



**Asia-Pacific  
Economic Cooperation**

**Advancing** Free Trade  
for Asia-Pacific **Prosperity**

## **RESEARCH REPORT: Report on Capacity Building to Improve Economic Reactivation in Sustainable Aquaculture**

Oceans and Fisheries Working Group

January 2023



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AMYPE	Micro and small aquaculture
AREL	Limited resources aquaculture or subsistence aquaculture
BFAR	Bureau of Fisheries and Aquatic Resources from The Philippines
CARES Act	Coronavirus Aid, Relief and Economic Security Act
COVID-19	SARS-CoV2 pandemic
EIDL	US Economic Injury Disaster Loans
EU	European Union
FAO	Food and Agriculture Organization
FONDEPES	Peruvian National Fisheries Development Fund
GDP	Gross Domestic Product
HORECA	Hotels, Restaurants and Catering sector
IFAM	Australian International Freight Assistance Mechanism
ILO	International Labour Organization
IYAFA	International Year of Artisanal Fisheries and Aquaculture
ISSCAAP	International Standard Statistical Classification of Aquatic Animals and Plants
KRW	Korean Won
LPMUKP	Indonesian Maritime and Fisheries Business Capital Management Institute
MARD	Viet Nam's Ministry of Agriculture and Rural Development's
MYR	Malaysian Ringgit
MMAF	Indonesian Ministry of Marine Affairs
NGOs	Non-Governmental Organizations
NTD	New Taiwan Dollar
OECD	Organization for Economic Co-operation and Development
PPE	Personal Protective Equipment
PHP	Philippine peso
R&D	Research and Development
SMEs	Small and Medium-sized Enterprises (SMSEs)
SDGs	Social Development Goals
SANIPES	Peruvian National Fisheries Health Organization
SEAFDEC	SouthEast Asian Fisheries Development Center
SERNAPESCA	Chilean National Fisheries and Aquaculture Service
SSA	Small-Scale Aquaculture
SSAFA	Small-Scale Artisanal Fisheries and Aquaculture
SPPR	Seafood Processors Pandemic Response
SWOT	Strengths, Weaknesses, Opportunities, and Threats
THB	Thai Baht
UNDP	United Nations Development Programme
USAID	The United States Agency for International Development
USDA	US Department of Agriculture
Virginia AREC	Virginia Seafood Agricultural Research and Extension Center
WB	World Bank
WHO	World Health Organization

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## EXECUTIVE SUMMARY

Almost three years have passed since the World Health Organization (WHO) declared COVID-19 a global pandemic, and the aquaculture sector is still experiencing some of its effects. Additional stressors, such as the conflict between Ukraine and the Russian Federation have also affected aquaculture, primarily through impacts on inputs and commodity prices. **Recovery from the pandemic and additional stressors for the sector remains uneven and among the most affected groups is Small-Scale Aquaculture (SSA).**

Small and Medium-sized Enterprises (SMEs) play a major role in most economies. According to the World Trade Organization they represent over 90% of the business population, 60-70% of employment and 55% of the GDP worldwide. Aquaculture is no exception to this, about 70–80% of all the actors involved in fish farming worldwide are considered small-scale. On top of that, SSA contributes to socio-economic development, poverty alleviation and food security. Notwithstanding, SSA enterprises are often vulnerable due to informality, limited or no access to finance and low skill base.

To date, there has been no systematic review of the extent of COVID-19 constraints on the sector and the measures taken by policymakers to mitigate these constraints and ensure its development in the APEC region. Assessing the performance of the sector will assist local, regional and national<sup>1</sup> policymakers by providing a better view of the level of performance (good or bad), the understanding of the main challenges faced by different member economies and thus determining appropriate interventions and assisting in setting priorities and allocating resources (highlighting the positive aspects, preventing or mitigating the negative factors) based on the diversity of actions taken by governments in the region and their impact.

The overall objective of this research report is to assess the impact of the COVID-19 pandemic on the aquaculture sector in the APEC region and the effectiveness of the measures taken by APEC economies, and to develop policy recommendations and improve policy responses to the lingering effects of the pandemic and future similar shocks, **with emphasis on measures for economic recovery and improving the sustainability and resilience of the SSA sector.** This report provides conclusive data on policies, actions, measures, programs and/or experiences implemented by APEC economies that have had an impact on the economic reactivation of small and medium-sized aquaculture companies.

The report includes answers to a digital questionnaire and interviews, used as a tool to identify policies, highlight key difficulties found by APEC economies when dealing with major disruptions caused by COVID-19 and develop recommendations for the economic recovery and enhanced resilience and sustainability of the sector. The report is divided into **four main sections: (1)** the current state of the aquaculture in the APEC region (before and after COVID-19); **(2)** specific impacts of the pandemic on the aquaculture value chain (AVC) of APEC economies; **(3)** actions and recovery measures taken by APEC members; and **(4)** general recommendations and conclusions for the improvement of the economic recovery, sustainability, and resilience in the post-pandemic aquaculture sector. Key findings from each section are included:

**Section 1: State of the aquaculture sector in the APEC region** - This section provides insights into the relevance of aquaculture to the APEC region, trends developed in the last decade, and outlines the size of the COVID-19 shock mainly during the first year of the pandemic (2020) and insights into the ongoing recovery phase for key socio-economic

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<sup>1</sup> Note: The terms “national,” “nation” used in the text are for purposes of this report and do not imply the “political status” of any APEC member economy.

parameters (production performance, employment performance and trade in fish<sup>2</sup> commodities) at the regional and individual member levels.

**Section 2: Major disruptions of COVID-19 in the aquaculture value chain** – Aquaculture was one of the food sectors most directly affected by COVID-19. Here, the disruptions to the different stages of the AVC are classified into labor disruptions, supply chain and production disruptions, market demand and prices disruptions, financial disruptions, impacts on seafood consumption, and amplification of sex and gender inequalities. Details on the aspects of each topic are presented and specific examples for APEC economies (including case studies) are brought into the discussion as a mechanism to highlight the most relevant issues and where mitigation policies need to focus.

**Section 3: Policy mapping of actions and measures taken by APEC member economies to support aquaculture-** Several measures have been taken by governments to ensure social protection, guarantee decent working conditions for fish farmers<sup>3</sup> and to secure the seafood supply chain. The measures were divided into health and safety measures, financial assistance, social protection, supply chain and marketing measures, management and technical measures, digitalization and innovation, and promoting sustainability and resilience. First and foremost, it was important to declare the sector essential. Other measures were taken to ensure the continuity of fish food supply, such as expanding access to local or rural markets, supporting national and local production through consumer awareness campaigns, and promoting e-governance and e-commerce.

**Section 4: Conclusions and policy recommendations** - Based on all the previous sections, gaps and opportunities for improvement were identified. Overall, the general recommendations for an APEC strategy were divided into short- and long-term actions. The main objective of the policy recommendations is to outline the best immediate response to future pandemics or similar challenges and the best measures to mitigate the residual effects of the COVID-19 pandemic and to take advantage of this exceptional opportunity to enhance the resilience and sustainability of the aquaculture sector and small-scale fish farmers.

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<sup>2</sup> We use the term fish commodities to refer to all products obtained from aquatic food systems (including capture fisheries).

<sup>3</sup> We use the term fish farmers to refer to all farmers of aquatic food products.

## INTRODUCTION

Since early 2020, the SARS-CoV-2 (COVID-19) pandemic has spread rapidly around the globe. WHO declared it a global pandemic on 11 March 2020 and called on countries to take urgent and aggressive action to contain the spread of the virus (WHO, 2020). Since then, the disease has killed more than six and a half million people and rendered hundreds of millions ill. To contain the health risks, most countries introduced unprecedented restrictions and lockdown measures, **confronting policymakers with a dilemma**: the imposition of strict closures and social distancing mandates to reduce the risk of infection and, on the apparently opposite side, the adoption of less rigid mitigation measures to minimize economic consequences.

Aquaculture is a major source of food for the global community; it supplies around 56% of the total aquatic animal food production available for human consumption (FAO, 2022a). The aquaculture sector's contribution to the supply of fish for human consumption surpassed that of wild-caught fish for the first time in 2014 (FAO, 2016). Furthermore, capture fisheries resources are mostly overfished, and their production has not increased since the 1990s. Meanwhile, aquaculture is the fastest-growing food production sector in the world with an average annual growth rate of 6.7 % during the period 1990-2020 (FAO, 2022b). Fisheries and aquaculture are a source of income for over 10% of the world's population (OECD, 2020), providing relatively affordable, accessible, high-protein products that contribute to food and nutrition security, especially in low-income countries (Troell et al., 2019). Hence, **aquaculture is both the present and the future to meet the growing global demand for fish and seafood products**, and a low carbon emission product that can contribute to global food sustainability (Galanakis et al., 2021).

Aquatic species are not infected with SARS-CoV-2 or pose a risk of transmission to humans (Bondad-Reantaso et al., 2020; Godoy et al., 2021). However, the pandemic and the responses to it initially caused a major shock to aquaculture practices, and the highly globalized nature of the sector allowed it to spread very fast across all regions of the world (Ahmed & Azra, 2022; Alam et al., 2022; Belton et al., 2021; Jamwal & Phulia, 2021; Love et al., 2021; Mangano et al., 2022; Sarà et al., 2022). A significant number of aquaculture producers had to temporarily cease production or severely reduce their aquaculture practices during the pandemic. Lockdown measures and restrictions on movement and transportation affected the mobility of fish farmers to work, disrupted the aquaculture supply chain, fish demand and prices, and international trade in fish products, with severe impacts on finances, livelihoods, food security, and nutrition (Mangano et al., 2022; Manlosa et al., 2021). Closed borders, travel restrictions, and disruptions in trade flows have affected countries that rely on exports of aquatic products. Lockdowns and "stay at home" orders combined with restrictions on tourism, affected the local demand for aquaculture products. Fish is highly perishable and thus extremely vulnerable to supply chain disruptions, making it one of the agricultural products most affected by COVID-19.

The disproportionate magnitude and persistence of the economic impact of the pandemic forced governments and all aquaculture stakeholders to take immediate and adaptive measures to combat it. However, in order to **make correct decisions regarding aid, it is necessary to diagnose the state of the aquaculture sector in order to carry out interventions and manage solutions to priority problems**. Assessing the impact of COVID-19 on the aquaculture sector requires that governments, academia, associations, companies, farmers, and workers share information on the main impacts of local, national, regional, and international trade on the aquaculture supply chain. To further characterize the impacts of COVID-19 on AVC, qualitative and quantitative assessments are needed.

In this context, **APEC economies, which account for more than 80% of the world's aquaculture production**, have taken various measures to minimize the economic impact and guarantee the economic reactivation of the sector. Nonetheless, a regional assessment of the benefits of these measures has yet to be carried out. Therefore, it is necessary to call upon aquaculture sector officials and policymakers to share the experiences and results of the initiatives, which will benefit the actors involved and will provide a report on the impact of economic reactivation initiatives for SMEs in the APEC region. The benefits of economic reactivation in the region must reach aquaculture producers, to ensure the continuity of their activities through specific policies or programs.

Some reports indicate that government assistance to the small-scale sector (both fisheries and aquaculture) has been less definitive in developing countries, possibly as a consequence of the limited information available on the economic impact of COVID-19 for SSA, and the composition of the sector, with thousands of independent or informal actors as owner-operators, micro-enterprises or small businesses, and a fragile network of markets, mostly without formal financial records or connected to financial institutions (FAO, 2020e).

This is neither the first, nor the last pandemic, consequently, **it is essential not only to guarantee economic recovery but also to establish a resilience approach to address similar concerns in the future**. Collaboration between aquaculture major stakeholders is pivotal, including international and national agencies, corporations, associations, farmers, researchers, donors, and policymakers is essential to establish more resilient and sustainable aquaculture practices against the remaining challenges of COVID-19 and future similar shocks or stressors to the sector. Globally, there is an urgent focus on food security to mitigate the challenges posed by the potential occurrence of future viral pandemics, such as that caused by SARS-CoV-2, and to protect vulnerable critical supply chains. Scientific evidence must always shape effective responses to the impact of such stressors on aquaculture systems.

Therefore, the objective of this report is to develop an integrated analysis of best practices and recommendations to contribute to the implementation of economic reactivation measures for the aquaculture sector in APEC economies with a sustainable approach. To achieve this objective, the report first provides a comprehensive diagnosis of the impact of COVID-19 and related sanitary-risk mitigation measures on the aquaculture sector in the APEC region, and then presents and discusses the implications of immediate and medium-term mitigation measures for the sector with a particular focus on measures affecting SSA. The methodology used to prepare this report is shown below.

## **I.1. Methodology**

Quantitative and qualitative data on the impact of COVID-19 on aquaculture systems and policy mapping for economic recovery were collected from all 21 APEC economies through primary and secondary sources.

### **I.1.1. Primary Source**

Initially, a digital questionnaire with 30 structured questions was designed to collect information from regulators representing seven different APEC economies (Australia; Hong Kong (China), Japan, New Zealand, Peru, Chinese Taipei, and Thailand, from both developed and developing countries). Later, virtual interviews with 8-10 semi-structured questions were conducted with various professionals in the aquaculture sector, including intergovernmental officials, scientists, and government representatives. The interviewees represented the economies of Chile, Mexico, New Zealand, Philippines, Chinese Taipei, and Thailand. The questions were designed using the FAO guideline: "Best practices for developing surveys and questionnaires on the impacts of COVID-19 on fisheries and aquaculture" (FAO, 2020a). The designed questionnaire can be seen in [Annex 1](#). The complete list of respondents for both

instruments is shown in [Annex 2](#) and the complete responses to the interviews questions can be seen in [Annex 3](#). The questionnaire and interview questions covered two main subjects: 1) impacts of COVID-19; 2) mitigation measures implemented to cope with the impacts.

### **I.1.2. Secondary Source**

The above information outlined the search for secondary data. This study included a systematic review approach for the most relevant literature. Reports and literature were reviewed to shape the framework, identify sector disruptions, and map policies. The inclusion criteria were: (1) documents in English; (2) published after January 1, 2020 (when necessary for specific concepts, articles with earlier publication dates were consulted); (3) related to the impact of COVID-19 and/or mitigation policies on the aquaculture sector. Keywords included: fisheries, aquaculture, COVID-19, public policy, and economic impacts. Various keywords were entered according to the research objective, and the operators 'AND' and 'OR' were intentionally used to expand the search. The reviewed literature included:

- Research and review academic papers from the most extensive databases: ScienceDirect, Web of Science, EBSCO, Scopus, Taylor & Francis, Wiley and Google Scholar.
- Reports, databases, and gray literature from the websites of intergovernmental and international organizations such as: FAO, UN, ILO, World Bank, OECD, World Integrated Trade Solution, INFOFISH, GLOBEFISH, WorldFish, SEAFDEC, OFWG, USDA.
- Reports and gray literature from websites of official governmental sources.
- Official press releases and newspaper articles were used only to track specific actions implemented by governments in the APEC region.

Publications with a global or regional (Asia, the Americas and Oceania) perspective on the subject were included, as well as documents containing any information related to one or more of the 21 APEC economies. Specific data from outside the APEC region was, for the most part excluded. Most studies covered the first year of the pandemic, with few reports addressing the impact beyond that time.

### **I.1.3. Quantitative Data**

Quantitative data were obtained primarily from the following international databases: FishStatJ (FAO), OECD Agricultural Statistics, World Bank, and World Integrated Trade Solution (World Bank). Data from these sources only covered the first year of the pandemic (2020); therefore, data for 2021 were obtained from national government agencies and market reporting companies where available. Socio-economic data were extracted over a period of 10 years (2010–2020). Data were grouped as: total aquaculture sector, ISSCAAP division for grouped species (aquatic plants, fishes, crustaceans, mollusks, and other animals), and selected species (tilapia, salmonids). Species representing 90% of the production volume for each country were included. Note: A species' production volume is only recorded by FAO if it is greater than 0.5 T; therefore, production volumes below 0.5 T are recorded as 0.

Data from all 21 APEC economies were combined for comparison with other regions including Africa, the Americas, Europe, Asia, and the world, to determine the trends followed by each one. Additionally, countries were categorized for comparison based on income levels (World Bank classification) and production volumes/values.

## BACKGROUND

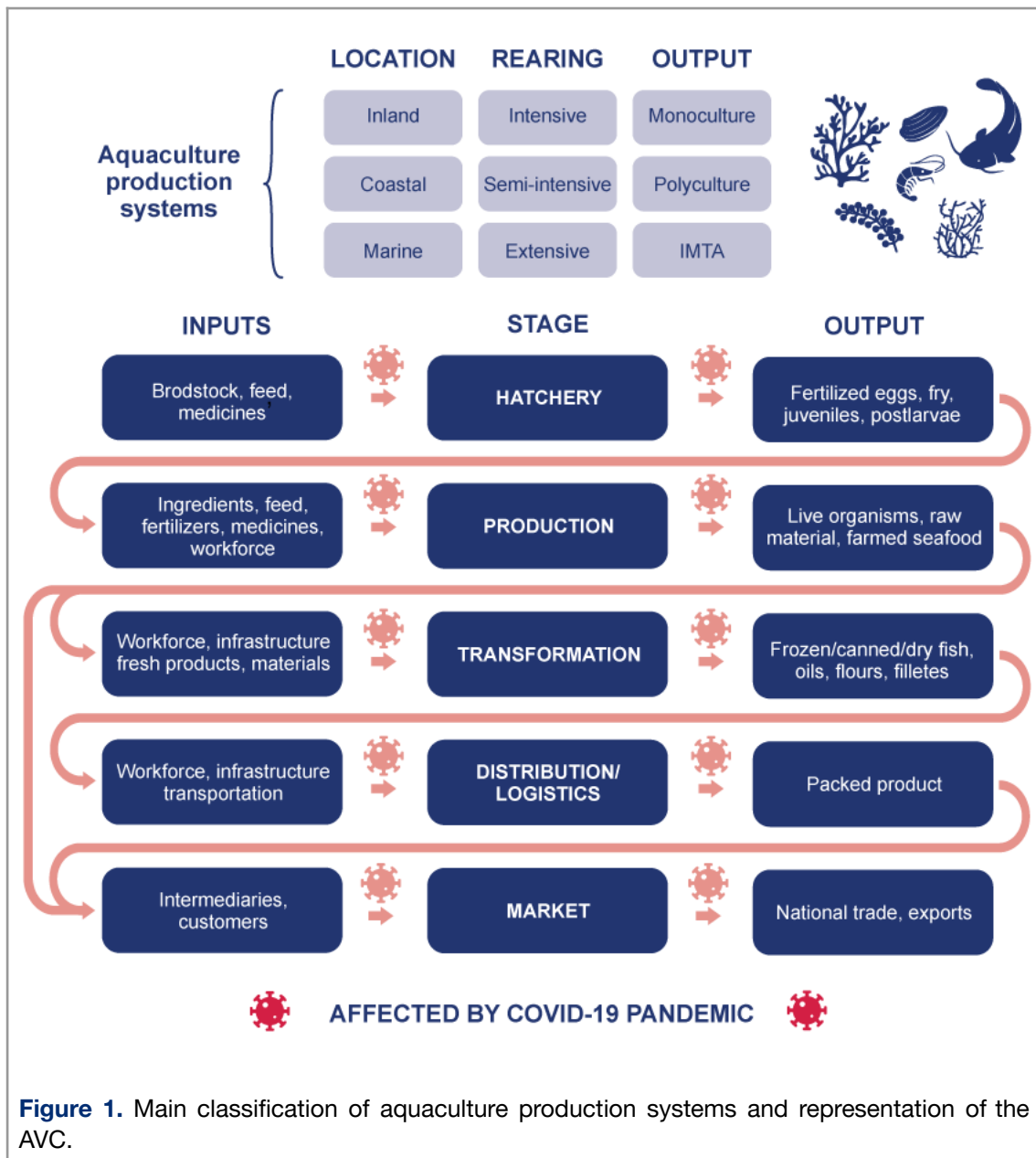
The FAO defines aquaculture as the farming of aquatic organisms including fish, mollusks, crustaceans, crocodiles, alligators, turtles, amphibians and aquatic plants. Farming implies some form of human intervention in the process to enhance production, such as breeding, regular stocking, feeding or protection from predators (FAO, 1988).

Aquaculture systems can be classified as intensive, extensive, or semi-intensive depending on the production techniques employed (Tidwell, 2012) (Figure 1). **Intensive** systems are characterized by high densities in artificial enclosures with high-quality artificial feed, while **extensive** systems have lower densities in natural or artificial enclosures, with no feed input. Finally, **semi-intensive** systems are in-between systems with intermediate densities, the use of fertilizers to enhance natural feed production, complementary artificial feed or the simultaneous farming of more than one species (polyculture). In addition, according to the number of species and the synergy between them, systems can be **monoculture** (1 species), **polyculture** (>1 species) or **integrated multitrophic aquaculture (IMTA)** (Tidwell, 2012), which uses many species from different trophic levels to enhance the production and reduce waste, simulating a food web.

There are numerous and equally valid definitions of **small-scale aquaculture (SSA)**, that vary from region to region. SSA can sometimes be used as a synonym for the earlier concept of “rural aquaculture” and can be defined as the farming of aquatic organisms by small-scale farming households (mostly family-owned, managed and operated) with limited investment in assets and/or systems, where aquaculture is the main source of livelihood, and where the operator has invested significant time and livelihood assets.

The AVC can be divided into five stages: **hatchery, production, transformation, distribution/logistics and market** following the Mangano et al. (2022) classification with modifications (Figure 1). This classification is used in this report to address the impacts of the COVID-19 pandemic. The hatchery involves the production of seeds (early life forms) to be used in the production stage. The output of the production stage can either be transported directly to the consumer (live or chilled) or be transformed by secondary industries into various products, including frozen, dried, smoked, fileted, or canned seafood, along with refined products like flour and oils. The distribution and logistics component includes the activities related to the delivery of the final product to the consumer and includes cold storage facilities for temporary storage. Finally, the market stage is the last link in the chain and includes the trade of the product at national level or international trade networks. The COVID-19 pandemic affected all stages of the aquatic food system, from hatchery to final consumption.









## I. SECTION 1: OVERVIEW OF THE AQUACULTURE SECTOR IN THE APEC REGION BEFORE AND AFTER THE COVID-19 PANDEMIC

### Key messages:

- » The APEC region is the most important aquaculture region in the world, producing more than 81.8% of the total volume and value of aquaculture products.
- » The aquaculture sector in the APEC region experienced the lowest growth rate (1.6 %) in the past decade during the first year of the pandemic (2020).
- » The overall increase was an achievement in the midst of a 3.3 % decline in the global economy in 2020.
- » The People's Republic of China<sup>4</sup> ensured the growth of the aquaculture sector in the APEC region and the world during the first year of the pandemic growing by 3 %.
- » The aquaculture industries of APEC economies were not equally affected by the pandemic.
- » The impact of COVID-19 on the aquaculture sector of the APEC region in 2020 was more severe for the value of farmed products, than for the volume of aquaculture products.
- » The aquaculture sector in Peru; Chile; Singapore; Canada; the United States, and Indonesia were the most affected in the first year of the pandemic, when considering data for both the total volume and value of aquaculture products.
- » The aquaculture sector in Brunei Darussalam; Malaysia; Australia; Russia, and China saw considerable increases in both total volume and value of aquaculture products during 2020.
- » Employment in the region has been relentlessly decreasing in the past decade.
- » Most of the exports of seafood products decreased in APEC economies in 2020, except for Indonesia and Brunei Darussalam.

The following analysis is based on the FAO's database (FishStatJ) on aquaculture production volumes and values and the total trade value of fishery products (exports and imports) for global, continental, regional, and individual production from all 21 APEC economies for the period 2011-2020. Additionally, the OECD Agriculture Statistics database ([https://stats.oecd.org/Index.aspx?DataSetCode=FISH\\_AQUA#](https://stats.oecd.org/Index.aspx?DataSetCode=FISH_AQUA#)) on employment in aquaculture for 17 reporting APEC economies (data not available for Brunei Darussalam; Chinese province of Hong Kong; Papua New Guinea, and Singapore) and World Bank data were used.

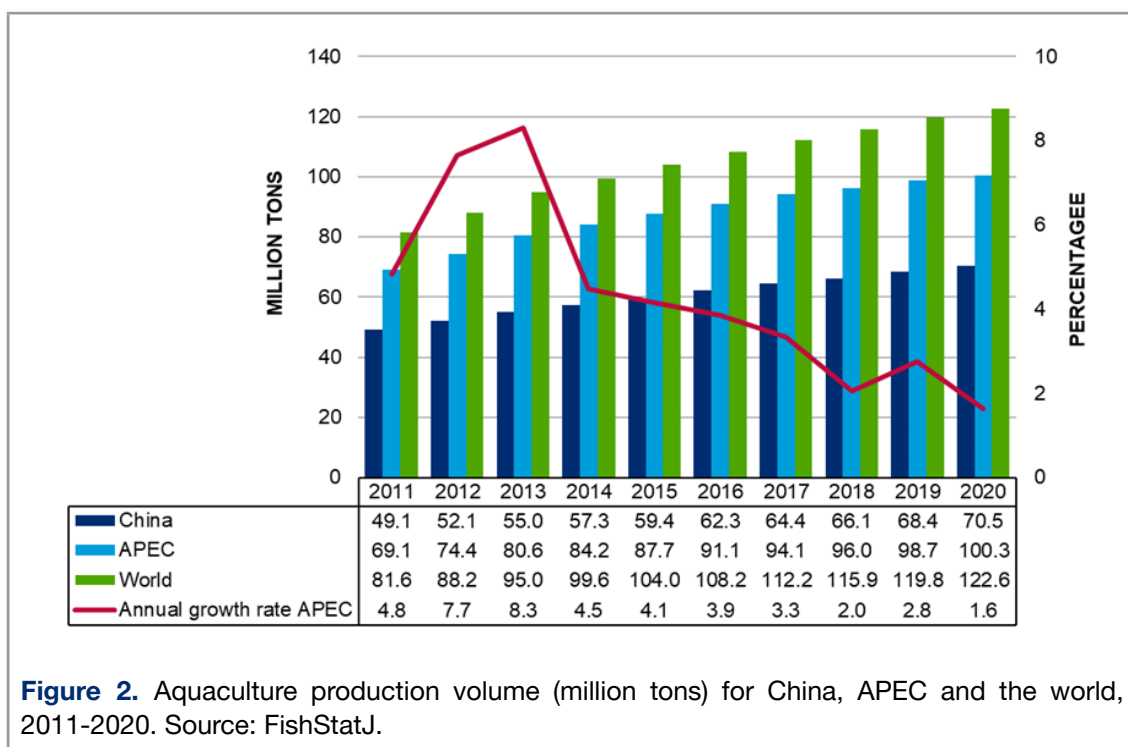
### **I.1. Socio-economic impacts of the COVID-19 pandemic at the regional level**

#### **I.1.1. Productive performance**

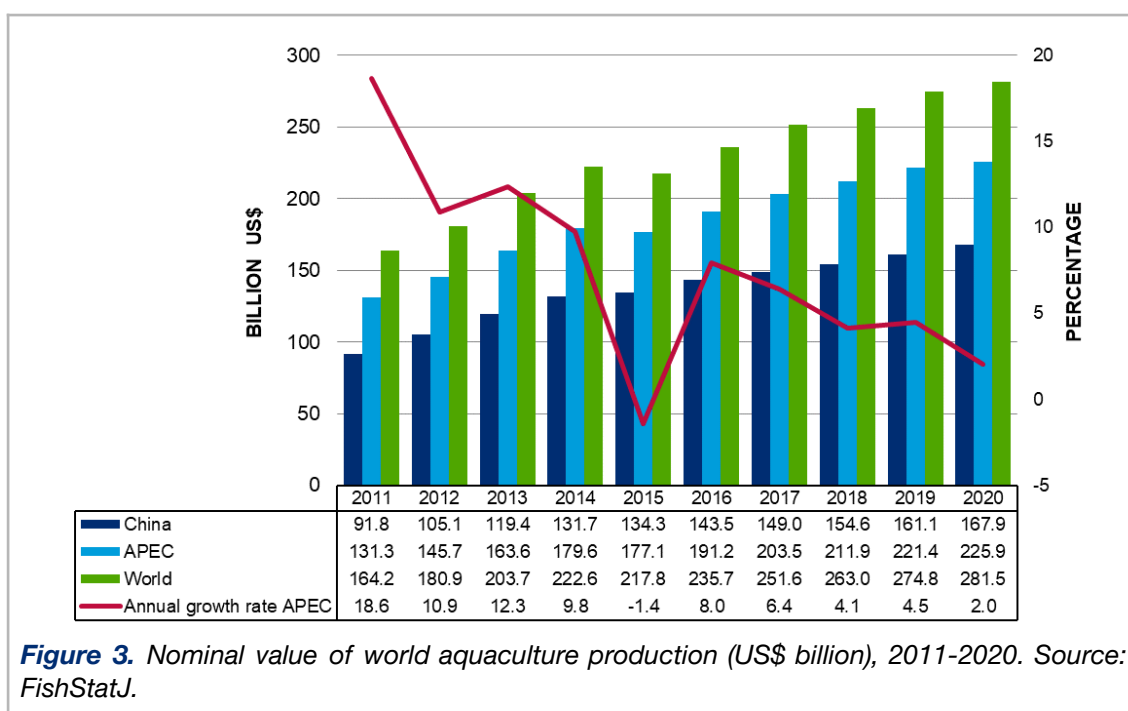
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<sup>4</sup> Hereinafter "China".

**The APEC region is by far the most important aquaculture region in the world.** Of the world's top 10 aquaculture producers, five are located in the APEC region: China (1st), Indonesia (3rd), Vietnam (5th), Chile (8th) and Thailand (10th) (FAO, 2022b). In 2020, the region's total aquaculture production reached 100.3 million tons accounting for 81.8% of the world's aquaculture production volume (122.6 million tons) (Figure 2), and US\$ 225.9 billion, corresponding to 80.3% of the world's aquaculture production value (US\$ 281.5 billion) (Figure 3). In 2020, China's share of the world's total aquaculture production was 57.5% and 59.6% by volume and value, respectively. When isolating the participation of China, the APEC region represents 24.3% and 20.7% of the world's aquaculture volume and value, respectively.

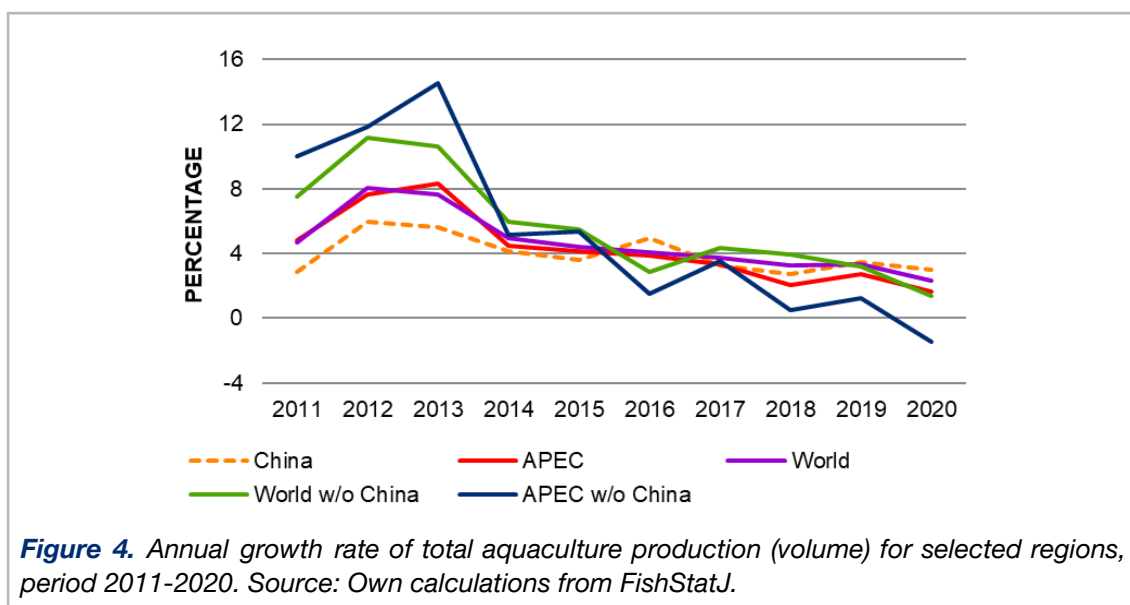


**Figure 2.** Aquaculture production volume (million tons) for China, APEC and the world, 2011-2020. Source: FishStatJ.



**Figure 3.** Nominal value of world aquaculture production (US\$ billion), 2011-2020. Source: FishStatJ.

The total aquaculture production volume of the APEC region grew by 1.6 % in 2020 compared to 2019, the lowest in the past 10 years (Figure 4), and well below the average annual growth rate in the period 2011-2019 (4.6 %) showing the size of the COVID-19 shock in the region (Table 1). Nonetheless, **the overall increase was an achievement amid the 3.3 % decline in the world economy in 2020<sup>5</sup>**, especially since aquaculture was considered to be a hard-hit sector by the pandemic (Cai et al., 2021). China's growth heavily influenced this small increase in the region as data from the APEC region excluding China show an actual decrease in total aquaculture production (-1.5 %). The APEC region excluding China had a lower performance than the world (2.3 %), even after removing China's contribution (1.4 %).



**Table 1.** Average annual growth rate of total aquaculture production (volume and value) for selected regions in 2011-2020 and 2019-2020.

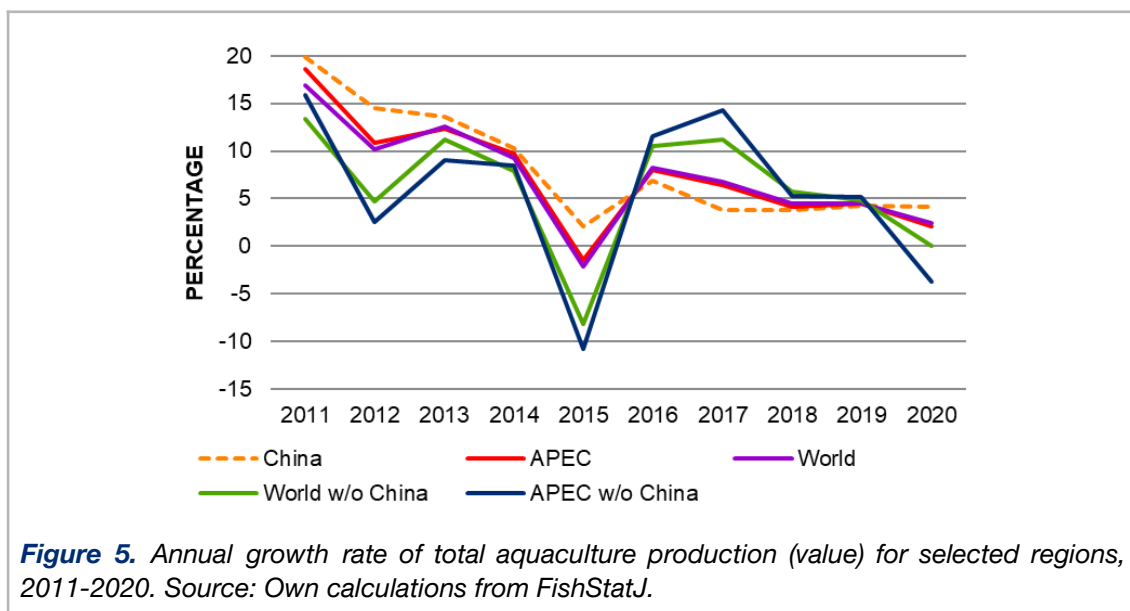
	TOTAL VOLUME		TOTAL VALUE	
	Average (%) 2011-2019	Growth rate (%) 2019-2020	Average (%) 2011-2019	Growth rate (%) 2019-2020
China	4.1	3.0	8.8	4.2
APEC	4.6	1.6	8.1	2.0
APEC w/o China	6.0	-1.5	6.8	-3.8
World	4.9	2.3	7.9	2.5
World w/o China	6.1	1.4	6.8	0.0

Source: Own calculations from FishStatJ.

