

COVID-19 CRISIS CATALYZED DISRUPTIONS IN THE THAI SEAFOOD SUPPLY CHAIN

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Abstract

This research studied the impacts of the COVID-19 pandemic on the Thai Seafood Supply Chain (ThaiSSC) and the responses taken by the supply chain from the beginning of the pandemic through the first quarter of 2022. Twenty-four semi-structured 1-to-1 in-depth interviews with veterans and leaders of the Thai seafood industry (farmers, processors, seafood brokers, importers, exporters, government officials and distributors) revealed the overall negative impact of the pandemic due to drastic changes in peoples' livelihoods, and laws and regulations. Nevertheless, ThaiSSC maintained its overall structure, due to the transformations of many actors in the chain. Prompatanapak and Lopetcharat (2020) reported the transformation resembled to this findings. Hence, the COVID-19 pandemic was a catalyst in accelerating these transformations from several years to a few months. This demonstrates the resiliency of the ThaiSSC, even though, about 30% of its connections disappeared due to the diminished influences of several stakeholders. Pre-processors and sourcing agents emerged as important new actors in the Thai seafood supply chain. The new roles and functions of these actors in the Thai seafood supply chain after the COVID-19 pandemic are reported and compared with those from before the pandemic.

Keywords: COVID-19, Seafood, Fishery, Supply chain, Thailand

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INTRODUCTION

Since the 1990s, Thailand has weathered many crises such as Early Mortality Syndrome, the enforcement of a global food traceability system, and labor welfare (Prompatanapak & Lopetcharat, 2020). Throughout the years, Thailand has kept its lead as a seafood exporting country (BOI, 2018; FAO, 2020; Kaewnuratchadasorn et al., 2020; TTIA, 2022). The reason behind this lasting top position is disruptive evolution in the ThaiSSC (Prompatanapak & Lopetcharat, 2020). Studies about the ThaiSSC are very limited, with most studies being either limited to a specific product class or region (e.g., a case study on a fisherfolk shop in Prachuap Khiri Khan province) (Aueaungkul, Bunmak, Amage, & Srichookiat, 2020), or based on non-Thai publications such as Making Sense of Wild Seafood Supply Chains (Future of Fish, 2015). Prompatanapak and Lopetcharat (2020) is the only published paper mapping the 17 components of the overall ThaiSSC industry and identifying the 6 change-inducing parties (primary suppliers, middlemen, processors, distributors, retailers and consumers) in its recent disruption. The 17 components corresponded to the 7 stages (source, seed production, on-growing farm, harvesting & processing, wholesale and distribution, market, and consumer) of the general seafood supply chain mapped by Fox, Mitchell, Dean, Elliott and Campbell (2018). The ThaiSSC evolved organically from the 1970s to 2010s while, driven by the 6 parties identified, other major changes were anticipated to happen between late 2019 and early 2020. These changes should have taken several years to settle (Prompatanapak & Lopetcharat, 2020). However, the COVID-19 pandemic changed everything.

The fisheries and aquaculture sector could not escape the impact of the COVID-19 pandemic (Kaewnuratchadasorn et al., 2020; Love et al., 2020; Stoll et al., 2020). The pandemic, reported first in Wuhan, Hubei Province, China in December 2019, was officially confirmed by The World Health Organization (WHO) on January 5, 2020. The

first officially confirmed COVID-19 case outside of China (13th January 2020) was from Thailand (WHO, 2020). The Thai government issued an emergency decree on March 25, 2020, that remained in effect during the writing of this manuscript (Q1 2022) (ILO, 2021). The pandemic impacted the Thai economy directly (through the domestic lockdown) and indirectly (through the disruption of the global supply chain). About 20 million people in the Thai population were severely affected through the informal economy that made up 54.3% of total employment in Thailand. Impacts included a reduction of social protections, especially sick leave, that greatly weakened overall income security (ILO, 2021). The pandemic disrupted both supplies and demands in the ThaiSSC through both economic routes. Regarding supplies, 200 registered seafood processors, contributing about 2.2% of all food processors in Thailand with market cap of USD 4.72 billion, were impacted by the shutdown-order given by the Thai government at the initiation of the 2nd wave of the pandemic which was found in a fish market in Samutsakorn in December 2020 (SEFDEC, 2020a; TFFA, 2022). ThaiSSC was responsible for this event as it was later found by the government that the origin of the 2nd pandemic wave was the migrant laborers in this area. This incident alone was estimated to have an impact of around USD 33 million per day, on the Thai economy (Bangprapa, 2020a) and was the first time that the Thai public learned about the involvement of the ThaiSSC in the pandemic.

After two years, the ThaiSSC emerged with export-import levels close to those of 2018 (pre-COVID) indicating the resiliency of the ThaiSSC. This research aimed to study and identify the changes which occurred in the ThaiSSC amidst the pandemic by comparing the structure, roles and importance of actors between the pre-COVID and post-COVID periods, to understand the resilience of the ThaiSSC. Finally, the research reported how various actors in the ThaiSSC and government coped with the crisis.

MATERIALS AND METHOD

Primary information was obtained through 24 semi-structured 1-on-1 in-depth interviews with veterans and leaders of the Thai seafood industry. These informants were representatives of corresponding industries and were selected to cover the whole of the ThaiSSC reported in Prompatanapak and Lopetcharat (2020). Interviewees represented a surimi-based product processor (contributing about 60% of total Thai surimi production by volume in Thailand), three frozen shrimp processors (contributing about 60% by volume to total Thai frozen shrimp production), two canned tuna processors (contributing about 70% by volume to the Thai processed tuna production), two fishermen's associations, two seafood brokers, two shrimp farmers' associations, two seafood trade associations, one Australian seafood importer, one US seafood importer, two EU seafood importers, a loan officer from a bank, two international non-profit organizations, two local non-government organizations and a former Director-General of Thailand's Fishery department. The interview responses were

analyzed by focusing on the impacts of the pandemic regarding the interviewee's role(s) in the ThaiSSC, changes that occurred, and how they coped with the situation. All interviews were conducted between March 2020 and February 2022. Consent to use the information was obtained from all informants. Export and import statistics were collected and rearranged (no statistical analysis performed on these data sets). All statistics are publicly available from corresponding association and government reports.

