed goods. Surimi products, canned meat, fish meal, and fish oil account for around 45% of all production [24].

Second, fish may be imported into China for consumption. Hairtail, prawn, crab, salmon and squid are the main products. Some fish harvested on the high seas or the exclusive economic zone by Chinese distant fishing vessels are processed (heading and gutting) on the fishing or transit vessel or in ports of other countries, then imported into China for further processing and consumption [25]. Due to its large aquaculture industry, fish fry, feed and other inputs also rely heavily on importation. According to the GAC, China’s fish meal imports amount to 1,418,725 tons, with a total value of $1970 million in 2019. Peru is the biggest exporter, accounting for 58% of fish meal imports.

Third, fish may be imported to processing factories located in China and exported to foreign markets after processing, primarily Japan, South Korea, the EU, and the US. Cod, trout, squid and prawn are good examples. Processing factories are normally in coastal cities located in Liaoning, Zhejiang, Shandong, Jiangsu, Fujian, and Guangdong province, with many skilled migrant workers from inland provinces.

2. The analytical framework

First, the change of fish trade is assessed by investigating the imports and exports of fish and fish products in China. It selects imports and exports value per month for all fish and fish products as indicator of trade vitality. These monthly imports and exports data in the first nine months of 2020 is compared with trade data in the same period of 2019. The change of infections in China and the world are also added to show the potential relation between trade change and the COVID-19 pandemics. In present study, fish and fish products refer to products under the category HS Code 03, including live, fresh, chilled and frozen finfish, molluscs and crustaceans; dried, salted and smoked fillets, and fish fry. Since most products in this category are fresh or frozen products, they are more vulnerable to the changed trade environment than those secondary processed goods such as canned meat or fish oil.

In addition to investigation on imports and exports for all fish and fish products, it also investigates the trade change in key markets and on specific goods: (1) based on the total import and export value in 2019, the top-ten biggest export markets and imports markets are selected. Trade value with the European Union (EU) and Association of Southeast Asian Nations (ASEAN) are collectively counted. The imports and exports value per month for all fish and fish products with these markets in the first nine months of 2020 are compared with the trade data in the same period of 2019; (2) the trade performance of three main trading products is assessed, i.e. fresh or cold salmon, frozen tilapia, and cuttlefish and squids. They well-represent the typical imported goods, exported goods, and re-exported goods. The imports and exports value for each product per month from January 2019 to September 2020 in total and with main trading markets are shown.

Second, a descriptive analysis is applied with focus on examining the dynamics of disruptions and coping strategies which may affect fish trade and supply chain. While there are a variety of reasons behind the changed trade, this analysis tries to explain those related to the pandemic and the coping strategies. Inquiry is informed by and connected to a conceptual framework of food system resilience [26]. Trade activities and supply chain are an important dimensions of such a system in building resilience against crisis and pandemic [11,27]. To be specific, the outbreak of COVID-19 pandemic is considered as the main stressor which transmit pressures to fish market, affecting trade activities and supply chain. It may cause disruptions independently or with combination of other stressors, such as disruption caused by trade friction or border disputes. To manage these disruptions, adaptive measures are adopted. Some coping strategies are reactive in nature with short-term effects, while others have more enduring effects.

The source of the trade data for China’s fish import and export were mainly collected from the General Administration of Customs of China (the GAC). Data for COVID-19 cases in China from 10 to 19 January were collected from the Wuhan Health Commission (10–19 January 2020) and the National Health Commission of the People’s Republic of China (from 20 January 2020). Data for infections in other countries were collected from the World Health Organization. Policies and market information were collected from news articles relevant to COVID-19 pandemic from December 2019 to September 2020. Source for news articles is mainly from the monthly Global Fisheries Observer compiled by the China Aquatic Products Processing and Marketing Alliance (CAPPMA), Shuichan Website – one of the biggest fisheries trade information websites (www.shuichan.cc), and the CAPPMA official website. Information on policymaking and implementation was also collected.
from government websites, in particular the COVID-19 information columns provided by GAC, Market Supervision Bureau (MSB) and the State Council. Information was also from communications with officials in the National Fisheries Technology Extension Centre and local officials from Zhejiang, Fujian, and Shandong Province. To protect their privacy, the personal information of these officials is not disclosed in this paper.

3. Findings

3.1. Fish imports and exports during the COVID-19 pandemic

According to GAC, the total value of fish exports from China was $7619.77 million from January to September 2020, falling by 15.42% in a year-on-year comparison. The total value of fish imports was $9253.32 million, falling by 15.11%.

From Figs. 3 and 4, exports to most countries indiscriminately suffered a reduction of about 20% in January and February, a period with the initial outbreak of the COVID-19 pandemic in China. A gradual recovery was then detected with the reduction of infections in China in March. However, with more infections in many other countries, exports reduced again in April and May. Interestingly, the overall exports started to recover since then although the infections increased sharply worldwide. The gap was narrowed to 5.68% in September by comparison with the performance in 2019.