The total value of aquaculture production in the APEC region registered a 2 % increase in 2020 compared to 2019, **the second lowest growth of the decade, behind only the decline in 2015 (-1.4 %)** (Figure 5). The decline registered in 2015 was related to a mix of global effects that affected both the fisheries and aquaculture sectors, including the economic crisis and uneven economic recovery in developing countries (Russia and Brazil), rising geopolitical tensions, weak global investment growth, maturing global supply chains, the effect of an

<sup>5</sup> Measured by the World Bank as GDP growth (annual %). Accessed: 18 January 2023. Available in: <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>

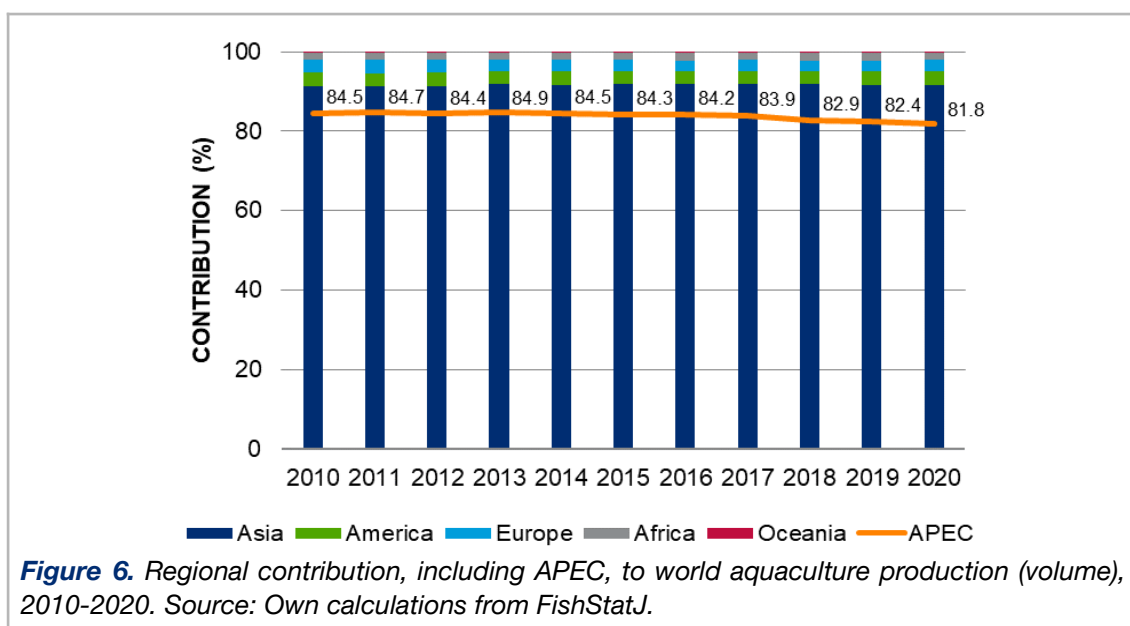
appreciating dollar, strong exchange rate fluctuations and slowing momentum in trade liberalization (FAO, 2016). The performance of the total aquaculture value in the region and the world in 2020 was better compared to the situation in 2015, if we consider that in 2020, the global economy contracted by 3.3 %, while in 2015 the global economy expanded by 3.1 %, while the aquaculture sector dropped heavily.



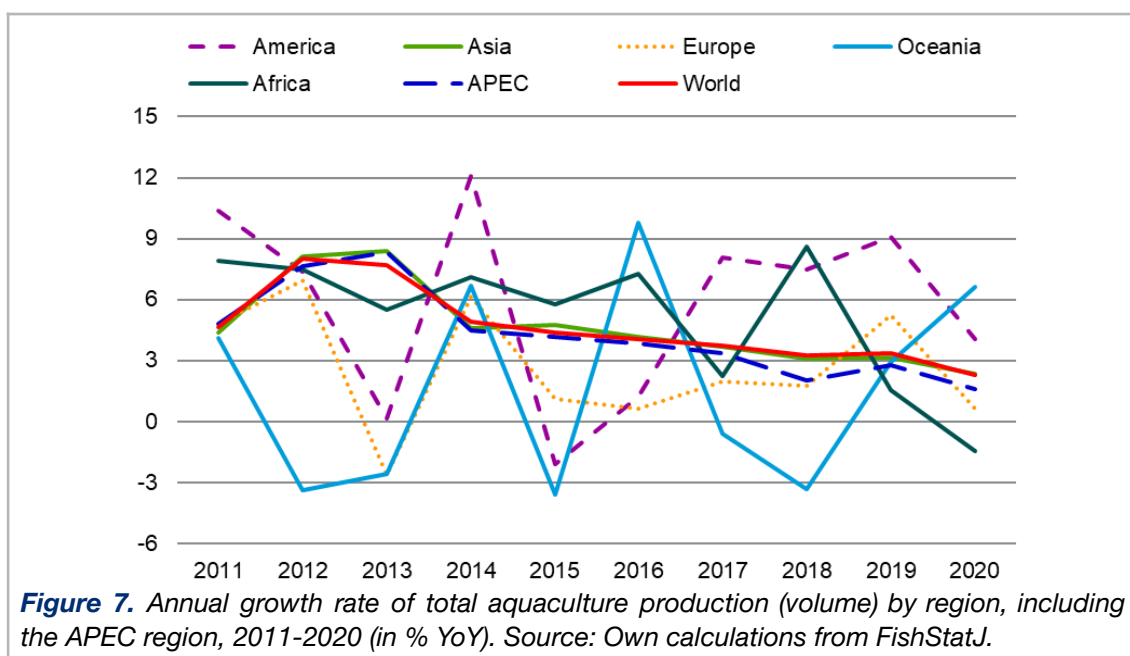
The growth in 2020 was driven by China's increase of 4.2 %. The total aquaculture production value of the APEC region excluding China actually decreased by 3.8 %, more in line with the performance of the world economy, but contrasts with the 2.5 % growth of total world aquaculture production and is even less than the non-variation seen when China's contribution is isolated from the world production ([Table 1](#)). Due to the large imbalance in aquaculture production among APEC economies, regional patterns may not adequately capture national level variations, which are covered in detail in the following subsection ([Section 1.2.](#)).

Data for 2021-2022 are not currently available in FishStatJ, and have therefore not been included in this analysis. Nonetheless, in 2022, world aquaculture production's growth is expected to rise by 2.9 %, albeit below the previous long-term trend of 4-5 %, mainly due to continued caution on stocking rates and input costs (FAO, 2022c).

**The contribution of the APEC region to global aquaculture production (volume) registered a constant slight decline over the last decade** from 84.5% in 2010 to 81.8% in 2020, while Asia's contribution has remained unchanged from 91.4 in 2010 to 91.6% in 2020 ([Figure 6](#)). In 2020, the share value from each region in global aquaculture volume production was: Asia (91.6%), APEC (81.8%), America (3.6%), Europe (2.7%), Africa (1.9%), and Oceania (0.2%). When the global aquaculture production value (in 2020) is analyzed, Asia decreases to 85.6%, APEC to 80.3%, America increases to 6.3%, Europe to 5.4%, and Africa's contribution remains at 1.9%, and Oceania at 0.7%.



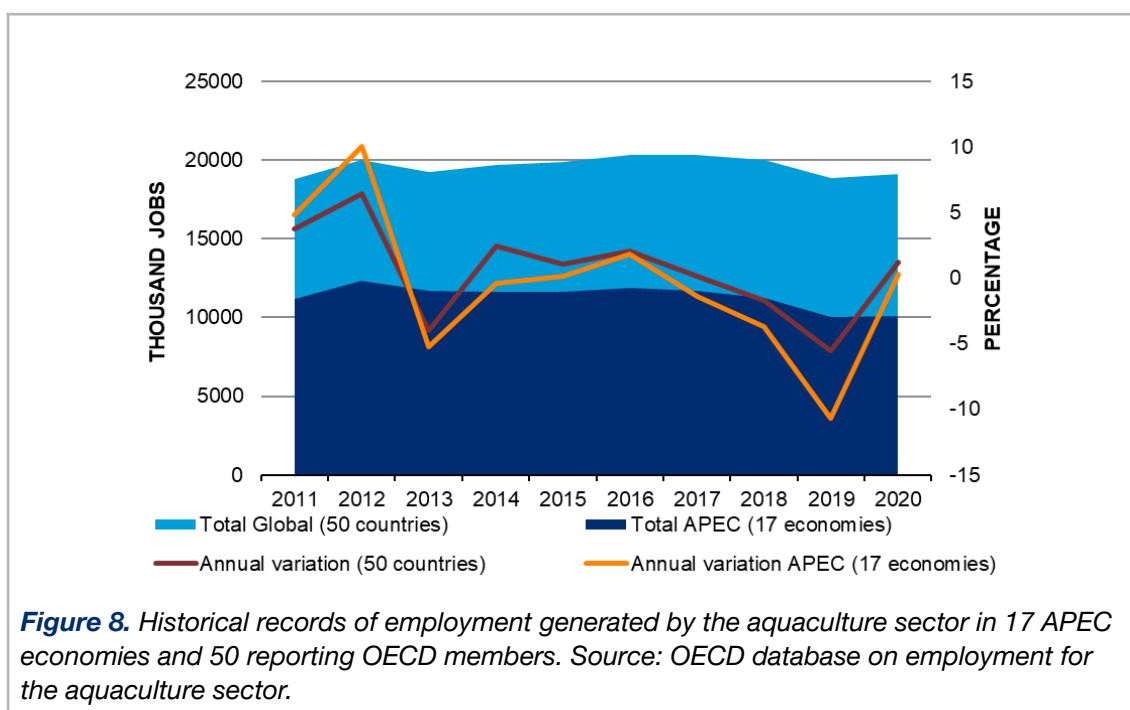
APEC and Asia's enormous contribution to world aquaculture forces the trend of the three regions through the same path each year, **showing a steady decline in the average growth rate of total aquaculture production (volume) before the pandemic (since 2013)** (Figure 7), which can be explained by the maturation of the aquaculture sector in the APEC region and the subsequent lower growth rates, particularly in China. On the other hand, America, Oceania, Europe and Africa show very different values, with no clear trend during 2011-2020. In 2020, the only continent that registered an actual decrease in aquaculture production (volume) was Africa with -1.4%; the other regions achieved growth in the same year, although a significant decrease in growth rates is observed. Contrarily, Oceania showed an increase of 6.6% over the same period, which was higher than the previous results for 2018 and 2019.



### 1.1.2. Employment performance

Total employment in the aquaculture sector has decreased slightly in recent years (2016-2019) in the region (Figure 8). This decrease has previously been associated with the stabilization of

growth in the sector (FAO, 2016). Lower employment generation has been reported in farms that have received interventions aiming to increase fish productivity (Nasr-Allah et al., 2020). This suggests that the intensification of production and maturation of the sector at the national level may explain the decrease in employment in the sector while production volumes have increased. Notwithstanding, employment data should be interpreted with caution, as specific employment data for the aquaculture sector are difficult to obtain for several reasons: (1) aquaculture data from all stages are often combined with capture fisheries, (2) informality characterizes SSA production in many developing countries and (3) no recent data on indirect employment generated by aquaculture-related activities are currently available (ILO, 2021). Additionally, official figures are not available for all countries in the OECD's database, and some data are based on estimates. Governments should make the effort to keep these databases accurately updated, as they can provide extremely valuable information for analyzing the impact of various crises, policies and other factors.

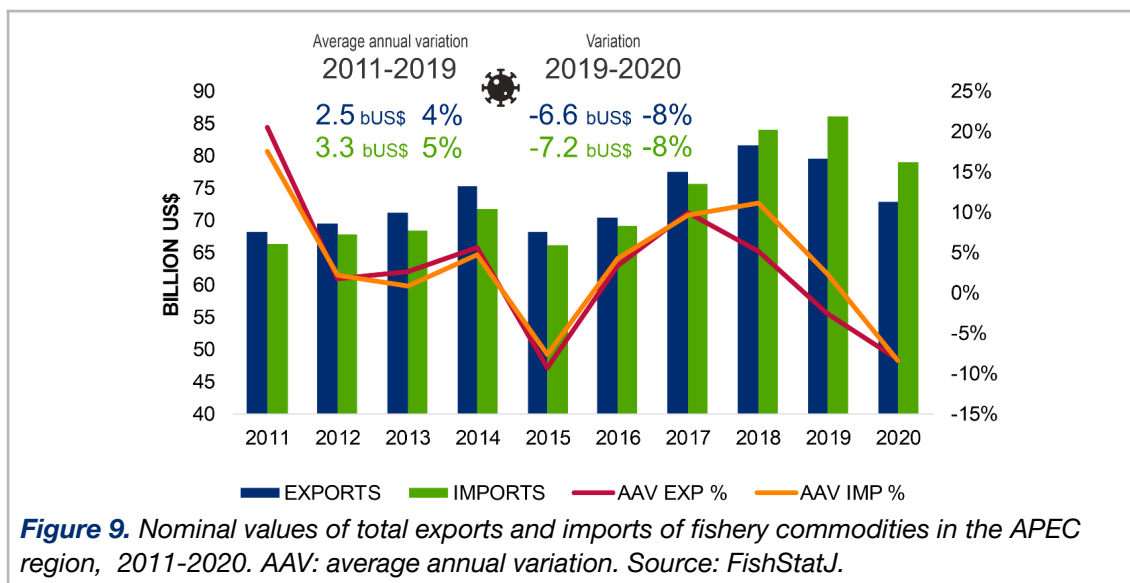


During the past decade (2011-2020), APEC economies (excluding unavailable data for Brunei Darussalam, the Chinese province of Hong Kong, Singapore, and Papua New Guinea) have generated an average of 11.3 million jobs per year, with an average annual variation of -0.4 %. In 2020, employment in the aquaculture sector in the APEC region accounted for 10,073, 772 jobs, 0.3 % more than in 2019, but -4.4 % less than in 2018, explained by the sharp decline (-10.7 %) experienced in 2019.

### ***1.1.3. Trade of fisheries commodities***

Thirty-eight % of aquaculture production is traded globally, making aquatic food the most globally traded major food group (Stoll et al., 2021). During the 2011-2020 period, the total value of fish commodity exports in the APEC region, the world's largest exporter of fish products, followed a mixed trend, but the region showed an average annual increase of US\$ 2.5 billion, or 4 % annual variation (Figure 9). Meanwhile, the total imports of fish commodities show similar values, with an average increase of US\$ 33 billion, or 5 % annual growth. In 2015, both exports and imports experienced a disproportionate decline, reaching -9% and -8% respectively, due to a decline in prices caused by several factors, such as geopolitical conflicts, dollar appreciation and strong exchange rate fluctuations, as explained above. During the first year of the pandemic, the region experienced a decrease comparable to the performance in

2015, with exports and imports decreasing by -8%. Noteworthy, this decrease followed a previous downward trend that began in 2017 and may have been exacerbated by the pandemic.



**Global seafood demand rebounded strongly in 2021**, adding US\$ 13 billion of trade in 2021, driven by growing demand for high-value seafood in the US, EU, and China, as seen in demand for shrimp, salmonids, and crabs in the US (Sharma & Nikolik, 2022). Worldwide exports of shrimp and salmon have increased in 2021, with annual growth in trade of 17% and 20% respectively. The high demand for healthy and premium species is expected to continue driving trade volumes of high-value seafood in the coming years. Unprecedented high prices for many seafood species are reported worldwide caused by challenges in international trade including rising freight and energy costs due to war and continued lockdowns in China, though studies have suggested that the impact on seafood demand may become material, only if a recessionary environment develops in the second half of 2022 or 2023 (Sharma & Nikolik, 2022). Additional data from 2021 and 2022, including national production and trade statistics will shed further light on the recovery process.

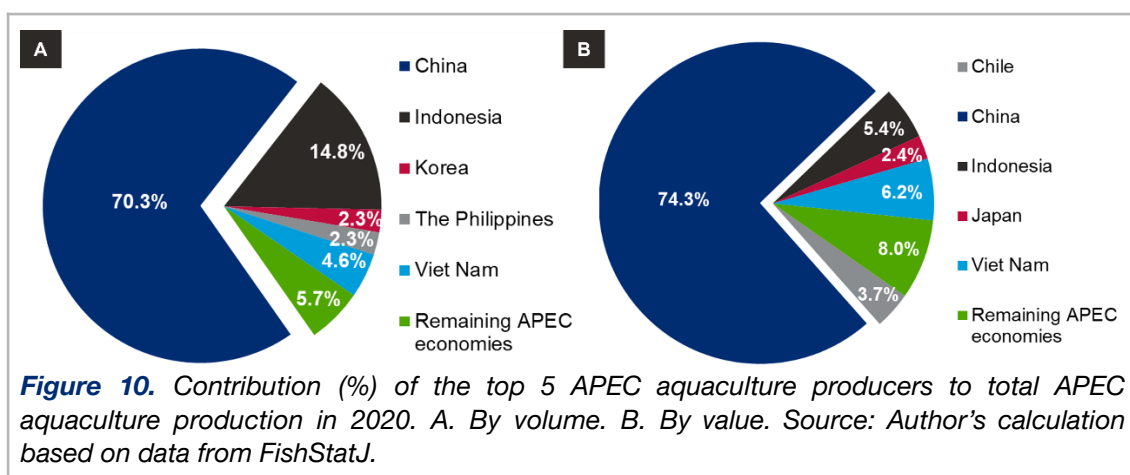
## 1.2. Socio-economic impacts of the COVID-19 pandemic at the individual member states levels

### 1.2.1. Productive performance

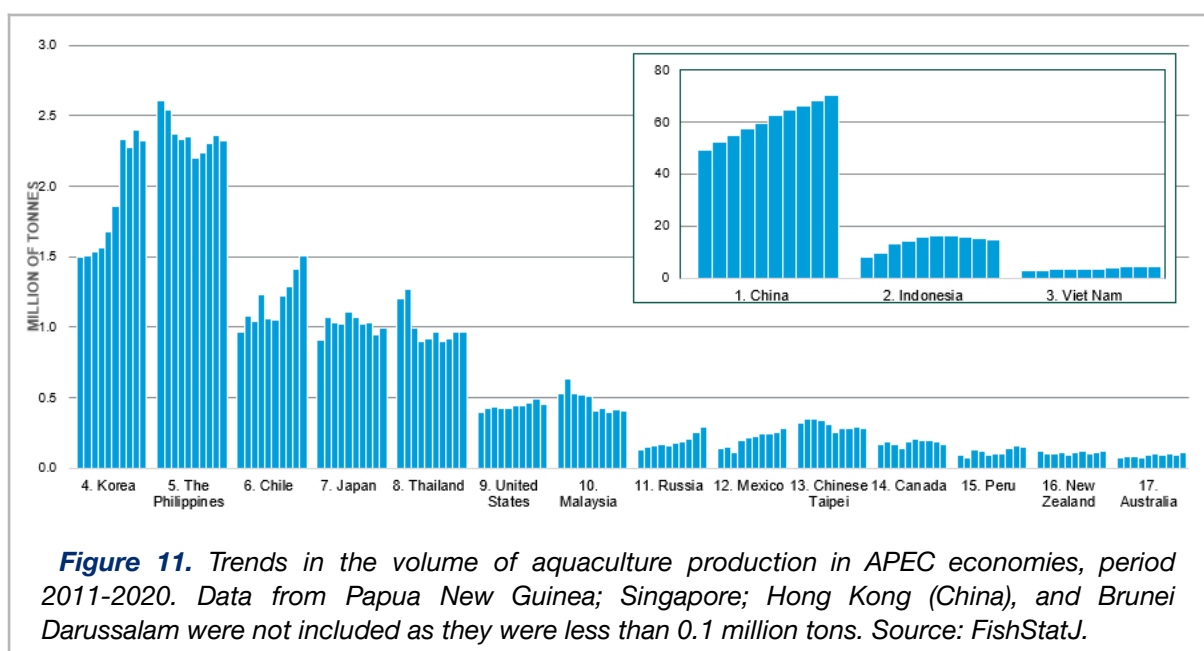
China outweighs the contribution of all other producers in the APEC region combined, accounting 70.3% and 74.3% of the region's total aquaculture production by volume and value, respectively (Figure 10). The following top producing countries in the region in 2020 by volume were Indonesia (14.8%); Viet Nam (4.6%); Republic of Korea<sup>6</sup> (2.3%) and the Philippines (2.3%) (Figure 10A), whereas by value they are Viet Nam (6.2%); Indonesia (5.4%); Chile (3.8%) and Japan (2.4%), while the remaining APEC economies contribution combined are 8% (Figure 10B). The differences in the volume and value in the ranking can be explained by the production of high commercial value species, like in the case of Chile with Atlantic salmon, Pacific salmon and rainbow trout, which increase its combined value.

<sup>6</sup> Hereinafter "Korea."





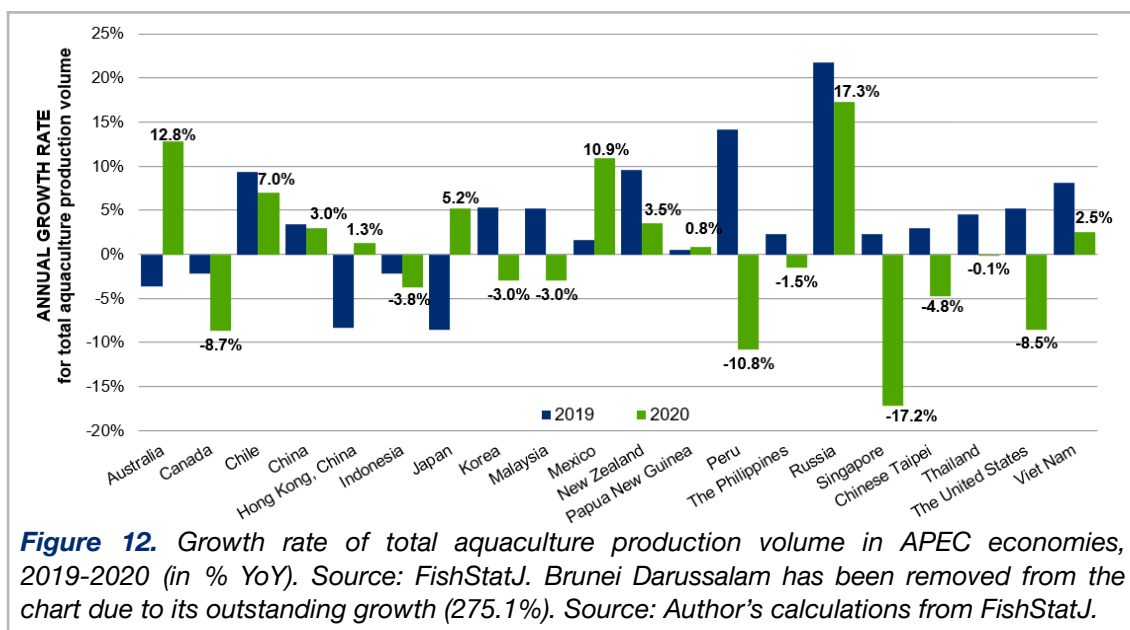
Chile is the sixth larger aquaculture producer (by volume) in the region, followed by Japan; Thailand; the United States; Malaysia; Russia; Mexico; Chinese Taipei; Canada; Peru; New Zealand and Australia (Figure 11). Papua New Guinea; Singapore; Hong Kong, China, and Brunei Darussalam are the last economies in the ranking, all producing less than 0.007 million tons of aquaculture products. The trends for the period 2011-2020 show consistent growth for China; Viet Nam; Korea; Chile; The United States; Russia, and México. Meanwhile, decreasing trends are observed for Indonesia; Thailand; Malaysia and Chinese Taipei. Mixed to minor variations in the past decade are documented for the Philippines; Japan; Canada; Peru; New Zealand and Australia.



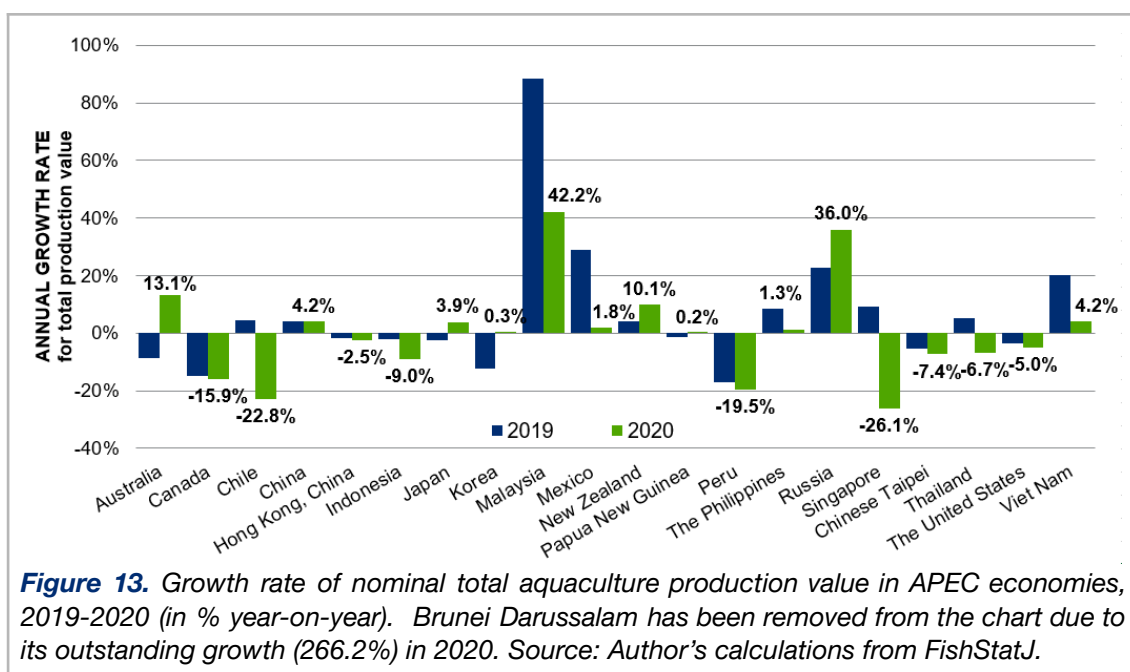
The annual variation in total aquaculture volume in 2020 was negative for nine APEC economies (43% of the region), the most affected being Singapore (-17.2%); Peru (-10.8%); Canada (-8.7%); The United States (-8.5 %); Chinese Taipei (-4.8%); Indonesia (-3.8%) and Korea (-3%) (Figure 12). On the other hand, 12 APEC economies (57% of the region) reported growth over the same period with Brunei Darussalam (275%), Russia (17.3%), Australia (12.8%), Mexico (10.9%), Chile (7%) and Japan (5.2%) having the highest variations. Brunei's astonishing expansion is explained due to increased production of marine farm prawns and is part of the government's drive to diversify the economy, through the expansion and



optimization of existing operator sites, the opening of new aquaculture sites, and the promotion of foreign direct investment<sup>7</sup>.



In 2020, total aquaculture production value decreased in nine APEC economies (43% of the region): Singapore (-26.1%), Chile (-22.8%), Peru (-19.5%), Canada (-15.9%), Indonesia (-9%), Chinese Taipei (-7.4%), Thailand (-6.7%), the United States (-5%) and Hong Kong, China (-2.5%) (Figure 13). The remaining 12 APEC economies (57% of the region) registered growth with Brunei Darussalam (266.2%), Malaysia (42.2%), Russia (36%), Australia (13.1%), New Zealand (10.1%), Viet Nam (4.2%) and China (4.2%) having the highest growth rates.



<sup>7</sup> Borneo Bulletin. 12 November 2021. Accessed: 18 January 2023. Available in: <https://borneobulletin.com.bn/aquaculture-pitched-to-japanese-investors/>

COVID-19's strongest impacts on the aquaculture sector were felt alike in countries of different income classifications, including high-income<sup>8</sup> countries such as Singapore, Canada, Chile, the United States, and Hong Kong (China); upper-middle-income, such as Peru and Thailand; and lower-middle-income countries such as Indonesia. Chile's case is particularly interesting as the value and volume growth rates contrast significantly. Although volume growth in 2020 was close to the average of the last decade 2011-2020 (8.5 %), value growth was on the opposite side of the decade's average (12.1%), suggesting that production could not be rescaled in the country and that lower prices had a critical effect, with the higher production not compensating for the low market price of the products.

The decline in the aquaculture sector (by value) corresponded to the overall performance of their respective economies (measured as annual GDP growth) for four of the most affected economies: Canada, Chile, Peru, and Thailand (Table 2). In 2020, sixteen economies (16/20) registered a decrease in total GDP, while only nine (9/21) registered a decrease in aquaculture production value, showing that the sector performed better than expected, and in some cases completely outperformed, results such as those for Malaysia; New Zealand; Russia; Mexico; Japan and the Philippines.

**Table 2.** Comparison of annual GDP growth (%) and annual growth of aquaculture products (by volume %) in 2015 and 2020 for APEC economies.

Economy	GDP annual growth (%)			Annual growth aquaculture* (%)	
	2015	2020	2021	2015	2020
Australia	2.1	0.0	1.5	-0.8	13.1
Brunei Darussalam	-0.4	1.1	-1.6	24.8	266.2
Canada	0.7	<b>-5.2</b>	4.6	10.3	<b>-15.9</b>
Chile	2.2	<b>-6.0</b>	11.7	-33.4	<b>-22.8</b>
China	7.0	2.2	8.1	2.0	4.2
Hong Kong, China	2.4	<b>-6.5</b>	6.4	-3.7	-2.5
Indonesia	4.9	-2.1	3.7	-17.0	<b>-9.0</b>
Japan	1.6	-4.5	1.6	-3.5	3.9
Korea	2.8	-0.9	4.0	0.2	0.3
Malaysia	5.1	-5.7	3.1	-17.4	42.2
Mexico	3.3	<b>-8.2</b>	4.8	1.0	1.8
New Zealand	3.7	-1.3	4.7	22.2	10.1
Papua New Guinea	6.6	-3.5	1.5	-7.0	0.2
Peru	3.3	<b>-11.0</b>	13.4	-43.4	<b>-19.5</b>
the Philippines	6.4	<b>-9.5</b>	5.7	-3.9	1.3
Russia	-2.0	-2.7	4.8	-6.3	36.0
Singapore	3.0	-4.1	7.6	15.4	<b>-26.1</b>
Chinese Taipei	**	**	**	-10.7	<b>-7.4</b>
Thailand	3.1	<b>-6.2</b>	1.6	-9.2	<b>-6.7</b>
The United States	2.7	-3.4	5.7	3.8	-5.0
Vietnam	7.0	2.9	2.6	12.5	4.2

Source: World Bank and FishStatJ.

The impact of the pandemic will also ultimately depend on management responses and how the sector performs in the recovery phase (2021-2022). Official statistics on the sector for the years 2021 and 2022 will shed further light on this. Data on the performance of the aquaculture sector in 2021 are not currently available in the FishStatJ database and official government reports for APEC economies are still being developed.

<sup>8</sup> Borneo Bulletin. 12 November 2021. Accessed: 18 January 2023. Available in: <https://borneobulletin.com.bn/aquaculture-pitched-to-japanese-investors/>

- Peru registered a minimum variation in aquaculture production (0.3 %)⁹.
- The Philippines saw a decrease of 3.3 %¹⁰.
- Viet Nam reported a 1 % growth in aquaculture products in 2021, achieving 4.80 million metric tons. However, industry contacts estimated production to be lower at 4 million metric tons, considering the challenges caused by lower demand and supply chain disruptions during the lockdowns, as well as rising logistical and freight costs, and higher feed prices.

When APEC government officials from the sector were asked about the performance of the aquaculture in 2021 in their economies, Australia's representative indicated approximately 10% variation, Hong Kong (China) a 4% decrease, New Zealand's representative reported values for three selected three species: Mussels (-10%), Oysters (24%) and Salmon (36%), Chinese Taipei a 1-2% of growth, Thailand a 0.69% growth and Japan a slight reduction. There are clear signs of recovery in the aquaculture sector. However this process has not been even among APEC economies, which has implications for the type of support that each one needs today.

The 2021 annual report published by the Indonesian Ministry of Marine Affairs and Fisheries (MMAF) summarized that the growth of aquaculture production between 2020–2021 was -13.57% for fish, 0.05% for seaweed with a total contraction for all aquaculture products of -5.33%, compared to the previous year or pre pandemic levels. It is clear that during the early pandemic (2020), aquaculture production was significantly reduced across all main aquaculture commodities, excluding shrimp. However, from 2021 to 2022, aquaculture production has fairly increased.

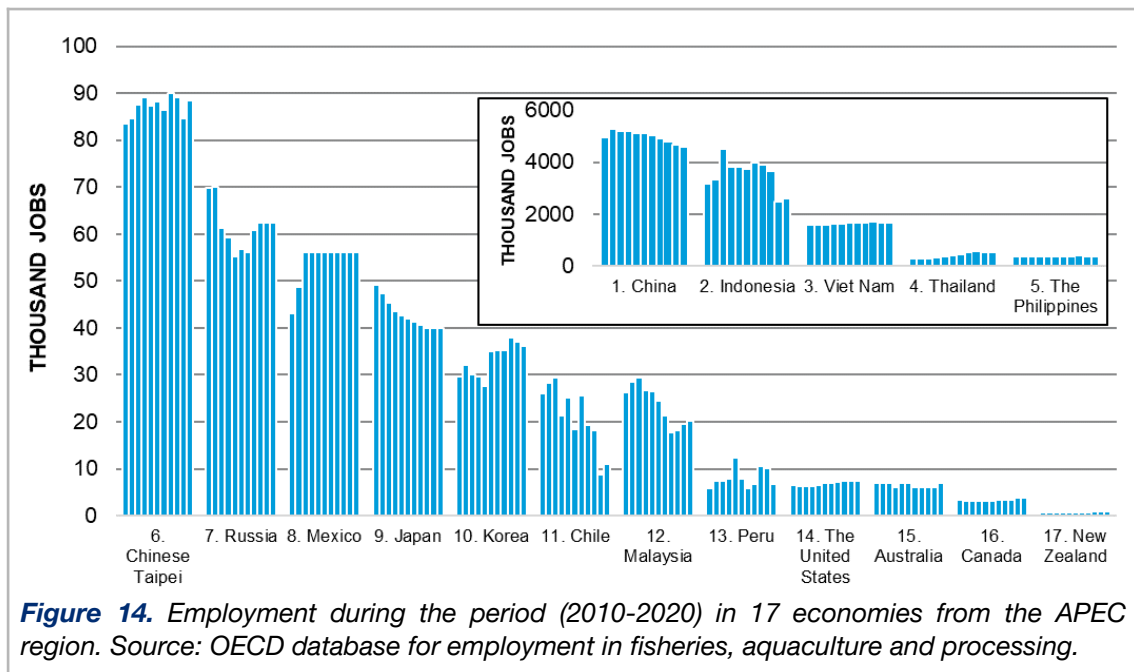
### ***1.2.2. Employment performance***

In general terms, a gradual and continuous decline in the number of jobs related to the aquaculture sector is observed for China; Indonesia; Japan; Chile and Malaysia over the period 2011-2020 (Figure 14). Most countries did not exhibit variation in employment generated by the aquaculture sector in 2019 and 2020, in fact only four countries reported job losses for the aquaculture in 2020: Peru with -33.5 % and the United States, Korea and China with minor reductions (Table 3). In 2020, China; Indonesia; Vietnam; Thailand and the Philippines headed the list as those generating more employment in the aquaculture sector, encompassing nearly 97% of the employment in the region. In addition, Chile; Australia; New Zealand; Chinese Taipei; Indonesia; Malaysia and Canada created new jobs in the sector, with a variation of 25.4%, 16.7%, 7.1%, 4.5%, 4.4% and 3.9%, respectively. A limitation of the OECD database is that a portion of the available data corresponded to estimates instead of official statistics (due to unreported data). The latter is the case for APEC economies such as Vietnam; Thailand; the Philippines; Mexico; Japan and Russia.

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⁹ Official site news of the Peruvian Ministry of Production. Accessed: 18 January 2023. Available in: <https://www.gob.pe/institucion/produce/noticias/593860-produce-la-acuicultura-nacional-se-recupero-en-el-2021>

¹⁰ Philippine Statistics Authority open STAT. Accessed: 18 January 2023. Available in: [https://openstat.psa.gov.ph/PXWeb/pxweb/en/DB/DB\\_\\_2E\\_FS/0092E4GVAP1.px/?rxid=1833d1ef-b062-4d03-b984-05da2a468e1b](https://openstat.psa.gov.ph/PXWeb/pxweb/en/DB/DB__2E_FS/0092E4GVAP1.px/?rxid=1833d1ef-b062-4d03-b984-05da2a468e1b)



**Table 3.** Total employment and variation rates in the aquaculture sector in 17 APEC economies, 2011-2020.

Economy	Total 2019	Total 2020	Average variation (%) 2011-2019	Variation (%) 2018-2019	Variation (%) 2019-2020
Australia	6000	7000	0.0	0.0	16.7
Canada	3785	3934	19.5	8.0	3.9
Chile	8881	11135	-60.8	-51.5	25.4
China	4663678	4575402	-13.5	-1.7	-1.9
Indonesia	2494507	2607530	-22.0	-30.7	4.5
Japan	39928	39928	-15.7	0.0	0.0
Korea	37034	36118	12.7	-2.5	-2.5
Malaysia	19469	20262	-29.2	6.4	4.1
Mexico	56250	56250	15.5	0.0	0.0
New Zealand	840	900	45.2	0.0	7.1
Peru	10162	6755	-8.9	-3.8	-33.5
The Philippines	350000	350000	0.0	0.0	0.0
Russia*	62516	62516	-10.6	0.0	0.0
Chinese Taipei	84669	88366	89.6	-5.0	4.4
Thailand	521372	521372	18.0	0.0	0.0
The United States	7543	7344	4.5	2.8	-2.6
Viet Nam	1678960	1678960	6.5	0.0	0.0

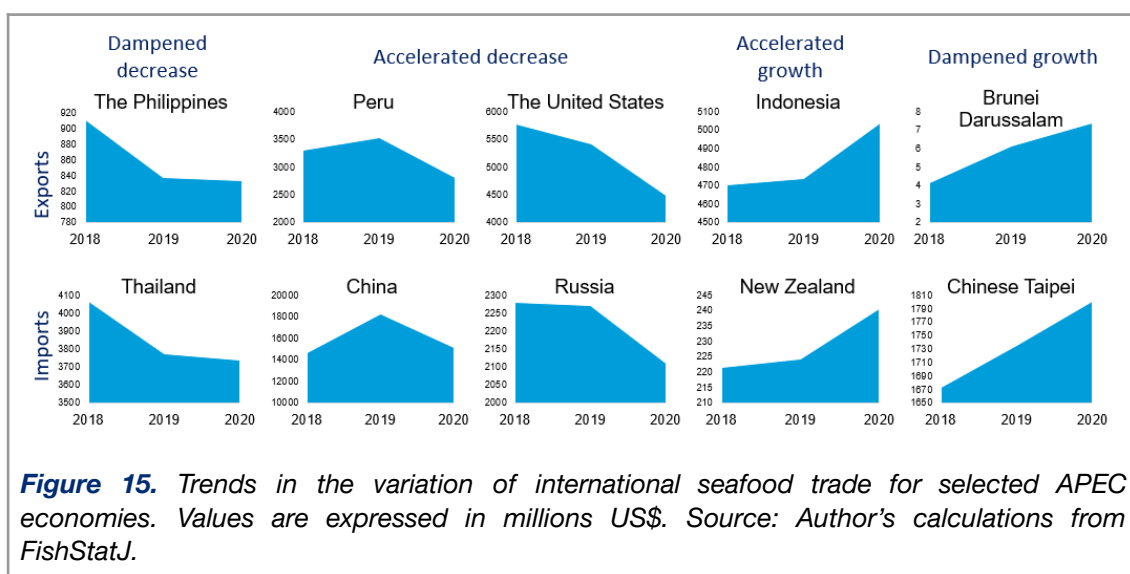
Source: OECD database for employment in fisheries, aquaculture and processing. \*Sector whether fisheries or aquaculture is unspecified.