RESULTS AND DISCUSSION

1. The Resilience of the Thai Seafood Industry During the COVID-19 Crisis

Resilience relates to the ability to become successful again after something difficult or bad has happened (Cambridge Dictionary, n.d.). Examining the export-import data of the ThaiSSC over several years indicates that the ThaiSSC exhibited this ability throughout the COVID-19 crisis from 2020-2021. Thailand's overall seafood exports bounced back to almost pre-Covid levels with some shifts in its patterns (Figure 1 and 2). The export quantity

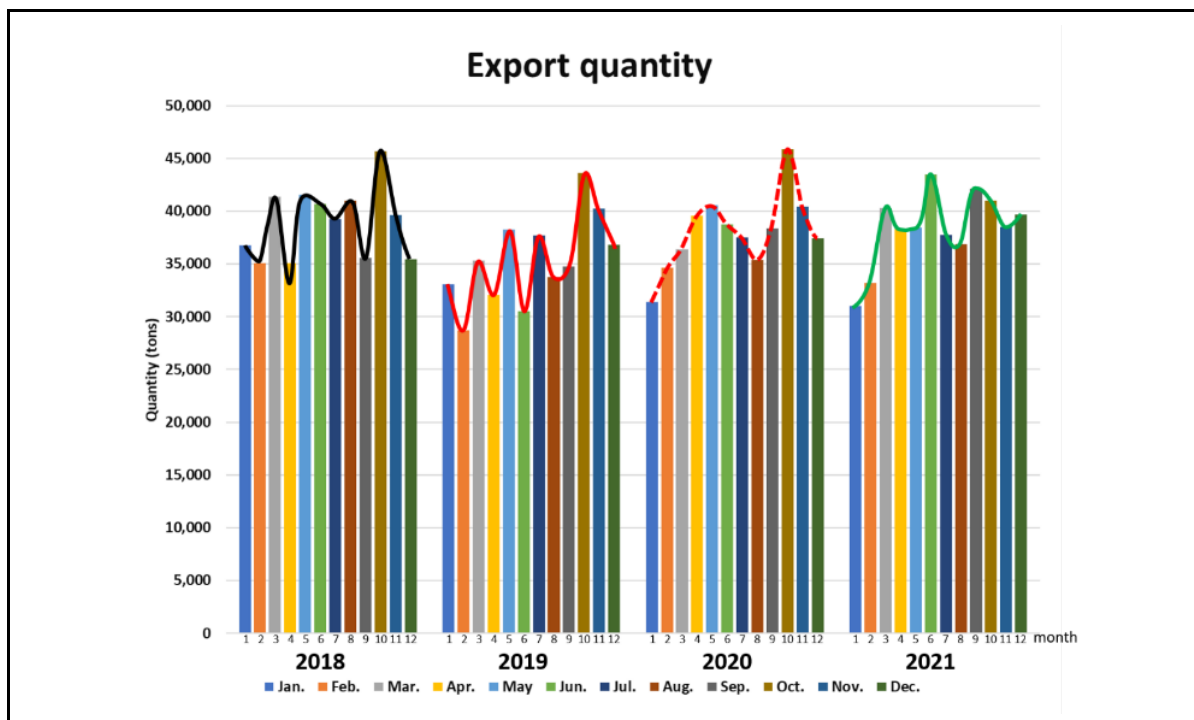


Figure 1 Thailand's Overall EQ (tons) of Fresh, Prepared, and Preserved Shrimp, Cephalopods, and Fish from January 2018 to December 2021 (adapted from TFFA, 2022)

(EQ) patterns from the pre-COVID period (2018 to mid-2019) shifted drastically at the beginning of the pandemic (from Dec. 2019 to Q1 of 2020) due to lockdowns in many importing countries (Figure 1).

From September through December 2021, the EQ patterns resembled those of 2018 and 2019, while the overall amounts of EQ in 2021 were also quite similar to those of 2019 and 2018 (Figure 1). The overall annual EQ of 2019 was -8.99 % (compared with 2018 year-to-year) except for prepared & preserved tuna, which increased by 69.88% (TFFA, 2022). After a year with the pandemic, the overall annual EQ increased by 7.42% in 2020 (compared with 2019 year-to-year), with the main driving force being in the fish category, as sales of those items decreased across the board in 2019 (compared with 2018). In 2020, after the start of the outbreak, the EQ of prepared & preserved tuna spiked by 695% (compared with 2019) while most other fish items also increased in sales (TFFA, 2022). During Q1 of 2021, two years after the start of the outbreak, the EQ pattern of Q1 2021 was similar to that of Q1 2020 (a steady increase from January through August) with this repeated pattern being caused by a “wait-

and-see” strategy of importing buyers who wanted to observe the market situation and the direction of the Thai government’s policy as there was still a possibility of lock down in Fishery provinces such as Samutsakorn, Rayong, and Chonburi. Overall, the 2021 annual EQ remained constant (+0.99%) (compared with 2020) with a 7.7% increased in value (TFFA, 2022). The constant EQ and the increase in export value reflected the price increase (USD/ton) of exported Thai seafood between 2020-2021 (Figure 2).

Figure 2 shows the pre-COVID export price (EP) patterns. During the outbreak (late 2019 through 2020), monthly EP patterns did not change much except for a drastic and continuing drop of prices for 6 months from the beginning of the outbreak in late 2019 to the first quarter of 2020, due to lockdown in most countries and economic insecurity among the consumers (Figure 2). Processors and retailers changed their specifications to using smaller sizes of raw materials and smaller retail packing sizes. After June 2020, the price climbed up steadily and began to resume its 2019 pattern, while it should also be noted that this price increase happened one-month earlier than in 2019 (see Figure 2).