From Figs. 3 and Table 1, it finds that the recovery may not be achieved by simply bouncing back to the pre-pandemic level. Exports to a few key markets, primarily the EU, Japan, and the US, slipped further in April and May. In general, exports to these markets did not return to pre-pandemic level in the first nine months. Exports to the UK has experienced steeper rise and fall. In comparison, exports to countries of the ASEAN, Hong Kong and Korea, increased sharply since March.

The import market showed a different picture. From Figs. 6 and 7, imports were not impacted as severely as exports in January and February. The imports started to recover at a time when the demand in China recovered gradually after April. However, imports plunged after a strong recovery in June. The total trade value only bounced back gradually from August.
Fig. 5. Comparison of China’s fish exports to major markets in 2020 with 2019. Note: Exports to ASEAN countries is calculated as a package. This includes Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

From Fig. 8 and Table 2, it finds that the imports from Ecuador increased sharply for the first six months. Imports from Canada, Australia, Russia, India and Norway dropped substantially in the first four months, while the pattern differed slightly. The US kept rising since January, from a deep reduction of 60% in comparison with the same period last year. ASEAN countries are exceptions. Imports increased up to 20% for some months.

By observing the imports and exports of three main trading products in general and with main trading markets, more details are illustrated. T illusion. The main fish product for export. China is the biggest producer, processor, and exporter in the world (29). The overall exports dropped in 2020 (Fig. 9). For four biggest markets, export to US kept at a low level. US market was the biggest market traditionally. However, the high tariff imposed in 2018 has substantially influenced its exportation of fish. Although the tariff was lifted in April 2020, the export was not high. The US market has been severely hit. The imports to Norway recovered since February but decreased suddenly in May. The only exception is Australia. It increased imports in all nine months.

Frozen cuttlefish and squids are the most important fish products for both imports and exports. For top five exporting markets, exports to Thailand, Korea and Philippines have increased 60.04%, 13.96%, 156.48% respectively, while exports to the US market dropped by 33.23% (Fig. 11). For importation, a general decrease is identified from March and April, which may be partly explained by its lockdown policies from 24 March to 14 April. Some farming activities were impacted differently at different periods of the pandemic. Both exports and imports were substantially reduced in the first five months when the initial outbreak occurred in China, and then recovered gradually. However, its impacts on certain markets last longer than the other. While the total exports almost returned to pre-pandemic level, it was not achieved by simply bouncing back; (2) imports from most markets plummeted after a strong recovery in May and June 2020; (3) while trade performance were going down for most markets, substantial growth were observed in some Asian markets.

In addition to the general trends, the trade performance is also varied with different markets and on different products. The varied responses may result from a range of reasons. Some are potentially related to this pandemic. First, the outbreak of COVID-19 pandemic and the lockdown policies applied by certain governments may cause disruption. India is one of the major suppliers of frozen shrimp. Its export to China dropped in March and April, which may be partly explained by its lockdown policies from 24 March to 14 April. Some farming activities were

### Table 1

| Country/Region | Jan | Feb | Mar | Apr | May | June | July | August | September |
|----------------|-----|-----|-----|-----|-----|------|------|--------|-----------|
| **China’s fish exports to major markets in 2020 and 2019** | | | | | | | | | |
| **Unit: USD thousand** | | | | | | | | | |
| **Country** | **2019** | **2020** | **% change, 2020/2019** | **2019** | **2020** | **% change, 2020/2019** | **2019** | **2020** | **% change, 2020/2019** | **2019** | **2020** | **% change, 2020/2019** |
| **Total** | 1,552,783 | 1,231,451 | -20.69% | 881,320 | 736,486 | -16.43% | 875,144 | 743,929 | -14.99% | 928,024 | 763,163 | -17.76% |
| **EU** | 256,066 | 185,156 | -27.69% | 120,387 | 101,058 | -16.06% | 177,727 | 136,872 | -22.99% | 180,888 | 119,927 | -33.70% |
| **Japan** | 296,585 | 258,366 | -12.89% | 150,451 | 139,027 | -7.59% | 145,399 | 132,835 | -8.64% | 206,127 | 151,494 | -25.82% |
| **the US** | 191,553 | 148,168 | -22.65% | 79,904 | 71,615 | -10.52% | 120,052 | 100,636 | -12.64% | 130,888 | 108,562 | -19.00% |
| **Korea** | 215,998 | 164,547 | -23.82% | 119,962 | 71,615 | -40.30% | 128,023 | 100,636 | -21.39% | 98,689 | 97,307 | -12.59% |
| **Hong Kong** | 141,627 | 88,190 | -22.60% | 99,964 | 48,987 | -28.71% | 61,393 | 41,627 | -31.96% | 81,342 | 71,615 | -15.96% |
| **Taiwan** | 115,897 | 88,190 | -23.91% | 61,964 | 48,987 | -20.94% | 55,750 | 41,627 | -23.33% | 54,266 | 35,901 | -34.54% |
| **ASEAN** | 285,124 | 238,459 | -16.37% | 224,848 | 208,434 | -7.30% | 155,203 | 144,188 | -7.55% | 138,563 | 128,484 | -7.30% |