### 1.2.3. Trade of fisheries commodities

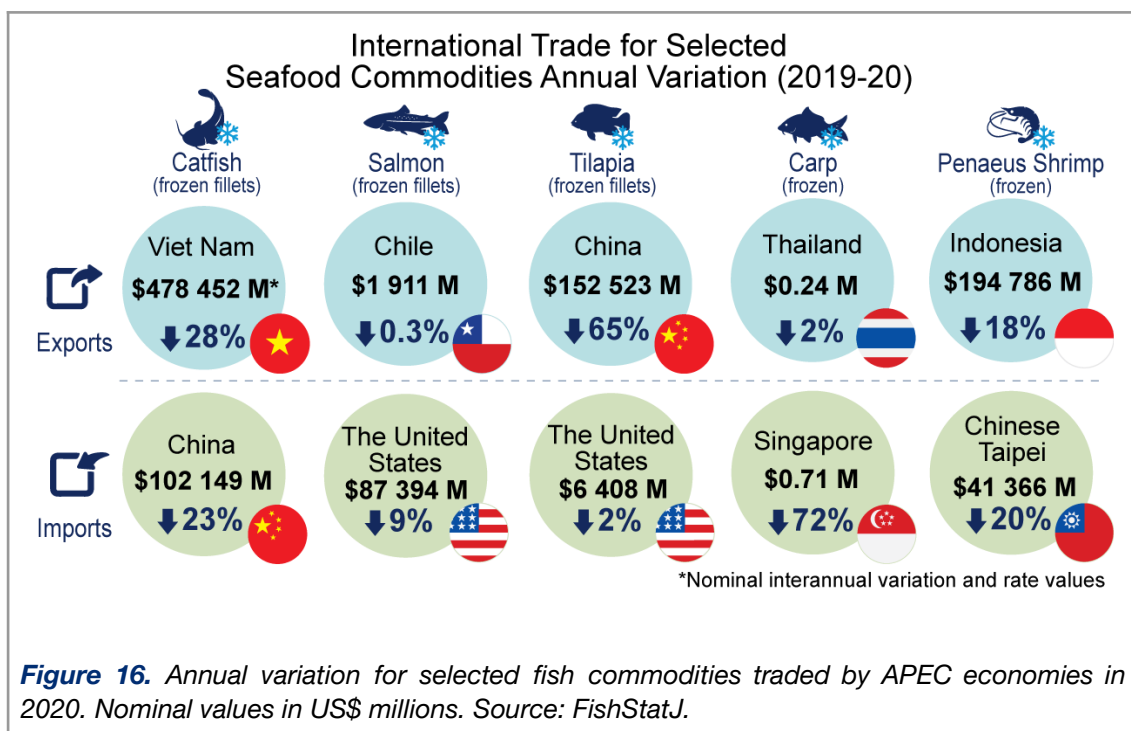
For the analysis of trade of fishery commodities in the first year of COVID-19, the total international trade of seafood products in APEC economies was categorized into four patterns (accelerated growth, dampened growth, accelerated decline and dampened decline) based on the growth rates in 2018-2020, following Cai et al. (2021) categorization. Both imports and

exports of most APEC members declined in 2020. For the total value of fisheries exports, 76% of APEC economies (16/21) showed accelerated decline. Two sub-patterns can be identified in this group, as some members evidenced a growing trend (e.g., Malaysia; Peru; Canada) or declining trend (e.g., Mexico; China; The United States) prior to the 2020 decline (Figure 15). Three APEC economies (14%) showed dampened decline (Viet Nam; Thailand; the Philippines). Only two APEC economies saw an increase in their seafood exports in 2020: Indonesia with an accelerated growth and Brunei Darussalam with a dampened growth.

Similar trends can be seen in the APEC region's seafood imports, with the majority (62%) again following an accelerated decline in 2020 and 10% (2/21) categorized as in dampened decline (Korea and Thailand) (Figure 15). Six economies show an increase in total imports, only one (Chinese Taipei) shows a dampened growth, while the remaining 24% (5/21) show an accelerated growth (Viet Nam; New Zealand; Papua New Guinea; Chile and Peru). Comparing the growth rates for total value of aquaculture production values (See Figure 13) with the performance of fish commodity exports, almost half of the region saw a drop in their production value in 2020, among the most affected members were Singapore; Chile; Peru; Canada and Indonesia. These economies also showed declining rates of seafood exports, with the exception of Indonesia, which showed an increase in exports growing in 2020. However, considering that the latter database is not specific to aquaculture products, this increase in exports in Indonesia was most likely a contribution from capture fisheries rather than aquaculture.



Despite the fact that there are more than 622 aquaculture species worldwide, a relatively small group of species accounts for most of the global seafood trade (FAO, 2022b; Naylor et al., 2021). Salmon and shrimp are the most traded products in terms of value, while carps are the leading group of aquaculture species in terms of volume (Ahmed & Azra, 2022; Naylor et al., 2021). Salmon, catfish and shrimp account for nearly one-third of the international seafood trade in terms of value (Naylor et al., 2021). In 2020, APEC members experienced large fluctuations in the trade of different fish commodities. Frozen catfish filets in Vietnam and frozen tilapia filets in China had large fluctuations in 2020 compared to 2019, while frozen salmon filets in Chile and frozen carp in Thailand had minimal annual fluctuations (Figure 16). Indonesia, the largest shrimp exporter, experienced a decline of 18%. This negative trend for the major exporters was mostly correlated with a varying decrease in imports, which is the case for China; Chinese Taipei, and Singapore, with frozen catfish filets, frozen *Penaeus* shrimp and frozen carp, respectively, showing the greatest annual variation. The main importers of frozen tilapia and salmon filets experienced a more gradual decline, but are comparable in terms of value.





## II. SECTION 2: MAJOR DISRUPTIONS FROM COVID-19 TO THE AQUACULTURE SECTOR IN APEC ECONOMIES

### Key messages:

- » There is a need to develop micro-regional and national studies on the recovery process of the aquaculture sector after the pandemic (2021 and 2022 data).
- » Signs of recovery have been identified and are more evident since 2021.
- » The first major disruption caused by the pandemic was related to labor.
- » Employment in the processing sector was hit the hardest.
- » The most vulnerable groups to the effects of the pandemic in both the primary and secondary aquaculture industries were migrant workers, ethnic minorities, gleaners and vendors, especially women.
- » The transport/logistics and market stages of the AVC were the most affected.
- » The decrease in demand and increase in production costs were among the main effects of the pandemic on aquaculture activities.
- » The impact of the pandemic was uneven across APEC economies and production systems, even within the same country.
- » Aquatic food consumption declined heavily in the early stages of the pandemic.
- » Digital sales and expansion of e-commerce were among the most used tools by fish farmers to access new markets.

### ***Available information on COVID-19 and aquaculture in the APEC region***

This section details the general disturbances observed in AVC worldwide, and highlights the specific challenges faced by the sector in APEC member economies. Key findings from some studies and information from interviews are presented as case studies. Most of the currently available information documents the impacts during the first year of the pandemic and during the lockdown periods in early 2020, while less is known about the adaptation and recovery phases in 2021 and 2022. This highlights the need **for global and regional studies and census on the recovery process of the sector in the post pandemic scenario** with participation of all major aquaculture stakeholders. Although most of the documents listed impacts and responses, data on governments responses are provided in the following section ([Section 3](#)).



### Classification of most disruptions

The pandemic triggered cascade effects, which for the purposes of the present report are grouped into six main areas, although there are complex interrelationships between them, and they have occurred in parallel. Conversely, COVID-19 has also created new opportunities such as expansion of direct sales, local markets, e-commerce and increased demand for non-perishable seafood, including processed seafood, also covered in this document.

#### COVID-19 MAJOR DISRUPTIONS

1. Labor disruptions
2. Supply chain and production disruptions
3. Market demand and price disruptions
4. Financial disruptions
5. Disruptions on seafood consumption
6. Amplification of sex and gender inequality

### Origin and duration of disruptions

Most of the disruptions in the sector were not caused by COVID-19 itself, but instead they were highly dependent on the severity of the restrictions imposed by governments introduced in order to control it (Rendón et al., 2021). Restrictive measures severely disrupted both the primary and secondary sectors, mostly through impact on the transport/logistics and the market stages, and up to the level of paralyzing fish production or severely reducing aquaculture practices, exposing weaknesses and vulnerabilities in the sector (Manlosa et al., 2021). The effects of the pandemic were felt by SSA farmers even in regions where no COVID-19 infections were registered, as seen in surveys applied to fish, crab, and shrimp small-scale farmers (<10 ha, <50 t annual production) in Thailand (Chumchuen et al., 2022).

Effects were more pronounced during the restrictive period in 2020, than 2021 (Belton et al., 2021). WorldFish applied surveys in five major aquaculture producing regions in Africa, Asia, and the Middle East in early 2021, and found signs of recovery after the pandemic. Many individuals stayed in business, while an increase in labor and better access to inputs was perceived. Sales performances were mixed and respondents in some but not all countries had better access to buyers in 2020 than 2021 showing that a complete recovery may take more time (Love et al., 2022). Aquaculture in APEC economies has apparently overcome most of the impact of the pandemic in macroeconomic terms, however in microeconomic terms, some small-scale farmers may still be experiencing difficulties. Situation in Thailand was described during the interviews as follows: *“During 2021 most of the aquaculture was recovered to near pre-pandemic levels, the fish farmers have produced more this year and the regulations were lifted”*, similar opinions were shared by representatives from Chile and Mexico.

### Vulnerable aquaculture systems

SSA was particularly vulnerable to the economic shock caused by COVID-19 due to informality, unpredictable sources of income, lack of access to finances, social protection and government support (FAO, 2021a; Love et al., 2022). Though the perception of this may vary between economies and policymakers. During the questionnaire, representatives from Thailand; Peru and New Zealand indicated that SSA was considered to be relatively more affected by the pandemic. Representatives from Chinese Taipei and Australia felt that the SSA of their economy was not the most affected. This was mainly explained by the fact that, for example, *“small scale aquaculture does not have a significant presence in Australia.”* While Japan and Hong Kong, China, representatives were not sure about this assertion.

Most small-scale fishers and fish farmers in Viet Nam did not have any livelihood strategies to cope with stressors/shocks beyond short-term saving (Rendón et al., 2021), a situation that is likely to be similar in most developing economies. On the other hand, seafood supply chains of larger companies with electronic traceability data had access to real-time information on market shifts and cold storage constraints, allowing for timely business and government interventions. For example, in Indonesia, the eLogbook system and post-harvest data made it possible to understand supply chain bottlenecks, including cold storage shortages, transportation limitations, and processing facility closures (Maruff, 2020). Fisheries and

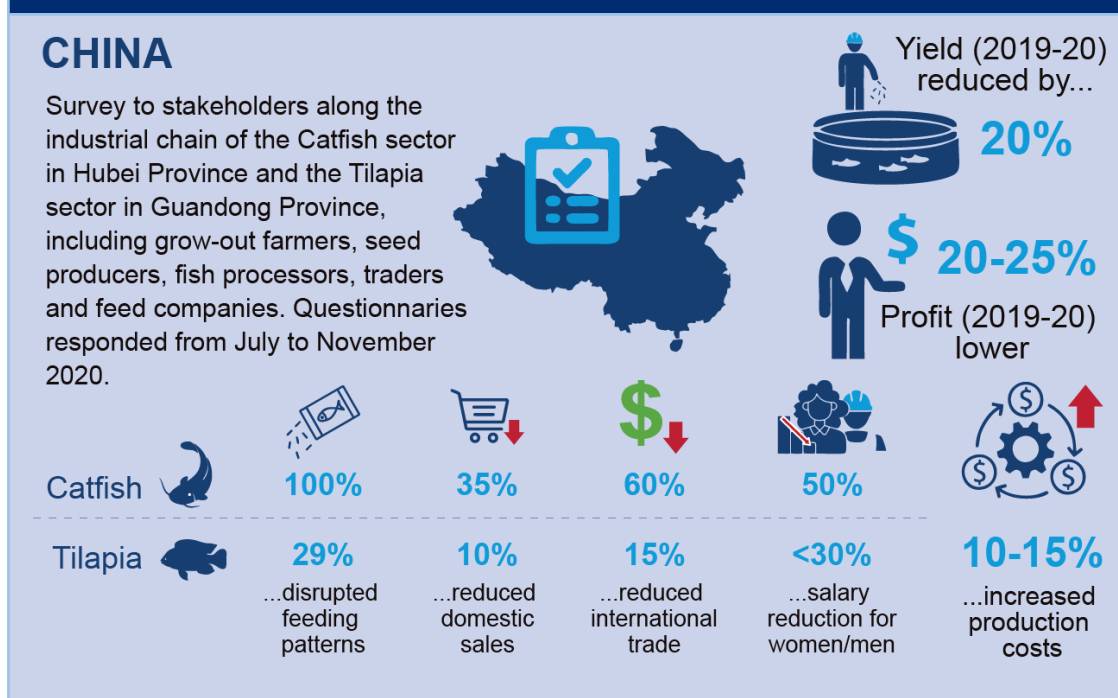


aquaculture producers exporting live or fresh products were more vulnerable, as well as were producers in low- and middle-income countries compared to high-income countries (Love et al., 2022; Maruff, 2020).

The effects were mixed for different production systems, even those located within the same economy. The shrimp sector in Viet Nam weathered the crisis (2020-2021), better than the catfish sector, the two main aquaculture species farmed in the country<sup>11</sup>. In China, the catfish industry was comparatively more affected than the tilapia sector in the first year of the pandemic (Yuan et al., 2022) (See Box1), while shellfish farms saw moderate impact (Zhang et al., 2021). Shellfish aquaculture has characteristics that can explain its resilience to the impact of the pandemic. Ma Junemie Hazel Lebata-Ramos, a scientist from the Aquaculture Department in SEAFDEC shared her insights into the situation of the mollusks industry during the pandemic.

*“Mollusk culture was not much affected during the pandemic, especially the two most important mollusk species produced in the Philippines, the oysters and mussels. These are non-fed species, and the seed stocks are from the wild. Culture begins with the settlement of competent larvae on available clutches and continued until they reached harvestable size, were harvested, and sold. Farmers' hands-on involvement is required only during spawning, harvesting, and marketing. Although marketing was affected due to the lack of transportation, the farmers can leave them untouched in the cultural areas until the condition becomes favorable and the situation is normal. Prolonging the culture doesn't entail additional costs since no feed is needed and it provides the farmer, his family, and his community with a source of food”.*

**Box 1.** The impact of COVID-19 on aquaculture in China and recommended strategies for mitigating the impact (Yuan et al., 2022).



<sup>11</sup> MARD, Vietnam Customs. Accessed: 18 January 2023. Available in: [https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual\\_Hanoi\\_Vietnam\\_VM2022-0026.pdf](https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Grain%20and%20Feed%20Annual_Hanoi_Vietnam_VM2022-0026.pdf)

## II.1. Labor disruptions

### *Labor was the most immediate disruption in the sector*

Mobilizing workers during the pandemic was logistically challenging due to lockdowns, transportation restrictions, physical distancing in the workplace, illnesses, a 14-day quarantine process, and travel barriers for seasonal or migrant workers. Several jobs in the sector were lost in the period, for example Peru saw a 33.5% drop in the number of jobs from the aquaculture sector ([See Section 1.2. Employment performance](#)). Some aquaculture companies in China delayed the resumption of work because employees who had returned to their hometowns to celebrate the Chinese New Year were unable to return to work due to the lockdown (Zhang et al., 2021). Rotating shift systems, quarantines and absenteeism due to illness as seen in the Chilean salmon industry, were among the main causes of reduced available labor in aquaculture farms during this period ([See Box 2](#)).

SSA is labor-intensive, making it more vulnerable to restrictions on the movement of workers and disruptions in the supply of input and transportation. However, this is not a rule of thumb, in Japan, it was observed that corporate businesses in the fisheries and aquaculture sector appeared slightly more vulnerable to the spread of COVID-19 than family-run enterprises, although more vulnerable than small-scale fishing operations (Sugimoto et al., 2022).

#### **Box 2. Impact of COVID-19 on the Chilean salmon industry.**

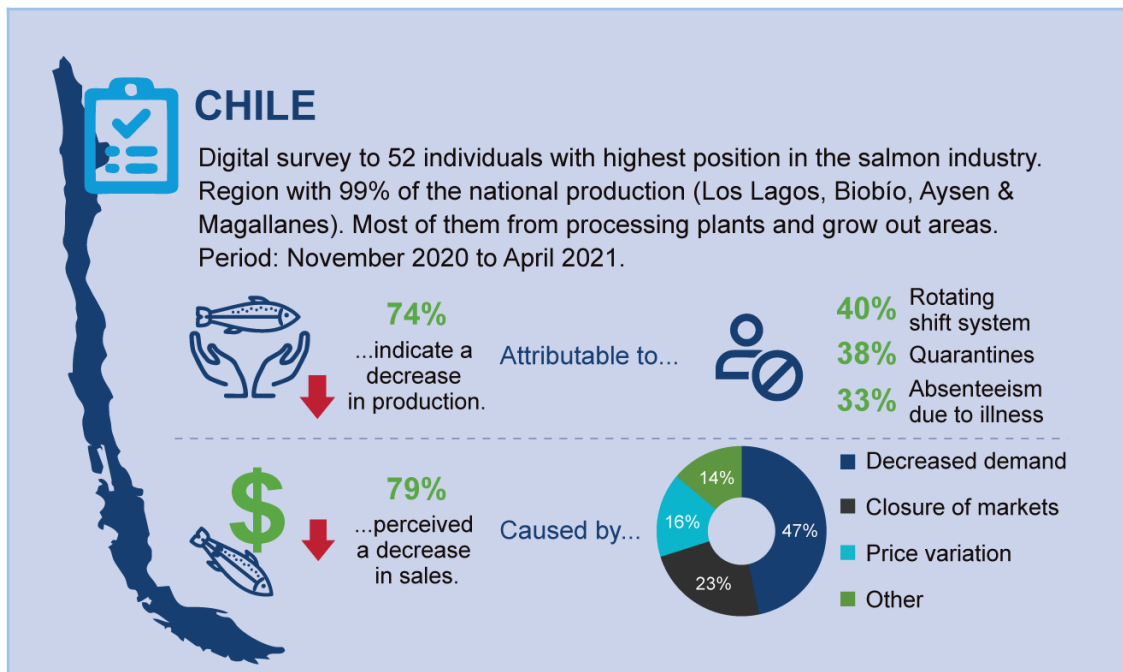
Information from an article by Lorena et al. (2022) and interview with Dr. Alicia Gallardo Lagnos. When asked about the impact of COVID-19 on the salmon industry in Chile, the former director of SERNAPESCA explained:

*“Chilean salmon farming exports to more than 120 countries, many shipments go through the airport in Santiago, which are fast shipments of fresh salmon, and others go through Argentina and also by sea. The first route that was affected in the salmon industry was the logistics of shipments for export, due to quarantine restrictions. In Chile, quarantines were carried out by geographical area and salmon farming is located in the three southernmost regions. Another problem was related to services for salmon farming, feed, vaccines, treatments, etc. The government rapidly listed the essential activities for the population, to which aquaculture producers were later added, by means of a safe pass that they had to apply for. In some cases, the delay of this meant a problem with the health condition of the animals. If you look at the analysis of antibiotics, there was a period when the consumption of antibiotics increased, probably because there was no logistics for health management, which was quickly recovered”.*

The extent of the impact of market restrictions on the salmon industry was detailed: *“China was the first to restrict the export of salmon because they began to analyze the product. At customs they found a positive PCR which meant that the processing plant (registered in the Biobio region) was restricted. It was at the beginning of the pandemic, we immediately conducted a remote inspection, with great effort and support from the Chinese ambassador and customs, the plant was removed from the export restriction”.*

When asked about the current state of the Chilean aquaculture industry and the recovery process: *“has already recovered, the two types of aquaculture are already with positive numbers and they are already exporting to other markets, even expanding the range of markets”.*

Moreover, the article by Lorena et al. (2022) gives some insights into the main difficulties perceived by the industry:



Some aquaculture farmers had to replace their permanent staff with seasonal workers or engage their family members to reduce farm production costs, which impacted the time of active fish surveillance (Manlosa et al., 2021; Salajegheh et al., 2022). As pointed out during the interviews: *“In other cases, there were also problems due to lack of surveillance in cages, the deficient surveillance generated robberies, among other direct impacts.”*

Although labor disruptions were considered the main problem during the pandemic for many economic sectors, labor-related issues were among the less common perceived impacts by aquaculture farmers in Malaysia and for about 50% of the respondents, reducing the number of employees was the last option to be chosen (Azra et al., 2021). Some aquaculture farmers had to replace their permanent staff with seasonal workers or employ their family members to reduce farm production costs, which affected the time for active fish monitoring (Manlosa et al., 2021; Salajegheh et al., 2022). Similarly in Thailand, 50% of respondents to a survey reported developing activities normally and for around 50% of respondent’s production quantity was not affected, while up to 90% reported reduced price of fish and reduced revenues as the main effect, and 50-70% noticed reduction in marketing channels (Chumchuen et al., 2022). This study was developed in an area with low COVID-19 cases among the general population.

#### **Comparison of labor disruptions in fisheries, aquaculture and seafood processing plants**

Compared to capture fisheries, the primary aquaculture sector has been suggested to have had lower infection rates during the pandemic because fish farm operators and workers are relatively stationary compared to capture fisheries which are characterized by the migratory nature of the fishing activities. **Nevertheless, the secondary sector (seafood processing plants), which usually employs a large number of workers, experienced the most severe labor disruptions during the pandemic.** In [Table 4](#) OECD data show that the seafood processing sectors in Australia; Chile; the US, and Peru experienced a reduction in the number of jobs created. The variation was higher than for the aquaculture sector (primary sector) in all economies except for Peru, which was hit the hardest in the aquaculture sector. Employment in the fisheries sector is highly seasonal and comparing job creation over several years is not feasible without taking into account other factors such as natural disasters, environmental issues or details of import demand from the major export markets in those years.

At the production stage, seasonal workers needed for harvesting, transportation, and other services were hired less due to the declining in production, with significant negative

consequences for many workers who were dependent on these activities (Mangano et al., 2022). Fish and seafood processing sectors are generally less automated than other food processing subsectors and were therefore among the most vulnerable food supply chains (Hailu, 2021). The fish processing sector also experienced shortages of raw materials in some cases, resulting in seasonal workers not being hired during this period.

**Table 4.** Employment variation in fisheries, aquaculture and seafood processing sectors in selected APEC economies (2018-2020).

Economy	Sector	2018	2019	2020	Variation 2019-2020
<b>Australia</b>	Aquaculture	3505	3785	3934	3.9
	Fishing Sector	45933	51381	49074	-4.5
	Processing	21602	21433	19716	<b>-8.0</b>
<b>Chile</b>	Aquaculture	18315	8881	11135	25.4
	Fishing Sector	37249	34973	32978	-5.7
	Processing	61794	41501	40537	<b>-2.3</b>
<b>Korea</b>	Aquaculture	37995	37034	36118	-2.5
	Fishing Sector	90728	88535	85434	-3.5
	Processing	38064	37921	43167	13.8
<b>New Zealand</b>	Aquaculture	840	840	900	7.1
	Fishing Sector	2602	2601	2688	3.3
	Processing	5150	5150	5150	0.0
<b>The United States</b>	Aquaculture	7334	7543	7344	-2.6
	Fishing Sector	158811	164522	164616	0.1
	Processing	34597	35406	32298	<b>-8.8</b>
<b>Indonesia</b>	Aquaculture	3600854	2494507	2607530	4.5
	Fishing Sector	2637269	2736218	2437787	-10.9
	Processing	61064	62866	78126	24.3
<b>Peru</b>	Aquaculture	10562	10162	6755	-33.5
	Fishing Sector	83542	84976	68010	-20.0
	Processing	41587	39761	31707	<b>-20.3</b>

Source: OECD database on Employment in fisheries, aquaculture and processing. Data based on estimates was discarded.

#### **Informality and labor disruptions in small-scale aquaculture**

Many workers in the aquaculture sector in developing countries operate in the informal sector without social insurance coverage and COVID-19 caught them unprotected. These individuals are usually self-employed, do not have a written contract, and/or are paid less than the legal minimum wage. This group includes small-scale farmers, migrant workers, ethnic minorities, harvesters, gleaners, and vendors, especially women, who have been among the hardest hit by the pandemic (FAO, 2021a). The pandemic has highlighted the previously invisible importance of migrant workers as a labor force for food supply, including for aquaculture (Galanakis et al., 2021). Dr. Alejandro Flores Nava, Principal Officer of Fisheries and Aquaculture for Latin America and the Caribbean from FAO, described the situation of informality in the Latin American aquaculture sector, which may apply to developing economies in Asia.

*“Many are in the informal sector because they are geographically dispersed, the state does not reach where they are and therefore, they do not participate in government programs, they are isolated, but they are still producers and have an impact on the economy of the community. A census is important, it is necessary to know how many there are, where they are and in what situation they are. This informality is sometimes due to geography, but also to ignorance, many believe that they will be charged, or that they will have a fiscal impact”.*

## II.2. Supply chain and production disruptions

### *Logistics bottlenecks, increase in transportation cost and the cost of supplies*

The availability of different aquaculture inputs essential to production (seed, feed, medicines, fertilizers) has been affected by border closures; national or regional lockdowns; restrictions on cargo movements; restrictions on exports and increases in transportation costs related to COVID-19 (Jamwal & Phulia, 2021; Love et al., 2022). For example, in Indonesia the logistics cost in the fisheries sector was reported to increase by 40% in 2020 (Robins et al., 2020). This led to an increase in the cost of most inputs (Salajegheh et al., 2022). In the US, several private orders were canceled by up to 81% (See Box 3). A global survey found that the main causal factors for supply chain disruption in aquaculture were shortages and higher prices of raw materials at the hatchery stage, lack of storage infrastructure at the production stage, and transportation disruptions at the distribution stage (Mangano et al., 2022). Most disruptions in access to aquaculture inputs were relatively short-lived, allowing recovery after the most strict lockdown measures were eased (Belton et al., 2021).

**Box 3.** *Impact of COVID-19 on US aquaculture, aquaponics and allied businesses located in the US in the aquaculture industry of United States (van Senten et al., 2020; van Senten, Engle, et al., 2021; van Senten, Smith, et al., 2021).*



In general, **supply chains dominated by SMEs were more vulnerable to COVID-19**, with informal supply chains facing the greater impact due to lack of formal contractual relationships, no established cold chain or access to financial services such as savings, credits or insurance. Poor access to cold chain infrastructure and subsequent degraded fish quality particularly



affected small-scale fishers and aquaculture producers, since fish products could not be properly stored until new markets were found, especially in rural areas as seen in Indonesia (Robins et al., 2020). In South Asia, prior to COVID-19, aquaculture was already constrained by insufficient cold storage, processing capacity and poor transportation infrastructure.

### **II.2.1. Fish stocking**

Fingerlings and fish are highly perishable, making **aquaculture highly vulnerable to disruption in transportation services**. During the first waves of the pandemic, aquaculture producers were unable to sell their products and had to stockpile large quantities of live fish, increasing production costs. In addition, holding ready-to-sale fish fry or post-larvae shrimp for extended periods of time increases the risk of mortality, and allowing fish to grow larger may have created challenges in processing and marketing certain product forms, potentially resulting in lower selling prices. Expanding the operational capacity of the fish farm without adequate resources can also lead to inadequate feeding, slow growth, risk of disease outbreaks, limited storage capacity at processing facilities and limited waste management capacity. Disposal of animal carcasses has been compromised during this period, posing a biosecurity risk with environmental impacts (Salajegheh et al., 2022). Hence, risk assessment and clear communication channels between the industry and aquatic animal health organizations were needed. A relevant feedback from the interview on this issue suggested: *“what the farmers can do is to reduce the culture density and amount, but better take care of the animals to get higher survival rate and decent production amount to maintain their income”*.

An important strategy for resilience would be to develop fry production at regional and national levels to reduce the current high dependence on imported fry (Manlosa et al., 2021). In this regard, an FAO representative recommended the following: *“We must give a push to artisanal aquaculture, which is not given attention. Governments have research centers that could be poles for the development and monitoring of aquaculture. In Ecuador, for example, subsidized fingerlings are offered, where initial stocks are sold at a lower price. It is important that these centers are aligned with the institutional framework and health elements.”*

Due to the characteristics of the AVC adapting to changes in demand can be challenging due to the propagation of the disruption upstream and downstream of the value chain. Disruptions in the production of seed will manifest as disruptions in the supply of final products in the coming weeks or months, depending on the duration of the production cycle for the species. In China, according to statistics up to 14 March 2020, there was significant overstock of aquatic products such as tilapia, prawns, crayfish and bulk freshwater fish in farms from the Hubei province (up to 410,000 tons) and Hainan province (45,000 tons), among others Chinese provinces (Chang et al., 2022). Moreover, according to the traditional management of the aquaculture businesses, the post-Chinese Spring Festival period (January–February) is a critical time to clean, disinfect and prepare fishponds and aquafarms. However, since aquatic products could not be sold in time during early 2020, this resulted in overstock of aquatic products and rendered it impractical for many to begin a new cycle (Chang et al., 2022).

### **II.2.2. Other production inputs**

Challenges with other production inputs such as feed, chemicals, fertilizers, therapeutics, growth hormones, lime, or probiotics were reported worldwide. In most Asian aquaculture countries, feed is usually manufactured domestically while some feed ingredients are imported. In Peru, the world largest producer of fishmeal and one of the largest fish oil producers, the industry was shut down due to national lockdowns, causing a major disruption to the aquaculture sector in China, which is highly dependent on such imports. The situation improved in 2021 with exports of fishmeal rising to 1.22 million tons, from 856,000 tons in 2020, whilst exports of fish oil soared from 129,000 tons to 225,000 (FAO, 2022c).

Farmers had to spend a large amount of money on fish feed. During the first COVID-19 wave in Viet Nam, sales from aquaculture producers were delayed for 3 months and farmers still had to buy fish food during this time (Rendón et al., 2021). In this regard, the production and use of locally available feeds was an important resilience mechanism in some aquaculture supply chains that allowed them to navigate successfully through the COVID-19 crisis (Manlosa et al., 2021). This can be further strengthened by supporting local feed producers to mobilize and collectively formulate an action plan for similarly disruptive scenarios. In general terms, there are major advantages of promoting local input sourcing.

At the beginning of the pandemic, a severe shortage of life saving medical oxygen also reduced the availability to other non-health sectors, with some countries even banning its use in other sectors. Liquid oxygen is used in aquaculture to transport live fish (whether for seed transportation or ornamental purposes) to increase availability of dissolved oxygen as well as elimination of carbon dioxide and ammonia that accumulates during fish transport, which causes stress and related mortalities (Rajts & Shelley, 2020).

### **II.3. Market demand and price disruptions**

#### ***Drop in foreign demand***

The closure of sales outlet markets, and distribution channels caused a significant drop in demand, instability in market prices, and reduced production volumes for most seafood products. Export restrictions placed on foreign markets, such as for pangasius, significantly reduced the foreign demand and prices. The **logistics/transport and marketing were the most affected stages of the aquaculture value chain** of APEC economies as seen in Malaysia (Azra et al., 2021); Thailand (Chumchuen et al., 2022) and Viet Nam (Lebel et al., 2021), due to transportation bottlenecks, farmers's inability to access markets, and lower demand and prices. Significant reduction in demand from major fish importers such as the US, the EU and China affected global seafood trade. For example, from January to September 2020, the total value of fish imports in China fell by 15.11% year-on-year, while the value of fish exports fell by 15.42% (Y. Zhang et al., 2021).

#### ***Decrease in local demand***

Local demand was severely reduced by **the closing of the hotels, restaurant and catering (HORECA) sector**, which accounts for a significant proportion of fish consumption in many economies. The closure of HORECA and the cancellation of events led to an initial sharp drop in local demand for aquaculture products, particularly for high-value products such as lobsters and oysters (OECD, 2021). The initial sharp drop in demand for fresh fish products was later accompanied by an increase in demand for canned, frozen and processed fish, driven by consumer stockpiling (Havice et al., 2020). The combined decline in foreign and local demand forced fish farmers who could not sell their product to adopt different coping strategies. As a result, some decided to stockpile large quantities of live fish, raising expenses and expenditures and risks. The vulnerability and complexity of the AVC made the operations loss-making, and many producers had to discard their products within weeks.

#### ***Recovery of the demand after most restrictions were eased***

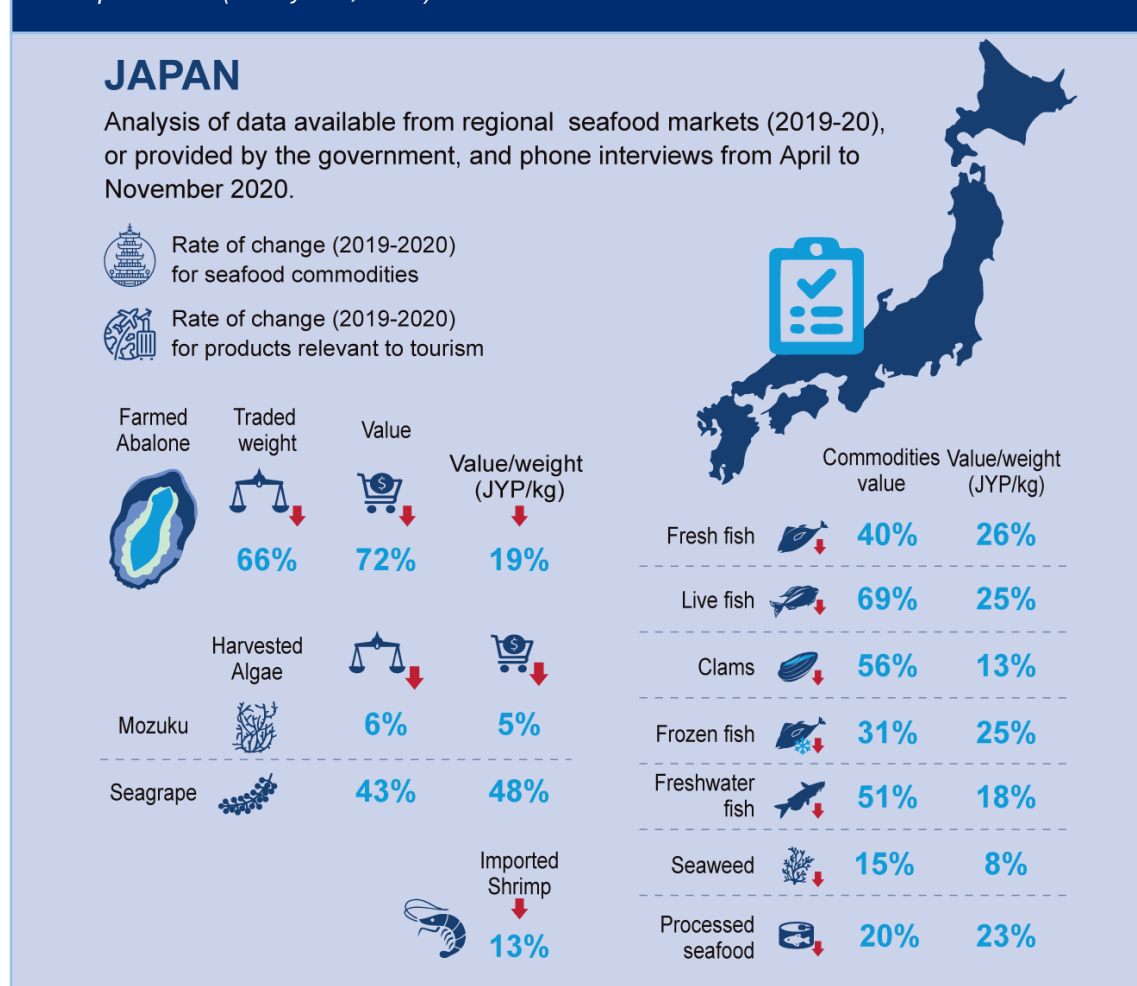
The lagged effects on demand and prices persisted for several months after the most restrictive regulations were eased (Belton et al., 2021). Notwithstanding, demand for seafood products recovered strongly in 2021 and 2022 in most economies, as COVID-19 pandemic restrictions were lifted. However, the Chinese seafood market has recently shown signs of weakening due to the Zero-Covid policy with recurrent restrictions. Data from local markets in China show that seafood sales in September 2022 decreased by 19.6% compared to September 2021, the average seafood price decreased 12.1% compared to the same period

last year. While the volume of freshwater seafood sold fell by 16.5%<sup>12</sup>. The trend of the Chinese market in the coming time is unpredictable and will depend on the performance of the adjustments in the Zero Covid policy.