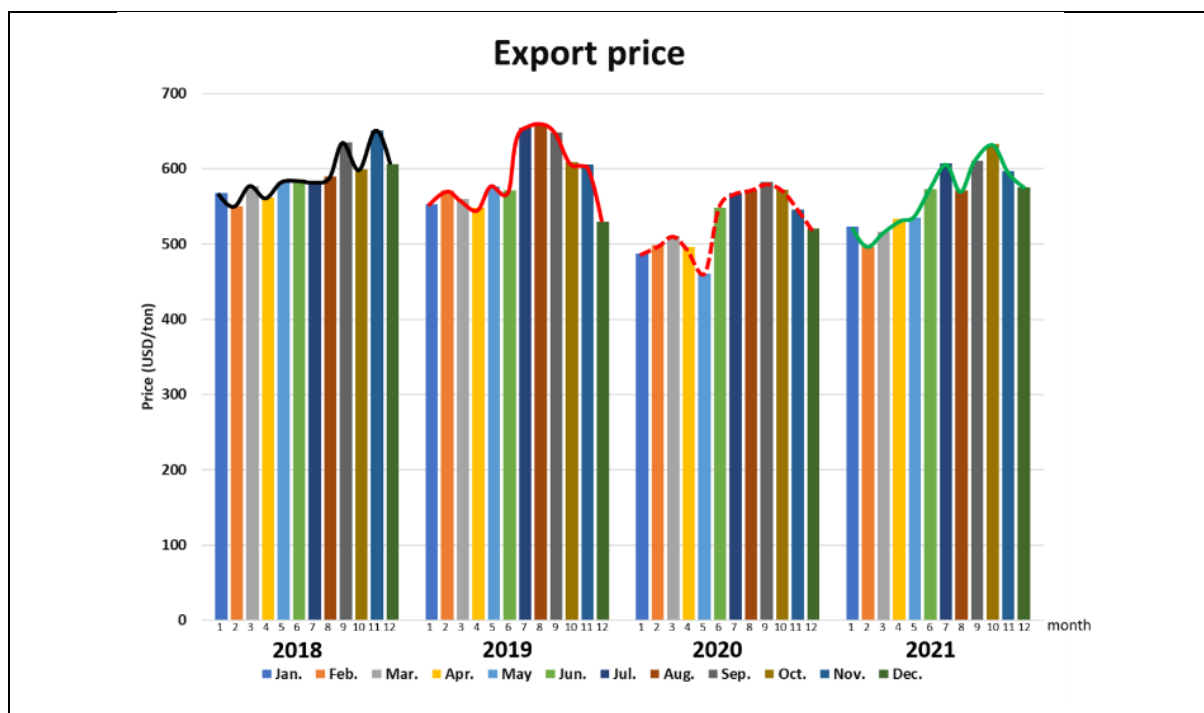


Figure 2: Thailand’s overall EP (USD/ton) for fresh, prepared and preserved shrimp, cephalopods, and fish, from January 2018 to December 2021 (adapted from TFFA, 2022).

In 2021, the EP pattern resembled that of 2018 (pre-COVID) while the price level increased when compared to that of 2020. The 2021 price-pattern differed from that of 2018 with a 3-month shift of the beginning of price increase, which began in June 2021 rather than September (as in 2018) (see Figure 2). A drop in price in December remained constant throughout the four years regardless of the outbreak.

Regarding the seafood import sector, the pandemic impacted annual import quantity (IQ) more than import price (IP) (Figure 3 and 4). Considering Figure 3 it should be noted that 2018 and the first 6 months of 2019 show the pre-Covid IQ patterns, while late 2019 through 2021 show during pandemic patterns. The annual IQ seems to be constant except for a spike from July to November in 2020. This spike is categorized by a rapid increase from July to November and a rapid drop at the end of 2020 and differentiates the 2020 IQ pattern from that of 2018 or 2019. In 2018 and 2019, a quantity drop happened from October, while in 2020, it happened in November (a 2-month shift) (see Figure 3).

As Thailand had been the largest Tuna importer for a number of years, in 2018 and

2019, fresh tuna raw materials for canned tuna and fresh fish imported for Surimi based products drove the price increases seen in these years (ATUNA, 2021). During the pandemic (2020-2021), Thailand imported 1.95 and 1.84 million tons of seafood, of which the biggest proportion was fresh tuna (about 40%), followed by other fresh fish (38%), fresh cephalopods (9%), fish fillet & surimi (8%), and fresh shrimp (1%) (TFFA, 2022, TTIA, 2022).

Regarding the changes in import price (IP) patterns, interestingly, there was an IP swing in the pre-COVID years (2018 - 2019) compared with the during-COVID years (2020-2021) (Figure 4). The average annual IP of 2018 was higher than that of 2019, 2020 and 2021. The reduction in IP happened in the first quarter of 2019 (pre-Covid). After the spread of COVID-19 began at the end of 2019, the aftershock led to a reduction in the sales of frozen seafood products (-11%) and an increase in the sales of canned fish (+14%) and frozen Surimi (+17%) (TFFA, 2022; TTIA, 2022). Even though there were fewer seafood raw material supplies, the price did not increase as farmers and fishermen did not operate at full capacity, as they expected