Note: The EU statistics cover 27 countries, excluding the UK.
suspended and processing delayed [31]. In June, a new round of lockdown was implemented as the number of infections increased. Even worse, escalated border conflicts with China and detection caused uncertainty and influenced trade activities since July (Fig. 8) [32]. Second, the capacity to deal with the tightened control measures at border matters. While the importation from Ecuador has expanded massively since 2019, the serious outbreak of COVID-19 pandemic in Ecuador and its ineffective control on production and processing has rendered many samples of imported goods tested coronavirus positive at Customs. Since China is the main market for Ecuador, its exportation has been hit severely since June 2020. Third, the capacity to provide cheap or alternative transportation may also affect fish trade, especially for fresh and chilled products. While imports of salmon were reduced substantially in the first nine months (Fig. 10), Australia actually increased its exports. Its initiative of establishing International Freight Assistance Mechanism (IFAM) by motivating 15 airlines and traders under the

![Fig. 6. Comparison of China’s fish imports in 2020/2019 with the COVID-19 infections in China from January to September 2020.](image)

![Fig. 7. Comparison of China’s fish imports in 2020/2019 with new COVID-19 infections globally from January to September 2020.](image)

![Fig. 8. Comparison of China’s fish imports from major markets in 2020 and 2019.](image)
coordination of Australia government in April may have largely alleviated pressure and facilitated trade of high-value and time-sensitive perishables goods [33].

In general, it may not be able to identify and quantify each factor on trade activities at present stage, especially when there is more than one element behind the changed fish trade. The trade data just gives us some clues about the impacts of COVID-19 and the disruptions it may cause to the fish trade. To better understand the dynamics of the impacts, it is necessary to conduct a qualitative inquiry from a country’s perspective.

3.2. A qualitative inquiry on the impacts of the COVID-19 pandemic on fish trade and supply chain

Informed by a conceptual framework of food system resilience, three specific phases are identified by considering impacts at different period of the pandemic:

- Phase 1 (January–March 2020): the outbreak of COVID-19 pandemic. China has experienced a so-called “initial stage of outbreak”. Little information is available regarding the origin of disease and vectors. New infections increased sharply. Uncertainty caused panic in the market and disruptions to fish trade.
- Phase 2 (April–May 2020): Chinese domestic market gradually recovered, while infections in many other countries increased gradually. Outbreak in a few advanced economies and lockdown policies has significantly influenced the export market.
- Phase 3 (June–September 2020): In fear of a second wave of COVID-19 outbreak, some strict control measures were placed to prevent transmission of virus from imported goods.

3.2.1. Impacts on fish trade and supply chain in initial outbreak of the pandemic

The initial outbreak has caused several disruptions for both imports and exports activities. Imports were disrupted indirectly as a result of lockdown policies and social-distancing measures. The government initiated an emergency response system immediately after confirming a potential outbreak of infectious disease as early as 21 January 2020.
Under a hierarchical governing system, the State Council soon established the Joint Prevention and Control Mechanism (JPCM) to lead actions. A lockdown policy was introduced in most provinces under the Level I highest emergency. Quarantine rules were applied to districts with confirmed infectious cases.

Demand was suppressed since parties and gatherings were prohibited during the spring festival holiday (from 25 January–1 February), a period normally marked by strong consumption [34]. In addition, a temporary ban on consuming and trading all “wild” animals not on the Livestock and Poultry List was introduced [35]. Since first outbreak occurred in a seafood market, some wholesale and retail markets for raw meat, fish and other live animals were shut down as a precautionary measure [36]. Worries of the safety of fish products had spread panic in the market, resulting in low demand for fish products. According to the Ministry of Agriculture and Rural Affairs (MARA), fish transactions in key markets with monitoring networks dropped to 10% in early February compared with the same period in 2019 [37]. The disruptions were sudden and unpredictable, price for carp, hairtails and yellow croakers dropped more than 50%, causing big losses for traders, suppliers, and retailers, regardless of whether they were domestically

Fig. 9. Export value & volume of frozen tilapia from January 2019 to September 2020.
supplied or imported [9]. The traders adjusted its import plans by delaying or canceling orders with a gloomy market prospect, which may explain the reduced imports in following months, especially the high-end products for restaurants and hotels. Importation of salmon has revealed the plummeted market demand for high-end products (Fig. 10).