#### Volatility in fish commodities prices

The volatile market system led to **sudden massive price drops of most fish commodities** (See Box 4) **while others increased in price**. Specific data on the prices of aquaculture products can be difficult to obtain since data are often combined with capture fisheries, particularly for marine species, although information for classic aquaculture species such as tilapia, catfish, carps, salmon and shrimp provide insight into the uneven impact among products. In China, the market prices of several marine species experience a significant decline from January to April 2020, however remained stable in the later period of 2020, indicating that the adopted policies were effective<sup>13</sup>. In the Philippines, the prices for various types of fish species from capture fisheries did not decline as much as high-value aquaculture products because they were regularly consumed by local people (Manlosa et al., 2021).

**Box 4. The COVID-19 impacts and challenges to achieving sustainability in Japan's fisheries and aquaculture (Kobayashi, 2022).**



<sup>12</sup> Vietnam Seafood. Restricted by Covid, the Chinese market still attracts 160 Vietnam pangasius exporters. Accessed: 17 January 2023. Available in: <https://himex.vn/en/restricted-by-covid-the-chinese-market-still-attracts-160-vietnam-pangasius-exporters/>

<sup>13</sup> Zhengyong Yang. The impacts of Covid-19 on fisheries and aquaculture in East Asia. Accessed: 17 January 2023. Available in: <https://www.fao.org/3/cb2362en/cb2362en.pdf>



The prices of low-cost products such as tilapia (freshwater fish widely consumed because of its low market prices) were not as affected and prices have picked up ever since. Similarly, the price of farmed milkfish was not significantly reduced in the Philippines since it is commonly consumed by locals, compared to prawns that are mostly exported and saw price drop up to 50% (Manlosa et al., 2021). The prices of grass carp, Prussian carp, and Amur carp in China, important local fish products, remained stable before COVID-19, but increased significantly after it, reaching the highest point in the second half of 2021 (Wang et al., 2023). Surprisingly, the demand for farmed Atlantic salmon has proven quite robust (Love et al., 2021), due to its highly diversified global market and multiple commercialized forms through both food service (HORECA) and retail (FAO WorldFish, 2021).

#### II.4. Financial disruptions

The COVID-19 pandemic increased financial risks at all stages of the AVC, including difficulties in obtaining insurance coverage, reduced cash flows, liquidity and incomes, business losses, reduced capacity to repay loans and meet financial obligations to suppliers, and bankruptcies, which have been a major source of financial instability, as farmers can only produce if they have access to finance (FAO, 2020e). The increase in the cost of and access to production inputs as a result of the restrictive measures has been a major cause of decline in productivity. The implementation of health measures and the distribution of PPE reduced production capacity due to increased costs, issues that may have been more pronounced in the processing sector. The vulnerability of the aquaculture sector to this type of crisis was clearly demonstrated and risk management plans should be in place to deal with future crises or disasters.

**Studies on stakeholder's perception** are key to defining coping strategies for the aquaculture industry and **will be key to developing transformations and resilience for the sector** (Mangano et al., 2022). In the U.S., several surveys developed by the Virginia AREC made it possible to map the economic impact of the pandemic during each quarter of 2020 and even the %age of aquaculture farmers benefiting from government support across the country (van Senten, Engle, et al., 2021b; van Senten et al., 2020; van Senten, Smith, et al., 2021) ([See Box 3](#)). U.S. aquaculture farmers reported lost sales to domestic markets, cancellations of private contracts, cancellations of government contracts and lost sales to international export markets (van Senten et al., 2021). In order to know the current status of the aquaculture sector in the post-pandemic scenario, APEC economies could develop such tools. There is an urgent need to develop census and studies, particularly to know the situation of the SSA farmers and develop policies accordingly. Among the best actions to increase resilience and sustainability in the aquaculture sector Dr. Alejandro Flores Nava suggested:

*“In order to act, it is important to have updated information, it is necessary to carry out analyses at the micro-regional level, the needs are different. I recommend performing a diagnosis of the vulnerability of aquaculture to the effects of climate change, as a baseline for the design of a national adaptation strategy. The vulnerability of the sector may vary from region to region. Information, on the one hand, and then the design of strategies, in the case of climate change, adaptation, and in the case of unforeseen external shocks, protocols that allow, as much as possible, to have an immediate response capacity to avoid the suspension of activities that has been so harmful to many producers.”*

Economic losses in the aquaculture sector have varied widely worldwide (Mangano et al., 2022). In the Chilean salmon industry, up to 71% of stakeholders surveyed reported the increase in productive costs as the main challenge during the first stage of the pandemic, while a decrease in sales was the fourth most significant challenge for up to 37% of respondents (Lorena et al., 2022). In South Asia, up to 82% of farmers reported lower net income than expected and 7% exited the aquaculture business due to COVID-19 (Lebel et al., 2021). Small farmers were more likely to experience a reduction in net income and farmers with debt

repayment problems were more likely to exit, while those who used savings, borrowed money, or sought new markets were less likely to exit. Additionally, semi-intensive farms were more likely to exit than subsistence farms and pond farms less likely to exit than cage ones (Lebel et al., 2021). In Japan, a nationwide online survey ran from 29 May 2020 to 18 October 18, 2020, found that all aquaculture stakeholders surveyed reported a large to moderate decrease in total annual sales in 2020 and nearly half of them experienced changes of more than 50% from the previous year (Sugimoto et al., 2022).

## **II.5. Impacts on seafood consumption**

### ***Initial decrease in seafood consumption***

Global consumption of aquatic foods has increased at an average annual rate of 3 % since 1961, almost twice the population growth rate of 1.6 % (FAO, 2022a). In 2020, worldwide seafood consumption, as calculated by FAO, slightly declined from 20.5 kg in 2019 to 20.2 kg in 2020 (FAO, 2022b). The reasons for the initial decline in seafood consumption are numerous. First, there was widespread misinformation that fish could carry the SARS-CoV-2 in the early months of 2020, which was linked to media images of the Wuhan seafood market (Jamwal & Phulia, 2021), even though aquatic animals (finfish, reptiles, amphibians and invertebrates such as crustaceans and mollusks) play no epidemiological role in spreading COVID-19 to humans (Bondad-Reantaso et al., 2020; FAO, 2020c; Godoy et al., 2021). Considering the infodemic<sup>14</sup> and misinformation that were already established in the society before the pandemic, but were exacerbated by COVID-19, mostly due to incorrect use of social media; the **appropriate management of future crises in the aquaculture sector should promote rapid, creative and effective communication campaigns to mitigate such effects.**

Second, during the early stages of the pandemic, there were sudden changes in consumer behavior, including a surge in consumption of prepared foods, while the consumption of fresh foods particularly fish and seafood products was disproportionately affected (Workie et al., 2020; J. Zhang et al., 2020). Studies in Europe, Asia and Latin America have reported decreases in seafood consumption intakes from 9.4% to 31.3% during the first wave of COVID-19 (Mignogna et al., 2022). Another explanation is that fresh seafood preferred by customers in several economies could not be delivered outside the provincial area during the restriction periods due to the difficulty of maintaining the quality of chilled products.

Furthermore, job losses and reduced incomes during this period significantly reduced purchasing power, which affected the expenses on fish purchases. The cancellation of major seafood trade events such as the Lunar New Year celebrations in China during the early stages of the pandemic and low demand for seafood from the HORECA sector affected seafood consumption, with the late-cyclical initially suffering the greatest impact (Havice et al., 2020). In Indonesia, an estimated 65% of the population lives in coastal and marine areas, and fish is the main source of protein in many parts of the archipelago. The sharp drop in demand suggests that the poor were consuming much less fish protein (Robins et al., 2020).

### ***Increase demand for local seafood***

In the early months of the COVID-19 pandemic, there was a rapid increase in demand for local and direct seafood from alternative sources, as seen in the United States and Canada, at a time when many other segments of the broader food system were disrupted (Stoll et al., 2021). In China, food consumption surveys, conducted in the Jiangsu province, found that rural households involved in agricultural/aquaculture production increased their consumption of aquaculture products in the short term (2020), compared to 2019, and these changes persisted even one year after lockdown was lifted (2021) (Tian et al., 2022). The Jiangsu province is one of the richest provinces in China and is famous for its aquaculture and rice production, which

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<sup>14</sup>An overabundance of information – some accurate and some not – that makes it hard for people to find trustworthy sources and reliable guidance when they need it.

may have contributed to preserve the consumption of aquaculture products and food security, exhibiting the importance of rural farmers and aquaculture to food security.

## **II.6. Exacerbation of sex, gender and other inequalities**

Women's contribution to aquaculture is often not recognized globally, mainly because the seafood industry has a strong gendered vertical division of labor, with women occupying low-income jobs, mainly in the secondary sector, and men occupying the top jobs<sup>15</sup>. Women in the seafood industry play a key role in ensuring food security for all. In the primary fisheries and aquaculture sector, about 21% of the workforce in 2020 were women, but this number rises to nearly half the workforce when both primary and secondary fisheries and aquaculture sectors are considered (FAO, 2022b). Other reviews indicate that women may represent between 56% and 99% of the workforce in the post-production nodes of aquaculture (Kruijssen et al., 2018).

Women's employment status in the seafood sector appears to have declined more than that of men, as the secondary sector was particularly hard hit by the pandemic. A study of gendered predictors of the impact of COVID-19 on cross-border fish trade in Zambia and Malawi found that a higher proportion of women than men reported facing high impact of COVID-19. Moreover, educated and experienced male traders were less likely to face high impact of COVID-19. In contrast, female traders with larger family sizes and from households managed by single-heads were more likely to face high impact of COVID-19 (Mwema et al., 2022). In addition to job loss, women had to bear much of the responsibility for caring and educating children when schools closed, and for keeping their families safe during the uncertain pandemic times (Jamwal & Phulia, 2021).

In this regard, intergovernmental agencies are important to understand such impact in the Asia-Pacific region. A SEAFDEC study developed in 2021 found that in terms of gender roles, there were no changes in small-scale and commercial fishing activities before and during the COVID-19 pandemic. In Thailand, the gender roles in small-scale fishing activities were the same before and during COVID-19; however, men's inland capture fishing activities intensified during the pandemic (SEAFDEC, 2022a). In Papua New Guinea women are the majority of fresh food vendors, including fish products, and are considered most impacted than men during the lockdown period (Robins et al., 2020). Noteworthy, there is still insufficient data on this issue and proper conclusions will demand more analysis including sex-disaggregated data.

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<sup>15</sup> Briceño Lagos. Why use a gender lens to analyze the impacts of COVID-19 on the seafood industry. The International Organization for Women in the Seafood Industry. Accessed: 18 January 2023. Available in: <https://womeninseafood.org/why-using-a-gender-lens-to-analyse-covid-19-impacts-on-the-seafood-industry/>



### III. SECTION 3: ACTIONS AND POLICY MECHANISMS TO COPE WITH THE COVID-19 CRISIS IN THE AQUACULTURE SECTOR OF APEC ECONOMIES

#### Key messages:

- » The main goal of the measures developed within the context of the COVID-19 pandemic were to protect public health in the industry, ensure the basic livelihood and maintain the supply chain operative.
- » The pandemic required the timely development and implementation of specific health and safety regulations for the fisheries and aquaculture sector.
- » Economic support was the number one measure requested by aquaculture farmers.
- » The high informality and lack of social protection of small-scale aquaculture enterprises in developing economies made it difficult to access economic support packages.
- » Fisheries and aquaculture specific economic relief packages in developing economies were introduced mostly in the form of low interest credits, particularly by members where SSA dominated the sector.
- » In developed APEC economies, such as the U.S.; Canada; New Zealand and Japan, general and Fisheries sector-specific economic compensation for the extra costs for the pandemic response were introduced in various forms.
- » Measures to secure the aquaculture supply chain and to promote new markets were the most frequently adopted measures.
- » The institutional purchase of food and the promotion of seafood consumption contributed significantly to absorb stagnant production during the initial period.
- » The pandemic has accelerated the trend towards digitalization and e-governance within fisheries and aquaculture government agencies.
- » Sex-disaggregated data and gender statistics are still not properly collected and are key to formulating inclusive policies.

#### **Policy mapping**

COVID-19 had an abrupt, prolonged and mixed impact on the aquaculture sector of APEC economies, as discussed in the previous section. This forced all aquaculture stakeholders: governments, intergovernmental organizations, NGOs, industries and businesses, farmers and consumers to take action to address the ongoing crisis. In this section, relevant policies for the aquaculture sector implemented by APEC economies at the national level were identified and the coping strategies adopted by farmers were mapped. Policies were mostly identified by consulting official websites of government agencies for the fisheries sector and related sources. Additionally, some policies were previously recorded in consulted articles and reports, while interviews also contributed to some policies. Policies at the municipal levels are more difficult to identify and obtain and were beyond the scope of this report. The full list of identified policies for selected APEC economies can be seen in [Boxes 9-10-11](#).

#### **Main objectives of the introduced policies**

- (1) Protect public health in the industry
- (2) Ensure the basic livelihood
- (3) Maintain the supply chain operative

Initially, most of the policies adopted by governments were not specifically aimed at fisheries or aquaculture, although aquaculture producers could benefit from several of them, especially those aimed at SMEs designed for SMSEs. The overall objectives of the policies were three.

At the global and regional levels, intergovernmental agencies such as FAO, OECD, SEAFDEC have published several policy recommendations to support the fisheries and aquaculture sector since the beginning of the pandemic (FAO, 2020 a,b,c,d,e, 2021a,b, 2022a,b,c; FAO WorldFish, 2021; OECD, 2020,2021; SEAFDEC, 2022a,b).

#### **Diversity of the mitigation and adaptation measures introduced for the aquaculture sector**

In response to the evolving and complex nature of the problem, responses varied (See Figure 17). In the early stages of the pandemic, most governments attempted to ensure health and safety, by closing ports, quarantining foreign vessels, closing open-air fish markets, disinfecting ports and fishing boats, providing masks for workers and raising awareness of hygiene measures. A survey conducted in Malaysia during the restrictive period showed that the measures perceived as to be most effective by fish farmers were the use of digital platforms/online markets, technical assistance, financial assistance and moving to sales services (Azra et al., 2021).

- Health and safety measures
- Financial measures
- Social protection and employment measures
- Supply chain and marketing measures
- Management and technical measures
- Promoting digitalization, innovation and sustainability
- Promoting sex and gender equality

#### **Limitations of the policies implemented for the sector**

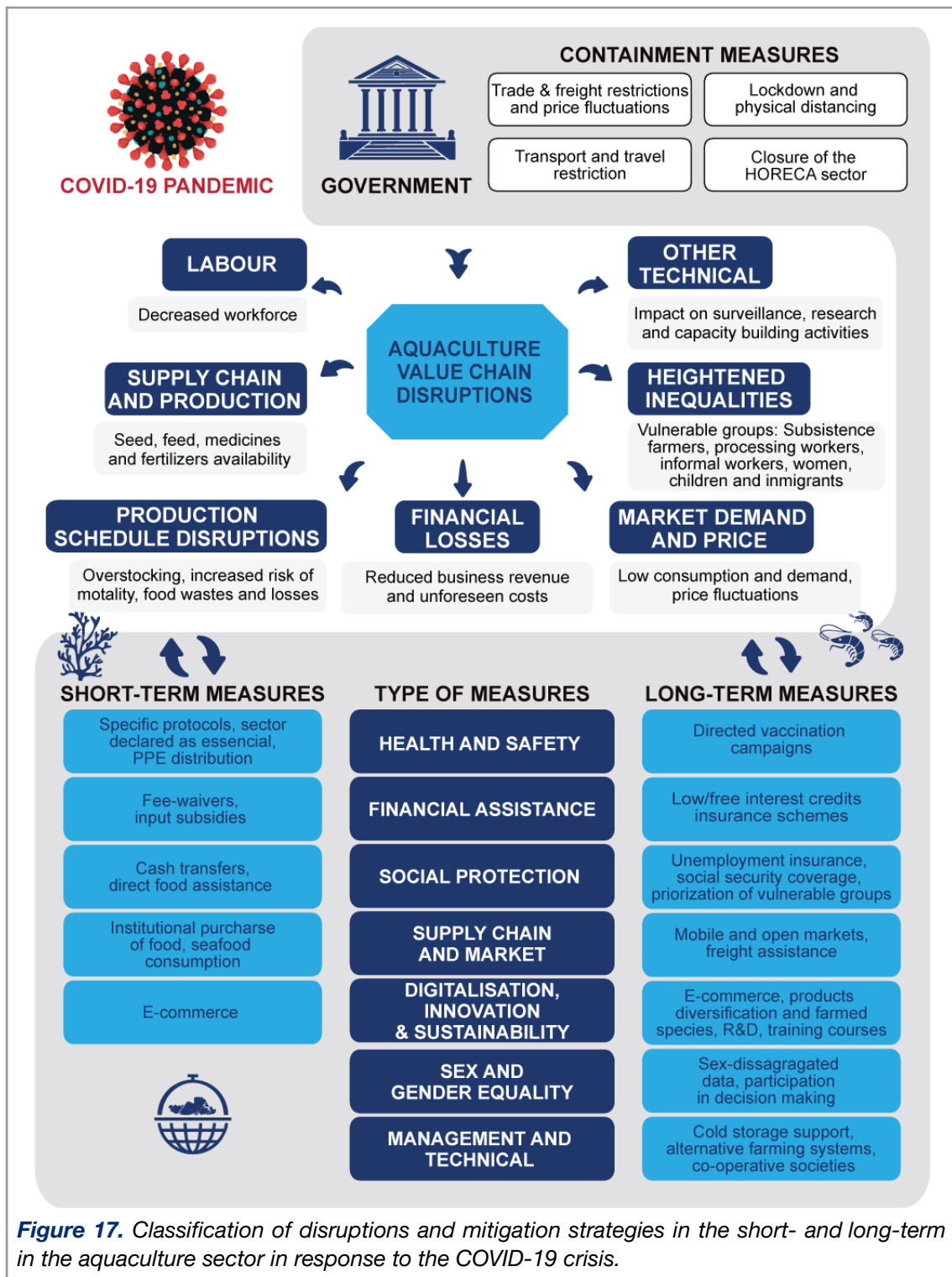
In addition to programs for SMEs and measures specific to fisheries and aquaculture, the national responses to the pandemic included measures to strengthen the health system and vaccination programs, which varied widely according to each country's healthcare system, its capacity, quality of care and accessibility. These measures had a profound impact on the duration and magnitude of the crisis and certainly on the process of economic recovery for aquaculture, but are not covered as they are beyond the scope of this report. UNDP analysis suggested that the economic recovery rate is predicted to be faster for countries with higher vaccination rates, with about US\$ 7.93 billion increase in global GDP for every million people vaccinated<sup>16</sup>. High-income countries and groups with access to medical resources (vaccines, protective equipment, therapy), government support (i.e., financial stimulus, social safety nets), and personal savings have fared better. Furthermore, the coverage of the social protection systems in developing nations was lower than in developed economies, which limited the initial financial compensation needed for work interruptions and job losses. In general, the availability of public resources has been the main constraint in action.

#### **Main difficulties in implementing measures**

When asked about main difficulties faced by APEC economies in implementing support measures for the aquaculture sector, official representatives cited inadequate budget allocations and the need to involve vulnerable groups in such policies and programs, as well to build confidence in vaccination. Japan's representative highlighted the *"shortage of staff in central and local governments to cope with the increased workload and lack of digitalization of administrative procedures. In addition, in shifting the destination of aquaculture products from the food service industry to household consumption and school meals, the lack of processing plants and workforce to meet the specific requirements for such destinations was the main problem"*.

<sup>16</sup> Estimates until October 2021. Impact of vaccine inequity on economic recovery. United Nations Development Programme. Accessed 18 January 2023. Available in: <https://data.undp.org/vaccine-equity-archive/impact-of-vaccine-inequity-on-economic-recovery/#:~:text=UNDP%20analysis%20suggests%20that%20the,for%20every%20million%20people%20vaccinated.>





**Figure 17.** Classification of disruptions and mitigation strategies in the short- and long-term in the aquaculture sector in response to the COVID-19 crisis.

An important lesson from the pandemic was the need for clear contingency mechanisms to deal with such crises. In this regard: “*Response protocols are essential for responding to future crises. This was a fundamental lesson. What is the chain of authority for decision-making? Who is responsible for activating these procedures? Finally, these protocols now need to be designed not in times of pandemics or external shocks, but during "normal" times. We should always have a backup plan in place, anticipating that these shocks may occur more often in the future.*” The uncertainty of the markets was another major concern, as not much was known about the pandemic. Internally, situations with officials who were afraid to go to work on some

inspections were seen in Chile, however workforce groups were created for those mandatory physical inspections, besides the implementation of online procedures.

### III.1. Health and safety measures

The novelty of the COVID-19 crisis **required the rapid development and implementation of specific health and safety regulations** to protect aquaculture workers at all stages of the aquaculture supply chain, including consumers and the processing sector, from the risks of the infection itself, which may not have been implemented fast enough in all cases, exposing these workers and their families to increased risks of infection as seen in the major COVID-19 outbreaks documented at seafood processing plants around the world<sup>17</sup>. The fish processing sector is labor-intensive and requires workers to be in close proximity for long periods of time, in low temperatures, and often involves shared housing and transportation, which exacerbated the risk of virus transmission during the COVID-19 outbreak (ILO, 2021).

To ensure compliance with and confidence in sanitary standards, it is recommended that a centralized, empowered and with well defined functions sanitary authority for the fisheries and aquaculture sector be present in the country. The pandemic has highlighted the importance of avoiding variations and inconsistencies in the working competencies of specific fisheries agencies and provides an opportunity to work on legislation to correct them. The recommendations outlined by (Chang et al., 2022) for China on this issue can be applied to other APEC economies ([See Box 5](#)).

#### **Box 5.***The Impact of the COVID-19 on China's Fisheries Sector and its Countermeasures. (Chang et al., 2022).*

Researchers from China analyzed the current (2022) legal safeguards measures put in place by the Chinese government to mitigate the effects of the pandemic in the fisheries sector and concluded with three major policy recommendations:

**(1) Legalization of policies**, considering the various policies formulated by China after the COVID-19 outbreak as well as the lack of specific regulations on the quality and safety regulations, it is considered urgent for China to formulate specific laws and regulations to regulate the quality and safety of aquatic products with the following objectives:

- **Clarify** the food safety standards of aquatic products, into national standards and local standards.
- **Establish** clear legal responsibilities for violations of aquatic product food safety issues.
- **Stipulate** the relevant enterprises and departments shall establish aquatic product food safety traceability system.

**(2) Provide free legal advice and support to fishers** to enhance the legal awareness of fisher's groups. There are multiple ways to provide free legal advice, such as:

- Providing online or offline legal advice.
- Disseminating knowledge of fisheries law and national policies related to the fishers themselves.
- Answering fishers' legal questions related to their own interests.

<sup>17</sup> Amanda Moeser, "The most dangerous job in fishing isn't fishing—it's processing fish during a global pandemic", Union of Concerned Scientists: Science for a healthy planet and safer world (blog), 21 November 2020. Accessed: 18 January 2023. Available in: <https://blog.ucsusa.org/science-blogger/the-most-dangerous-job-in-fishing-isnt-fishing-its-processing-fish-during-a-global-pandemic/>

**(3) Establish a specialized fishery product monitoring agency**, as local fishery monitoring departments and testing institutions have different and inconsistent working competencies. Recommendations on this issue include:

- **Attach** further importance to the establishment of inspection and testing departments, especially the establishment of rapid inspection teams.
- **Increase** the penalties imposed on those who violate rules or regulations.
- **Introduce** innovative monitoring technology.
- **Encourage** the bring-in and training of professional and technical personnel with high comprehensive quality and clarify their main responsibilities.
- **Drive** the improvement of the detection ability of grassroots technical departments and perform supervision and inspection methods and measures such as inspection and surveillance, law enforcement supervision, publicity guidance.
- **Promote** the sharing of information and resources among aquatic product regulatory agencies.

#### *Industry compliance with COVID-19 national health and safety protocols*

The main measures adopted by the aquaculture industry included social distancing, mandatory use of masks, increased frequency of cleaning and provision of soap and sanitizers by the company. Social distancing and the related work shifts were the most commonly adopted internal mitigation measures in the aquaculture sector worldwide (Lorena et al., 2022; Mangano et al., 2022). These health measures were of great importance during this pandemic, as their implementation significantly reduced the spread of COVID-19. In Chile, up to 67% of salmon industry stakeholders surveyed reported that the company where they were employed had implemented health measures due to the COVID-19 pandemic and more than 50% of the respondents indicated that the implementation of the safety measures was moderately difficult, although was very effective and relevant (Lorena et al., 2022).

Critical shortage of personal and protective equipment (PPE) has been reported worldwide and actions to provide AVC workers with protocols, equipment and materials to prevent transmission of COVID-19 have been extremely beneficial in terms of health and safety of the people, the availability of enough workforce for companies and securing the supply chain, as seen in South Asia (SEAFDEC, 2022b). The recognition of aquaculture as an essential sector has also been a key measure in this regard. From the outset, most governments excluded fish production from lockdown orders. Nevertheless, restrictions on the movement of people and lockdowns affected production, especially where fisheries were not initially exempted from lockdowns, such as processing plants in Peru, which further impacted the global supply of fishmeal and fish oil.

Additional health and safety measures taken by APEC members were:

- In Chile, salmon farms converted their laboratories into COVID-19 testing centers to allow health authorities to conduct tests on coronavirus samples. In addition, a safe pass for fisheries and aquaculture related industries was promptly introduced<sup>18</sup>.
- Thailand issued certificates to the operators who comply with measures to prevent COVID-19 contamination in aquaculture farms, fishing vessels, fish markets, quays, and central markets to enhance consumers' confidence in domestic and foreign markets (SEAFDEC, 2022b).

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<sup>18</sup> Adolfo Alvial Muñoz, "De ISA en salmónes a covid-19 en humanos: Similitudes y lecciones", AQUA. Accessed: 18 January 2023. Available in: <https://www.aqua.cl/columnas/de-isa-en-salmones-a-covid-19-en-humanos-similitudes-y-lecciones/>



- The Philippines introduced the “Food Lane Conduct Pass” to ensure the unimpeded supply and flow of food commodities, including fishery products, and inputs, and to facilitate the mobilization through quarantine checkpoints<sup>19</sup>.

## III.2. Financial measures

### *General packages vs specific fisheries financial support*

**The request for economic support was the most important external mitigation measure requested by aquaculture farmers** worldwide as a result of the coronavirus outbreak (Mangano et al., 2020, Lebel et al., 2021). The fisheries and aquaculture sectors have mostly benefited from general support packages for SMEs, although in some economies specific fisheries and aquaculture financial packages have been introduced, such as in the US with numerous grants and programs through various government agencies. The need for and extent of fisheries and aquaculture-specific support programs depended on both the national context of the sector (relative contribution to GDP) and the complexity of the impacts of COVID-19 (OECD, 2021).

Peru introduced fisheries and aquaculture-specific low interest credits for micro and small aquaculture (AMYPE) and for limited resources or subsistence aquaculture (AREL) in May 2020. The special credits program was developed by the Peruvian National Fisheries Development Fund (FONDEPES). Fish farmers were required to have an authorization resolution for each type of aquaculture in force. In the case of loans for AREL systems, farmers were required to belong to native and indigenous communities with resolutions granted by their respective Regional Government agencies. The maximum value of the credits were \$ 2000 Peruvian “soles” or US\$ 520, with a six month grace period, 3% annual interest and up to 36 months to pay. Peruvian aquaculture is mainly composed of AMYPE (23.9%) and AREL aquaculture (74.7%)<sup>20</sup>, while authorizations for large-scale aquaculture only represent 1.4% of the total. This explains the necessity (among other reasons) to introduce such packages. The Peruvian Ministry of Production confirmed the following: *“In the framework of this program, in 2020, 501 credits were awarded, benefiting 365 AREL farmers and 136 AMYPE farmers, for an amount of S/ 1,002,000.00 soles for working capital”*. Recently (2023), the Peruvian government has expanded the funding for FONDEPES for similar credits from \$12 million soles to \$30 million soles.

Several characteristics of the sector, such as the seasonality of work, the employment of foreign crew and relatively high levels of informality and self-employment, mean that general stimulus packages alone may not have been as effective. In Thailand, Dr. Cherdasak Virapat, General Director of the Centre for Integrated Rural Development for Asia and the Pacific (CIRDAP) highlighted the situation of access to financial assistance for small-scale farmers: *“Many small-scale farmers have debts and don’t have access to loan contracts. Few farmers have access to microcredit provided by the bank. Farmers should be encouraged to form cooperatives or groups to share their knowledge, plan, and implement activities to increase their business power”*. Similar situations, although probably to a lesser extent, exist in developed economies such as Chinese Taipei for instance: *“Some of the culture places are not registered due to some difficulties such as property ownership, land rent, unlicensed water source...etc., and therefore the farmers who culture animals in the specific place are not eligible to apply for subsidy. The law of registration for culture license should be properly scrutinized and reformed to solve the problem and the standards should be untightened”*.

### *The major role of governments in financial assistance*

<sup>19</sup> Department of Agriculture, Philippines. 2020. Food Lane Conduct Pass (online). Quezon City. Accessed: 17 January 2023. Available in: <https://www.da.gov.ph/infographics/food-lane-conduct-pass/>

<sup>20</sup> Ministry of Production (PRODUCE). Catastro Acuicola Nacional. Accessed: 17 January 2023. Available in: <http://catastroacuicola.produce.gob.pe/web/>

Governments have been the main source of support, although cooperative societies and trade associations have also played an important role in supporting people in aquatic food value chains. The open question is whether the level of cash transfers and the delivery mechanisms adopted by countries were effective in mitigating the shock to the sector and whether they are still needed. This can be assessed by analyzing available high-quality transparent public data on the beneficiaries of such programs. Public data was used by decision-makers as a reliable database of current workers eligible for emergency relief funds (Maruff, 2020)

Easier access to financial compensation for the temporary suspension or reduction of production and control measures were introduced for the aquaculture sector in several APEC economies mostly through fee waivers, payment deferral, payroll tax refunds, tax rate reductions, input subsidies (ice, fuel, nets, etc.) and access to credit at reasonable interest rates. National or local governments subsidized bank loans, extended loan contracts and/or reduced interest rates, so small businesses did not have to pay for the last year because of COVID-19 (Rendón et al., 2021). Furthermore, financial support to farmer's organizations for the temporary storage of aquaculture products for human consumption, to ensure market stability and reduce the risks of products being wasted or diverted to non-human food uses was an important tool for immediate economic mitigation, discussed in the Section 3.4.

Relaxed loans and credit terms were helpful for farmers with repayment problems, but SSA farmers are less likely to borrow in response to impacts, so special attention needs to be paid to the credit needs of small farmers is required as seen by Lebel et al., (2021) in Thailand and Viet Nam. Direct financial assistance, developing new markets and promoting resilient supply chains have been identified as effective measures (Mangano et al., 2022). The government support measures and the challenges faced by SSA farmers in Indonesia are presented in (Box 6). The interviews indicate that financial assistance in the form of economic relief or credits have not been developed for the aquaculture sector in Chile; Mexico and the Latin American region as a whole.

**Box 6. Government mitigation measures and challenges for the SSA in Indonesia within the context of the COVID-19 pandemic.**

Interview with: Dr. Hatim Albasri from the Research Center for Fisheries National Agency for Research and Innovation, Indonesia.

Recent aquaculture policy changes by the MMAF have resulted in programs to improve the supply chain and management of fish farming in Indonesia, which were developed based on three strategic pillars: **sustainability, competitiveness and fish-farmer welfare**. Programs included the creation of fish-farming centers oriented to exports, guidance and support in certification-related procedures, the promotion of HORECA-related initiatives, the support to the private investment and adoption of state of the art technologies in cooperation with local governments. A direct intervention of the Ministry was the enactment of a decree regarding the COVID-19 protocol enforcement, regulating critical points of the aquaculture through biorisk management to provide a guarantee for exportation commodities. No particular program was developed for the market stage, but after shortages of air cargo during 2020 the MMAF coordinated among stakeholders, including airline operators and fish farmer associations, to explore alternatives for the improvement of cargo availability for seafood products.

On the other hand, direct and indirect endowments were given at the national and subnational level by the MMAF or other ministries. Direct endowments came in the form of fish feed and farming equipment, while indirect ones in the form of reduced credit interest rates, improved water supply, relaxed farming permits and the allocation of extension officers to help identify and solve fish-farming issues on site. However, the effectiveness of

these measures varied, being direct endowments less effective: “considering that the estimated number of small-scale fish farmers in Indonesia is more than 1.3 million people, a direct endowment is much more symbolic and only received by a limited number of individuals or fish farmer cooperatives.”

The main challenges that fish farmers faced to access government support were:

- A. Most fish farmers are small-scale and many reside in remote areas of Indonesia, so their access to indirect endowments was hindered.
- B. Existing fish farmer cooperatives are few and far between, the government usually forms instant cooperatives to distribute direct support legally, reducing the effect of direct endowments.
- C. Most small-scale fish farmers have a low educational background and believe that the credit scheme is a burden, in addition to showing skepticism to accept new fish farming technologies, improving farming practices or learning new ones.
- D. Some direct supports are too advanced for small-scale fish farmers and challenging to implement in the existing farming conditions.

### ***Input subsidies may not be as inclusive***

Policies that reduce the cost of inputs, such as fuel subsidies, while beneficial, are not the most inclusive, because they tend to favor large companies over small producers. In 2017, such policies accounted for 40% of the direct support to individuals and companies in the fisheries sector, as reported in the OECD Fisheries Support Estimate database, for 27 OECD countries. The OECD recommends that the goal should be to move away from such policies and instead, where possible, provide direct income support through targeted cash transfers instead, to the benefit of both livelihoods, the environment and the sustainability of the sector (OECD, 2021).

### ***Extensive specific financial support for the aquaculture and fisheries in developed countries***

Numerous programs were developed by the United States government to assist general SMEs, including fisheries and aquaculture companies, while also specific fisheries and aquaculture programs were introduced. Most programs were designed to compensate for the additional costs incurred during the pandemic response with non-payable and payable credits and grants. In the case of New Zealand and Japan, numerous general financial assistance programs were established in the form of direct economic relief and credits, some of them ended up benefiting aquaculture farmers ([See Box 12](#)).

The United States allocated US\$ 300 million for fisheries and aquaculture businesses under the Coronavirus Aid Relief and Economic Security (CARES) Act. The categories for funding were direct payments, fishery-related infrastructure and fishery-related education. Within this framework the Coronavirus Food Assistance Program 1 (CFAP-1) was implemented, which consisted of direct assistance to producers of agricultural commodities who suffered a price decline of 5% or greater as a result of the pandemic, and who incurred substantial marketing costs on their inventories. To be eligible for payments, an individual or legal entity had to have an average adjusted gross income of less than \$900,000 for tax years 2016, 2017, and 2018. However, if 75% of their adjusted gross income was derived from farming, ranching, or forestry, the limit of \$900,000 did not apply. For the CFAP-2, in effect from September 2020 to October 2021, all species of aquatic organisms grown for human consumption, fish raised as feed for fish consumed by humans, and ornamental fish. propagated and reared in an aquatic medium were eligible. Eligible aquaculture species had to be grown in water in a controlled environment by a commercial operator. This included molluscan shellfish and seaweed that were previously covered by a different program under the U.S. Department of Commerce. Eligible sales included only sales of raw commodities grown by the producer. The portion of sales resulting from value added to the commodity, such as processing and packaging, and from sales of products purchased for resale were not included in the payment calculation.