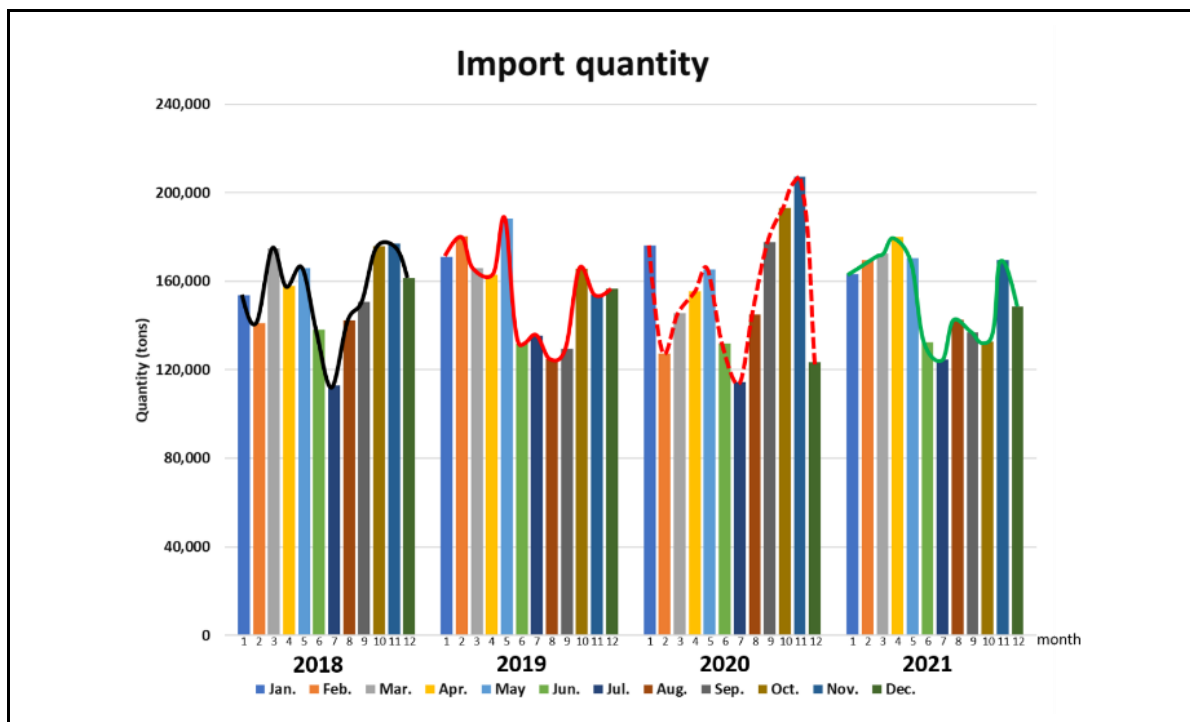


Figure 3: Overall seafood IQ (ton) that Thai Seafood Processors Imported to Thailand Between January 2018 and December 2021 (Adapted from TFFA, 2022).

lower demand due to city shut down and emergency decrees. There were overseas orders, but the retail prices could not increase as there was no buying power from consumers. It is worth noting that, the IP in 2021 increased from September to December when the price should drop according to 2018 and 2019 patterns. It seems that the IP pattern of 2021 resembled a hybrid between 2018 (in the first 6 months) and 2020 (in the last 6 months). It remains to be seen whether the 2021-pattern will remain in the future. These business results and patterns demonstrate the resilience of the ThaiSSC, in the midst of the disruption induced by the pandemic.

2. Changes in the ThaiSSC System Caused by COVID-19 Pandemic Disruption

Normally, connections between actors in a supply chain system are difficult to alter or break abruptly, with any changes happening gradually over several years (Glavee-Geo and Engelseth, 2018). In the seafood industry, relationships among stakeholders in the supply chain are key to the success of the actors (Wang et al., 2018). Over time, the ThaiSSC has faced and overcome many forms

of disruption such as upgrading the traceability system, antibiotic issues, and the EMS disease in farmed shrimp. The COVID-19 pandemic brought abrupt changes throughout the world and the ThaiSSC was no exception. Even though this impacted the overall import-export patterns (in terms of both quantity and price), the Thai seafood industry managed to survive and gradually resumed its normal patterns with a few changes (Figure 1, 2, 3 and 4). This resilience was the product of drastic changes in the structure of the ThaiSSC where actors in the industry were required to adapt their strategies to maintain their positions in the supply chain. There were three types of primary changes: 1) the specific situation for each actor, 2) the influences of each actor on the supply chain and 3) changes in the number of connections in the supply chain.

2.1 Situation Changes Due to COVID-19 Pandemic

1) The primary suppliers: The State of Emergency decree issued on March 26, 2020, stopped fishermen and fish farmers (the primary suppliers) from working. This decree was in effect until Q1 of 2022. The Food and

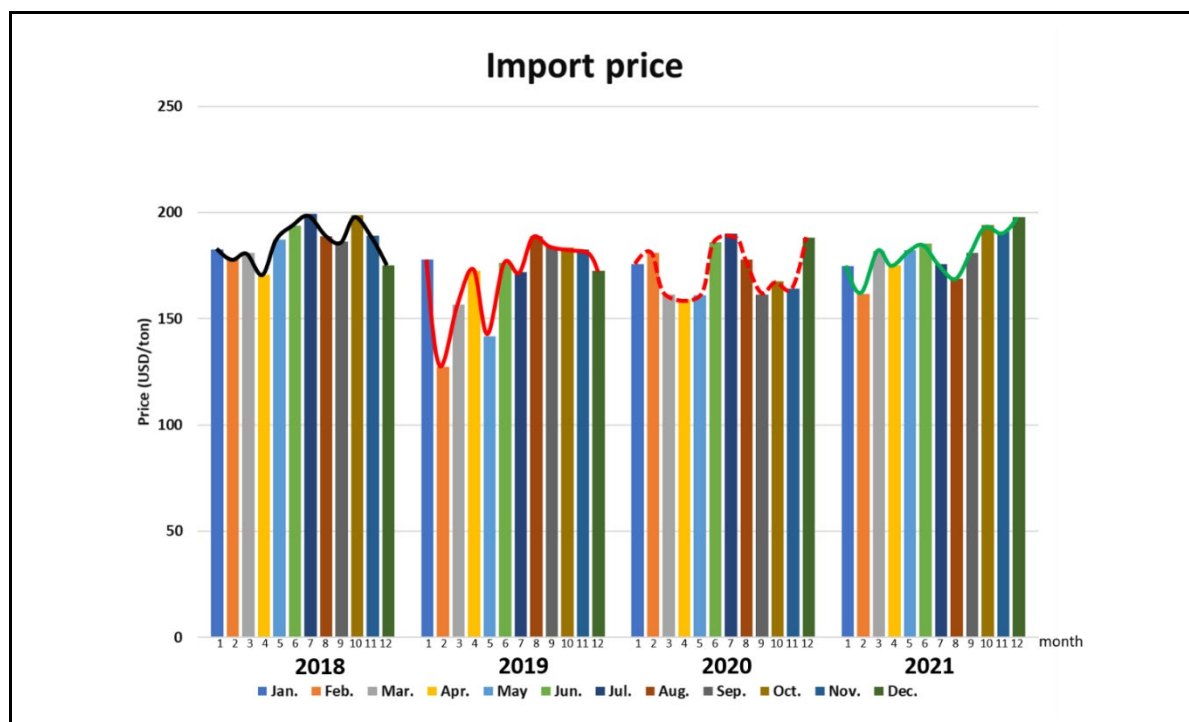


Figure 4: Overall seafood IP (USD per ton) that Thai seafood processors paid between January 2018 and December 2021 (adapted from TFFA, 2022).

Agriculture Organization (FAO) predicted a seafood product shortage in 2021, with an associated price increase (FAO, 2020). However, at the time this research was conducted (Q1 2022), prices had not increased significantly from the previous years. This discrepancy is due to the unstable global economy outlook during the recovery phase after the pandemic, as well as the war between Russia and Ukraine, which also suppressed the aggregate demand for seafood products. If the war drags on, the predicted price increase may happen.