For exportation, a drop of over 20% of trade value was identified in most markets in January and February. Uncertainty regarding the origin of virus and vectors of the disease paralyzed the market. Rumors were widely spread regarding the danger of consuming animal-related products. Some follow-up research made the situation even worse, as it indicated that certain aquatic species (turtles) may have been the vector [38]. With little knowledge developed, a few countries issued temporary import restrictions or even closed border markets. According to the World Trade Organization (WTO), several notifications and communications were made relating to import restrictions on animals or agricultural products [39]. These restrictions may have been even broader, as some were not effectively communicated to the WTO. For example, Mongolia, Russia, and Tajikistan closed their border market in February for a while [40].

More serious disruption to exports might come from lockdown

Fig. 10. Import value & volume of Atlantic salmon, fresh or cold, from January 2019 to September 2020.
3.2.2. Impacts on fish trade and supply chain due to infections in foreign countries

With the reduction of infections in China, domestic market gradually recovered in March. However, infection in a few important exporting markets or disruptions in supply market became serious. For import, to prevent infection from abroad, the GAC applied more stringent controls at border since March. Many ports or border markets in China required 14-day quarantine to prevent infectious cases from abroad. The clearance of goods was thus delayed, and storage fees and the risk of the spoilage of perishable foodstuffs increased [42]. This tightened control caused high risk and costs associated with trade, which may explain a further decrease of trade activities in March and April (Fig. 6).

Fresh and chilled products were more severely affected than frozen products. Many of these products need to be transported by air cargo. The cancellation of many international flights to and from China has disrupted transportation [43]. According to CIRIUM, only roughly 5% of flights flew to and from China since April 2020 in a year-on-year comparison [44]. Imports of fresh salmon, lobsters, and crabs from countries like Chile dropped significantly (Fig. 10).

For export, with fewer new cases since March, the production and processing industry recovered quickly. However, the lockdown policies in targeted markets have disrupted trade in several ways. Local governments may have imposed temporary lockdowns or stricter control measures as a response to the surge of infections. Demand and consumption preferences changed. Some small and medium exporters were unable to act based on experience or trading data. They were generally at a disadvantage in obtaining instant information due to culture differences and unfamiliarity with local markets, laws, and administrative systems. Information costs could be high.

Language barriers made things worse. For example, the FAO and World Health Organization (WHO) jointly issued an interim guidance for food businesses on 7 April, which was made available only in English, French, Spanish, Russian and Arabic [45]. The message was not transmitted in a timely manner, and certain information may have gotten lost in translation.

Furthermore, the restricted movement of people made some traditional trading channels unable to function. Exhibition is an important means of making deals in the fish sector. However, most major exhibitions were canceled. Although exporters might use online tools to communicate with potential buyers, such tools have several defects, including discriminating upon medium and small-sized providers as trust may be harder to establish.

3.2.3. Impacts on fish trade and supply chain with a sudden decrease of imports in June

After entering mid-May, as the number of infections continued to increase in many other countries, there were worries over a second wave of infection. It has identified a massive drop of overall import volume since June 2020. A number of infection incidents related to frozen seafood showed how easily new risks could substantially damage fish trade.

The events outlined in Table 3 have impacted importation (Fig. 5).

Their unpredictability caused serious concerns regarding the safety of food along the cold chain. Since salmon from Norway were doubted in the first incident in Beijing, the imports of salmon from Norway suffered huge losses (Fig. 10). After each incident, the same batch of imported goods was removed from shelves and recalled, causing big losses to traders. Market confidence was also difficult to restore.

The risk of transmission via cold chain was unclear. As more incidents occurred in July, Customs started to increase the frequency of inspections of seafood, and required food safety warranties to be issued by the exporting Customs department, which was not easy to obtain for many companies [46]. After receiving reports from the German authority that an outbreak of COVID-19 among workers occurred in a pork processing factory, Customs temporarily halted imports from company, even though there was no clear evidence that contamination occurred in the batch of imported goods [47]. This was followed by more notices of restrictions on frozen pork, poultry, and beef imports from companies located in other countries [48,49]. In total, 23 companies received temporary bans in July [50]. GAC announced a new policy in