The US Paycheck Protection Program (PPP) was an emergency disaster loan program administered by the Small Business Administration (SBA) designed to provide funding to small businesses with fewer than 500 employees who were affected by the 2020 coronavirus pandemic. The PPP loans were up to 2.5 times the average monthly payroll in 2019 (with different payroll windows available for seasonal or startup businesses) to pay up to 8 weeks of payroll costs, including benefits. Funds could also be used to pay mortgages interest, rent and utilities. Annual wages were capped at \$100,000 for payroll calculation purposes. To be eligible for payments, an individual or legal entity had to have an average adjusted gross income of less than \$900,000 for tax years 2016, 2017, and 2018. Funds were fully forgiven if used for payroll costs, mortgages interest, rent, and utilities (if at least 75% of the forgiven amount must have been used for payroll). Loan payments were deferred for six months. No collateral or personal guarantees were required. Neither the government nor lenders charged fees to small businesses. Interest rate was 1%, and the loan was to mature in two years. The aquaculture sector benefited with 962 business, for a total value of \$45.6 million and at an average of \$47,376 per loan (reported through 1 December 2020)<sup>21</sup>.

The Economic Injury Disaster Loans (EIDL) was a U.S. program established prior to COVID-19 that distributed loans from the SBA to help small businesses whenever a disaster was declared by the federal government. The loans ensure that a business has access to working capital and can pay for all business expenses while recovering from the disaster. As a result of the economic impact of COVID-19, the entire U.S. was declared a disaster area and several changes were made to the program. First, in addition to the traditional EIDL program, the CARES Act provided US\$10 billion to the SBA to fund a new EIDL Advance program. Low-interest loans and loan advances were available to small business, agricultural business (including aquaculture) and private non-profit organizations. EIDL assistance was available only to small businesses when the SBA determined that they were unable to obtain credit elsewhere. The maximum amount was US\$ 2,000,000 for loans and up to US\$10,000 for loan advances. The repayment period was up to 30-year.

USDA launched the “Seafood Processors Pandemic Response (SPPR) and Safety Block Grant Program in 2021 with approximately US\$ 50 million in funding to provide grants and loans to seafood processors and processing vessels for pandemic response costs, including measures to protect workers against novel coronavirus. The purpose of the SPPR was to assist State agencies in paying for COVID-19 preparedness, exposure prevention and response costs for seafood processing facilities and processing vessels. State agencies issue payments for costs incurred between 27 January 2020, the date upon which the public health emergency was declared by the U.S. Department of Health and Human Services and 31 December 2021. For example, costs associated with paid sick leave for an employee or housing for workers’ quarantine due to COVID were eligible for funding. However, lost revenue due to spoilage or lost production were not eligible for reimbursement under the SPPR Grant. The fund encouraged applications that benefited smaller processors and vessels, socially disadvantaged processors, veteran processors, and/or underserved communities.

In 2022, the USDA created the program “The Tribal Seafood Pandemic Response and Safety”, which provided grants to seafood processors owned and operated by Federally Recognized Indian Tribes, as defined in the List Act of 1994 (Pub. L. No. 103—454). The program was developed in response to extensive stakeholder feedback from Tribal representatives indicating that they were significantly impacted by the COVID-19 pandemic and were receiving inadequate federal assistance. The grant program provided funding to help offset the costs of measures taken by companies to protect workers from novel coronavirus. Approximately US\$ 1,000,000, less administrative expenses, was available to fund applications. Funds could be used to cover costs incurred between 27 January 2020 and 31 December 2021. The minimum funding request amount was US\$ 100,000 and the maximum US\$ 500,000.

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<sup>21</sup> <https://www.federalpay.org/paycheck-protection-program/industries/other-aquaculture>

In Canada, the Canadian Seafood Stabilization Fund provided \$62.5 million Canadian dollars to help applicants: (1) increase storage to deal with excess inventory, (2) ensure the health and safety of workers and the local food supply, (3) adopt advanced manufacturing technologies and (4) adapt to changing needs and demand, only aquaculture processing sectors were eligible for this fund. However, the fund could be used to aid in the farming of aquaculture products (Government of Canada, 2020).

During the interview with the representative of Chinese Taipei representative, a number of financial support programs for fish farmers in place during the pandemic crisis were listed:

*“There are programs to support financially such as giving subsidy directly to farmers 10000-30000 NTD/person (US\$ 329-989), subsidy when reducing culture amount, interest free loan for 1 year, subsidy for longer culture period (reducing selling pressure), help to obtain Aquaculture Stewardship Council certification (for grouper), help open overseas market for ornamental fish, grouper, tilapia and soft shelled turtle, subsidy for transportation fee to overseas market (grouper and tilapia), subsidy for drug residue testing, money to sellers if the selling amount decreased by 20%, money for grouper farmers if they were awarded with Traceable Agricultural Products certification and subsidies for packaging materials, processing, frozen storage, canning, etc.”*

Additional programs identified in the island include the COVID Relief Stimulus 4.0 program, which provided incentives for processed, canned and preserved fishery products to benefit food producers that needed to use storage facilities for their products for more than one year (6-15 yuan/unit). Additionally, credits were available to fishers and aquaculture farmers through the “Credit Department of the Agriculture and Fisheries Association” and the “Agricultural Bank of Chinese Taipei”.

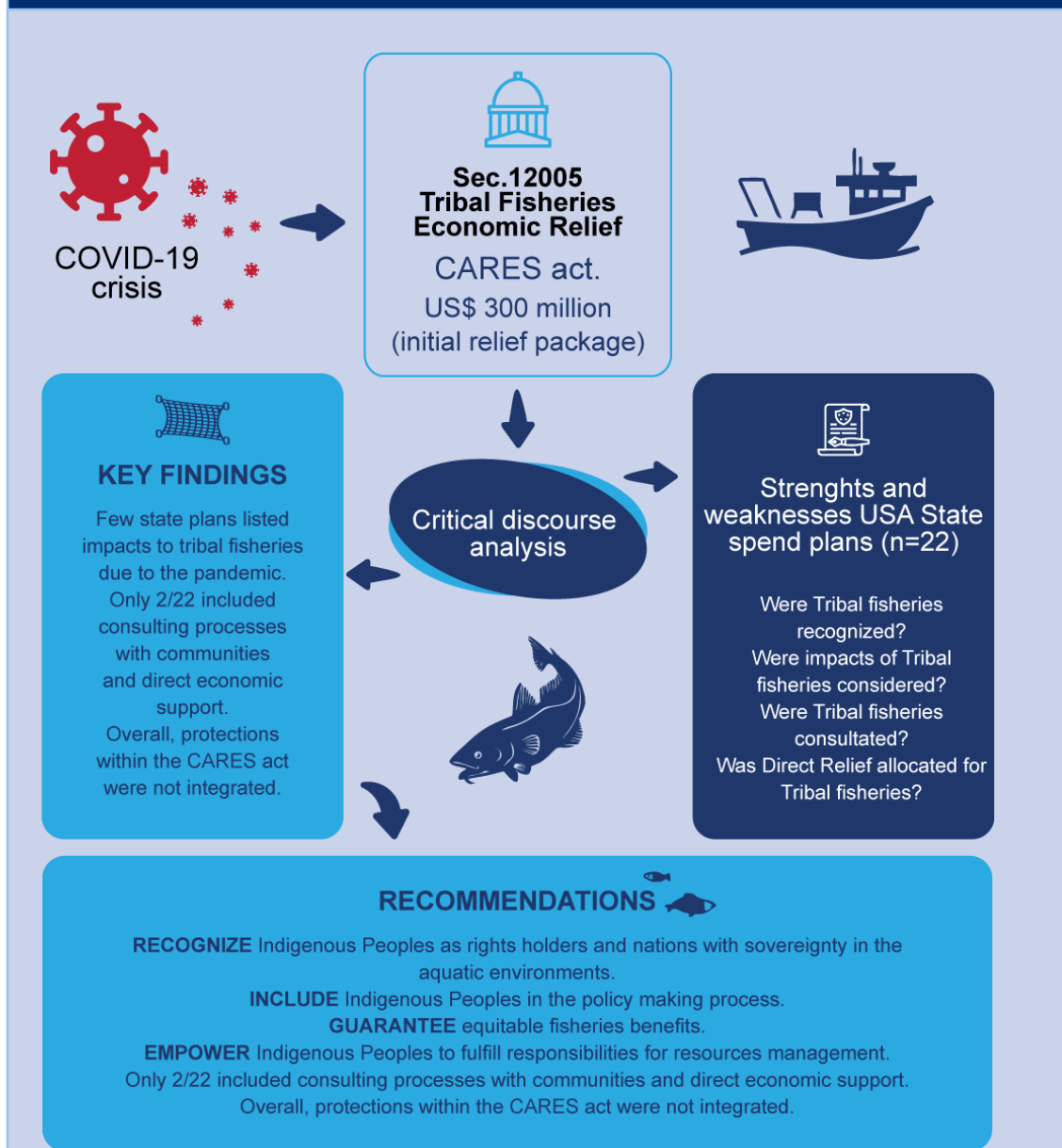
#### ***Inclusive financial assistance***

Financial assistance policies, particularly in crisis events, must include all vulnerable groups within their plans and guarantee conditions that allow them to receive such benefits. A global assessment on sources of injustices across aquatic food systems in national policy documents found that a frequent failure is that policies lack or do not specify how different groups can participate in the decision-making processes (Hicks et al., 2022). Leonard, (2021) analyzed the inclusion of Tribal Fisheries in some of the implemented COVID-19 policies for the fisheries sector in the United States through Social Discourse Analysis showing that few State plans recognized the impact of the pandemic on these group and considered direct financial relief for Tribal Fisheries, even when the Federal Sec. 12005 Tribal Fisheries Economic Relief recognized their importance ([See Box 7](#)).

Small-scale fish farmers should have easy access to loans with few requirements and higher tolerance. For example, collaterals in loans are one of the most feared issues by fish farmers and fishers alike, since SSA farmers have limited physical capital to serve as collateral. In Indonesia, funding schemes with special characteristics for SSA are granted by the Maritime and Fisheries Business Capital Management Institute (“Lembaga Pengelola Modal Usaha Kelautan dan Perikanan”, LPMUKP), this agency was established in 2009 by the MMAF to improve access to capital for marine and fishery communities. LPMUKP is a financial agency that can provide financial assistance and business advice to small-scale fish farmers and fishers, so that they are not burdened with debt to major cooperatives, which usually charge high interests, and are also not dependent on middlemen who provide loans but with significant impacts on purchase prices. During the interviews it was mentioned that “*the role of this special agency is currently limited by funding and human resources to reach more small-scale fish farmers distributed in Indonesia’s regions*”. LPMUKP helped farmers during the pandemic by signing loan facility agreements to help absorb the impacts for fishers and fish cultivators affected by the COVID-19 pandemic with fisheries cooperatives and processing

market groups, as well as developing loan restructuring programs with extension of the credit period for fish farmers and even a mentoring program that allowed to discuss and provide solutions to each producer's problems.

**Box 7. Sustaining tribal fisheries: U.S. economic relief policies during COVID-19 (Leonard, 2021).**



Additional selected financial measures introduced by APEC economies for the fisheries and aquaculture are shown below:

- Chile introduced specific aquaculture credits: “PAR Chile Apoya Acuicultura de Pequeña Escala (APE) y MyPEs acuícolas”. This initiative supports micro and small companies through the financing of individual projects, the possibility of training, business plans, consulting, technical assistance, working capital and/or investment projects.
- Mexico provided subsidies for fuel, refrigerated vehicles to transport fish and reductions in duties and tariffs on the importation of essential fishing tools and equipment in an attempt to lower the market prices at which fishers sell their catch to local processors.



- Indonesia launched the Warehouse Receipt Program, in August 2020, through which fishers could store their catch in designated cold storages and receive a receipt to use as collateral for the bankbacked loan at 6% interest per year.
- In Korea, the government has allocated HRW \$ 3 billion (US\$ 2.4 million) to provide low interest (1.3%) loans to aquaculture households and fisheries businesses facing cash flow difficulties due to COVID-19 (OECD, 2021).
- The Philippines launched a loan assistance for marginal farmers and fisherfolk, as well as agri-fishery micro and small enterprises in the midst of the COVID-19 pandemic (Nakpill, 2020).
- In Thailand, low-interest bank loan programs were developed by government banks and ultimately benefited SSA farmers, including the “Quick Loan Support for Persons Affected by COVID-19” with a maximum loan of THB 10,000 (US\$ 325) and the “Project on Reducing Production Cost of Marine Shrimp Farming to Increase the Sustainable Competitiveness in Marine Shrimp Industry 2021” with a maximum loan of THB \$ 3 million or US\$ 100,000. These programs were available for farmers who needed more financial support to maintain their livelihood.
- In April 2020, the 25% tariff on tilapia imported from China to the United States was removed, which softened the blow of the pandemic and contributed to the growth of the tilapia industry seen in China in 2020 (Dai et al., 2022). However, the tariff was reinstated in August of that year.

#### **Government support is necessary, but not sufficient**

The pandemic has strengthened the role of governments around the world to addressing the health and economic crisis, however, poor economies cannot rely on the government alone to address all the needs of the sector. In this sense, as one interviewees point out, *“linkages or collaborations between government agencies, the private sector, research institutions, or the academy can be more efficient and beneficial to all concerned parties. The research institutions or the academy can provide the science-based technologies developed through research. The private sector can provide the capital, and the government agencies can supervise and monitor the project. These joint efforts can accelerate development and help increase production for the small-scale aquaculture sector”*. NGOs have supported the fisheries and aquaculture sector during the crisis in developing countries (Aliyah et al., 2021).

### **III.3. Social protection and employment responses**

#### **COVID-19 and social inequalities in aquaculture**

COVID-19 has highlighted and exacerbated existing social inequalities and the weakness of existing forms of social protection in many countries (FAO, 2021a). Social protection is a human right, and according to the ILO, can be defined as a set of measures aimed at preventing poverty and vulnerability throughout people’s lives<sup>22</sup>. Several social protection measures have been introduced by APEC economies to mitigate the impact of COVID-19 on the livelihoods and poverty of the general population (See Table 5). Some of these measures may have directly benefited small-scale aquaculture farmers. However, the extent of the direct benefits from those measures for aquaculture workers is difficult to measure, yet informal aquaculture workers remained beyond the reach of these measures. The World Bank has developed a tool considered a “living paper” that compiles social protection and labor measures planned or implemented by 223 world economies in response to COVID-19<sup>23</sup>. The document, updated through 2 February 2022 shows that all APEC member economies, with the exception of Papua New Guinea, introduced or extended general cash payments to vulnerable groups in the population. Such payments most definitely indirectly reached artisanal aquaculture farmers since they are part of the general population with less income.

<sup>22</sup> International Labor Organization. Accessed: 18 January 2023. Available in: <https://www.ilo.org/100/en/story/protection/>

<sup>23</sup> World Bank. Accessed: 18 January 2023. Available in: <https://openknowledge.worldbank.org/handle/10986/33635>

	SOCIAL ASSISTANCE					SOCIAL INSURANCE			LABOR MARKETS			
	Cash-based transfers	Public works	In-kind (in-kind school feeding)	Utility and financial support	Paid leave/une mployment	Health insurance support	Pensions and disability	Social security contributions (waivers/subsidy)	Wage subsidy	Activation (training)	Labor regulation adjustment	Reduced worktime subsidy
Australia												
Brunei Darussalam												
Canada												
Chile												
China												
Hong Kong, China												
Indonesia												
Japan												
Korea												
Malaysia												
Mexico												
New Zealand												
PNG												
Peru												
The Philippines												
Russia												
Singapore												
Chinese Taipei												
Thailand												
US												
Vietnam												

Source: Extracted from Social Protection and Jobs Responses to COVID-19: A Real-Time Review of Country Measures. World Bank.

**Table 5.** Overview of social protection measures by different components in APEC economies



### *Loosening visa restrictions for seasonal workers*

The loosening of travel and visa restrictions to attract foreign seasonal workers, and administrative flexibility were introduced in Canada; Brunei Darussalam; Japan; New Zealand, and Australia. Some of the actions for social protection and employment responses that benefited the fisheries and aquaculture sector are summarized next:

- In Indonesia employment of thousands of fisheries workers who have lost their jobs due to COVID-19 was performed through the “Indonesia Coral Reef Garden”, the National Economic Recovery Program and the “Mangrove Restoration Program” (SEAFDEC, 2022b).
- Malaysia provided a one-off cash payment of MYR 1000 (247 US\$) to households belonging to the bottom 40 income group (monthly earning less than MYR 4000 (US\$ 990), where most fishing households belong (Ferrer et al., 2021).
- The Philippines established a subsidy in the form of PHP 2000 (US\$ 41), a voucher for food items and a cash voucher worth PHP 3000 (US\$ 62) under the Cash and Food Subsidy for Marginal Farmers and Fisherfolk Program (Ferrer et al., 2021).
- In Thailand, SSA benefited from direct economic assistance from the national government (THB 5000 or US\$ 163 per farmer per month during April–June 2020) and subsistence supplies (e.g. rice, instant noodles, preserved foods, etc.) from provincial governments (Chumchuen et al., 2022).

### **III.4. Supply chain and marketing measures**

#### *Securing the aquaculture supply chain*

The most important measure taken to secure the aquaculture supply chain worldwide was the inclusion of aquaculture as an essential sector and the issuance of safe passes to transport either products or inputs. Most governments excluded fish production from lockdown orders from the beginning. However, delays in exemptions from lockdown measures greatly affected production such as seen in Peru processing facilities, which had further repercussions on the global supply of fish meal and oil.

Support for airfreight to maintain important international routes for high-value products, including highly perishable fish products such as chilled seafood was important in Australia and New Zealand, which suffered disproportionately from the collapse of air travel. Brunei Darussalam also created a top-up fund for aquaculture operators to bring in raw materials such as fish fry by chartered flight (SEAFDEC, 2022b).

Typically, Australian seafood exports are transported in the cargo hold of commercial aircraft, but with few international passenger flights under COVID-19 restrictions, the majority of outbound flights were canceled, resulting in the loss of transport routes (Bernadette, 2020). The Australian Government’s “International Freight Assistance Mechanism (IFAM)” was a temporary emergency measure to help restore these critical global supply chains, with aircraft departing from key Australian ports to deliver high-value Australian products to priority export markets. IFAM helped move high-value perishable Australian products to existing international markets, including seafood products such as lobsters, given the cost of airfreight, low-value products were not eligible. The program began on 1 April 2020 and closed on 30 July 2022 and allowed Australia’s fishers and fish farmers to deliver products to key international markets including China, Japan, Singapore and the United Arab Emirates. The IFAM was not intended to fully offset the increase in freight costs to pre-COVID19 levels. However, by contributing to a portion of the airfreight costs, the Government seeks to ensure Australian exporters can reset and recover quickly when the COVID-19 crisis begins to abate.

The New Zealand Government has established programs to ensure that critical supplies can continue to flow to and from New Zealand called “International Air Freight Capacity” and “Maintaining International Air Connectivity”. The former will run until March 2023. These programs provide a predictable and regular schedule of air services to maintain New Zealand's

international connectivity to key markets. Exporters can access flights through freight forwarders.

#### **Internal measures: new marketing or sales channel**

In the US, a national survey of aquaculture, aquaponics and allied business found that up to 55% of the respondents had implemented or attempted to implement a new marketing or sales channel by the end of the year 2020 (van Senten, Smith, et al., 2021). However, where local markets were not mature enough, companies could not redirect sales, as in the case of high-value export species farmed in small aquaculture markets such as Brunei Darussalam, which were mainly exported to China, before the pandemic<sup>24</sup>.

#### **Temporary removal of fish production: the importance of cold storage facilities**

Changes in demand for fish products led to increased food waste and losses. Some fish farmers used to sell to the HORECA adopted the coping strategy to keep their fish alive or to stock their products, mainly by freezing them, in the hope of selling them shortly afterwards. However, as demand did not recover quickly enough, they also had to find alternative market channels. Temporary withdrawal of fish production from the market was mandatory to reduce loss and waste of fish products, and increasing cold storage was an important strategy for aquaculture products where demand had decreased but production could not be easily slowed or stopped.

- In Indonesia, cool boxes were distributed to fishmongers and collectors to improve the implementation of the cool chain and the Warehouse Receipt Program contributed to ensuring the preservation of fish products during the low demand periods (Maruff, 2020). In August 2020, the MMAF launched this program through which fishers could store their catch in designated cold storage facilities and receive a receipt to use as collateral for the bank-backed loan (up to 70% of their catches' value) at 6% annual interest. This initiative was designed to address the shortage of cold storage capacity caused by the decline in export demand.
- The Japanese government provided real-time data on the storage capacity of frozen warehouses to help farmers decide the best responses to remove their excess production.
- Malaysia allocated MYR 100 million (US\$ 25 million) to develop food storage and distribution infrastructure (Ferrer et al., 2021).

One of the lessons from the pandemic is that sufficient cold storage capacity could mitigate major demand constraints, according to an interview with a leading Filipino scientist: *"The government should also build infrastructures such as cold storage and processing plants in the top fish- and aquaculture-producing provinces or cities to preserve the products and extend their shelf life. These facilities are only available in metropolitan areas like Manila, Cebu, or Davao."* The interviewee from Chinese Taipei mentioned that a better cold chain is currently under construction in the island and that products such as cans are being encouraged for processing more fish production and maintaining quality control.

#### **Promoting seafood consumption and institutional seafood purchasing**

Promoting domestic seafood consumption was taken by some APEC economies including Australia; Indonesia; Japan; Peru, and Thailand. Another measure taken by governments was the institutional purchase of seafood, which had two main benefits in combating the effects of the pandemic, first to absorb the fishery/aquaculture products when farmers had difficulty marketing their products, and second, to help alleviate hunger. In addition, some local

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<https://www.seafoodsource.com/news/aquaculture/brunei-aquaculture-firm-switches-to-seedlings-as-transport-to-china-remains-closed>

governments bought fish to include it in the food distribution to families affected by quarantines.

- The Australian Government launched a AUD \$4 million program, the “Eat seafood Australia” campaign, to support the survival and recovery of the Australia’s seafood sector through a 12-month (2021-2022) national awareness campaign encouraging Australians to eat healthier sustainable Australian seafood. Funding was provided to Seafood Industry Australia (the National peak body representing the entire Australian seafood industry or SIA) to deliver the marketing campaign to help the sector recover from the significant decline in demand for Australian seafood as a result of COVID-19. (Australian Government, 2020). SIA has also developed a simple Fish Finder Directory to help consumers find and purchase fresh or cooked Australian seafood online or direct from retailers for delivery or pick-up<sup>25</sup>.
- Indonesia adopted the institutional purchase and distribution of seafood products in the Disaster Care Program to assist seafood producers receive their products for processing and distribute them to the most affected communities. Fish was included in food packages under central and local governments support programs (e.g., “Program Keluarga Harapan”, “Bantuan Pangan Non Tunai”) (Ferrer et al., 2021).
- The Peruvian national program “A Comer Pescado”, which promotes the consumption of hydrobiological products, was an important tool for the reactivation of artisanal fisheries and rural aquaculture during the pandemic. The program develops regular open fairs named “Mi Pescadería”, which are disseminated through social networks and the media such as local radio and television channels to stimulate the commerce of hydrobiological products<sup>26</sup>.
- During the pandemic in the US, the Agricultural Marketing Service purchased a wide variety of fruits, vegetables, meat, dairy and seafood products. These “USDA Foods” were provided to USDA’s Food and Nutrition Service nutrition assistance programs, including food banks that operate The Emergency Food Assistance Program, and are a vital component of the nation’s food safety net.

#### **External measures: new marketing or sales channel**

As the marketing stage of the AVC was one of the most affected by the pandemic, the National/Federal Governments in the region applied external strategies to facilitate the farmers’ access to new markets and the consumption of seafood products. Additionally, promoting digitalization and e-commerce contributed to this goal (See Section 3.6).

- In the Philippines, through the program “Seafood Kadiwa ni Ani at Kita on Wheels” (FAO, 2020c) the BFAR facilitated assistance by linking fish producers to markets outside of their municipality, such as mobile or open markets. This allowed farmers to bring fresh fish products (retail selling) to communities affected by the lockdown, helping to stabilize food supply, which was perceived as very helpful by fish farmers and fishers (Manlosa et al., 2021). The program has continued in 2021 and 2022.

### **III.5. Management and technical measures**

#### **Internal measures: mitigation through changes in production techniques**

Several strategies were adopted by aquaculture farmers worldwide to cope with the initial shock of the pandemic: low densities, the introduction of new aquaculture species, staggering harvest over different periods and increasing varieties of high-value species (Lebel et al., 2021; Mangano et al., 2022). In the Mekong region (including Thailand and Viet Nam), the most

<sup>25</sup> Seafood Industry Australia. Accessed: 12 January 2023. Available in: <https://seafoodindustryaustralia.com.au/fish-finder/>

<sup>26</sup> Peruvian Government, Ministry of Production. Accessed: 18 January 2023. Available in: <https://www.gob.pe/acomerpescado/>

common coping farming strategies (seen in June-August 2020) included adjusting stocking rates, reducing labor inputs, using savings, and borrowing money (Lebel et al., 2021). Chumchuen et al., (2022) found that in Thailand more than 70% of small-scale farmers in the crab, fish and shrimp industries reported that they have adapted their farming activities mainly by delaying stocking and to a lesser by reducing stock density, some farmers in the study even opted to sell all of their production immediately, despite of low profits, during the early stages of the COVID-19 pandemic and before the market collapse. The shrimp farming industry in Thailand was advised to reduce their production by 50 % due to the expected low demand for shrimp as most consumers choose cheaper protein sources (Kaewnuratchadasorn et al., 2020).

In Indonesia, a SWOT analysis found that the main strategies for the recovery of aquaculture business in Magelang were: increasing production capacity, digitalization, increasing the frequency of mentoring and group development by the government, improving product quality, business diversification, proportionality of the number cultivators in the hatchery and rearing segment, providing education to farmers regarding the impact of COVID-19, strengthening capital, expanding the implementation of the Independent Fish Feed Movement program, protecting the farmers, and strengthening of market access (Rochvita et al., 2021). On this topic, Dr. Hatim Albasri synthesized the coping strategies applied by aquaculture farmers in Indonesia:

- Keeping the stock of ready-to-sell fish until buyers are available.
- Reducing the feed given, feed quality, feeding frequency of the stocked fish and number of workers. Members of Immediate families are directly involved in reducing hired workers' expenses
- Looking for direct local and regional sales for some of the highly valued species due to reduced or no demands from overseas.
- Change of farmed fish from highly valued species to low value or low trophic farmed fish. For example, shrimp ponds were temporarily used for farming milkfish or seaweed.
- In the most extreme cases, farming operations were stopped entirely after most of the last batches of fish were sold
- Reducing the selling price to improve cash flow and reduce fish maintenance risks.

### III.6. Promoting digitalization, innovation and sustainability

#### *COVID-19 and aquaculture leap into e-commerce*

**The pandemic has accelerated the diffusion of e-commerce and delivery intermediaries in the food industry**, allowing companies to make their supply chains more resilient, at least temporarily, and hopefully in the long term (Reardon et al., 2021). Digitalization of the marketing stage of the AVC was one of the most applied and effective solutions to withstand the pandemic by both producers, sellers, and national agencies. In China, processing plants reported that the most immediate measures to cope with the pandemic were to improve processing technology, produce high-value products, and increase e-commerce and online sales (Yuan et al., 2022). This strategy was probably severely limited in Papua New Guinea given the low level of Internet access<sup>27</sup> in the economy, 12% in 2020, well below the regional average of 74% (APEC, 2022). In such cases, a more fundamental goal should be pursued: increase Internet access for the general population, before making major investments in massive digital sites or technologies.

During the COVID-19 pandemic, several APEC economies introduced or strengthened measures to promote the e-commerce in seafood products:

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<sup>27</sup> Measured as the % of total population that used the internet on any device at least once in the past three months.

- The Local Catch Network, created by The University of Maine, linked its members to direct seafood products sales in the US and Canada.
- Thailand set aside a budget to develop an e-commerce platform, where fishers and fish farmers could sell their products and have direct contact with customers without having to deal with middle persons. The budget included the construction of eight distribution centers for fisheries products, including storage and transportation to support the new e-commerce site (Maruff, 2020; SEAFDEC, 2022b).
- Instead of building a government-run e-commerce platform, the MMAF in Indonesia, chose to build the website, [www.pasarlautindonesia.id](http://www.pasarlautindonesia.id), which enables and facilitates fisheries SMEs to join existing e-commerce sites such as Shopee, Lazada, Tokopedia, Gojek and Grab (Maruff, 2020).

The reliance on the domestic market has declined as export markets reopened, however the e-commerce platforms and digital marketplace for domestic market access are likely here to stay (Maruff, 2020) and can even be expanded to regional and global markets. Industries and governments should be aware that this increases the risk of unsustainable, unregulated, and unreported seafood entering domestic markets. One solution is **to link these digital marketplaces to government systems to issue compliance and verification certificates** (Maruff, 2020).

#### **COVID-19 and the prospect to accelerating e-governance**

The pandemic has also served as an **opportunity to simplify and digitalize licensing systems, certificates, processes and even establish remote monitoring** in fisheries and aquaculture related agencies in developing nations that had not adopted such technologies.

- In Indonesia, the government simplified and digitalized licensing across 38 Ministries, including the MMAF, which is now fully consolidated under the National Investment Board. The MMAF has improved its online licensing system, SILAT, which is managed by the Directorate of Capture Fisheries, to process licenses within one hour, which previously took four days (Maruff, 2020).
- In Chile, all documents that would normally be received at SERNAPESCA were allowed to be delivered through electronically and remote health monitoring was installed. As mentioned during the interview with the Chilean representative: *"The digital part was the best of the pandemic, it was the unexpected result, everything has already become digital, inspections are even done remotely. There was a lot of interest from officials to learn and train, even officials who were not from the technical areas, to be able to support. The online world allowed more and more meetings with the competent authorities in a very short time."*
- The processes were digitalized through the Mexican Fisheries and Aquaculture Information System (SIPESCA).
- The Peruvian National Agency for Fisheries Health (SANIPES) introduced the issuance of export certificates with digital signatures and QR codes, for hydrobiological products. During the interview with the representative from the Peruvian Ministry of Production they listed several actions taken to increase e-governance such as: *CREDIPES*, a smartphone application to facilitate the access of fish-farmers to different credits, developed by FONDEPES. Moreover, the Peruvian National Program for Innovation in Fisheries and Aquaculture (PNIPA) implemented the SAPEL application, that allowed digital management of processes, including monitoring, related to the innovation grants for the fisheries and aquaculture sectors offered by the institution.

#### **Using the momentum to accelerate the adoption of innovative technologies for aquaculture**

The experience of accelerated digitalization during the pandemic can be used to increase the rate of adoption of innovative technologies for aquaculture. Innovation can increase the



sustainability components of aquaculture to meet the opportunities arising from the COVID-19 pandemic (Galanakis et al., 2021). For example, digital farming or precision farming and IoT-based solutions can minimize human contact and labor constraints during lockdown periods, facilitate traceability programs and data-driven decision making, and subsequently increase the productivity and sustainability of aquaculture (Maruff, 2020; Jamwal & Phulia, 2021). However, the extent to which smallholder farmers could gain access to such advanced technologies, that require more complex skills, is probably very limited for most developing nations and needs further evaluation (Salajegheh et al., 2022). Experiences from Indonesia indicate that new programs to promote innovation and digitalization for SSA alone are not enough, and such programs should include communication campaigns since most small-scale fish farmers have very little interest in using them ([See Box 8](#)).

**Box 8. Experiences with digitalization and innovation in SSA in Indonesia.**

Interview with: Dr. Hatim Albasri from the Research Center for Fisheries National Agency for Research and Innovation, Indonesia.

Digitalization of aquaculture in farming activities is still low in Indonesia, most of them are still in the research stages. Some startup companies, such as “e-fishery”, have developed robust water quality monitoring systems, automatic feeding and several other innovations in aquaculture. *“However, the cost of running the system, including licensing, is just too expensive for small-scale fish farmers.”* Dr. Hatim Albasri led a research program in cooperation with Japan called “SATREPS Mariculture”, a five year program (2016-2021) to try to introduce digitalization and innovation in marine culture and capture. *“We have developed several digitalization systems such as real-time water quality monitoring system, digitalization of operational records, display viewer for water quality and educational and training platform. Despite the system working perfectly and being free of charge, fish farmers have very little interest in using it due to their strong attachment to their local and personal knowledge-based experience.”*

Several market and traceability systems were developed by the MMAF as part of the effort to digitalize the market system and improve traceability. An application called “STELINA” for the National Fish Traceability and Stock System was launched in 2018 by MMAF. This was a collaboration between USAID Oceans, MMAF, Indonesian local governments, private sector and non-governmental partners to develop and implement an electronic catch documentation and traceability system in the program’s learning site of Bitung, Indonesia. *“However, the rate of use and voluntary reports were relatively minimal, and thus, the Ministry still relies on manual data records to supply the application with recent and complete data regarding the production and traceability of aquaculture products.”*

In the case of small island developed states the pandemic has increased the awareness of the importance of innovation for aquaculture development and ultimately for food security.

- In Singapore, during the COVID-19 pandemic, the government added \$30 million Singapore dollars (about US\$ 21 million) to a 2019 program designed to increase food self-sufficiency from 10% to 30% by 2030, commonly called the “[Singapore Food Story](#)”. The money was used to rapidly increase the production of vegetables, eggs and fish by local farms in the shortest time possible (Teng, 2020). Ensuring food security can be especially problematic in small island states like Singapore, where self-sufficiency is limited by the availability of land, fresh water and labor. Aquaculture can contribute to such a goal in these states through innovative technologies.
- In late 2020, Hong Kong adopted a similar approach with the “[Accredited Fish Farm Scheme](#)” to promote the sustainable development of the local aquaculture industry. This program aims to increase the contribution of local seafood consumption by

providing technical assistance, regular visits and sampling, complementary veterinary services, strong product traceability, a platform for business opportunities and opportunities to participate in exhibitions and trade shows<sup>28</sup>.

For government-sponsored projects to succeed, there must be integral oversight from the proposal to the final product development with ongoing support along the way: *“The government should consider providing technical assistance to the farmers interested in these production systems, especially when new concepts are being introduced. The government should provide funds to the farmers for them to attend training courses to better understand these new systems.”* Furthermore, financial assistance, such as loans with low interest rates, should be provided to help them start their businesses. For new farmers, the government should first help them find and establish markets for their products.

### **Promotion of sustainability and resilience**

Prior to the COVID-19 crisis and its aftermath, aquaculture was already facing major challenges including diseases, natural disasters, environmental threats and social development. In some cases, COVID-19 has combined the effects of simultaneous stressors, including climate change, pollution, fish diseases, natural disasters and war (Sarà et al., 2022b). In areas prone to natural disasters, the pandemic was perceived as less impactful than climate change or natural disasters (Rendón et al., 2021; Sarà et al., 2022). These factors will affect aquaculture once again in the future and the current knowledge of this crisis must be seen as an opportunity to change the future direction of the aquaculture sector.

There is an increasing pressure worldwide on stakeholders, policymakers, industries and farmers, to adopt more sustainable policies, practices, and processes (Galanakis et al., 2021). **The pandemic has impacted the Paris Agreement’s goals of “enhancing adaptive capacity”, “strengthening resilience” and “reducing vulnerability” to climate change**, as countries have been forced to prioritize health and economic recovery (UNEP, 2021); this means that COVID-19 recovery plans should include an environmental component to support blue economic recovery. To cope with the increased risks and to enhance resilience of aquaculture systems, a range of different mitigation measures should be applied.

### **Diversification of farmed species and products**

Kevin Heasman, a researcher from the Cawthron Institute in New Zealand provided insights into the benefits of diversifying farmed species: *“Most of the main species (King salmon, oysters, mussels) are investment intensive. Smaller players need to develop alternative species that require less upfront investment, or the development of co-operatives with a central supply/market hub with satellite grow-out options. This is not a traditional avenue of advancement for New Zealand and may have difficulty getting traction.”*

### **Polyculture systems and their observed resilience in the COVID crisis**

Resilience can be defined as the ability of a production system to respond and adapt to unexpected events while maintaining the same function and structure as before. Polyculture practices, including IMTA, aquaponics and integrated agriculture–aquaculture, can improve the resilience of aquaculture and among such systems IMTA farming has been shown to be more resilient to most of the effects observed during the COVID-19 pandemic, [See Box-9](#) (Mangano et al., 2022). Nevertheless, IMTA systems are still an emerging technology in many countries, as highlighted in an interview, *“IMTA is an emerging technology in the Philippines. It is not a major aquaculture system used by the aquaculture sector. Where IMTA is being practiced, usually at the experimental level, not at the large-scale and commercial level”*. When introducing

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<sup>28</sup> Mark Godfrey. New fish farming standards designed to lift Hong Kong’s aquaculture sector. 12 November 2020. Accessed: 18 January 2023. Available in: <https://www.seafoodsource.com/news/aquaculture/new-fish-farming-standards-designed-to-lift-hong-kong-s-aquaculture-sector>



new polyculture systems, including IMTA, it is critical to ensure species compatibility and complementarity (Thomas et al., 2021).