2) Middlemen: Fish markets were in a difficult situation because of market lockdowns (1st lockdown between March 26 – July 1, 2020, and 2nd lockdown in Samutsakorn on December 17, 2020) (Bangprapa, 2020b) and the shortage of raw materials (both in terms of quantity and variety). The fear of contracting COVID-19 caused fewer consumers to visit fish markets, especially the Samutsakorn Fish Market (Thailand's largest fish market). Thus, middlemen could not work.

3) Processors: The seafood processors and the peeling houses were pressured by a drastic reduction of raw materials and unpredictable demands. The seafood processors had big orders in early 2020 caused by the panic from overseas consumers (Hobbs, 2020). Later, on in the pandemic, orders plummeted from April through August 2020 (TFFA, 2022; TTIA, 2022).

4) Local provisional markets and local supermarkets were affected when retail markets were shut down nationally by the Thai government. Top managers of leading supermarkets informed that Thai consumers normally preferred to buy imported fish, but during the pandemic, these items were completely depleted. After the crisis, longer lead times were needed to replenish their stocks because of global supply chain disruption. This led to the “empty shelf” situation that was a taboo for supermarkets and opened a new opportunity for local seafood farmers. Supermarket operators cooperated directly with domestic primary suppliers to sell local seafood products

directly to the consumers (often accompanied by marketing stories about the products). Consequently, the fishermen and fish farmers began developing direct relationships with local retailers as well as major supermarkets and hypermarkets.

5) Overseas supermarkets and seafood importers: Normally, the orders of seafood from abroad dropped after December (except those from the USA and China). When the pandemic hit in late 2019, big retailers stocked seafood products in anticipation of the impacts of COVID-19. Unfortunately, during the first quarter of 2020, consumer demand stagnated rather than increasing as anticipated. Retailers were required to cancel their orders and delay new shipments due to over stocking of products. This caused an overall drop of 8% in annual seafood exportation in 2020 (Hobbs, 2020; Stoll et al., 2020; TFFA, 2022; TTIA, 2022). Meanwhile, sales of canned tuna and surimi-based products increased by 30% and 5% respectively, by the end of the Q1 2020 (TFFA, 2022; TTIA, 2022). The CEO of a major Thai seafood exporter explained this phenomenon stating that the overseas supermarkets anticipated an increase in sales from the “panic buying” of consumers, but this did not last due to “the lockdown”. Under the lockdown, consumers spent less on food services and switched to cheaper protein sources (Kaewnuratchadasorn et al., 2020). Supermarkets adapted to these uncertain situations by making smaller orders to avoid holding too much stock as they did in early 2020 (TFFA, 2022), adopting a just-in-time supply chain model to serve the short-term consumption of their customers (Hobbs, 2020). Moreover, they adopted a “self-inspection” procedure where seafood processors performed quality inspection themselves before shipping the goods (SEFDEC, 2020b). This work process continued until the pandemic was settled globally.

6) Consumers: Seafood was the healthiest protein option and offered the most variety (SEFDEC, 2020b). However, during the pandemic consumers switched to cheaper

protein sources because of economic concerns. With multiple lockdowns and a state of emergency, many food services stopped their operations due to lack of business (Chase, 2020). With low consumer demand and over stocking in the first quarter of 2020, Thai frozen seafood export sales plummeted throughout 2020. However, the sales of more shelf-stable seafood products (e.g., canned tuna and surimi-based products) increased (TFFA, 2022; TTIA, 2022).

2.2 Changes in the Influences of Many Players in the Supply Chain

1) The rise of primary suppliers: Traditionally fishermen and aquaculture farmers have built tight relationships with traders who in turn trade with the brokers. The brokers then traded with seafood processors (for more details on the relationships see Prompatanapak and Lopetcharat, 2020). These relationships had been established since the 1970s; however, in the 2000s, the primary suppliers developed direct relationships with the seafood processors, leading to a decrease in the influence of middlemen (the traders and the brokers). This new relationship was formed through trade associations and was expected to take several years to settle fully (Prompatanapak & Lopetcharat, 2020). However, the pandemic accelerated this process to within a few months of 2020 due to the shutting down of the fish markets during the pandemic.

2) The fall and transformation of the middlemen: Traditionally, the middlemen facilitated the transactions of raw materials trading, acting as quality inspectors for their customers. However, these roles became less important with the establishment of new direct relationships between the primary suppliers and seafood processors from the late 2000s onwards (Prompatanapak & Lopetcharat, 2020). The pandemic accelerated the formation of these direct relationships. In order to survive, the middlemen evolved their roles by upgrading their facilitation roles, focusing on the role of quality inspection and financial facilitation between the primary suppliers and processors.

In addition, they took on the role of logistics provider for both primary suppliers and processors.

3) More resilient and agile processors: Peeling houses and seafood processors constituted the processors in the ThaiSSC. Normally, the peeling houses supplied prepared raw materials to the seafood processors. However, labor welfare issues had weakened and disrupted this relationship since 2006. To circumvent labor and traceability issues, both actors diversified their strategies, with these new processes requiring several years to settle (Prompatanapak & Lopetcharat, 2020). However, the pandemic accelerated the processes, changing many relationships in this section of the ThaiSSC.

Seafood processors became more flexible in respect to consumer demand than before the pandemic, while overseas supermarkets and overseas importers adopted a just-in-time management system since the second quarter of 2020 to mitigate the risk of overstocking. Seafood processors were required to produce smaller retail packs (of about 400-800 g.) rather than the bulk packs they had produced previously (1000+ g.), to consolidate shipments with many types of products, and to adapt to a just-in-time order system from their customers (Hobbs, 2020). The CEO of a world leading tuna processing firm pointed out that being more agile and resilient were keys to business survival.