| Date        | Place     | Description                                                                                                                                                                                                 |
|-------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9 June      | Beijing   | Four new cases were found after 56 days with no new case reported. It was traced back to a fish and meat wholesale market in Fengtai District. Samples from a salmon chopping board and frozen fish imported from Norway were tested coronavirus-positive. |
| 3 July      | Liaoning  | Samples from inside a cargo ship carrying whiteleg shrimp (Penaeus vannamei) from Ecuador were tested coronavirus-positive at Customs.                                                                         |
| 3 July      | Fujian    | Samples from the package of whiteleg shrimp from Ecuador were tested coronavirus-positive at Customs.                                                                                                        |
| 14 July     | Chongqing | Samples from the package of whiteleg shrimp from Ecuador were tested coronavirus-positive at Customs.                                                                                                      |
| 16 July     | Yunnan    | Samples from the package of whiteleg shrimp from Ecuador were tested coronavirus-positive at Customs.                                                                                                     |
| 25 July     | Liaoning  | Twenty-four new cases were found in Dalian City. More cases were found in other cities of the same province. It was traced back to an employee in Dalian Kaiyang Seafood Co. Ltd. After investigation, the infection was confirmed to have occurred in his workplace, via his contact with frozen import fish products. More samples from the processing factory were tested coronavirus-positive. |
| 11 August   | Shandong  | Samples from the package of whiteleg shrimp from Ecuador were tested coronavirus-positive in a routine inspection of a restaurant by the MSB.                                                              |
| 12 August   | Anhui     | Samples from the package of whiteleg shrimp were tested coronavirus-positive in a routine inspection of a restaurant by the MSB.                                                                          |
| 13 August   | Shaanxi   | Samples from the package of whiteleg shrimp were tested coronavirus-positive in a routine inspection of a seafood market by MSB.                                                                      |
| 16 August   | Shenzhen  | One new case was found in Shenzhen. An employee of the He Ma Fresh food market was tested coronavirus-positive. Samples from imported frozen meat were tested coronavirus-positive afterwards. |
| September   | Not specify | Samples from a package of frozen fish products from one fishing vessel and one transit ship with the flag state of Russia were tested coronavirus-positive at the port. |
| 23 September| Not specify | Samples from package of frozen Sebastes mentella from Norway were tested coronavirus-positive at Customs.                                                                                           |
| 25 September| Not specify | Samples from frozen hairtail from Brazil were tested coronavirus-positive at Customs.                                                                                                                      |
September. If more than two batches of goods were tested coronavirus-positive, the importing qualification would be suspended for one week; if more than three batches of goods were tested coronavirus-positive, the suspension would be extended to four weeks [51].

More serious problem was on those products on market. Once contaminated goods were found in the marketplace, it was difficult to trace back those in the same batch. “Wet market”, the place for distribution of fresh foods in many medium and small cities, were generally lack of supervision. In peak time (normally morning), these markets could be quite crowded with booths randomly distributed. Fish and raw meat were not packaged and with unpleasant smelling.

3.2.4. Summary

It may be able to detect several major challenges for fish trade activities caused by the pandemic (Table 4). A general observation is that the disruptions caused by the outbreak of COVID-19 in China and many other countries presented different challenges to fish trade network. In the initial outbreak, uncertainty caused panic which substantially influenced exports. Lockdown policies caused disruptions in the supply chain and consumption, thus impacted both imports and exports. In April, as fewer new cases were reported in China but infections increased rapidly in many other countries, the challenges shifted to those caused by the restricted movement of people across borders, changed consumption preferences, and lockdown policies in foreign markets. From June, controlling measures due to fear of a second wave of outbreak have substantially affected the importation.

3.3. Coping strategies to disruptions to fish trade

To meet the abovementioned challenges, some coping strategies were adopted, most of which attempted to offset the negative impacts upon the fish trade and supply chain. Some of these strategies are short-term measures, while others have a more profound influence on fish trade and supply chain.

3.3.1. Responses to the closure of aquatic markets and ban on eating "wild" animals

3.3.1.1. Establishment of a list to exclude aquatic products. To avoid the disruption of market supply caused by bans on eating “wild” animals, MARA and the National Forestry and Grassland Administration acted quickly in clarifying the safety of certain animal products. A list of aquatic species excluded from the ban were soon established in February [52]. A notice granted by the Standing Committee of National People’s Congress provided a clear signal that most aquatic products “are safe for edible use” [53]. Associations and academic institutions were also mobilized to clarify why it is impossible to transmit coronavirus via fish and most other aquatic species. These measures allowed most seafood markets reopened soon and saved public confidence on consuming aquatic products [54].

3.3.2. Responses to domestic lockdown policies and social-distancing measures

3.3.2.1. Emergency plan for returning to work. To alleviate the losses caused by restrictions resulting from lockdowns, guidelines were drafted and published by JPCM on lifting policies and precautionary measures taken to ensure the orderly resumption of production in February. Prevention and emergency plans were required as a precondition for factories to resume production. Railway and airline companies were required to establish plans to reduce the risk of infection on the road. A 14-day quarantine rule was applied to workers returning from other places before attending work [55]. According to CAPFMA, the return-to-work rate has gone up to pre-pandemic level since the beginning of March [41].