#### *Innovation and current customers preferences for aquaculture products*

The pandemic has shifted customers preferences and has accelerated pre-existing innovation trends. Over the last years, strengthening the immune system has been a priority for consumers, a trend that has accelerated in the COVID-19 era, and consumers' interest in sustainable, healthy, organic, and functional foods has grown rapidly. In this regard, the Korean Ministry of Oceans and Fisheries announced, in December 2021, a Master Plan for the Management and Utilization of Marine Healing Resources to promote the marine healing industry. “Marine healing” refers to activities to improve the health of the people, such as improving constitution, enhancing immunity, and anti-aging through the use of marine healing resources. Over the next five years (until 2026), the master plan will lay the foundation for the marine healing industry and promote full-scale industrialization through R&D, the establishment of an integrated information system, professional training, the establishment of cooperative networks and the promotion of public awareness.

#### **Box 9. The aquaculture supply chain in the time of covid-19 pandemic: Vulnerability, resilience, solutions and priorities at the global scale (Mangano et al., 2022).**

A global digital survey (52 countries) was conducted on the perceptions of aquaculture stakeholders from different farming strategies (land-based or sea-based, intensive or extensive and IMTA systems) during the initial shock phase of the pandemic, May 5-29, 2020.

In this assessment, **IMTA systems were more resilient to most of the impacts observed during the COVID-19 pandemic**. IMTA stakeholders, from both land-based and sea-based, extensive and intensive farms, experienced proportionally less or no economic hardship during this phase, and statistically less or no impact on job losses, particularly in sea-based intensive systems. IMTA systems offer diversified products with more than one or two market options, which may have allowed farmers to take advantage of still-active sales channels and weather the pandemic.

Moreover, firing was a less common mitigation measure adopted by IMTA farmers, an important response from a social resilience perspective. Among external mitigation strategies, IMTA farmers expressed a higher interest in exploring new market strategies and direct sales, scientific support and supply chain promotion, while non-IMTA farmers expressed a higher preference for direct economic support from government agencies.

In general, farmers working with IMTA showed a preference for tools typical of “Flexible Business Models” which are considered one of the best mitigation strategies to cope with distribution risk. However, IMTA systems may be more vulnerable to external shocks at the hatchery stage, due to difficulties in seed availability, as they rely on seeds for different animal species.

### **III.7. Promoting sex and gender equality**

#### *Sex-disaggregated data and gender statistics are key to formulating inclusive policies*

Concerted efforts are needed within the aquaculture sector to prevent the pandemic from reverting all the achieved progress towards gender equality. This will require the development of appropriate gender-sensitive mitigation strategies. Despite their importance, sex disaggregated data and gender-specific data were not systematically collected worldwide before COVID-19, and this has been exacerbated by the global pandemic. **Sex-disaggregated**

**data and gender statistics are key to identify discrepancies between women and men during COVID-19**, and to making informed policy and development program decisions for people who depend on the aquaculture sector (Choudhury et al., 2022). To develop effective responses, women must also be a part of the decision-making process and this process must be supported by high-quality data and evidence-based solutions.

In 2021, the government of Chile published a report about the status of men and women in the fisheries and aquaculture sector, which shows that in the national composition of the sector 25% are women and 75% are men, among numerous details of gender disparities in the sector, demonstrating minor advances, although there is still a long way to go to empower women (Government of Chile, 2021). The development of similar tools should be considered across all APEC economies, and more importantly, maintain them in the long term, not only to map the current status, but also to monitor the effectiveness of actions and policies towards women's equality in aquaculture.

### **III.8. Compilation of key measure introduced by APEC member economies that have benefited the fisheries and aquaculture sector since COVID-19**

A summary of the identified general and fisheries-aquaculture specific is presented next:

**Box 10.** *Key measures and programs implemented by APEC economies in the America to the support of the aquaculture sector in response to the COVID-19 pandemic.*

#### **Chile**

Safe pass for fish and aquaculture related industries (March 2020).  
 Action plan for the coronavirus in the salmon industry supply chain (April 2020).  
 Resolutions were adopted to extend the stocking period, facilitate the shipment of samples as part of disease surveillance programs, and extend the time fish can remain in the water and in storage facilities.  
 Digitalization of processes, including licensing in SERNAPESCA. (March 2020).  
 Implementation of remote sanitary surveillance of aquaculture farms.  
 Aquaculture specific grants “PAR Chile Apoya Acuicultura de Pequeña Escala (APE) y MyPEs acuícolas”, for micro and small companies, with 100% financing of each individual project with a maximum of \$4 million pesos (US\$ 4400). Additional regional plans have been developed within the scope of the national program.

#### **Peru**

Specific guidelines for COVID-19 health measures in the aquaculture sector.  
 Digitalization of health certificates for the exportation of fish products.  
 Technical support and free assistance to managers of businesses in the seafood sector in order to improve the productive processes, by means of the promotion of e-commerce and trade networks with the virtual platform “Reactivación en Marcha.”  
 Promotion of domestic consumption of seafood and diversification of seafood products through the National program “A Comer Pescado” that included open mobile fairs “Mi pescaderia.”  
 Financial credits for up to US\$ 525 for artisanal fisheries and aquaculture with limited resources for a total of US\$4.4 million, starting in May 2020.  
 General measure: Access to credits for small and medium-sized companies through the “Reactiva Peru” and “FAE-MYPE” programs. The “Reactiva Peru”, although not specific to the sector, benefited several small and medium-sized enterprises in the fisheries and aquaculture sector.

In 2023, Peru launched the program “Con Punche Productivo”, this is a reactivation package with specific measures for the Fisheries and Aquaculture sector, including \$ 17 million Peruvian “soles” (US\$ 4.4 million) for loans for artisanal and formal fishers and fish farmers, \$ 16.8 million soles (US\$ 4.3 million) for the national program “A Comer Pescado” and \$ 20 million soles for direct cash relief to fishers (US\$ 5.2 million), \$500 soles or US\$ 130 each.

## **Mexico**

Digitalization of government procedures related to fisheries and aquaculture government through the National Fisheries and Aquaculture Information System (SIPECA).

The annual National incentive of the Support Component for the Well-being of Fishermen and Aquaculturists “Bienpesca” was advanced to be delivered in May 2020 to help small-scale producers maintain their activity in the face of the COVID-19 contingency.

Subsidies for fuel, refrigerated vehicles for the transportation of fish and reductions of duties and tariffs for the importation of essential fishing tools and equipment.

## **United States**

Guidance for field activities during the pandemic.

The Agricultural Marketing Service purchased a variety of fruits, vegetables, meat, dairy and seafood products. Food was provided to USDA Food and Nutrition assistance programs, including food banks

The COVID-19 Fisheries Assistance (12005) of the CARES Act 2020 in support of private aquaculture businesses in US states, tribes and territories, funded with US\$300 million from 26 May 2020 through 12 October 2021.

The Paycheck Protection Program was an emergency disaster loan program designed to provide funds to small businesses with less than 500 employees who were affected by the 2020 Coronavirus epidemic, beginning 3 April 2020.

The Coronavirus Food Assistance Program 1 provided direct assistance to producers of specified agricultural commodities including seafood products, who suffered a price decrease of 5% or more as a result of the COVID-19 pandemic, and faced substantial marketing costs for inventories (May 2020 to September 2020).

The Coronavirus Food Assistance Program 2 included assistance to producers of all species of aquatic organisms grown for human consumption, fish raised as feed for fish that are consumed by humans, and ornamental fish. (September 2020 through December 2020 and April 2021 through October 2021).

The Seafood Processors Pandemic Response and Safety Block Grant Program, funds to provide grants and loans to seafood processors and processing vessels for costs incurred in response to the coronavirus pandemic.

The Tribal Seafood Pandemic Response and Safety Grant Program provided grants to seafood processors owned and operated by Federally Recognized Indian Tribes. (Final Application 18<sup>th</sup> April 2022).

The COVID-19 Economic Injury Disaster Loan (EIDL) offered loans to ensure that businesses had access to working capital and could pay for all business expenses they may incur while it is recovering from the disaster. As a result of the economic impact of COVID-19, the entire US was declared a disaster area.

## **Canada**

The Canadian Seafood Stabilization Fund provided funding to the fish and seafood processing sector to increase storage to deal with excess inventory, ensure the

health and safety of workers and of the local food supply, implement advanced manufacturing technologies and adapt to changing needs and demand.

Travel exemptions for all temporary foreign workers, including fish/seafood workers.

The Mandatory Isolation Support Program for Temporary Foreign Workers to assist the farming, fish harvesting, and food production and processing sectors by covering the incremental costs associated with the mandatory 14-day isolation period imposed on foreign workers upon entry into Canada under the Quarantine Act.

The Surplus Food Rescue Program enabled the management and redistribution of existing food surpluses to organizations addressing food insecurity and ensuring that these surplus products were not wasted. The program was designed to address high volume, highly perishable surplus products including fish and seafood.

**Box 11. Key measures and programs implemented by APEC economies in Asia to support the aquaculture sector in response to the COVID-19 pandemic.**

**Indonesia**

Assistance to fishers and fish farmers in the provision of food, personal protective equipment, portable and mobile cold storage, ice makers machines and others.

Employment of workers who lose their jobs through the Indonesia Coral Reef Garden 2020–2024 and the Mangrove Restoration Program (2020–2024)."

Institutional purchase of seafood products by the Disaster Care Program and inclusion of fish in food packages (e.g. "Program Keluarga Harapan", "Bantuan Pangan Non Tunai").

Promotion of aquaculture through the provision of seeds, seedlings, broodstock, feed, pond revitalization, cold chain facilities and support to affected actors.

Development of a platform to enable and facilitate small and medium enterprises in the fisheries sector to join existing e-commerce sites such as Shopee, Lazada, Tokopedia, Gojek and Grab.

Simplification and digitalization of licensing processes.

Warehouse Receipt Program, through which seafood producers stored their production in designated cold storage facilities and receive a receipt to use as collateral for the bank-backed loan (up to 70% of the value of their catch) at 6% interest per year.

**Japan**

Access to continuous data on cold storage capacity created by the Japan Association of Refrigerated Warehouse Association for businesses that were forced to consider implementing frozen storage.

The opening of applications for residence and technical training, and the reception of foreign human resources related to fisheries.

Promotion of local demand by the Go To Eat Campaign, which aims to stimulate local demand for a limited period of time through public-private integration in the food industry.

Sustainability benefits to support the continuation for businesses that were severely affected by the spread of the infection (sales reduced by 50% or more by December 2020 (1 May 2020 to 15 February 2021), including fishers, cooperatives and processors of fishery products.

Temporary support to mitigate the impact of the declaration of a state of emergency, small, medium size and individual businesses (including farmers, fishers, etc.) affected by the shortened business hours of restaurants or refraining from going out due to the declaration of a state of emergency and with a decrease in sales by 50% or more received support from the government through a temporary support fund system (January 2021 to 31 May 2021).

Monthly support money to small and medium-scale enterprises and sole proprietors (including fish farmers and fishers) who have experienced a decrease in monthly sales of 50% or more due to the effects of restaurant closures and shortened business hours, and who self-restricted themselves from going out due to the declaration of a state of emergency or priority measures to prevent the spread of disease (26 June 2021 through 7 January 2022).

Business revival support money, which included benefits to small and medium-sized corporations and sole proprietors (including fish farmers and fishers), who as a direct or indirect result of the coronavirus pandemic (31 January 2022 through June 2022), experienced a 30% or more decreased revenue in any month from November 2021 to March 2022 compared to a base month from November 2018 to March 2021. Subsidies to support the introduction of machinery and equipment for market recovery.

The Rent Support Benefit to reduce the burden of land rent, in favor of workers in agriculture, forestry and fisheries (large companies are not eligible).

## Malaysia

Sector declared as essential, allowing aquaculture activities during the Movement Control Order.

Development and dissemination of clear standard operating procedures and relevant guidelines by the Fisheries State Office and through social media.

In the second economic package the government included the allocation of a special fund of MYR \$200,000 to fishermen's associations to assist them in developing short-term agri-food projects that can produce food within 3 to 6 months and ensure the food supply.

Promote access to new markets through the establishment of alternative marketing and distribution channels such as controlled fresh markets in locations accessible to the public.

Recovery plans to revive the fisheries and aquaculture sector by including the sector in the short, medium and long-term development plans.

## Singapore

General measure - Temporary Bridging Loan Program for business owners to borrow up to approximately US\$ 3.7 million for working capital payable for five years (April 2020).

General measure - The Foreign Worker Levy Rebate which was a waiver of the monthly Foreign Worker Levy Fee by providing businesses with US\$ 555 rebate on the levy paid for each Work Permit/Special Pass Holder (April 2020).

General measure - Jobs Support Scheme as wage support for employers to retain local employees during the period of economic uncertainty by co-funding a proportion of the first US\$ 3,400 gross monthly wages paid to each local employee (February 2020).

Singapore Food Story, which included US\$ 21 million to accelerate the production of vegetables, eggs and fish by local farms in the shortest time possible (April 2020).

## Thailand

The Department of Fisheries issued certificates to operators who follow the measures to prevent COVID-19 contamination in fish products.

General measure: Direct income for small scale aquaculture with US\$163 per farmer (April 2020).

Promote access to new markets through the establishment of distribution channels for the domestic consumption of fish products and the temporary creation of a seafood marketplace.

Promote local markets through the program "Fisheries Shop" in zero-Covid areas.

The Department of Fisheries established a pilot project to promote e-commerce and online marketing platforms.

Project to reduce production cost of marine shrimp farming to increase the sustainable competitiveness in marine shrimp industry (2021) with a maximum loan of US\$ 100,000.

Low interest loans at 5% interest rate.

The implementation of the project “The Dream Comes True” in agriculture, with a total amount of 30,000 million bahts (US\$ 800 million) which consisted in loans of 1000 baht at 1% interest rate.

## **Korea**

The government allocated US\$ 2.4 million to provide low interest (1.3%) loans to aquaculture households and fisheries businesses facing cash flow difficulties due to COVID-19.

Expansion of the Korean fishery exports national brand: K-FISH on global online platforms like Amazon and Shopee.

Promotion of innovation through the development of the Marine Healing Resources program.

**Box 12.** Key measures and programs implemented by APEC economies in Oceania to the support of the aquaculture sector during the COVID-19 pandemic.

## **New Zealand**

International Airfreight Capacity and Maintaining International Air Connectivity, government support for airfreight to maintain international routes for high-value products that suffered disproportionately from the collapse of air travel (May 2021-March 2023).

General measure – Help for businesses to pay their employees while they waited for PCR test results (Short-Term Absence Payment) and for business staff who could not work because of self-isolation (Leave Payment).

General measure - The “COVID-19 Wage Subsidy”, which helped businesses pay employees who could not work, and had a 30% decline in revenue (March 2020).

General measures - The Income Relief Payment was a temporary, short-term payment for people who lost their jobs (March-June 2020) and the Essential Workers Leave Support for employees of essential businesses with a decrease in revenue (April 2020).

General measure - The Small Business Cash Flow Loan Scheme, which provided loans to small businesses, including sole traders and the self-employed, affected by COVID-19 to support their cash flow needs, enterprises should have experienced at least a 40% decrease in revenue over a consecutive 7-day period to be eligible.

## **Australia**

All the fees in Commonwealth fisheries for 2020 were waived.

The Eat Seafood Australia, a 12-month national awareness campaign in support of the seafood sector, a \$4 million AUD program that encouraged the consumption of sustainable Australian seafood (2021-2022).

General measure - “IFAM” which facilitated the export of high-value perishable products (including seafood products such as lobster) to international markets, as well as the import of goods with subsidized air freights (April 2020-September 2022).

General measure - Payment arrangements for overdue debts to businesses and customers facing financial hardship after being affected by natural disasters or COVID-19.

General measure - Migrant visa arrangements to address labor supply issues during the COVID-19 crisis, such as extensions, permissions of regional travel and employee retention.





## IV. SECTION 4: CONCLUSIONS AND POLICY RECOMMENDATIONS

In this section, policy recommendations are formulated based on the lessons learned during the discussion of the previous main sections (including data from questionnaires and interviews) and additional reports on selected issues. Considering the most common disruptions seen during the pandemic ([See Key messages in Section II](#)) and the diversity of strategies designed to mitigate the challenges of COVID-19 in APEC economies ([See Key messages in Section III](#)). Recommendations are divided into **short-term or immediate** responses for future similar crises and **long-term transformative support** to ensure economic recovery and enhance the resilience and sustainability of aquaculture, particularly for SSA and vulnerable groups. A lasting change in the sector can only be achieved through the implementation of a mix of existing, reformulated and/or new policy mechanisms through an **integrated approach that includes financial, social and environmental actions**. Recovery strategies for the SSA sector should follow the recommendations developed for the commemoration of the International Year of Artisanal Fisheries and Aquaculture in 2022 (IYAFA 2022), See Box 13, (FAO, 2022b).

### **Box 13.** *The International Year of Artisanal Fisheries and Aquaculture 2022.*

IYAFA 2022 highlights the importance of small-scale artisanal fisheries and aquaculture (SSAFA) for food systems, livelihoods, culture and the environment, and states that they can become **key agents of transformative changes** including the reduction of food loss and waste, overexploitation of natural resources, and resilience to climate change disruptions and from other important issues such as the COVID-19 pandemic.

For the IYAFA 2022 a Global Action Plan was created, organized around seven interconnected pillars that address challenges and opportunities for small-scale artisanal fisheries and aquaculture to contribute to the achievement of the SDGs.

- **Environmental sustainability, resource stewards:** SSAFA play a fundamental role in ensuring the responsible management of aquatic resources.
- **Economic sustainability, value for all:** Access to markets, appropriate infrastructure and inclusive value chains should be ensured for SSAFA to better provide high quality fish products, promote economic development and generate employment.
- **Social sustainability, living well:** SSAFA need decent living and working conditions to secure their livelihoods and maintain their social, cultural and physical well-being.
- **Governance, nothing about us without us:** SSAFA must have effective participation, supported by comprehensive data and information in the decision-making processes that shape laws and policies that affect them.
- **Gender equality and equity, women and a changing tide:** Recognizing the role of women in SSAFA is essential for women's empowerment and sustainable development.
- **Food security and nutrition, nourishing nations:** SSAFA play a fundamental role in providing healthy, safe, affordable, and nutritious aquatic food and products.
- **Resilience, aware and prepared:** Policies and actions should support the building of resilience for the long-term continuity of the SSAFA.

### **IV.1. Short-term mitigation recommendations**

Immediate recommendations to mitigate the impact of future shocks similar to COVID-19, including future pandemics, on the SSA should seek to ensure that aquatic food value chains



operate as close to “normal” as possible and provide emergency relief and financial support to small-scale farmers.



**Ensure that the aquaculture industry is among essential and priority sectors as soon as possible.** Among the experts consulted, articles and reports, there was a consensus that this was the most important immediate response and in some cases it was not developed as fast as authorities, experts and farmers would have liked. Such policies were key to supporting the input supply, marketing, processing, import and export activities. In cases where budgets for financial assistance are severely limited, fast and proper implementation of such actions is even more crucial.



**Restrictions on the import of seafood products should be avoided; when they are in place they should be reviewed as frequently as possible** and lifted when sufficient scientific data indicate that they do not pose a health risk. These measures disrupted marketing channels for small-farmers even in areas where the COVID-19 pandemic did not affect the general population and contributed to customer panic.



**Small and medium scale companies should be the focus of support packages,** as they are more labor-intensive and account for the majority of aquatic food produced and have fewer contingency mechanisms. Fisheries and aquaculture specific packages should be considered according to the size of the sector, its specific characteristics (informality, associations, seasonality) and differential impacts compared to other economic sectors.



**Eligibility criteria for cash transfers must include vulnerable groups** that depend on informal employment including migrant workers, secondary industries workers, women and native communities. Informal farmers for example may be excluded if social security registration is required. Transparent, simple, and inclusive eligibility criteria needs to be pursued.



**Recovery policies should be regionally specific.** COVID-19 significantly disrupted the spatial market integration of fish in Chinese provinces with high infection rates, while less disruption was found in provinces with low infection rates, suggesting that supportive policies were most needed in such provinces (Wang et al., 2023).



**Increase institutional purchases of seafood during such periods,** which can be included in food aid packages and distributed through social programs to hospitals, schools or directly to the population, is a fast mechanism to absorb the stagnant production and mitigate income losses, particularly for fresh products, while also ensuring livelihoods and food security with a highly nutritious, affordable and low carbon emission food source.



**Ensure the automatic extension of visas for migrant workers during crises periods** for workers, particularly in the fisheries and secondary sectors. Governments must be aware of the contribution of migratory workers to their national aquaculture sector.

## IV.2. Long term support measures

The COVID-19 pandemic not only had a moderate to severe financial impact on aquaculture but has also reversed years of progress on key social indicators such as poverty, food and nutrition security and sex and gender equality, hence measures to promote economic recovery and improvement of social indicators were needed, and in some cases, are still needed. While not all APEC economies have been affected equally, nor have developed economic recovery programs, the pandemic represents a great opportunity for all member economies to enhance

the resilience and sustainability of the sector by highlining weakness such as the heavy dependence on foreign markets, imported products, or weak social security coverage, and by identifying opportunities or accelerating trends such as local supply networks, open markets and digitalization. To this end, this report sets out an action plan of long-term measures. The proposed measures are in line with the Aotearoa Plan of Action for the implementation of Putrajaya Vision 2040<sup>29</sup>, which was endorsed by APEC economies in 2021, and emphasizes the importance of Promoting Innovation and Digitalization; Strong, Balanced, Secure, Sustainable and Inclusive Growth, through the development of resilient supply chains.

#### IV.2.1. Knowledge of the current status and future of aquaculture



**Develop micro-regional and national surveys and studies on the current status of the aquaculture.** Prior to any intervention, knowledge of the current situation of the sector including socioeconomic data and stakeholders' perception is key to formulate effective short- and long-term actions and policies for aquaculture. Special attention to the situation of small-scale farmers to address their needs and the inclusion of sex-disaggregated data are imperative. The government must take the initiative to establish a broad, solid and permanent collaboration with the private sectors, academia, international agencies and local communities, so that all entities contribute to this goal.



**Elaborate a national strategy plan for the development of aquaculture.** This must be formulated together with the actors of each economy, and implemented at the national level as a state policy with a long-term vision, with at least five years into planning. Measures to support aquaculture should align with these objectives.

#### IV.2.2. Strengthening the governance of the sector



**Improve the data collection, database development and transparency on small-scale aquaculture official data and its quality and accessibility.** There is a need for better access to productive and socioeconomic data in seafood from government organizations. Public data has been used by decision-makers as a reliable database of current workers eligible for emergency relief funds, and in some cases, discrepancies in such databases have left people in need without the much-needed income support, while those who were less in need received economic relief packages.



**Consolidate interinstitutional and intersectoral work to maintain a permanent fishery-aquaculture governance.** Regular and fluid interaction between aquaculture stakeholders, including government, relevant aquaculture organizations/associations, and farmers is essential to quickly identify emerging issues and establish consensual actions to promote the health and secure the work of aquaculture farmers. Strong cross-sectoral engagement and co-learning can help to develop more inclusive policies.



**Vulnerable groups need to be identified and consulted in the design of public policies.** Countries produce and consume less aquatic products when wealth, formal education and voice and accountability are lacking. Hicks et al. (2022) conclude that public policies in aquatic food systems from around the globe do not sufficiently address political and gender-based barriers.



**Digitalization of tools for e-governance,** the simplification and digitalization of licensing procedures, sanitary certificates, meetings, introduction of remote inspection and increasing traceability of products were among the positive outcomes of the

<sup>29</sup> Asia-Pacific Economic Cooperation. Accessed: 17 January 2023. Available in: <https://aotearoaplanofaction.apec.org/#:~:text=The%20Putrajaya%20Vision%202040%20will,implementing%20the%20Putrajaya%20Vision%202040.>

pandemic and should be followed or expanded by economies. Promoting digitalization in the sector does not mean banning non-digital options.



**Create emergency protocols for unforeseen external shocks**, such protocols would allow immediate response capacity to avoid this suspension of activities that was so harmful to many producers. The protocols should specify the competencies of each government agency.

#### IV.2.3. Building capacity and enhance the association of small-scale farmers



**Design a national strategy to promote strong, empowered and sustainable SSA farmers' associations.** Aquaculture is dominated by small-scale producers in most economies, however their size and lack of resources have limited their opportunities in many ways, especially in accessing financial resources during the pandemic. This can be improved in the future through association. Association has countless benefits for small-scale aquaculture enterprises, can facilitate collaboration with government in policy making, facilitate the access to credit, facilitate the communication with academic institutions, NGOs and input providers, accelerate technology transfers, among others. The FAO Fisheries and Technical Paper N°655 developed in 2020 can be used as a guide to promote such an objective in developing APEC economies (See Box 14) (Hassan et al., 2020).

#### **Box 14. FAO recommendations for strengthening, empowering and sustaining small-scale aquaculture farmers associations.**

This report provides policy and action-oriented recommendations for strengthening, empowering and sustaining small-scale aquaculture farmers associations through stakeholder discussions and country-based workshops. The main recommendations were:

- (1) Professionalization of association.
- (2) Constantly improve the technical capacity of members.
- (3) Development of a cluster mode of cooperation among members and their operating as a business enterprise.

To achieve the professionalization of the association the following specific strategies were proposed:

- Training of leaders and all members in leadership and management skills.
- A leadership succession plan through training and mentoring.
- Improvement of officers and members' ability in strategic planning, organizational development and financial management.
- Development of a strategic communications and information system for internal communications among members and for stakeholder relations.
- Development of an information system for collection, processing and dissemination of industry/sector data.
- Establishment of a well-equipped and well-managed office, to ensure efficient operation and project a professional and credible image.
- Establishing and adhering to standards of conduct to earn the trust of stakeholders and obtain the social license to operate, which is as important as a legal license.

#### IV.2.4. Expansion of social security



**Expansion of social security and protection systems for fisheries and aquaculture workers.** In the long term, broader and more inclusive coverage of social protection systems will be key to ensuring livelihoods and food and nutrition security. Changes to regular social security schemes should include, where possible, increasing

coverage, relaxing eligibility, benefit values, program duration or introducing extraordinary payments when needed.

#### IV.2.5. Promotion of seafood consumption and adoption of new customers trends



**National, regional and local communication campaigns to promote local seafood consumption** can help to diversify markets and avoid excessive dependence on exports, while offering highly nutritious and low environmental impact products, contributing to food security.



**Developing seals and certificates for seafood products, including for local production.** Seals for products from SSA would line-up perfectly with effective communication campaigns for the promotion of local seafood consumption. Furthermore, the risk of seafood spoilage during transport can deter customers from buying online. Labels and certificates that guarantee safety and quality of fish can help to increase the consumption of fish products in digital markets.



Governments could **support aquaculture farmers to meet and market their products in line with current customer trends**, exacerbated by the pandemic, for bioactive compounds, immune-enhancing products, alternative protein sources, processed or ready to cook items and marketize their products accordingly. Experiences like Korea's "Master Plan for the Management and Utilization of Marine Healing Resource" go in that direction.

#### IV.2.6. Building a new momentum for the digital transformation of aquaculture



**By supporting the creation of digital market channels or facilitating farmers' access to available digital marketing channels**, digital trade has clearly strengthened the aquaculture supply chain, increasing its resilience, while contributing to food security.



**Provide training to support the digitalization of aquaculture** to facilitate advertising, marketing, delivery of technical advice and payments. The search for new marketing channels and especially e-commerce was the most frequently used tool to cope with the effects of the pandemic. Tools such as digitization, and automation have the potential to mitigate the impact of future food security risks.



**Promote the digitalization of SSA with low-tech technologies.** Digital transformation should recognize that some households cannot afford Internet service or digital devices, others may have difficulty in using new technologies and that the older generation may feel left behind if they are unable to keep-up with new digital and high-tech business models. Therefore, alternative non-digital resources must be ready and available in such cases.

#### IV.2.7. Promoting diversification, innovation and advanced aquaculture technology



**Supporting the development of sufficient cold storage in susceptible fish production areas**, to adequately manage market supply and demand disruptions and to preserve fish products, whether frozen or in other processed forms, until the market

improves. Research will be needed to help identify the most vulnerable areas for such investments in each economy.



**Promote the diversification of aquaculture operations**, including species farmed, value added, diversified markets and competitiveness, to maximize the value of their products and maintain a sustainable business. Diversification of the aquaculture sector in terms of species or technologies requires incentives from governments, particularly in countries that are heavily dependent on few species for most of their national production. National authorities can take different approaches to achieve this goal, either by applying regulations that make current applied technologies more expensive than the new ones (e.g. limits or taxes on the discharges) for those with the greatest environmental impact or by subsidizing cleaner technologies.



**Promote innovation and advanced aquaculture technologies**, from the basic ones such as better animal health management through vaccination and adoption of disease resistant strains, up to more complex ones such as remote and real-time digital monitoring and auto-feeding. Digitalization and innovation are the future of aquaculture, they can increase production efficiency and profits. However, the awareness of fish farmers, especially small-scale fish farmers, must be increased to ensure high acceptance and use of digital fish farming and similar more complex technologies.

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## ANNEX

### Annex 1: Digital questionnaire

1. Indicate your full name, institution, and economy that you represent.
2. Indicate the institution and position in the institution that you represent.
3. Sex (female/male).

#### IMPACTS AND DISRUPTIONS

4. How did the aquaculture sector in your economy perform during the year 2020?
  - A. Reduced significantly
  - B. Reduced slightly
  - C. Unchanged
  - D. Increased slightly
  - E. Increased significantly
  - F. Not sure
5. How did the aquaculture sector in your economy perform during the year 2021?
  - A. Reduced significantly
  - B. Reduced slightly
  - C. Unchanged
  - D. Increased slightly
  - E. Increased significantly
  - F. Not sure
6. What was the variation (%) in overall aquaculture production (by value) in your economy during the period 2020-2021? Guesstimate is welcome.
7. How does your economy define the concept of small-scale aquaculture?
8. What is the current proportion of small-scale aquaculture (considered in the present questionnaire as rural aquaculture, including aquaculture for subsistence and artisanal aquaculture) in your economy? Guesstimate is welcome.
  - A. <25%
  - B. 25-50%
  - C. 50-75%
  - D. >75%
  - E. Not sure
9. Do you consider that small-scale aquaculture was more affected by the COVID-19 pandemic? If yes, please mention the three main problems found in this sector.
  - A. Yes
  - B. No
  - C. Not sure
10. Please rate the intensity of the following impacts derived from the COVID-19 pandemic and related restrictions for small-scale aquaculture in your economy? Please rate from 0-5. 0- no negative effect 1-slight effect 2-small effect 3-moderate effect 4-severe effect 5-catastrophic effect
 

Supply chain disruption	0-5
Restrictions of imports/exports	0-5
Drop demand and price variation	0-5
Labor shortage	0-5
Lower seafood consumption	0-5
Amplification of sex and gender inequity	0-5

#### REACTION AND POLICY MECHANISMS

11. Which group of measures has your economy implemented to assist the aquaculture sector during and post COVID-19 pandemic and when were they first implemented? *Yes, no, not sure and quarter of 2020.*
  - Health and safety responses
  - Financial assistance
  - Social protection

Management guides and technical measures

Promotion of digitalization

Promotion of innovation

12. When was the aquaculture sector of your economy exempted from COVID-19 suppression policies (lockdown measures)?

- A. First quarter of 2020
- B. Second quarter of 2020
- C. Third quarter of 2020
- D. Fourth quarter of 2020
- E. It was never included in the lockdown measures
- F. Not sure

13. When were specific COVID-19 biosecurity and sanitization measures (disinfection and work protocols) for the aquaculture sector first implemented in your economy?

- A. First quarter of 2020
- B. Second quarter of 2020
- C. Third quarter of 2020
- D. Fourth quarter of 2020
- E. None of the above
- F. Not sure

14. Please indicate if the following measures were taken within your economy to mitigate the effects of the COVID-19 pandemic in the aquaculture sector and rate the suspected impacts (strong, moderate, low, not implemented).

Financial assistance

Expansion of social protection coverage

Support for access to new markets

Direct food distribution

Input subsidies (ice, fuel, etc.)

Promotion of local consumption of seafood

Purchase of seafood for institutional use

15. Have regulatory burdens been reduced for the commercialization of aquaculture products after the beginning of the COVID-19 Pandemic?

- A. Yes
- B. No
- C. Not sure

16. Were actions to accelerate digitalization of small-scale aquaculture implemented in response to the COVID-19 pandemic? If yes, please mention the programs.

- A. Yes
- B. No
- C. Not sure

17. Were actions to encourage processing plants and fish farmers to develop new products implemented in your economy in response to the COVID-19 pandemic? If yes, please mention the programs.

- A. Yes
- B. No
- C. Not sure

18. Were specific mitigation and recovery measures for vulnerable groups (women, subsistence farmers, rural workers, migrants) to the effects of the pandemic within the aquaculture sector applied in your economy? If yes, please mention them.

- A. Yes
- B. No
- C. Not sure

19. Have specific policy frameworks to increase aquaculture sustainability and resilience after the COVID-19 crisis been elaborated and applied in your economy?

- a. They were elaborated and are currently being applied
- b. They were elaborated but have not been applied



- c. They are currently being elaborated
  - d. Not elaborated/applied.
  - e. Not sure
20. In your opinion, which are the key measures to support economic recovery of small-scale aquaculture after the COVID-19 crisis? Multiple choice selection.
- A. Establish unrestricted logistics to ensure normal production
  - B. Direct financial assistance
  - C. Promotion of organizational development and insurance schemes
  - D. Expansion of social protection coverage
  - E. Accelerate digitalization and innovation
  - F. Other measures.
21. In your opinion, which are the key measures to increase the sustainability and resilience of small-scale aquaculture to future shocks like the COVID-19 crisis? Multiple choice selection.
- A. Promote organizational development and insurances schemes
  - B. Shift toward better management practices
  - C. Diversification of supply sources and marketing channels
  - D. Diversification of practices and farmed species
  - E. Accelerate digitalization and innovation
  - F. Other measures
22. Please summarize the main difficulties encountered in your economy when implementing measures, programs, or policies for the economic recovery of the small-scale aquaculture sector during the COVID-19 crisis? *Open question.*

## Annex 2: List of respondents to the questionnaire and interviews.

Name	Economy	Relevant position
<b>QUESTIONNAIRE</b>		
Prof. Dr. Lee Po-Tsang	Chinese Taipei	Associate Professor, National Taiwan Ocean University
Puncharas Gorcharoenwat	Thailand	Department of Fisheries, Fisheries Biologist
Daniel Lees	New Zealand	Manager Aquaculture Strategy and Development
Sally Truong	Australia	Director, Multilateral, Aquaculture and Recreational Fisheries, Department of Agriculture, Fisheries and Forestry
Adam Camilleri	Australia	A/G Director - Multilateral, Aquaculture and Recreational Fishing, Department of Agriculture Fisheries and Forestry
Hong Kong Special Administrative Region Government	Hong Kong	Agriculture, Fisheries and Conservation Department (AFCD), Hong Kong Special Administrative Region Government
Sayako Takeda	Japan	Assistant Director, International Affairs Division, Fisheries Agency
Rodolfo Alejandro Espinoza Ruiz	Peru	Director of the General Direction of Aquaculture, Ministry of Production
<b>INTERVIEWS</b>		
Prof. Dr. Lee Po-Tsang	Chinese Taipei	Assistant Professor National Taiwan Ocean University.
Dr. Alejandro Flores Nava	Mexico and Latin America	Principal Officer of Fisheries in Aquaculture for Latin America and the Caribbean at FAO.
Dr. Alicia Gallardo Lagnos	Chile	ex National Director and sub-director of Aquaculture from SERNAPESCA and Officer for Fisheries and Aquaculture in Latin America and the Caribbean at FAO.
Dr. Cherdsak Virapat	Thailand	General Director, Centre on Integrated Rural Development Asia Asia and the Pacific (CIRDAP)
Dr. Ma. Junemie Hazel Lebata-Ramos	the Philippines	Scientist Aquaculture Department of the SEAFDEC
MSc Kevin Heasman	New Zealand	Principal Investigator Cawthron Institute
Dr. Hatim Albasri	Indonesia	Research Center for Fisheries, National Agency for Research and Innovation, Indonesia
Dr. Diana Chan Pek Sian	Singapore	Deputy Centre Temasek Polytechnic Aquaculture Innovation Centre
Rodolfo Alejandro Espinoza Ruiz	Peru	Director of the General Direction of Aquaculture, Ministry of Production

### Annex 3.1: Virtual interview Chinese Taipei representative

Prof. Dr. Lee Po-Tsang, Assistant Professor National Taiwan Ocean University.