4) More conservative distributors and importers: Distributors and importers are consumers in the ThaiSSC. Generally, importers act as legal and financial facilitators for the seafood processors who are exporting their products. Interviews revealed that during the pandemic, overseas seafood importers behaved more conservatively as their major retailers switched to only placing orders for short-term demands increasing the uncertainty for importers who needed to speculate on the market. The strategy used by the importers was to maintain good relationships with their major retailers and food services as a long-term business strategy to maintain the business post-pandemic. The

Table 1 Changes in the Roles and Importance of Actors in the Thai Supply Chain Before (pre-COVID) and After (post-COVID) the Pandemic

Actors	Role and Importance	
	Pre-COVID*	Post-COVID
1) Primary suppliers (Fishermen and Aquaculture)	They supplied their outputs to the fish markets and supplied seafood raw materials via fish brokers and traders.	They supplied directly to the seafood processors, local food services, and retailers. They conducted online marketing to directly reach the local household consumers. The primary suppliers slowed production.
2) Middlemen (Fish markets, Fish traders, Fish brokers)	Fish markets ran daily auctions. Fish brokers provided transportation between the primary suppliers, the fish markets, and the seafood processors. Fish traders traded the raw materials in the markets and sourced raw materials as per orders from the seafood processors	They became less important in the supply chain because of the formation of direct relationships between the seafood processors and the primary suppliers. They were needed only in an emergency (e.g., filling up the space in their cargo). Only small and medium size processors needed a middleman.
3) Processors (Peeling house and Seafood processors)	They sourced raw materials from the fish markets, processed seafood and supplied the seafood processors and local food service. They received raw materials from the middlemen and processed the finished products to export to the distributors.	The peeling houses received lower and unstable demands from the local food services and had very little business with the seafood processors. They lost their influence due to new processor-primary supplier relationships. The seafood processors received raw materials directly from the primary suppliers and exported to the overseas importers.
4) Distributors/ Importers	The overseas importers imported products from the seafood processors and delivered them to the retailers.	Their position in the supply chain remained firm but they were required to hold their stocks longer and were faced with smaller orders than in the pre-COVID period.
5) Retailers (Hypermarkets, Provincial markets, Local supermarkets, Overseas supermarkets)	The local hypermarkets, provincial markets, and local supermarkets received seafood products from the middlemen and sold to the consumers. Overseas supermarkets bought products from the importers and tried to order directly from the processors (skipping the distributor).	The local retailers procured products directly from the primary suppliers and processors. Overseas supermarkets stopped ordering directly from the processors and maintained their relationships with distributors to avoid complicated import procedures and stocking.

Table 1 (Continued)

Actors	Role and Importance	
	Pre-COVID*	Post-COVID
6) Consumers (food services, domestic consumers, international consumers)	Consumers bought products from supermarkets, provincial markets, and hypermarkets. They ordered seafood via food services.	Consumers globally changed their habits and paid more attention to food prices, particularly in reference to dining out and the origins of the seafood they consumed. Customers increased online shopping and bought products directly from local primary producers and processors.

roles and functions of the distributors and importers in the ThaiSSC remained significant, while their importance in the corresponding markets was most likely to increase due to economic uncertainty and the greater complexity of export-import procedures post-pandemic.

5) More cautious retailers: Overseas supermarkets and food services have been the main customers in the ThaiSSC during the last two decades. Before the pandemic, retailers tried to establish direct connections with the processors and assumed many of the importers' functions, especially regarding the traceability of products. However, the pandemic put a stop to this direct relationship. The COVID-19 virus can survive and spread through chilled and frozen seafood (e.g., salmon in the case of the 2nd outbreak in Wuhan, China; and shrimp in the case of the 2nd outbreak in Samutsakorn, Thailand) and, consequently, longer quarantine periods and more stringent inspection of all products was established. To avoid these issues, retailers returned to the old model where distributors and importers were responsible for the tedious legal, operational, and storage tasks. Apparently, the pandemic helped distributors to retain their importance.

6) Budget-tight consumers: Traditionally, there were two main types of consumers, food services and household consumers. Due to the lockdown policy, the food service sector suffered from low sales, with a drop of at least a 25% in sales. Some outlets were closed down or reduced their menu items, especially regarding seafood-related items (Stoll et al., 2020). Local food

services switched to local seafood materials (Witteveen, 2020). Overseas and local household consumers (the shoppers) paid more attention to their spending, reducing dine-out spending and preparing more food by themselves to reduce spending and ensure safety. Convenient types of seafood (i.e., canned seafood (especially tuna) and surimi-based products) became more popular than fresh and frozen seafood, leading to an increase in sales of these specific products during the pandemic (TFFA, 2022).

The pandemic greatly disrupted many relationships in the ThaiSSC by changing the situation around the actors in the supply chain and forcing various actors to adapt. Consequently, the roles and functions of the actors were redefined or eliminated. Many changes had been evolving before the pandemic, but the pandemic catalyzed these changes from several years to several months. Table 1 summarizes and compares the roles and importance of major actors in the ThaiSSC before (pre-COVID) and after (post-COVID) the pandemic.

The Rise of Sourcing Agents and Pre-Processors

The presence of the sourcing agents and the pre-processors in the ThaiSSC during the pre-COVID period was not prominent and their functions were covered by other actors. The pandemic created opportunities for these two actors, especially in the domestic market (Figure 5). During the pandemic, there were shortages for local seafood supplies, with sourcing agents and pre-processors assuming

the role of providing seafood raw materials and products to local food services, hypermarkets, and local supermarkets. In addition to the disappearance of many actors in the ThaiSSC, the emergence of sourcing agents and pre-processors caused disruption in the roles and connections among actors, with about 30% of traditional connections in the ThaiSSC disappearing in comparison to those reported in the pre-COVID period (see Prompatanapak and Lopetcharat, 2020).

Sourcing agents: Sourcing agents took on the roles of the traders, markets, and brokers. They supplied seafood in bulk quantities with basic specifications. During the pandemic, seafood cargo was re-routed from other countries because major markets were shut down. Consequently, Thailand imported more seafood; the sourcing agents offered these imported seafoods to local food services and local hyper markets in addition to the seafood processors.

Pre-processors: Pre-processors replaced the middlemen and peeling houses in the

ThaiSSC. They supplied pre-prepared raw materials to domestic niche markets, while small businesses were also willing to pay more for the pre-processors' services due to staff-reduction policies during the pandemic. This role was maintained after the pandemic.

2.3 Disruption in the Number of Connections and Relationship Types Between the Players

In 2020, Prompatanapak and Lopetcharat reported that some parties (e.g., Fish brokers, peeling houses, and Exporters) would have reduced bargaining power or may even disappear from the ThaiSSC (ICFA 2019). The pandemic accelerated these changes in just a few months in the first quarter of 2020 (Figure 5). According to Prompatanapak and Lopetcharat (2020), there was an 18% reduction in the number of relationships in the ThaiSSC network from the pre-COVID to post-COVID period (Figure 5).