3.3.2.2. Transportation solution. To meet the challenges caused by the closure of aquatic markets and alleviate pressures on the delivery of goods caused by lockdown policies, fin fish, fish fry, and other agricultural inputs were soon included in the emergency transportation coverage of daily necessities by the end of January. MARA, the Ministry of Transport (MoT) and the Ministry of Public Security jointly issued an order that strictly prohibited the blockage of transportation of agriculture products. Officials blocked the transportation of certain goods that were name-shamed and punished immediately [56]. Many places also established “green lanes” for essential goods [57].

3.3.2.3. E-commerce. The well-functioned online platform and infrastructure has played an important role. For example, JD.com utilized its advanced dispatching network and offline store chain to directly deliver seafood overseas to domestic consumers. Its quality control system established before the pandemic has allowed it quickly meet virus screening requirements provided in government guidelines. Contactless deliveries were widely applied in delivery. Its sale reached ¥201 billion for the second quarter of 2020, rising 33.8% in a year-on-year comparison [58]. Small businesses also used open platforms. “Zhi Shou Huo” (Live streaming and Sale) was a good example. The rationale is that the producer/traders use popular online platforms to introduce its farm/fishing activities and products to the potential buyers. Buyers could purchase those products via reliable big e-commerce platform such as Taobao.com.

3.3.3. Responses to the restricted movement of people across borders and tightened border check

3.3.3.1. Streamlined border rules. To accelerate the clearance of goods, GAC issued a series of 50 important measures in March [59]. This rule divided actions into control and preventive measures (13), measures to streamline clearance (16), reduce costs (6), and support supply chain (15). For fish trade, many policies provided guidelines and facilitated the paperless declaration and clearance of goods, as well as those applied to prioritize inspection at borders. For example, protocols were made for release at the ship side, advance declaration, inspections without in-person presence, and the submission of electronic documents such as contracts and packing lists.

Table 4

| Stressors and disruptions to fish trade under the COVID-19 pandemic. |
|-----------------|-----------------|
| **COVID-19 pandemic** | **Disruption** |
| Uncertainty regarding the origin of the virus and the vectors of the disease | ✓ Closure of aquatic markets and ban on eating “wild” animals |
| Need to prevent the spread of COVID-19 domestically | ✓ Import restriction |
| ✓ Lockdown policies in areas with Level 1 highest emergency |
| Increased infections and outbreaks in foreign markets | ✓ Social-distancing measures |
| ✓ Restricted movement of people across borders |
| ✓ Tightened border check for fish products |
| ✓ Lockdown policies in some foreign markets |
| Threat of a second wave of infection | ✓ Tightened inspections at borders |
| ✓ Temporary ban on importation |

Note: other stressors also caused disruptions to fish trade, such as trade friction with the US and Australia, and border disputes with India.
3.3.4. Responses to lockdown policies in some key markets

3.3.4.1. Find alternative market. To cope with the disrupted markets, traders attempted to find opportunities from the changed consumption preference, and employed the advantage of quick recovery to compete in new markets. Tilapia is a good example. A quick recovery of processing industry allowed exports of tilapia from China increased in a few new markets, primarily those in the Africa and UK (Fig. 9). Processing was adjusted to changed preference as consumers became more inclined to buy affordable frozen fish and cook at home [60].

3.3.4.2. Cultivate regional market. Low infections in Asian market have also created opportunities. The government adopted policies to promote integration into regional markets. An important statement was made between China and ASEAN countries on combating COVID-19, followed by a minister-level meeting between ASEAN countries, China, Japan, and Korea on expanding the market to combat the pandemic [61,62]. The development of free trade zones (FTZ) in Hainan and the establishment of the new FTZ in Beijing added more vitality. The negotiation of Regional Comprehensive Economic Partnership, signed by 15 countries in November 2020, was a milestone [63].

For fish trade, above measures facilitated movement of goods and people. Tariffs are reduced to the lowest level. Under RCEP, Customs procedures are simplified. Countries should provide facilities to allow release of fresh products within 6 hours upon arrival. Digitalization is emphasized. Rules for certificate for origin are vastly simplified [64]. Since competition between exportation of fish products are relatively low among China and many Asian countries due to varied products, facilitation measures provided by RCEP benefited trade and value chain [65]. For example, yellow croaker is a main product for export, and a welcome product in most Asian markets. A more integrated market allows trade of fresh or cold yellow croakers easier. China is also an important exporter for squids. It has seen a rapid increase in most Asian markets in 2020, which offset the decrease in the US market (Fig. 11).

3.3.4.3. Expand the domestic market. Even before the pandemic, there was a call to expand the domestic market. The deteriorating US-China relationship and “trade war” has already indicated the danger of an export-oriented economic model. The pandemic served as a catalyst in expanding the domestic market. President Xi made a further statement at United Nation General Assembly that China will foster “a new development paradigm with domestic circulation as the mainstay and
domestic and international circulations reinforcing each other", which formally declared that the domestic market would be a key for the next phase of economic development [66]. The State Council issued a high-level document to lower market access and increase recognition of international certifications in the domestic market [67]. For the fish sector, it provided financial support (insurance and loans) for export-led enterprises expanding sale channels in the domestic market.