- 1. Which aquaculture production systems (e.g., by size, farmed species, applied technology) have been more impacted by the COVID-19 pandemic and related mitigation measures in your economy, and how were they impacted? If the sector was not as affected in your economy, what do you consider were the main reasons for this? Please elaborate.**

*Covid-19 situation was not that serious in Taiwan, but there were some impacts from it due to the situation in mainland China and Hong Kong since we export mainly to this country. Therefore, I think there was a negative impact for market size grouper and fourfinger threadfin to sell/transport to China. And according to the news, in 2020, the market price for grouper dropped 36%.*

- 2. In your knowledge, what were the main measures (general or sector specific) applied by your economy that contributed to mitigate the outcomes of the COVID-19 pandemic on the aquaculture sector (including financial assistance, input subsidies, social protection, support for access to new markets, and other measures)? When possible, please specify the name of the action/measure/program, objective and impacts (suspected or observed).**

*There are programs to support financially such as give subsidy directly to farmers 10000-30000 NTD/person, subsidy if reducing culture amount, interest free loan for 1 year, subsidy for longer culturing period (reducing selling pressure), help to obtain Aquaculture Stewardship Council (ASC) certification (for grouper), help open oversea market for ornamental fish, grouper, tilapia and soft shelled turtle, subsidy for transportation fee to overseas market (grouper and tilapia), subsidy for drug residue examination, award (money) to seller if the selling amount grow for 20%, award for grouper farmer if they awarded with Traceable Agricultural Products certification. Additionally, the Fisheries Agency have kept trying to help to develop new markets such as Muslims and Singapore.*

- 3. Were specific COVID-19 stimulus packages (including economic relief, interest free loans) for the aquaculture sector or small-scale farmers applied in your economy? Can you mention the impacts (suspected or observed) of them? Please specify the name of the program, objective and impacts.**

*As mentioned earlier, many stimulus packages were applied and yes, interest free or low interest loans were applied to small-scale farmers. There are programs but I can't find the English name for it. Stimulus such as production adjustment, drug testing during the manufacturing process, subsidies for packaging materials, processing, frozen storage, canning, etc., as well as group meal materials for marketing, fish market transactions, and promotion of domestic and foreign activities. One of the major moves is to accelerate selling domestically, for instance, the production of grouper, from March 15 to May 1 increased by 54.8% compared with the same period last year, but the price also increased by 0.4%, with an average price of 167 NTD per kilogram. Similarly, for tilapia, milkfish, barramundi, Japanese seaperch, cobia, sweetfish, fourfinger threadfin, and white shrimp, etc, although the price dropped by 5.9% compared with the same period last year, the transaction volume increased by 6.4%.*

- 4. In your knowledge, what were the major challenges that small-scale aquaculture (SSA) farmers encountered in your economy to access government support/programs and how do you consider that financial measures could have been improved to benefit this sub-sector?**

*Some of the culture places are not registered due to some difficulties such as property belonging, land rental, unlicensed water source...etc., and therefore the farmers who culture animals in the specific location are not eligible to apply for subsidies. The law of*

registration for culture licenses should be properly scrutinized and reformed to solve the problem. And the standards should be untightened.

5. **Were strategies used by small-scale aquaculture farmers in your economy to cope with the initial COVID-19 shock identified (such as delay production, reduce employee, market expansion, introduction of new species, etc.)? What can we learn from this knowledge?**

*As mentioned before, many of the measures such as delay and regulation of production, reduce employee, market expansion, encourage frozen food production. The best thing we can learn is not to focus on only certain species and foreign markets to obtain more chances to sell products globally. Additionally, we should always consider the backup plan and expect this kind of shock may come more often. What the farmers can do is to reduce the culture density and amount, but better take care of the animals to get higher survival rate and decent production amount to maintain their income. Also, it is encouraged for the farmers to use online platforms to build their own brand to sell products directly to customers to increase the profit.*

6. **Were programs to accelerate diversification (of inputs, production systems or products), digitalization or innovation applied or boosted in your economy after the COVID-19 crisis? If yes, please mention examples and the impacts. If no, what's your opinion on the implementation of such programs for the sector and what type of technologies should be promoted for SSA.**

*Yes, I think market expansion and development are the most critical measures for it which will allow us not to rely on certain markets/countries. Digitalization, and innovation such as IoT and AIoT are also under development, which will definitely facilitate the production rate and save more energy/money/resources in aquatic animal production. For the products, fish was majorly sold as whole fish and filet in Taiwan, but a better cold chain is under construction and products such as cans are also encouraged for processing more fish production and maintaining quality control.*

7. **How could governments help to improve the response of vulnerable groups to the effects of the pandemic or similar stressors (including climate change, natural disasters, etc.) within the aquaculture sector such as subsistence producers, informal workers, processing plants workers, migrants and women?**

*To have regulations or assistance to secure their work, working hours, average salary rate. Additionally, there can be some programs to help them to acquire more techniques/skills for acquiring more job opportunities.*

8. **In your opinion, which were the best short- and long-term measures applied in your economy to deal with the impacts of the COVID-19 pandemic on the aquaculture sector**

*In my opinion, opening broader overseas markets would be the most important part for our aquaculture. So, the best long-term measures would be those programs which help the market expansion besides the main importer (e.g. China). And the best short-term measure would be the support from the government on the tax and export fee to the market outside of Taiwan (e.g. USA and Southeast Asian countries).*

9. **What could be the best response to accelerate transformations in the aquaculture sector of your economy, particularly small-scale aquaculture, to build sustainability and resilience for future similar shocks?**

*The government must help to regulate the number and species of major farmed fish and shrimps to avoid price drop. Additionally, enhancing the cold chain and frozen sector would help to avoid price crash if certain species are overproduced. Again, opening new markets (instead of relying majorly on certain market or domestic demand would help more investment and profit in the future.*

**10. Do you have any other suggestions that could help in the development of the small-scale aquaculture sector in your economy?**

*I think it is important to re-evaluate the appropriateness of culturing aquatic animals in certain regions, such as those areas without good freshwater and seawater sources.*

### Annex 3.3: Virtual interview Mexico and Latin America representative

Dr. Alejandro Flores Nava, Principal Officer of Fisheries in Aquaculture for Latin America and the Caribbean at FAO.

- 1. How severe was the impact of the pandemic on the aquaculture sector in Mexico and the Latin American region? What lessons did the pandemic give us regarding the state of aquaculture in the region?**

*The overall impact was very severe, but we can talk about stages. The first phase was the first few months of extreme uncertainty, not only for aquaculture, but for all economic sectors. Specifically, in aquaculture, we saw first of all that fish farmers with export and import chains stopped their commercial activities because the flights were paralyzed. For local fish farmers, the arrival of inputs was limited, as was their marketing. Aquaculture was slowly recognized as an essential activity, but there were efforts in some countries, such as Ecuador, to consider granting safe-passes and thus commercial activity began to reactivate. On the one hand, we had impacts due to the lack of inputs to continue. In many cases, aquatic organisms were still in culture or had to be harvested to avoid unnecessary mortality, or in other cases had to be stored and frozen, adding costs to the process. In a struggling economy, consumers had to absorb an initial increase in selling price. In other cases, there were also problems due to the lack of supervision in the cages, which led to robberies, among other direct consequences. In general, the commercialization of marine food shrank by 80%.*

- 2. Regarding the measures taken by the government to mitigate the effects of the pandemic in the aquaculture sector, what type of measures were taken in the region? Including financial assistance, credits and subsidies, social protection, etc.**

*There was no change in the soft credit policy. The immediate response was to include aquaculture as an essential activity, returning it to normal in terms of mobility, mobility of products and supplies was a measure that began to reactivate the industry. Over time, the resumption of flights also reactivated exports. This was followed by the sanitary inspection, a case of detection of COVID-19 in a package stopped that production batch and the exports themselves. Flights were reinstated, and the inspection began the reactivation. Small producers were more affected, as most do not have emergency capital to withstand months without sales. In some countries, the Fisheries and Aquaculture Department began to design a response protocol, as was the case in Costa Rica. In other countries in the region, such as Panama, social protection measures such as food pantries were regularly offered during the first months as food did not arrive in rural areas. Response protocols are essential for future disasters. This was a fundamental lesson. In some cases, there are even exercises. What is the chain of authority for decision-making? Who is responsible for activating these procedures? Finally, these protocols must now be designed not for pandemics or external shocks, but for "normal" times.*

- 3. Do you consider that the aquaculture sector in the region has recovered economically? What would be the current state of aquaculture regarding the crisis suffered?**

*From a macroeconomic point of view, the sector has already recovered and production volumes have returned to pre-pandemic levels, both in the region and globally. At the level of small producers, there is a lack of information, it is necessary to carry out an analysis or a census and, based on this, to design the appropriate public policies for their development.*

- 4. If we had key information about these small players who are needing economic support to face the effects of the crisis, what kind of measures could contribute to improving the situation of small-scale producers?**



At FAO, we have classified fish farmers into two groups, which is already used by several countries. The AREL (fish farmers with limited resources), with small production, many subsistence, are highly vulnerable and are the target of government sustenance support programs. The other group, the AMYPE (small and medium-sized fish farmers), although they mostly produce mostly for sale, still require support, especially during times of crisis. The levels and needs are different, the AREL micro-producers need an extensionist advisory force to accompany them, they need to strengthen their associativity, among other needs. By doing things collectively, they have better opportunities to develop as producers and to be sustainable. AMYPE fish farmers already have open marketing channels, certain knowledge of technology, and management markets. Associativity is also very important. Working with collective brands of small producers that standardize their quality helps their introduction into the market and helps the consumer to identify the quality of the product, for these policies are required and sometimes NGOs can play an important role as a link between government and society. Many ingredients are commodities, with high inflationary pressures, in the face of this, in which small producers adopt substitution strategies, producing their own food with locally available ingredients, which is viable for species with a low trophic level species. Sometimes the enabling environment that the state is called upon to provide is not fully consolidated.

5. **Regarding informal workers, which represent a large portion of the aquaculture sector in some economies and who find it difficult to access economic benefits, how could governments improve the situation of these workers in the face of the next crisis?**

First of all, to identify them, many of them are in the informal sector because they are geographically dispersed, the state does not reach where they are and therefore they do not participate in government programs, they are isolated, but they are still producers and they have an impact on the economy of the community. A census is important, it is necessary to know how many there are, where they are and in what situation they are. This informality is sometimes due to geography, but also to ignorance, many believe that they will be charged or that they will have a fiscal impact. An intelligent communication campaign is needed to show them that it is in their own interest. Most fisheries and aquaculture authorities have few human and financial resources to reach these small, often informal producers. The involvement of leading aquaculturists can be used to formalize and transfer knowledge to their peers through a self-management mechanism, which also requires specific public policies for the sector and greater knowledge of the sector.

6. **What was the impact of the measures to accelerate the digitization and innovation of the aquaculture sector taken in response to COVID-19 in the region?**

There are trends to digitize processes, one is the development of applications to be able to consult in situations like this, which has come before, while another is more related to reporting activities, which is important for statistics and measuring efficiency. I have not seen any difference as a result of the pandemic. The commercialization of aquaculture, but in general of products, through electronic sites has been a trend beyond the pandemic. Communication becomes faster in certain situations, in the case of natural disasters of a different nature (hurricanes) this measure is not as effective.

7. **What would be the best actions to increase resilience and sustainability in the aquaculture sector, with a focus on small-scale producers?**

In order to act, it is important to have updated information, it is necessary to carry out analyses at the micro-regional level, the needs are different. I recommend making a diagnosis of the vulnerability of aquaculture to the effects of climate change as a basis for designing a national adaptation strategy. The vulnerability of the sector may vary from region to region. Information, on the one hand, and then the design of strategies, in the case of climate change, adaptation, and in the case of unforeseen external shocks,

*protocols that allow, as much as possible, to have an immediate response capacity to avoid this suspension of activities that has been so harmful to many producers.*

**8. Do you have any additional suggestions that could help to improve the economic recovery of the aquaculture sector?**

*To have information, but also to formulate action plans based on sectoral policies. Regardless of any shock, it is important that each country has a national strategy for the development of aquaculture to open markets, improve productivity and increase consumption. This must be formulated together with the actors of each region, but implemented at the national level as a state policy due to lack of resources or changing priorities, with a long-term vision. Consumption has increased in the region, but this must be part of an action plan that informs consumers and also allows access to the vulnerable part of the population. Those who are aware that food from fisheries and aquaculture is healthy are also people in the middle to high-income bracket, and they think of high-quality products such as salmon. The majority of the population does not have access to these resources. It is important that aquaculture contributes to food security by making products more accessible. It is important to include the small producer in institutional purchasing programs. There needs to be a much more holistic analysis.*

### Annex 3.3: Virtual interview Chile representative

Dr. Alicia Gallardo Lagnos, former National Director and sub-director of Aquaculture from SERNAPESCA and Officer for Fisheries and Aquaculture in Latin America and the Caribbean at FAO.

**1. Which aquaculture production systems (including production of salmon, mussels, trout, etc.) were most affected by the COVID-19 pandemic in Chile and how?**

*Salmon farming exports to more than 120 countries, many shipments go through the airport in Santiago, which are fast shipments of fresh salmon, and others go through Argentina and also by sea. The first route affected in salmon farming was the logistics of shipments for export due to quarantine restrictions. In Chile, quarantines were carried out by geographical area, and salmon farming is located in the three southernmost regions of Chile, there was a logistical problem related to exports. Another problem was related to services for salmon farming, food, vaccines, treatments, etc. The government quickly listed the essential activities for the population, to which aquaculture producers were later added, by means of a safe pass that they had to apply for. In some cases, the delay caused a problem in the health of the animals. If you look at the analysis of antibiotics, there was a period when the consumption of antibiotics increased, probably because there was no logistics for health management, which then recovered quickly. Another important production is mitilids, or mussels, unlike salmon farming, this occurs in a single region (Los Lagos) and there are also small producers who were the ones who found themselves in a more complicated situation. Many of them produce on the island of Chiloé, which is more isolated, where there are additional logistical problems, both for export and for production in the primary phase. A third problem was the market restrictions, China was the first to restrict the export of salmon since they started to analyze the product. At customs they found a positive PCR, which meant that the processing plant (registered in Biobio) was restricted. At the beginning of the pandemic, we immediately conducted a remote inspection, and with great effort and support from the Chinese ambassador and customs, the plant was removed from the export restriction. From then on, confidence was built with the markets.*

**2. Do you think that aquaculture in Chile has recovered from this initial phase of the pandemic?**

*Yes, it has already recovered, the two types of aquaculture are already with positive numbers and they are already exporting to other markets, even expanding the range of markets. I think they have already recovered, yes.*

**3. Among the general and specific measures for the fishing and aquaculture sector that were implemented by the government, which do you consider were the main ones that helped to mitigate the negative impacts of the pandemic on the aquaculture sector?**

*In Chile, there is a very good relationship between the public and private sectors. Not only does the public sector take responsibility, but the private sector also looks for alternatives. This constant conversation we had with the associations allowed us to look for new ideas. Establish a permanent channel of communication with the union. In Chile, we are used to emergencies, we have an emergency committee, we activated the public-private emergency committee. The second is the government measures that could consider exceptions while maintaining sanitary control of the pandemic for aquaculture producers. It has not been as fast as we would like, especially for the mitilids, who are small producers. Here in Chile, although salmon farming is important, agriculture is more important, peasant agriculture is politically important, and the ministries are different. For agriculture, there is a Ministry of Agriculture, while the Ministry of Economy has other interests besides fishing and aquaculture, so it took time. The third was to implement online channels, emergency phone numbers, emergency mail, and we also increased online procedures. We*

*implemented procedures quickly, and electronic certificates increased. Small aquaculture is not registered, we are implementing a system called Online Cove, for direct sales to consumers.*

**4. Was there any financial support measure for small producers?**

*Salmon farming is very large and there has been no economic support for mussel farming. The companies themselves monitor the production areas and buy from small producers. We developed a support program with the fishermen to promote cooperation and entrepreneurship, especially among women. They received and applied technical training in order to diversify. For the fishermen, there was a project called "Caleta Inteligente", where the Internet was installed in the landing places to be able to manage better, we helped them with procedures to form cooperatives, supporting entrepreneurship more than anything, there were no subsidies.*

**5. What were the biggest challenges in implementing these containment and mitigation measures for the aquaculture sector?**

*The uncertainty of the markets because we did not know much about the pandemic, we did not know. Internally, we also had problems with officials who were afraid to go to work for some inspections, but we created a group of people who were available for that, but we also created online procedures. There were inspections where we needed a minimum of staff, and I thank the civil servants for that. The third thing would be the fight between aquaculture and agriculture, who has the most right to get these permits, there was a fight between two ministries. Both are important for local food security and self-consumption. People have internalized that a small farmer has products and feeds on them, while at the political level, decision-makers in America still do not internalize that there are fish farmers for self-consumption, which is something rare, and they see the big aquaculture as just one thing.*

**6. Within the actions taken to accelerate the digitization and innovation of the sector, how important were these measures? Does remote monitoring still continue today?**

*The digital part was the best part of the pandemic, it was the unexpected result, everything is already digital, inspections are even done remotely. There was a lot of interest from officials to learn and train, even officials who were not from the technical areas, to be able to support. The online world allowed more and more meetings with the competent authorities in a very short time.*

**7. What strategies could be used to improve the situation of vulnerable groups, including women, processing plant workers and subsistence farmers in the aquaculture sector to future crisis?**

*This is an issue we have been working on a lot. Productive diversification is essential, fishermen must learn to switch to aquaculture, and this requires knowledge transfer, technology packages, as well as private support for small producers. It is a leap that has to be made. Then fishermen should also jump into the world of adding value to resources, embarking on elements related to ship owners, gourmet products, and algae. Seaweed, for example, is a very important product today because of its nutritional value. There is a lot of money that countries have invested, but sometimes these projects fail due to lack of support and guidance from the government. In aquaculture, nobody talks about it, in Chile they didn't talk about it. Another option would be innovative aquaculture, aquaculture and tourism, for example, stations where people go to see how the fish are raised, for children to see. Women have developed companies where they take people diving, others have implemented a kit to make "asado", a kind of experiential tourism. Crafts with fish leather, everything related to summer camps for children. Basically, it is about diversifying both aquaculture and plant workers so that they have a plan B. We can no longer stop having plan B and plan C. The promotion organizations have to change their structure to an accompaniment. Regarding recycling and circular economy, several countries have the*

concept of agro-aquaculture in their regulations, large producers also produce fish, for example native fish, which they use to feed the workers and even the local people. Eating locally promotes food security. It is important that these places are small poles of food security through aquaculture and artisanal fishing.

**8. In many cases, local fish products lose competitively at the price level, compared to foreign products. How can we encourage the population to pay a little more for locally produced products?**

*The seals, the certifications. In Brazil, for example, there is a seal for artisanal fishing. Consumers value environmental attributes and contribution to communities. It is no longer enough to produce cattle if it is not linked to good labor practices, local agreements, and animal welfare. Aquaculture has a bad reputation from an environmental point of view, aquaculture must be linked to consumption, limited production and the circular economy. Countries like Peru have a high consumption of fish, but in the case of other countries where it is very low, it becomes a difficulty. Developing the accompaniment with non-traditional inputs for food changes the concept. Products made by women, produced locally. There are issues of consumer perception that need to be well understood to put a stamp on this aquaculture production.*

**9. What could be the best actions that should be implemented to increase resilience and sustainability in the sector?**

*Permanent communication between the public and private sectors, the private sector could take charge of the small producers. Maintain a permanent aquaculture-fishery governance, for climate change, pandemics, resource scarcity, etc. The second thing is to maintain support programs. Fishermen need to understand that resources are not forever. Maintain the associativity among fishermen. Let the good examples be communicated to the rest, so that they can see among themselves how good entrepreneurship is. Regarding the training schools, for fishermen who participate themselves, as the message of the International Year of Artisanal Fisheries and Aquaculture 2022 says: "Nothing about us without us", to establish the exchange of knowledge between small-scale aquaculturists from different regions and even countries. The congresses, the nets are well appreciated by fishermen and aquaculturists. It's not just about bonuses, it's about investing in diversification to support small producers. We need to give a boost to artisanal aquaculture, which is not getting the attention it deserves. Governments have research centers that could be poles for the development and monitoring of aquaculture. In Ecuador, for example, they offer subsidized fingerlings, where the first stocks are sold at a lower price. It is important that these centers are aligned with the institutional framework and health elements. Coordination and updating between sectors within the government. It seems that aquaculture is not fully considered. In the case of agriculture, they usually have their own ministry. It would be necessary to study what has been done to promote small-scale agriculture to reach this point with aquaculture and artisanal fishing.*

### **Annex 3.4: Virtual interview Thailand representative**

Dr. Cherdsak Virapat, General Director Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP).

- 1. How hard was the aquaculture sector in Thailand impacted by the COVID-19 pandemic crisis and what is the current state of the aquaculture sector compared to the pre-pandemic status?**

*The COVID-19 affected the aquaculture sector in Thailand from a moderate to high degree during the infection period. Aquaculture production and fisheries market was affected by the lockdown. During the COVID-19 most of the aquaculture markets were closed and people were prohibited from entering to risk areas. Fish farmers could not sell their products or sell them at low prices. During 2021 most of the aquaculture was recovered to near pre-pandemic levels, the fish farmers have produced more this year and the regulations were lifted.*

- 2. Which were the main lessons of the COVID-19 pandemic for the aquaculture industry?**

*Pandemic can affect movement of people and food, throughout the entire value chain. The lockdown should be planned systematically so that non-infected people and non-contaminated food can be transported to destined markets. Government should establish a certification system to ensure safe transportation of food to consumers. Government should establish an emergency plan to manage the crisis. The implementation should be evaluated on a regular basis, so the emergency plan can be adjusted to minimize impacts. Aquaculture farms and fish markets should implement the COVID-19 free practices in order to prevent contamination and infection. Fish farmers should also have preparedness and response plans to adapt themselves to changes due to the COVID-19 situation, natural disasters and abrupt variations in the market.*

- 3. Which were the main measures introduced by the government to mitigate the economic impact of the pandemic in the aquaculture sector?**

*In Thailand, the Department of Fisheries under the ministry of Agriculture and cooperatives, introduced several measures. The first can be farm COVID-free practices and the certification to support transportation of farm products to markets and processing plants. Second, the Department of Fisheries opened and facilitated market places within non-lockdown areas, promoting local consumption and demand. Third, the government established and implemented financial assistance programs, such as the interest payment arrangements, set up the e-commerce and online marketing of aquaculture products, opened new fish market channels, such as fishermen shops in the 0-COVID areas and low interest loans 5%. The implementation of the project "The Dream Comes True" in agriculture, with a total amount of 30000 million baht (800 million US) which consisted in loans of a total amount of 100000 baht at an interest rate of 1%.*

- 4. In your opinion, regarding these types of measures ¿Which were the challenges that small scale aquaculture farmers encountered to access these programs?**

*There are several, I can point out three of them. First one, the technology to online markets and access information. Secondly, fish farmers can sell their products to market channels provided by the Department of Fisheries, but they will need to adapt the selling practice due to the multiple harvest. Many small scale farmers have debts and they can't find the access to loan contracts. Few farmers can access microcredits provided by the bank. Farmers should be encouraged to form cooperatives or groups for exchanging their knowledge, planning, and implementing activities to increase the business power.*

- 5. How important were programs to accelerate digitalization and innovation applied in Thailand in Thailand to deal with this crisis?**



*The Department of Fisheries established a pilot project to promote online markets, so that small-scale farmers can sell their product during the pandemic period. Later the Department of Fisheries developed a more advanced platform for aquaculture markets by setting up an Aquaculture Innovation Centre (AIC) in every province. The AIC integrates academic institutions and governmental agencies of each province to start aquaculture innovation, including aquaculture practices, organizing meetings and seminars regularly at the national and provincial levels communicating and transferring innovative technologies to fish farmers.*

**6. How could the government improve the situation of vulnerable groups to the effects of the pandemic or similar situations within the aquaculture sector, such as subsistence workers, migrants and women?**

*This should be done by improving fundamental knowledge and research on the small scale aquaculture and the management of relevant databases. In case of natural disasters, small-scale farmers can obtain some compensation provided by the government according to predetermined rules and procedures. The Department of Fisheries has an important role to motivate and communicate with small-scale aquaculture farmers to be aware of natural disasters and climate change. There are local consultation meetings developing local preparedness and response plans to mitigate the impacts such as preparation of stock water, culture ponds, use of chemicals, feeding and post-harvest. Inclusive groups are identified to be aided in the future but more work is required, and an aquaculture insurance policy is being prepared, covering natural disasters and diseases.*

**7. What could be the best responses to build sustainability and resilience in the aquaculture sector for future similar shocks?**

*This may be done through the implementation of partial financial support to SSA, building small groups of farmers, introducing new generation farmers, providing training and implementation of modern practices and biotechnology, innovative technologies in the farms, promoting online markets for sales and distribution.*

**8. Do you have any other suggestions to support the recovery and development of the aquaculture sector?**

*Government should have strong policy support to help aquaculture farmers to meet the materials quality and standards. At present the SSA farmers have cooperated to form groups for exchanging their technical knowledge, but few have less efforts to formulate for building business power. The pandemic has created higher costs, due to the disruption of markets and transportation. The Department of Fisheries has yet to find ways to help them with this issue in the future, such as species diversification, improving relationships and the creation of associations and processing or cold storage facilities. Adaptive capacity on communication technologies would help with online meetings, direct sale to consumers, provide capacity building on preliminary fish processing, market knowledge, access to new markets, and online market and products development, added value products of interest for tourism, including ornamental fishes. Thanks to the shrimp board and the low price mechanism and aid with cold storage facilities, the price of these commodities did not fall during the pandemic. Future development SSA should put more emphasis on cooperation among producers. Having representatives of new generation farmers to cooperate and collaborate on planning and management would result in better understanding and knowledge gain and the government can play an advisory role in support of required resources such as technologies, market channels and trade facilitation.*

### **Annex 3.5: Virtual interview Philippines and South Asia representative**

Dr. Ma. Junemie Hazel Lebata-Ramos, Scientist Aquaculture Department of the SEAFDEC

**1. What were the main impacts of the COVID-19 pandemic on the aquaculture sector in Asia and has the sector completely recovered to pre-pandemic levels?**

*The COVID-19 pandemic has disrupted transportation (land, sea and air) and affected all levels of the aquaculture supply chain. It has affected the transportation of seed stocks/fry/fingerlings from the hatchery to the nursery or grow-out facilities. It has affected the delivery of feed from feed mills to markets/distributors and/or farmers. It has affected the transportation of harvested products from the farm/aquaculture facility to the markets, fish ports or restaurants. Some restaurants were closed during the pandemic, so aquaculture products that were normally delivered to these restaurants before the pandemic were stuck somewhere. In places without storage or post-harvest facilities, they were sold at break-even or even low prices rather than left to rot. Staff deaths and severe cases of COVID were inevitable at the height of the pandemic. These staff reductions also affected production and other activities along the supply chain. In addition, some facilities reduced staff to minimize costs, while others closed. Today, the sector has recovered, but not fully. Recovery will depend on the losses incurred during the pandemic and the availability of capital to finance a fresh start.*

**2. Compared to other aquaculture production, how did the aquaculture of mollusks perform during the COVID-19 pandemic?**

*Mollusk culture was not much affected during the pandemic, especially the two most important mollusk species produced in the Philippines, oysters and mussels. These are non-fed species and the seed stocks are from the wild. Culture began with the settlement of competent larvae on available clutches and continued until they reached harvestable size, were harvested and sold. The need for farmers' hands-on involvement is only during clutching, harvesting and marketing. Although marketing has been affected due to lack of transportation, the farmers can leave them untouched in the culture areas until the condition becomes favorable and the situation is normal. Prolonging the crop doesn't involve any additional costs because no feed is needed, and it provides a source of food for the farmer, his family, and his community.*

**3. Compared to traditional monocultures, how did IMTA (integrated multi trophic aquaculture) systems performed during the COVID-19 pandemic? What lessons can we learn from this knowledge for the future of aquaculture?**

*IMTA is an emerging technology in the Philippines. It is not a major aquaculture system used by the aquaculture sector. Where IMTA is practiced, it is usually at the experimental level, not large-scale and commercial. I am not in a position to answer this question given my limited knowledge of where and what IMTA activities, if any, are ongoing in the country.*

**4. What was the role of the SEAFDEC and research institutions in general during the COVID-19 crisis in the aquaculture sector and what lessons were learned from this?**

*Like any institution, SEAFDEC was affected by the pandemic, but not to a detrimental extent. Field experiments, especially in areas accessible only by public transportation (e.g., far-flung small islands), were either suspended or intermittently monitored. However, experiments, studies and hatchery production within our stations (Tigbauan Main Station, Igang Marine Station, Dumangas Brackishwater Station and Binangonan Freshwater Stations) were not affected. SEAFDEC provided vehicles to transport employees from their residences to the workplace and vice versa with proper implementation of strict health protocols. It also provided a quarantine facility for its employees and their immediate family members when needed. This minimized their exposure to more risks in overcrowded government quarantine facilities. In addition, SEAFDEC paid for the RT-PCR test of the employees who needed to be screened and monitored. This support from the ministry to*

*the staff allowed us to continue our activities regularly with minimal disruption, which in turn allowed SEAFDEC to continue providing technical assistance and seed stock to farmers within its reach. At the height of the pandemic, SEAFDEC continued to build its broodstock and hatchery facilities, which were opened and operational in time after the pandemic. This pandemic, which brought most industries to a standstill, not only aquaculture, has taught us the importance of protecting manpower resources, the driving force of the industry. It has also taught us to prepare for the future, not only for the worst-case scenario, but to be ready with improved facilities to fast-track the activities missed during the lockdown and to compensate for the losses when the situation returns to normal.*

- 5. The COVID-19 pandemic highlighted the need for an efficient articulation between science, scientists and policy makers. In the case of aquaculture how well do you consider that science is articulated with the politics being formulated for the sector?**

*To the best of my knowledge, no policy for the aquaculture sector has been specifically formulated to address the effects of the COVID-19 pandemic.*

- 6. What could be the best responses to accelerate transformations in the aquaculture sector, particularly small-scale aquaculture, to enhance its sustainability and resilience for future similar shocks?**

*The COVID-19 pandemic experience was very challenging, not only for the aquaculture sector, but for everyone. This experience has taught us lessons that can make us well-prepared for similar events in the future, God forbid. We saw farmers needing assistance in getting their products from farm to market. We saw farmers selling their produce at very low prices to make the most of their harvest. In the future, with the capabilities of the local government units (e.g., availability of vehicles, access to remote areas as frontline), they can assist the farmers by buying their products and distributing the goods to quarantine facilities or households during the lockdown. Or they can assist farmers by helping them find a market for their goods. The government should also build infrastructure such as cold storage and processing facilities in the major fish and aquaculture-producing provinces or cities to preserve the products and extend their shelf life. These facilities are only available in metropolitan areas such as Manila, Cebu or Davao. Multi-species hatcheries and feed mills should also be strategically located and easily accessible to farmers to ensure steady production and supply of seafood. The government should design and implement programs to increase food sufficiency in the small islands to minimize the dependence of the locals on supplies from more urbanized cities/towns.*

- 7. What considerations should governments have when promoting the development of more sustainable aquaculture production systems or practices such as polyculture, IMTA, aquasilviculture, among others?**

*Polyculture and aquasilviculture may have been practiced for quite some time in the country, but IMTA is just emerging. For a government-assisted project to succeed, somebody has to oversee it from conceptualization until harvest. The government should consider providing technical assistance to the farmers interested in these production systems, especially when new concepts are being introduced. The government should provide funds to the farmers for them to attend training courses to better understand these new systems. Financial assistance, such as loans with farmer-friendly terms, should be made available to help them start their businesses. For the newbies, the government can assist in finding and establishing markets for their produce.*

- 8. When talking about sustainability, farmers or even policy makers often see only expenses to comply with regulations, but with no economic benefits for them, how can aquaculture enterprises benefit from the adoption of more sustainable practices?**

*As observed, some farmers, especially those with limited financial resources, are hesitant to invest in something without the assurance of a large profit. Government agencies or research institutions must first invest in educating them about these sustainable practices and how profitable they can be to convince these farmers. They should realize that adopting sustainable aquaculture practices does not only bring financial returns but is also beneficial to the environment. Aquaculture practices that are damaging to the environment would deprive the next generation of clean waters for their fishing, aquaculture, and recreational activities. Adopting sustainable practices also ensures food security and a healthier ecosystem.*

**9. Do you have any additional suggestions that could help in the development of the small-scale aquaculture sector?**

*In poor economies, such as the Philippines, we can't solely depend on the government to provide for all the needs of the small-scale aquaculture sector. Tie-ups or collaborations between government agencies, the private sector, research institutions, or the academe may be more efficient and beneficial to all concerned parties. The research institution or the academe can provide science-based technologies developed through research, the private sector can provide the capital, and the government agency can oversee and monitor the project. These joint endeavors may speed up the development and help boost production from the small-scale aquaculture sector.*

### Annex 3.6: Virtual interview New Zealand representative

Interview MSc Kevin Heasman – Principal Investigator Cawthron Institute

- 1. In your opinion, why the aquaculture in New Zealand was not as hardly impacted by the COVID-19 pandemic crisis compared to other economies, was it more related to the situation of the pandemic itself or to the intrinsic resilience of the sector in your economy?**

*Salmon was most affected as its main market was the restaurant trade, but like shellfish it could also be sold to the domestic market, although not at such a high premium. All species were also able to be left in the water for a period of time without being forced to harvest, allowing some delays in supply. The industry also has a resilience that has allowed it to survive. Although they compete, they tend to come together in mutual support when under duress. The strengths of New Zealand's primary industry also help with the situation.*

- 2. What is the current situation of the aquaculture in New Zealand compared to pre pandemic levels?**

*In terms of the impact of the pandemic, the industry has been constrained mainly by labor shortages and to a lesser extent by supply chain issues. Marketing is picking up and people (internationally) are now visiting restaurants again, which is helping the industry. Production will be down a little, partly due to Covid 19 impacts (delayed knock-on effects), but also due to climate change (existing salmon farms are getting warmer with little opportunity to move to cooler waters due to other stakeholder conflicts). Mussel spat supply is at a premium (for a variety of reasons), which will have a delayed impact.*

- 3. What were the main government measures that contributed to mitigate the outcomes of the COVID-19 pandemic on the aquaculture sector in New Zealand (including financial assistance, input subsidies, social protection, support for access to new markets, and other measures)? If possible, please specify the name of the action/measure/program, objective and impacts.**

*I cannot name the programs responsible (I don't know the names) but the financial support provided by the Government enabled survival. Many would have dropped by the wayside if the support/subsidies were not there. Government funded research continued supporting development. The government also deemed the industry as a necessary industry allowing them to continue to function through the pandemic.*

- 4. In your opinion, currently is there a need to develop actions/programs for the economic reactivation of small-scale aquaculture in your economy?**

*I believe the aquaculture industry members will generate strategies within themselves and then work with the Government to obtain suitable support. This may be in terms of facilitating work visas (which is still an issue) through encouraging markets.*

- 5. How important were actions/programs to accelerate digitalization and/or innovation in New Zealand to deal with the COVID-19 crisis and the post-pandemic scenario?**

*It is important although some do not realize the potential benefits. Data utilization/manipulation and innovation will provide an edge that is required going forward to armor against future stress events.*

- 6. How could governments improve the situation of vulnerable groups to the effects of the pandemic or similar stressors (including climate change, natural disasters, etc.) within the aquaculture sector such as subsistence producers, informal workers, migrants and women? Enabling sustainable accessibility and the means to develop into existing aquaculture enterprises or supporting innovation to advance such developments will enable smaller/vulnerable/subsistence activities to advance. The development and**

*incorporation of restoration activities and “marine produce gardens” will also enlighten and enhance the ecology and subsistence production.*

**7. What could be the best responses to accelerate transformations in the aquaculture sector, particularly small-scale aquaculture, to build sustainability and resilience for future similar shocks?**

*Most of the major species (king salmon, oysters, mussels) are investment intensive. Smaller players need to develop alternative species that require less initial investment, or the development of co-operatives with a central supply/market hub with satellite growing facilities. This is not a traditional avenue of development for New Zealand and may struggle to gain traction.*

**8. What other suggestions do you have to support the development of small-scale aquaculture in your economy?**

*New species and innovation are the key to advancing development. Spinoff industry (e.g. from the blooming seaweed sector) will lead to developments and allow smaller players into aquaculture related activity.*

### Annex 3.7: Virtual interview Indonesia representative

Dr. Hatim Albasri. Research Center for Fisheries, National Agency for Research and Innovation, Indonesia.