Fish markets were greatly impacted due to abrupt changes in business transactions and

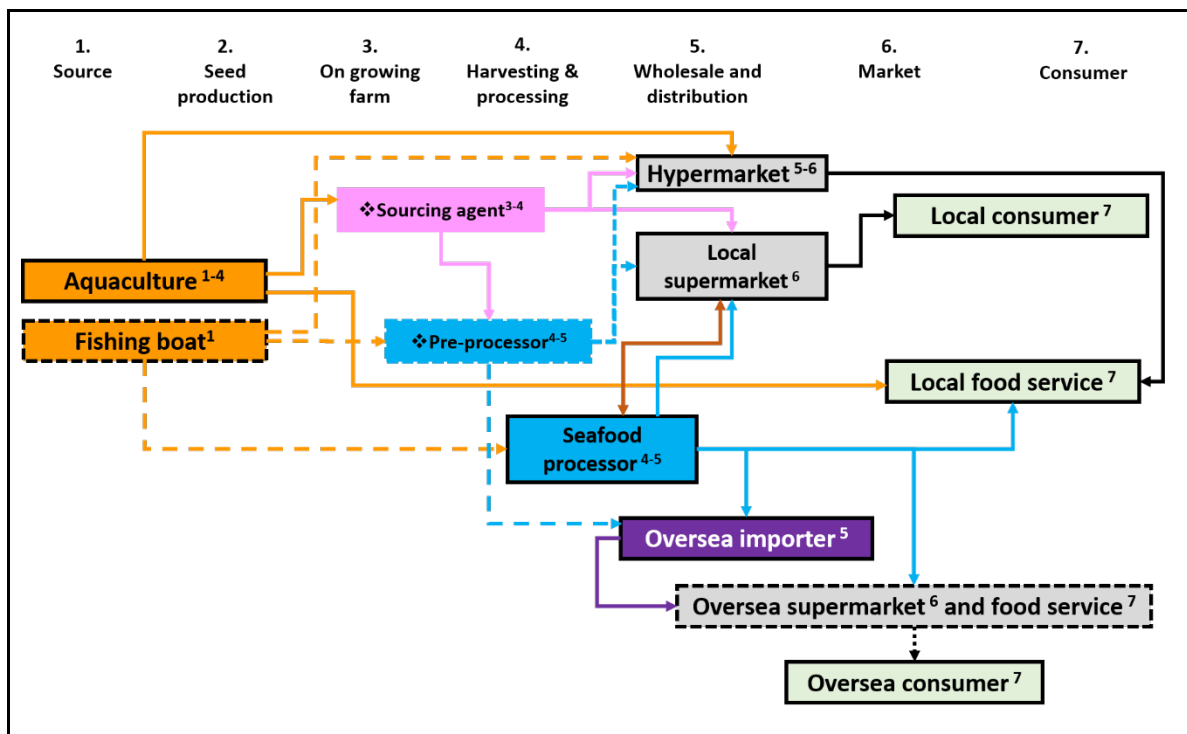


Figure 5: Post-COVID ThaiSSC (adapted from Prompatanapak & Lopetcharat, 2020) aligned with the 7 stages of general seafood supply chains mapped by Fox et al. (2018). The superscripts indicate the stages. Stars indicate new actors in the ThaiSSC which emerged during the pandemic.

the shopping behavior of the seafood processors, local food services, and consumers in the ThaiSSC. The hypermarkets, local supermarkets and processors traded directly with the primary suppliers, enabling product traceability and cutting costs, which ultimately eliminated the middlemen. In addition to being a trade center, the fish markets upgraded their role as quality certifiers, business matchmakers and seafood price index providers, similar to the Sydney Fish Market (Sydney Fish Market, 2020). Eventually, the provincial market would disappear from the ThaiSSC, as primary suppliers began trading directly with hypermarkets, local supermarkets, seafood processors, and even local food services, with the pandemic also accelerating the online shopping habits among consumers.

Regarding exports, overseas importers remained important as they facilitated complicated import procedures for the major overseas retailers. After the pandemic, all accounting transparency would be in the forefront with leaner and better business

processes to maintain customers' trust, especially regarding product quality and services.

Two new actors, pre-processors and sourcing agents emerged after the pandemic. These two actors replaced the middlemen and peeling houses. The differences between the traditional middlemen and the sourcing agents and pre-processors are shown in Table 2.

3. Coping with the Crisis

Three major stakeholders in the ThaiSSC (Thai government, Thai seafood industry and consumers) were forced to change in order to survive the pandemic.

3.1 Government Level

During the pandemic, the Thai government did not directly support the ThaiSSC and enacted only short-term nationwide strategies to cope with specific problems such as the *We travel together program*, and the *50-50 co-payment scheme*

Table 2 Comparison of the Differences Between the Two New Actors (Pre-Processors and Sourcing Agents) and The Fish Brokers

Pre-COVID19 Pandemic the Middlemen (Fish trader, Fish broker, and Fish Market)	Post-COVID 19 Pandemic Pre-processors and Sourcing Agents
<i>Specialized</i> in one or a few species of seafood	<i>Flexible</i> to their consumers' demands
<i>Selling only raw materials</i> (no value added)	The pre-processors <i>added value to the seafood raw materials</i> before delivering them to their customers and <i>created opportunities and ideas</i> for themselves and customers.
<i>Rigid and reactive business model</i> They kept doing the same things and waiting for customers to order.	<i>Flexible and proactive business model</i> They acted as business matchers. They proactively collected and contacted the primary suppliers and offered their products to prospective customers. They were constantly expanding their customer bases to create new business opportunities and ideas for themselves and customers.

(Love et al., 2020). The Thai Ministry of Commerce ordered the shipping lines to fix local charges, disallowed the cancellation of a container's booking, and prohibited unfair surcharge rates (MOC, 2021). However, there were no apparent long-term strategies as seen in other countries, where the governments created direct policies to support their seafood industry. For example, the Malaysian government provided three consecutive stimulus packages to aid aquaculturists: 1) Economic Stimulus Package 2020, 2) The Prihatin Rakyat Economic Stimulus Package (PRIHATIN), and 3) the PRIHATIN PLUS Package (Waiho et al., 2020), while the Canadian government emphasized the necessity for an adequate national food supply during the pandemic (Hobbs, 2020). Only when the 2nd outbreak occurred, did the Thai government begin proactive action by emphasizing quality and sanitary assurance in domestic seafood by leveraging the Thai Department of Fishery (Fishery Shop, 2022).