3.3.5. Responses to the tightened inspections at borders and temporary ban on importation

Tightened inspections and temporary bans on imports enforced by Customs placed excessive pressure and risks on border control. To offset these negative effects, pre- and post-arrival measures were established to reduce the potential risk of banning imports at the border.

3.3.5.1. Closer cooperation with border checks. Realizing the high risk associated with the temporary ban, GAC managed to obtain more information about the source of goods (from harvesting to processing on boats/in factories and transportation) and made judgements on their potential risks before their arrival/departure [68]. For example, it communicated with the competent authorities in Chile on sanitary measures taken in meat/seafood processing and the COVID-19 cases that had been reported among workers [69].

3.3.5.2. Improve sanitary condition of wet markets and storage facilities. MSB, in cooperation with commercial, transport and sanitary departments, organized enforcement actions to check for potential risks in the wet market, frozen food market, and storage facilities [70]. JPCM started to publish guidelines on preventive measures for the supply chain from meat processing factories to storage and transportation [71].

3.3.5.3. Establish traceability mechanism. Customs and MSB joined several relevant departments, and managed to create a more feasible traceability system on imported food by enhancing information-sharing and label requirements. Some soft law tools are also applied to enhance businesses capacity in handling crisis.

4. Discussion

Based on observing China’s import and export activities, and an in-depth analysis of the disruptions and coping strategies, some major disruptions to fish trade, and measures which reacted and adapted to those disruptions are investigated.

The finding shows that the government plays an essential role in handling immediate crisis following the outbreak. Its function is significant in maintaining production, offering solution to logistics and ensuring distribution at local markets. In China’s case, the JPCM effectively mitigated risk brought by sudden disruptions at the initial outbreak. When rumors widespread on the danger of eating wild animals, and lockdown and quarantine rules affected the supply, the measures which categorized fish as safe food and ensured the supply of fresh food and agricultural inputs have largely avoided the disruption in distribution and reduced transportation costs. JPCM has also successfully coordinated actions with relevant departments and monitored the implementation of contingency plan for the movement of people, which allowed people returning to work in an orderly manner. With the advanced e-commerce industry and delivery network, the domestic market recovered very quickly. In general, the Chinese fish market did not see a serious disruption before June 2020.

China’s experience also shows that the ability to mitigate risk by adjusting to new demand and developing alternative markets are crucial for exports. In present case, uncertainty in foreign markets resulted in the reduced demand in some target markets or shortage of supply for domestic processing industry. With diversified markets, businesses were able to mitigate risk by maintaining trade activities with less affected markets. The government also promoted regional trade cooperation by taking advantage of the relative low number of infections in most Asian countries and shorter distances of transportation. Exports of cuttlefish, squid and tilapia to regional markets are increased substantially.

In addition to these positive findings, China’s experience also show how some long-term regulatory problems in managing fish markets may damage fish trade in crisis. The initial outbreak of the pandemic and the infections in June both occurred in wet markets. Although no evidence indicates that these places have higher risk, they may create an easy route for contamination. For fish and fish products, the regulation on wholesale market is particularly weak. There could be places that illegal, unreported and unregulated fishes sold; the business mode of many booths renders it almost impossible to trace the source of goods; some illegal trading of wild animals occurred in these markets [72].

Due to the poorly operated traceability system, when there is suspicion of virus transmission along the cold chain, Customs and MSB cannot easily trace the source of problematic frozen foods. This has added pressure on Customs to examine batches of imported fish and delayed clearance of goods. More importantly, lack of traceability has allowed some unsafe products into market, increased the risk of contamination.

After the salmon incident, many local MSB joined several other departments conducted check programs on the sanitary measures taken in these places [73]. These campaign-style actions may reduce the risk of contamination. However, the cost of regulation is quite high. They could not be permanent solutions.

Although our primary focus is on China, it may also reveal the importance of a country’s approach on its trade performance from other countries’ performance. Imports of fresh and chilled salmon from Australia and Chile are good examples. The former has reacted quicker with better logistics to manage disrupted supply chain, while the latter suffered heavier losses when most international flights suspended. The imports from Ecuador also show how vulnerable it could be in international trade network. Heavily relied on China’s market and inability to control infections along cold chain rendered its exports to China dropped significantly.

From a broader perspective, this pandemic may also expose the fragility of cooperation between countries. When there is uncertainty associated with transmission of virus, countries may adopt measures to restrict imports. The lack of mechanism to address uncertainty under the international law was exposed.

Currently, GATT Article XX(b) prescribes circumstances in which countries may impose restrictive measures “necessary to protect human, animal or plant life or health”. The health concerns brought by the COVID-19 virus fall into its scope of application. However, a careful reading of the drafting history of Article XX(b), the purpose of this provision, the interpretation and case law shows that the discussion and analysis do not particularly target the present situation.

International standards or appropriate risk assessments are always considered as an important condition for imposing restrictive measures. For example, in the WTO dispute between Canada and the U.S. over salmon imports, whether risk assessments were justifiable is a focal point [74]. This is similar to the dispute between New Zealand and Australia over the apple import ban, or the dispute between the US and India over the poultry import ban [75,76]. However, in the current event, neither the CODEX, the WHO nor the OIE can provide clear guidance. Until September 2020, almost no clear guidance relating to risks of animal-related infections and risk assessments on goods trade issued to guide trade activities. Consequently, certain countries made notifications on import restrictions or strict inspection requirements based on unilateral judgements, largely increasing uncertainty.

5. Implications

On 16 July 2020, China announced its second quarter GDP with a growth rate of 3.2%, which is considered as "one of the world’s earliest
signs of recovery from the fallout of the coronavirus pandemic” [77]. This pandemic will end at some point. The post-pandemic world may need more attention. While the COVID-19 pandemic has caused painful losses, it also provides opportunities for some important reforms.

5.1. Better domestic regulation to ensure resilient food supply

One of the most important implications from China’s experience might be its actions in responding to crisis. As discussed above, the government was able to deliver clear message and secure supply of goods while not paralyzing its control measures. Its quick recovery from the pandemic has helped the recovery of its exports.

However, its imports have been severely affected when more infections occurred worldwide. Its inability to provide more flexible solution is noted. Although no food crisis occurred, some major cracks are found below the surface. The ineffectiveness in handling potential contamination along the cold chain is alarming.

To build resilience for managing this crisis and similar crisis in the future, a more comprehensive approach is required. EU’s “farm to fork” strategy is a good example. Communicated in May 2020, this strategy intends to connect several key regulations and allow a more comprehensive approach for a fair, healthy and environmentally-friendly food system [78]. Its preparation for a contingency plan based on lessons learnt from COVID-19 is an important step for development of a set of procedures to be followed in facing systematic risk [78]. Some problems exposed during the pandemic is noted and included in the objectives of the strategy, such as the inequality in market access and health food [79].

Similar to EU, it might be high time for China to crystalize the experience and develop procedural-based plan. A full investigation on the efficiency of actions taken during the pandemic, and weaknesses such as wet markets and risk management on cold chain shall be made. More importantly, this pandemic may provide opportunity for some regulations. A key one is traceability system. EU has imposed a traceability system as early as 2009 [80]. Major fish products are labeled after being caught and information was passed all the way to end market. This mechanism allows a full process control on fish and prevents illegal fishing or low qualified products entering the market. China piloted several programs but could not promote it nationwide [81]. This pandemic may accelerate national programs to embrace such a system by facilitating cross-department cooperation.

In addition, this pandemic may also accelerate the pace for the transition of food supply chain in China. Some innovative means in distribution may be promoted. For example, agricultural products, especially fresh goods, are reluctant to adapt to online sale mode. However, the change of consumption preference may accelerate changes in distribution.

5.2. Better international cooperation to deal with uncertainty

It is impossible to ask countries not impose any restrictive measures in facing uncertainty, but more can be done by building better cooperation. First, the WTO and regional treaty can provide more detailed information on how risk assessment and risk management shall be conducted in uncertain circumstances. The Trade Facilitation Agreement signed in 2017 is a good example. It is a successful initiative under the WTO which attempt to improve trade efficiency by cutting red tape at borders [82]. The Agreement encourages countries to adopt measures such as one-window-for-all, paperless declaration, prioritized inspection and test procedures, online application for qualification and border cooperation, which are proven crucial instruments in this pandemic. Second, transparency on controlling measures should be required as countries’ obligations. Information asymmetry is a key barrier for trade activities, especially in times of crisis. Measures like lockdown policies in certain provinces which may directly or indirectly affect the trade of fish and fish products. If they can be timely communicated, producers and processors along supply chain are more capable of adjusting to new situations. Third, border cooperation should be enhanced. Share of information on food safety control or infection condition of certain working places is crucial for building trust and avoiding unnecessary restrictions at borders. It is significant to prevent unexpected blockage or delays in clearance.

CRediT authorship contribution statement

Yi Tang: Conceptualization, Review, Funding acquisition. Yanxuedan Zhang: Project administration, Methodology, Investigation, Formal analysis. Yu Zhang: Data curation. Yuqiong Sun: Investigation. Haoran Yang: Investigation.

Conflict of interest

The authors have no conflicts of interest to declare.

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