3.2 Industrial Level

1) Primary seafood suppliers – In response to the pandemic, these businesses chose to focus on the domestic market by building their own brands through direct online shopping (FAO conference, 2020). To achieve success, many suppliers transformed themselves to be seafood processors, selling processed seafood products along with fresh seafood. This was the first time that the primary suppliers connected directly with their consumers. This aligned with the transparency trend whereby consumers are able to know about the origins of the products they are consuming.

2) Seafood processors – After the pandemic, it became essential for processors and other actors in the ThaiSSC to be able to prove both sanitation and cleanliness (Molinari, 2020). Processors were forced to produce smaller pack sizes to absorb hidden burdens (e.g., higher raw material costs, and higher freight cost) while still satisfying their customers' demands. The higher freight cost was due to port closures, port congestion,

increased shipping time, rerouting of ships, port-call cancellations, the short supply of containers in exporting countries, and overcrowding of demurrage containers at ports in importing countries (TNSC, 2022).

3) Local hypermarkets and Local supermarkets: The markets avoided the “empty shelf” situation by trading directly with primary suppliers through special promotional events.

4) Restaurants and Food chains: To cope with decreasing consumer numbers due to the pandemic, these businesses created many different marketing campaigns (e.g., such as set menus, promotions on some fish menus, etc.), expanded services using delivery services and online platforms, and added food retailer functions.

5) Overseas importers: Smaller and short-notice orders from retailers forced overseas importers to adopt a “just-in-time” strategy, stocking only a “just-for-demand” inventory. Results from the interviews indicated that the pandemic damaged the seafood business greatly due to the imbalance of demand-and-supply along the supply chain. The imbalance between demand and supply along the supply chain was expected to last until the pandemic became settled globally.

6) Sourcing agents – Even though sourcing agents had been in the ThaiSSC for many years, the pandemic forced them to evolve beyond their traditional roles and functions. The sourcing agent was a new actor that incorporated the traditional roles and functions of the middlemen especially for large seafood processors such as canned fish processors (Tuna, Mackerel, Sardine, etc.) and extended their reach to hypermarkets as they also supplied seafood in bulk quantities to the hypermarkets.

7) Pre-processors – Pre-processors were another new actor in the ThaiSSC who benefited from the pandemic. They provided smaller quantities and fulfilled orders from local food services, delivering customized seafood products to customers (regarding both product types and product processing

specifications e.g., headed, gutted, portion cut, etc.).

3.3 Customer & Consumer Level

Customers' and consumers' livelihoods and economic stability in the ThaiSSC were impacted greatly by government efforts to curve the pandemic. City shutdowns, curfews, work-from-home (WFH) policies and social distancing all negatively impacted businesses in Thailand. Even though COVID vaccines were invented and distributed, many new behaviors would stay after the pandemic, especially online shopping behavior.

1) The Customers (food services and restaurants): During the pandemic, the customers in the ThaiSSC were required to reduce the number of staff to cut costs and, consequently, demand for pre-processed seafood increased. This change may be permanent as the customers have adjusted their business operations to become sustainable.

During the pandemic, many premium restaurants faced low sales and a long lead time for imported seafood products. Two-star Michelin awarded chefs mentioned that it was necessary to focus on local seafood raw materials instead of imported ones. After the lockdown in March – April 2020, to abide with new social policies and reduce costs, the chefs demanded the suppliers to pre-process seafood materials for them as they wanted to purchase ready-to-prepare seafood raw materials from the pre-processors (a new actor in the ThaiSSC).

Therefore, after the pandemic, the pre-processors had established themselves in the ThaiSSC with customers demanded more pre-processed and ready-to-prepare seafood materials. The customers expanded their business functions to include take-out and home delivery (through on-line ordering platforms). These changes are most likely to be permanent.

2) The Consumers: The pandemic forced consumers (both domestic and overseas) to change their livelihoods, attitudes, and behavior, to cope with the restrictions caused by personal concerns or issued by their

governments. With economic uncertainty, 60.9% of Thai consumers were more frugal than normal and became more cautious regarding their spending on food items than in the pre-COVID period (Bangkok Poll, 2022). Daily COVID-19 reports strongly impacted consumers' decisions. Many chefs from all levels of restaurants in Bangkok informed that their reservations were canceled due to consumers' concerns based on the COVID-19 announcements. This phenomenon will remain until COVID-19 is at least considered an endemic disease.

CONCLUSION AND RECOMMENDATION

The COVID-19 pandemic negatively impacted most actors in the ThaiSSC. Most changes resembled what was predicted in Prompatanapak and Lopetcharat (2020). Food safety turned out to be the most concerning issue globally and caused many governments to enact additional preventative measures that put pressure on the ThaiSSC. Overall, the structure of the ThaiSSC did not change and still followed what was mapped by Prompattanapak and Lopetcharat (2020) and Fox et al. (2018). However, this study identified key characteristics (quick adaptability and readiness to change) that contributed to the resilience of the ThaiSSC. These characteristics were found in sourcing agents and pre-processors who emerged during the pandemic and gained importance in the ThaiSSC. Additionally, the connections in the ThaiSSC were rearranged according to new business demands. In this case, according to Fox et al. (2018), the pandemic put pressure on wholesale and distribution, markets, and consumers, in the ThaiSSC, but also created "new opportunities" for new actors (the sourcing agents and pre-processors) who gained importance and created new connections. Therefore, other existing actors in the ThaiSSC were required to transform themselves in order to survive; this involved amending their current roles and adopting digital transformations.

In terms of practicality, it was

recommended for the Thai government to provide financial support to SME businesses in the ThaiSSC and adjacent sectors. For example, long-term credit financial loans (similar to the programs enacted by the Malaysian government), subsidizing utilities, and controlling feed costs, would have helped the SMEs to survive the crisis. Any policies that could boost local consumption of seafood to reduce dependency on exportation and mitigate overall risk, were recommended. These activities would ensure the survival of the SMEs in the Thai seafood supply chain as such policies had been successful in the US and Canada (Stoll et al., 2020).

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