*\*All expressed views in this document represent the personal views of the contributor based on his experience in the aquaculture subsector and the reviewed literature.*

**1. How hard did COVID-19 impacted the aquaculture sector in Indonesia and has the sector completely recovered to pre pandemic levels?**

*Covid-19 has significantly affected the aquaculture subsector in Indonesia. The 2021 annual report published by the Indonesian Ministry of Marine Affairs and Fisheries (MMAF) summarized that the growth of aquaculture production between 2020–2021 was -13.57% for fish, 0.05% for seaweed with a total contraction for all aquaculture products of -5.33% compared to the previous year pre pandemic level. The table below provides a 5-year period of aquaculture production in Indonesia. It is clear that during the early pandemic (2020), aquaculture production was significantly reduced across all main aquaculture commodities, excluding shrimp. However, from 2021 to 2022, aquaculture production has fairly increased. The table below does not provide the total production of 2022 as the report is currently being finalized. However, the tentative production figures for the third semester of 2022 show that aquaculture production has reached 90% of the 2022 targets. This means that all the target productions of 2022 will likely be achieved, which are higher than the total production of 2021 commodities. Therefore, one might conclude that the current state of aquaculture production in Indonesia has recovered, at least compared to the early pandemic level in 2020.*

**2. What were the main government measures that contributed to mitigate the outcomes of the COVID-19 pandemic on the aquaculture sector in Indonesia (including financial assistance, input subsidies, social protection, support for access to new markets, and other measures)? If possible, please specify the name of the action/measure/program, objective and impacts.**

*There is a significant change in the aquaculture sub-sector development in Indonesia during the COVID-19 pandemic. The changes were driven partly by the recent change of aquaculture policy pursued by the new minister of MMAF, which seeks to increase the welfare index of fish farmers and production efficiency and guarantee the supply chain to improve the price of primary commodities. Some of the minister's programs include improving the supply of seed, broodstock, locally produced fish feed, and increasing the application of biofloc farming system, fish farming in rice paddy (minapadi), improving the farming technology by introducing better farming systems, biosecurity, waste management and farming area management. All of these programs are bundled within the new three strategic pillars of aquaculture development in Indonesia, which;*

- A. Prioritize first the ecological sustainability of aquaculture development.*
- B. Followed by increasing economic benefits of the sub-sector through the development of highly competitive commodities based on export and market demands.*
- C. Improving the socio economic condition of fish farmers.*

*The other part of the change in the development of aquaculture in Indonesia is due to the pressure of COVID-19 on the aquaculture system both in the input chain and market chain. Several related programs to suppress the effect of COVID-19 to the aquaculture subsector are;*

- A. Developing farming centers for export-oriented aquaculture commodities such as shrimp, lobster, barramundi, seaweed, pangasius and tilapia.*
- B. Improving competitiveness in export markets through simplifying the permit system while supporting fish farmers with process and quality certifications.*



- C. *Introducing a specific program called "One village, one fish commodity" based on the existing farmed species. It is also called "Aquaculture Village" program*
- D. *Supporting aquaculture investment environment via the banking system and crowdfunding. A direct intervention is a proposal to reduce credit interest rates for small-scale fish farmers from 6% down to 3%*
- E. *Developing aquaculture development centers that the MMAF fully supports. Such capital intensive program has been started by developing a 60-ha shrimp farming center using the state of the art technologies in Central Java, fully funded by MMAF in cooperation with the local government.*

*A direct intervention by MMAF to improve the condition of aquaculture activities was the enactment of a Decree of the Directorate General Aquaculture (DGA) of MMAF regarding the COVID-19 Protocol Enforcement on Aquaculture Business Activities. Decree #B.21940/DJPB/VIII/2021 regulates several critical points in aquaculture systems which is intended to provide a guarantee when the products are exported to other areas or overseas;*

- A. *Installing biosecurity to prevent COVID-19 outbreaks in farming and processing facilities*
- B. *Ensuring workers are healthy and not infected with COVID-19 and social distancing when entering farming and processing facilities*
- C. *Limiting visitation of outsiders to farming and processing facilities*
- D. *Tight control and surveillance of in and out of products, including transportation, vehicles, and workers of which a task force within the farming or processing facilities must be created to ensure obedience to the COVID-19 protocols.*

*In terms of facilitation to existing market destinations or opening new markets, as part of support during the COVID-19 pandemic, there is no particular policy or program launched by MMAF. However, during certain points between 2020 and 2021, there were shortages of air cargo to handle exports of frozen and fresh farmed fish products and limited to non-existent live fish trade boats from Singapore and Hong Kong. Such challenges particularly hit the farmers who farmed marine species such as shrimp, barramundi, silver pompano and live groupers. During the process, the MMAF initiated a series of discussions with airline operators, cargo management and the fish farmers association to find possible solutions. The result of the efforts was that the cargo began to be available in sufficient numbers in the middle of 2021 and has continued to improve until now.*

**3. What were the major challenges that small-scale aquaculture (SSA) farmers experienced in your economy to access government support/programs?**

*Two types of endowments are given by either the national government through MMAF and other ministries or local government (provincial and district government), which are direct and indirect. Direct endowment to help small-scale to initiate or increase farming activities, usually in the form of seed, fish feed, and farming equipment. However, considering that the estimated number of small-scale fish farmers in Indonesia is more than 1.3 million people, a direct endowment is much more symbolic and only received by a limited number of individuals or fish farmer cooperatives. The indirect endowments are in the form of reduced credit interest rates, improved irrigation/water supply for coastal and freshwater aquaculture, relaxed fish farming permits (only required registering their activities), and allocated extension officers at least two persons per sub-districts throughout Indonesia to help identify farming issues, improve farming practices and help solve fish farming issues on site.*

*Taking into the contexts provided above, the main challenges are;*

- A. *Most of the fish farmers in Indonesia are small-scale and distributed across Indonesia, and many reside in some of the remote areas in Indonesia with limited information*

access and available communication infrastructure. Such characteristics mean that any government program is difficult to access, particularly the national government's indirect endowment. Patronage flourish in these communities where fish farmers rely on intermediaries and local businessmen for support in farming and daily needs. This patronage system is powerful that at some point, it becomes another major challenge for the small-scale fish farmers to access government program

- B. Small-scale fish farmers are required to form a formal cooperative or group to receive a direct endowment program. This cooperative structure will facilitate easier distribution of direct support. For example, the cooperative leader will represent the cooperative members when receiving the support and distribute it to the members later on. However, existing fish farmer cooperatives are few and far between. Thus, the government usually forms instant cooperatives or groups to distribute direct support legally. Therefore, the effect of direct support is minimal in improving farming practices and production due to the fish farmers within the instant cooperative not working together to achieve the objective of direct support.
- C. Education plays an important part in accessing indirect support, such as small-scale credit schemes. Most small-scale fish farmers have a low educational background and believe that the credit scheme is a burden although it will help them improve their fish farming activities. Education also plays a vital role in behavioral change, for example, skepticism to accepting new fish farming technologies, improving farming practices or learning new things in fish farming.
- D. Some direct supports are too advanced for small-scale fish farmers and challenging to implement in the existing farming conditions. For example, the use of a sophisticated biofloc might be too complex for small scale where their activities are primarily low input and low output

**4. What were the main strategies used by aquaculture farmers in your economy to cope with the initial COVID-19 shock and what can we learn from this knowledge for the future of aquaculture?**

*Some of the main strategies of fish farmers were:*

- A. Keeping the stock of ready-to-sell fish until buyers are available.
- B. Reducing the feed given, feed quality, feeding frequency of the stocked fish and number of workers. Members of Immediate families are directly involved in reducing hired workers' expenses
- C. Looking for direct local and regional sales for some of the highly valued species due to reduced or no demands from overseas.
- D. Change of farmed fish from highly valued species to low value or low trophic farmed fish. For example, shrimp ponds are temporarily used for farming milkfish or seaweed.
- E. In the most extreme cases, the farming operations are stopped entirely by the fish farmers after most of the last batches of fish are sold
- F. Reducing the selling price to improve cash flow and reduce fish maintenance risks.

*An important lesson learned from the COVID-19 pandemic is that it is essential to ensure that supply inputs at a competitive price are available to ensure that fish farmers can continue their farming activities. Stable and consistent market demand should be maintained, including available cargo or fish transportation ships for live fish. Changing highly valued species to low trophic and lost cost farmed species temporarily could be a good solution where maintenance is less expensive, but the farmers can still have a healthy cash flow.*

**5. How important were programs to accelerate digitalization and/or innovation in Indonesia to deal with the COVID-19 crisis and the post-pandemic scenario?**

*Digitalization of aquaculture in farming activities is very few, and most of them are still in the research stages. Some startup companies, such as e-fishery, have developed robust water quality monitoring systems, automatic feeding and several other innovations in aquaculture.*

However, the cost of running the system, including licensing, is just too expensive for small-scale fish farmers. I led a research program in cooperation with Japan called SATREPS Mariculture to try to introduce digitalization and innovation in fish farming. We have developed several digitalization systems such as real-time water quality monitoring system, digitalization of operational records, display viewer for water quality and educational and training platform. Despite the system working perfectly and being free of charge, fish farmers have very little interest in using it due to their strong attachment to their local and personal knowledge-based experience.

Several market systems and traceability were developed by the MMAF as part of the effort to digitalize the market system and improve traceability. An application called STELINA was launched last by MMAF to serve just that purpose. However, the rate of use and voluntary reports were relatively minimal, and thus, the ministry still relies on manual data records to supply the application with recent and complete data regarding the production and traceability of aquaculture products.

Digitalization and innovation are the future of aquaculture, where production efficiency and improved profits can be achieved. However, the awareness of fish farmers, especially small-scale fish farmers, must be increased to ensure high acceptance and use of digital fish farming. Digitalization of farming practices also helps during a pandemic similar to COVID-19. It simplifies business activities and efficiently uses resources. For example, fish farming workers can use a digitalized monitoring of fish growth and feeding so that the owners or managers can control or oversee the activities from anywhere and at any time.

**6. How could governments improve the situation of vulnerable groups to the effects of the pandemic or similar stressors (including climate change, natural disasters, etc.) within the aquaculture sector such as subsistence producers, informal workers, migrants and women?**

- A. Improving educational levels and competencies of members of vulnerable groups in order to be able to adapt to changing conditions or stressors. Providing education facilities near vulnerable groups for easier access.
- B. Identifying the vulnerability risks within the vulnerable groups and providing both direct and indirect support to eradicate the vulnerability risks
- C. Increasing awareness among small-scale fish farmers of inherent vulnerability risks within their aquaculture systems and the environment through online educational platforms, media and other sources of information. The government, in tandem with the related organizations, should also be able to provide guidance or increase the knowledge of small-scale fish farmers and other vulnerable groups in quickly identifying indicators of vulnerability risks and facilitating discussion on how to overcome them.
- D. Identifying poorly performed capital assets and improving them through specific endowment programs to allow vulnerable groups to compete with their peers with better capacities.

**7. What could be the best responses to accelerate transformations in the aquaculture sector, particularly small-scale aquaculture, to build sustainability and resilience for future similar shocks?**

It is difficult to single out the best responses to accelerate the transformation in the aquaculture sector since the different farming systems in different areas of Indonesia face different problems and challenges. However, feed in fish farming in Indonesia has been one of the major challenges faced by small-scale fish farmers due to the price and consistent supply, particularly during the COVID-19 pandemic, where depleted stocks of fish feed in some areas took time to be replenished with increased price. Transforming national and local fish feed mills using locally sourced ingredients, especially fish meals or its comparable replacements, could provide a consistent supply of feed at a reasonable price. Another suggested response would be developing standardized national certification systems based

on or compatible with major global good aquaculture practice (GAP) standards such as EuroGAP, ASEAN GAP, and Aquaculture Stewardship Council. Indonesia has developed its own GAP encompassing every stage of the production system of aquaculture products called Cara Budidaya Ikan yang Baik (CBIB/Indo GAP), Cara Perbenihan Ikan yang Baik (CPIB/Good Hatchery Practices), Cara Karantina Ikan yang Baik (CKIB/Good Quarantine Practices and some other certification. However, these certifications are only compatible with some major GAP systems. For example, the ASC of the US does not recognize CBIB thus, certain farmed fish products exported to the US might have to satisfy the ASC standards. A comprehensive CPIB applicable to small-scale fish farmers should be developed in order to ensure that their products can also enter the overseas market system. This arrangement could ensure that small-scale fish farmers will have better prices for their products and ensure the sustainability of their economic activities.

Lastly, small-scale fish farmers sit at the bottom of a long market aquaculture chain. In order to improve the sustainability and resilience of these small-scale operations, shortening the market chain and empowering them in bargaining with the market system through partnerships such as the community-supported fisheries (CSF) model might reduce their vulnerability concerning human, physical, social and financial capital assets.

**8. Do you have any other suggestions that could help in the development of the small-scale aquaculture sector in your economy?**

*It is important to note that increasing the dependency of small-scale aquaculture cannot be achieved by investing heavily and directly to support their needs in operating their farming activities such as seed, feed and other associated costs. It is more beneficial to increase indirect endowments and ensure that small-scale aquaculture operators have access to them with fewer complex red tapes and requirements. For example, collateral when borrowing funds to support farming is the most feared issue by fish farmers and fishermen alike, considering that small-scale fish farmers have limited physical capital to serve as collateral. Indonesia, through MMAF, has developed such funding scheme by establishing the LPUMKP. LPUMKP is a financial agency that can provide financial assistance and business advice to small-scale fish farmers. However, the role of this special agency within MMAF is currently limited by funding and human resources to reach more small-scale fish farmers distributed in Indonesia's regions.*

### **Annex 3.8: Virtual interview Peru representative**

Interview with Rodolfo A. Espinoza Ruiz – General Director of the General Direction of Aquaculture, Ministry of Production of Peru.

- 1. How severe was the impact of the COVID-19 crisis on aquaculture production systems in Peru and what is the current state of aquaculture in the country compared to the pre-pandemic period?**

*COVID-19 caused a great impact on aquaculture production, since it limited the development of the entire production chain. Many of the transit restriction measures affected the supply chains causing difficulties for the transport of the product to be marketed, including inputs for production such as seeds and balanced feed, and sales levels reached, which reduced the reduction of income and finally lack of liquidity to maintain production. To this is added the increase in production costs due to the shortage of inputs, the closure of restaurants and consumption centers, the reduction in prices of products from aquaculture, among others. In addition, an increase in thefts was reported within aquaculture fish farms due to reduced security, as well as smuggling of aquaculture products due to the reduction of controls, suspension of inspection and the reduction of institutional attention to producers (general procedures), due to the state of quarantine. decreed by the state. It should be noted that for the year 2019 the annual aquaculture production was 161,279 MT, for the year 2020 of 150,816 MT, comparing those years the production reached 6.4%, that is, 10,463 MT less. Currently, the limitations that arose during the crisis caused by the pandemic are being overcome, with respect to 2020 a slight increase in aquaculture production is reflected, with the production of 2021 being 150,816 MT, however, it is still not possible to recover the production level reached in 2019.*

- 2. What were the main measures implemented by the government of Peru that helped mitigate the effects of the COVID-19 pandemic in the aquaculture sector (including financial assistance, credits, subsidies, social protection, access to new markets, promotion of consumption of fish, among others)? If possible, specify the name of the program/action, objectives and impacts.**

*Due to the economic impact caused by the pandemic in the country, the Peruvian Government implemented the "Reactiva Peru" Program at the national level, which aims to provide a rapid and effective response to the liquidity needs faced by companies in the face of the impact of COVID-19, this program included AMYPE fish farmers according to their application. Given the limitations on the transfer and sales of aquaculture products, the National Program of "A Comer Pescado" strengthened the programs that were being developed through the participation of aquaculture producers in itinerant markets/promotion fairs (Mi Pescadería PNACP, temporary local markets, satellite markets, others), for direct sales to the consumer thus avoiding intermediaries. Promoted platforms for the sale of aquaculture products articulated with regional and local governments, as well as the articulation of aquaculture producers with commercial channels (supermarkets, restaurants, hotels, among others) for the sale of their products.*

- 3. Regarding the special credit programs for AMYPE aquaculture farmers and limited resource aquaculture (AREL), what experiences were obtained for the benefit of small-scale aquaculture?**

*Faced with the state of emergency and in order to continue promoting financial support to the aquaculture sector, the Ministry of Production through FONDEPES approved the NATIONAL EMERGENCY CREDIT PROGRAM (COVID-19) through Chief Resolution No. 028-2020 -FONDEPES/J and its amendments; This Program is framed within the Institutional objectives of FONDEPES to facilitate access to financing opportunities under exceptionally promotional credit conditions that allow contributing to the recovery and reactivation of productive activities, giving continuity to the development of aquaculture activities (AREL and AMYPE). as well as artisanal fishing activities, having made credit*

conditions more flexible, in response to the National Emergency, it should be noted that said activities are considered high risk by the private financial system. Given the conditions, the National Emergency Credit (COVID-19) program also implemented a 100% virtual service platform on the Institutional Intranet ([www.fondepes.gob.pe](http://www.fondepes.gob.pe)), for financing working capital - exceptionally - awarding credits in cash, due to the National Emergency situation, it should be noted within the framework of the aforementioned program for the year 2020, 501 credits were awarded, benefiting 365 AREL farmers and 136 AMYPE farmers, for an amount of S/ 1,002,000.00 for working capital.

**4. What were the biggest challenges faced by the government in implementing post-COVID-19 mitigation and economic recovery measures for the aquaculture sector?**

*The development of AREL and AMYPE aquaculture, like any productive activity, generates expenses, which must be attended daily and constantly in order to carry out production without deficiencies, the main needs being the acquisition of inputs, such as seeds, raw materials, balanced food, fuel, payments to suppliers and the payroll itself in some cases. Given the negative economic impact caused by COVID-19, these requirements could not be met mainly due to the absence of income from sales. In this sense credits for working capital were required immediately or in a very short term, which was a challenge. In addition to that, other challenges were added such as non-compliance with the requirements demanded by the financing programs (FAE-MYPE and REACTIVA Peru) such as active RUC, ticket issuance, budget limitations, limited trade due to transportation difficulties and internal mobilization restrictions, as well as to the closing of borders.*

**5. What were the biggest challenges small-scale farmers in Peru faced in accessing government programs?**

*The most remarkable were, the non-compliance with requirements to obtain credit, such as the informality of aquaculture farmers (due to lack of authoritative resolution of the activity, sales record, commercial transaction documents such as receipts, invoices, inactive RUC or limited credit record information in financial institutions) and limitations in access to information provided virtually and physically on actions of technical assistance, training, as well as financing programs; since in many parts of the country there are deficiencies in coverage and connectivity (internet service, computers, telephone lines etc).*

**6. What actions are being implemented by the Peruvian government to accelerate the digitization and/or innovation of the aquaculture sector after the COVID-19 crisis?**

*Regarding digitization, the Ministry of Production, through FONDEPES, implemented the CREDIPES application to make it easier for fish-farmers to access the different credits, which can be downloaded to any cell phone and from there carry out the respective procedures. The latter allowing all those interested in accessing said credits from any part of the national territory, which includes balanced feed for the fattening stage, acquisition of materials and equipment, expansion of infrastructure, hatchery, purchase of eggs and/or fingerlings, among others. Likewise, the RAPIPEZ application is being implemented, which is a digital portal that allows the acquisition of hydrobiological resources from anywhere in the country from the comfort of a computer or mobile phone. Moreover, the National Program for Innovation in Fisheries and Aquaculture - PNIPA implemented the SAPEL application, which is a system through which the processes of tendering, calling, selection, negotiation, awarding of innovation fishing and aquaculture subprojects are managed, as well as their execution, monitoring and closure.*

**7. What strategies could be used to improve the situation of vulnerable groups in the aquaculture sector (including informal workers, subsistence workers, migrants and women) to the effects of stressors similar to the COVID-19 pandemic (including climate change, natural disasters, among others)?**

- A. *Promote the formalization with the support of specialized professionals who provide and guide in the assembly of the formalization files and follow-up of the procedure.*
- B. *Create a catastrophic aquaculture insurance whose coverage allows the farmer to continue with his aquaculture activities in the face of affectations generated by climatic and natural events.*
- C. *Strengthening capacities of aquaculture producers that allow them to acquire knowledge on measures to be adopted in the face of natural disasters and climate change.*
- D. *Strengthening of capacities in matters of safety and health at work that allow the profitability of the organization, since through the evaluation and identification of the health of each collaborator, savings can be generated thanks to the prevention of diseases and attendance at work days of workers, reducing turnover and absenteeism.*

**8. What measures could enhance the full economic recovery of the aquaculture sector in Peru?**

- A. *Promote seed production in national production centers, as well as strengthen the capacities of aquaculture producers to produce seed for self-supply and/or sale.*
- B. *Increase funds, as well as sources of financing and innovation (FONDEPES, PROINNOVATE, PROCOMPITE, PNIPA, among others).*
- C. *Increase R+D+I capacity in aquaculture, promoting productive development and competitiveness through research, technology adaptation and capacity building in the aquaculture sector.*
- D. *Promote the production of balanced feed that includes inputs from the region, in order to reduce costs.*
- E. *Promote the participation of aquaculture producers in traveling markets, promotional fares, temporary local markets, satellite markets, business roundtables, among others.*
- F. *Create an aquaculture extension program based on promoting the development of aquaculture activity through training, technical assistance and permanent on-site monitoring in the farming process, in order to improve and increase aquaculture production, which in turn contributes with productive scaling, formalization, business management, commercial articulation, associativity and innovation.*
- G. *Generate synergies with national and international sectoral entities linked to the sector that contribute to the responsible and sustainable productive improvement of aquaculture.*

**9. Which are the best responses that should be implemented to accelerate transformations in the aquaculture sector, particularly for small-scale aquaculture, to increase the resilience and sustainability of the sector to future shocks such as the COVID-19 pandemic?**

- A. *Promote technical assistance and on-site training for aquaculture producers, which would increase their productivity and consolidation.*
- B. *Accelerate the digitization and connectivity of small-scale fish farmers.*
- C. *Promote associations between small-scale fish farmers.*
- D. *Consolidate access to new markets, as well as the consumption of fish in the national population.*
- E. *Encourage investment in cold storage capacity through access to affordable credit, government-backed loans, duty-free imports of equipment, and tax breaks.*
- F. *Incentivize aquaculture investment through financial and tax incentives, preferential rates, such as tax exemptions.*
- G. *Promote compliance with sanitary requirements by aquaculturists, which guarantee the safety and quality of aquaculture products.*
- H. *Promote innovation and the adoption of technologies for the sustainable development of the aquaculture sector.*



### Annex 3.9: Virtual interview Singapore representative

Interview with Diana Chan Pek Sian – Deputy Centre Director of the Aquaculture Innovation Centre

**1. From your perspective, how hard did the COVID-19 crisis impact the aquaculture sector in Singapore and what is the current state of the sector after this shock?**

*Singapore is not an aquaculture or agriculture country and would rely mostly on imported food sources which make up about 90% of total food consumption. Although the local aquaculture sector is small with 110 coastal farms and less than 20 land based farms, the impact of COVID-19 on the aquaculture industry was felt but not significant. However logistic disruption was real and it had affected consumables like feeds, fries, etc and foreign labor. The local aquaculture production in 2020 during Covid-19 crisis fell to about 3,960 tonnes which was reported to be the lowest since 2014. Possible reasons for the lower production could be due to adjusted farming production in order to cater to a lower consumption demand at eateries and wet markets as a result of people movement restriction. Other reasons could be due to manpower shortage at the farms and import logistics disruption of fish fries from overseas countries. The local farms rely heavily on foreign manpower support for farming activities as well as imported fries for stocking their farms as there are only 1 or 2 hatcheries locally available. According to the Singapore Food Agency, the pandemic had led to disruptions in the setting up of new farms and the upgrading of some existing farms which could result in consequential impact on farm timelines for reaching production capacity. Following the pandemic crisis, the aquaculture industry took in great stride the demand set upon them by the government to ramp up production to meet the 30x30 goal for enhancing food supply resilience and food security. A few major aquaculture producers had started investing in smart technology to help increase production capacity and yield.*

**2. What were the main measures applied by the government to mitigate the effects of the COVID-19 pandemic on the aquaculture sector (including financial assistance, input sub/sidies, social protection, support for access to new markets, and other measures) in Singapore? If possible, specify the name of the program, objective and impact.**

*Apart from the COVID-19 pandemic, there are other concerns such as global resource constraints, effects of climate change and also the growing global population that could impact on food supply resilience in Singapore. In order to mitigate the effects of the pandemic and ride out similar occurrences that would impact food security, Singapore has set eyes on leveraging agri-food technologies to develop and commercialize solutions for sustainable food production.*

*The Singapore Food Agency had announced plans to ramp up local production to increase nutritional sufficiency from 10% to 30% by 2030. It aims to achieve this in land-scarce Singapore by harnessing technology, increasing space for farming, as well as supporting local agriculture and aquaculture other than encouraging consumers to buy local produce.*

**A. Infrastructure**

*AgriFood Innovation Park (AFIP)*

*The Singapore government announced the development of the AgriFood innovation Park in Sungei Kadut in 2019 as part of the Northern Agritech and Food Corridor together with food related industries. The 18-hectare park would enable urban high tech farming solutions to be integrated with associated R&D activities across aquaculture and agriculture to attract investment and R&D talent to Singapore. This would help forge partnership for Singapore companies and research institutes to do test bedding and prototyping as well as collaborative research.*

*Lim Chu Kang (LCK) Masterplan*

*Under the Singapore Food Agency's masterplan for enhancing food security, 390-hectare land situated in the LCK agricultural zone would be redeveloped*

sometime in 2024 into a high tech agri-food cluster with capacity to produce thrice the current food production. Shared facilities would be developed for farms to co-share the resources and to lower production costs.

#### *B. Unlocking sea space for coastal and offshore farming*

More sea space in the Southern Waters and East Johor Straits will be tendered out progressively in phases starting from end 2022 with longer lease according to the Singapore Food Agency. Farms would be able to apply for lease extension for another 10 years once their 20-year lease is up. With this move, farms would be able to plan long term for their business and farming capacity with the objective of supporting the nation's goal of meeting 30% of its total nutritional needs. In view of the transition to leases, existing coastal farms would have to pay for use of sea space other than farm license fee which would be reduced from \$850 per half hectare to \$145 per license.

#### *C. Research Grant and Funding Scheme*

The Singapore Food Story Programme, launched in 2019, had S\$144 million invested in R&D on sustainable urban food production, future foods, innovation and food safety. An additional S\$165 million was added for research into genetics and breeding of fish for quality seedstock as well as improving productivity and nutritional qualities of aquaculture and agriculture crops. In addition to the Aquaculture Innovation Centre established in 2019 for working with local farms and enterprises on their farming needs through advisory and consultancy services, innovative research and training, an Aquapolis programme was formed in Nov 2022 with support from Singapore Food Agency (SFA), research institute, institute of higher learning and a few farms to look into research and innovation for sustainable tropical aquaculture.

Due to covid-19 pandemic, the urgency to ensure sustainable food supply for local consumption had also led SFA to create the "30x30 Express" grant with an award of S\$39.4 million specifically for companies to ramp up production within 6 and 24 months. The funding scheme implemented is in addition to the Agri Food Cluster Transformation fund set up with the objective of transforming the industry into a highly productive, resource efficient and climate-tolerant one. Farms could tap on the funding for capability and capacity building, test-bedding of new technologies or upscaling of technologies at their farms.

#### *D. Agritech Startup Ecosystem:*

Singapore is internationally known for its pro-business environment, reliable intellectual property and standards framework other than stringent food safety regulation. As such, Singapore is often regarded as a suitable landing pad for enterprises including start-ups to export their solutions beyond Singapore.

Currently, the local agritech start-up ecosystem comprises farms, system providers and high-tech commercial farms that produce food for local consumption. Based on the Asia-Pacific AgriFoodTech Investment Report 2022, Singapore start-up companies raised USD\$1.1 billion in 2021 which represented 7.1% of the total USD investment. In 2021, the investment arm of Enterprise Singapore (ESG) called SEEDS Capital appointed seven co-investment partners to turn more than S\$90 million worth of investment into deep tech and early stage agri-food tech start-ups to churn up disruptive agri-food solutions.

Enterprise Singapore set aside S\$55 million for helping local agriculture and aquaculture companies to develop new capabilities and innovate focusing on the concept of growing more with less. Through the Startup SG Accelerator programme set up by ESG, the agency brought in global accelerators such as Big Idea Ventures, GROW, Hatch Blue, The Yield Lab, Trendlines, Agrifood Innovation Centre and Temasek Life Sciences Accelerator to groom more than 150 agri-food tech startups over a three-year period. The startups would be able to learn about fund-raising, product development, commercialization and internationalization through the mentorship by the accelerators.

#### *E. Buy local produce campaign*

In order for the local aquaculture industry to want to produce more so as to achieve greater self-sufficiency with lesser reliance on foreign imported food, the government tried to support the producers by promoting local farm produce to consumers through education,

social media and “pop up markets”. One scheme that the government also tried in getting greater acceptance of local farm produce is to entice hawkers or food stalls to use local produce in their food preparation. Through the local produce cashback scheme, hawkers would have short term subsidies in the form of cashbacks and this would help create public awareness about local produce. It also helps reduce the price to competitive levels which enables more demand for local farm produce which in turn would encourage farms to increase farm production.

**3. Were programs to accelerate digitalization and/or innovation in the aquaculture sector applied or boosted in Singapore after the COVID-19 crisis? What has been their impact so far?**

*Funds for farms in technology adoption:*

*A. Agriculture Productivity Fund (APF) and Agrifood Cluster Transformation Fund (ACT)*

*Launched in 2014, the objective of the APF fund is to help farms adopt innovative technology and advanced farming systems as well as provide co-funding support. As of end Dec 2020, 118 farms were awarded a grant of S\$43 million to use innovation and technology for production gain. They had saved on manpower costs other than achieving more than 648 tonnes of its production.*

*In April 2021, SFA launched the Agri-food Cluster Transformation (ACT) fund of S\$60 million for 5 years. Replacing the APF, the ACT provides co-funding support for farms and companies in technology upscaling, innovation and test-bedding and capability upgrading to achieve the “30x30” goal by 2030.*

*B. Singapore Food Story (SFS) R&D Grant*

*In order to strengthen food security, SFA is providing R&D funds for local institutes of higher learning and research institutes. The SFS grant is administered under 3 broad categories in the areas of diversification of import sources; growing food locally and growing food overseas. Three thematic grant calls emphasizing on sustainable urban food production, future foods using alternative proteins and food safety science and innovation were each made one per year since 2019.*

*The objective of the first grant call on sustainable urban food production focused on intensive farming that could produce high yield on a small footprint. Cell based meat production using animal and plant cells to produce lab grown meat was favorably highlighted as a means for helping to meet nutritional needs without the need for animal production and space for farming as compared to current aquaculture practices.*

*C. 5G technology*

*Singapore rolled out the island wide 5th generation (5G) technology standard for broadband cellular network that aims to cover the whole island by 2025. This would help farms wanting to use smart technology in their farming to upload data from sensors to the cloud and back to their server, thus helping to reduce costs and time. The power of 5G technology is detrimental to farms wanting to deploy precision farming whereby data-driven techniques are adopted for operational excellence to capture as much data as possible through automation, sensors, cameras and drones powered by 5G using its high throughput data transfer. This would enable farms to monitor farming processes and minimize wastage and therefore improve production cycle.*

*D. Sustainability Open Innovation Challenge*

*Launched by the Enterprise Singapore, the Sustainability Open Innovation Challenge serves as a platform that brings together industry partners and innovators to develop sustainable solutions in 6 key areas namely sustainable food source, zero waste, renewable energy, sustainable packaging and green buildings.*

**4. What was the role of the Aquaculture Innovation Centre in Singapore in supporting the aquaculture sector during the COVID-19 crisis and what lessons were learned during this period?**

*The Aquaculture Innovation Centre (AIC) is the national centre of innovation set up in July 2019 by Enterprise Singapore for serving the needs of the local aquaculture industry. Hosted by Temasek Polytechnic, AIC works closely with aquaculture farms and enterprises either as*

technology developer, translator for farm adoption or training provider for skilled manpower development. This is performed through consultancy services, pathogen, feed and water testing services, applied R&D, training and education.

During the Covid-19 period whereby there was movement restriction and supply disruption of imported feeds, feed ingredients, fry and other essential items relevant for farming, AIC continued to provide consultancy services and advisory consultancy for companies interested in expanding its market accessibility; validating or efficacy studies on their proprietary technology or product. In addition, AIC developed rapid on-site testing kits for farm biosecurity management; smart feed dispensing in association with water quality monitoring for environmental sustainability as well as customized feed as part of the research grant objectives. Being industry-centric, AIC worked closely with Singapore Food Agency and Standard Development Organization in the co-development of Singapore Standards namely SS 670:2021 on Good Aquaculture Practices and SS 689:2022 on Clean and Green Urban Farms (Aquaculture).

As there were also business disruptions and retrenchment during the pandemic, AIC was requested to develop and conduct 6-month skill-based training courses for displaced workers or those in mid-career switches. The 6-month full-time course on Entrepreneurship in Aquaculture which was supported under the SGUnited Skills (SGUS) Programme, in Aug 2020, resulted in 3 aquatechpreneur start-up companies which went on to develop their business in fish farming and aquaculture supporting technology. In addition to SGUS programme, AIC had conducted a few training sessions for

farms in SS670: 2021 for coastal and land-based farms with the objective of instilling responsible aquaculture practices for better farm operation and farm biosecurity management. Having completed the SS training would enable the farms to be better prepared for farm certification which would help elevate their market visibility locally and in the region.

Apart from offering skill-based training courses, AIC has also been working closely with Aquaculture Nutrition Network and World Aquaculture Society-Asian Pacific Chapter (WAS-APC) in conducting webinars for knowledge transfer and creating awareness about the regional aquaculture trends and development. In order to encourage youths to take greater interest in aquaculture, AIC initiated the Aquaculture Innovation Ideation Challenge in collaboration with WAS-APC in 2022.

In addition to the above-mentioned training, webinars, research and consultancy services, AIC has also been providing extension services and has worked with farms interested in improving farming yield through guidance in technology identification and adoption by farms.

**5. What are the current innovation trends in the aquaculture sector that could help to achieve the government goal to increase nutrition self-sufficiency to 30% (from 10%) by 2030?**

Singapore has only less than 1% arable land for farming with around 110 coastal farms and a few land-based farms. Due to land and sea space constraint as well as lack of aquaculture skilled workforce, it is imperative that adoption of super intensive farming via integrated system approach may help increase nutrition sufficiency from 10% to 30% by 2030.

With the dedicated land space earmarked for agriculture and aquaculture production in AFIP and LCK Masterplan, farms with super intensive vertical and technology integrated indoor farming would be able to produce more with less footprint. The target tonnage desired for super intensive farming is 500 tonnes /ha/year for food fish while the shrimp farming production is expected to be 250 tonnes/ha/year.

Currently, there is growing interest in innovation and technology development for optimizing efficiency of energy and water resource management, waste conversion or treatment and customization of nutrition for aquaculture production species.

In-depth study in the development of faster growing and stress tolerant species for super high stocking density within recirculating aquaculture systems coupled with customized nutrition and monitoring of water quality and animal health via sensor, IoT technologies and

*data analytics are some areas of innovation research that would be useful for increasing nutritional sufficiency.*

*As feed cost often makes up at least 60% of the production costs, R&D in feed and feeding performance for each species is also an important aspect for enhancing productivity. There is no commercial feed mill for producing feeds that cater to the local aquaculture industry and imported feeds containing fish meal often drive up the cost. Current interest in finding alternative fish meal protein and fish oil for replacement in fish feed has been on-going with increasing interest in the circular economy concept by utilizing agricultural and aquacultural wastes including processed food waste valorization as sources of alternative feed additives and ingredients for feed making.*

*With the 5G network set up for the whole island, more farms are trying to tap on the ACT fund to adopt smart technology using IoT and sensor technologies to help save on manpower cost and for better management of water quality and feeding.*

*With technology intervention in production, skilled manpower must be available to ensure that the farming operation and practices are consistent and reproducible for sustainable yield. Working on elevating skill competency and ensuring good and responsible aquaculture practices across farms would be one of the factors that could help increase production and therefore nutritional self-sufficiency to meet 30% of the total nutritional needs.*

**6. Considering the limitations of the small-scale aquaculture sector, in your opinion, what strategies could be used by governments to achieve proper transfer of new technologies to the small-scale aquaculture sector and enhance their benefits?**

*The current local aquaculture industry is fragmented and reliant on traditional farming practices and operations for most of the coastal farms. Establishing centralized infrastructure and support systems for water treatment, waste management, feed supplies & warehousing, hatchery, food processing and cold chain management would benefit the small scale aquaculture producers.*

*Strategies that could help the small-scale aquaculture farms to acquire new technologies and benefit from them could include the following:*

*Reducing capital investment and operation costs*

*Supporting infrastructure and equipment:*

- A. To help coastal farms better plan for investment in productive and sustainable technologies for improving farming productivity, the Singapore Food Agency is exploring the use of lease instruments and longer leases to provide farms with greater certainty on the use of sea space allocated to them. These would help reduce capital investment cost and operational burden.*
- B. Providing "Plug & Play farming units" for small holders would also help small scale farmers in transiting from traditional farming approach to technology invested farming.*
- C. Providing a framework that could encourage farms to upgrade their aquaculture knowledge, responsible aquaculture practices and upskill in performing responsible farm practices and operations as part of farming license requirement. Attending training would help the farms understand better the application of new technologies in enhancing farm production.*
- D. Providing manpower support and guidance to farms in using new technologies in their farming production.*
- E. Providing thematic research funding for research and development amongst institutes to develop technologies that could help reduce production and operational costs.*

*Low-cost and user-friendly technology that is energy efficient for enabling smart farming for greater productivity.*

*Low-cost feeds that could support a number of species since feed cost often makes up at least 60% of the farming production costs.*

**7. How could governments help to improve the situation of vulnerable groups within the aquaculture sector such as subsistence producers, informal workers, processing plants workers, migrants and women?**

- A. *To provide training subsidies for farms to apply to send their farm employees so as to enhance their knowledge and skill competency in farming. They would be able to have the versatility and confidence to take on more tasks or responsibilities for upward career mobility in the industry.*
- B. *To create career development and progression pathways in the industry*
- C. *To provide mentorship services and funding support to help small scale or subsistence producers in improving their farm productivity.*

**8. What could be the best responses to accelerate transformations in the aquaculture sector, particularly small-scale aquaculture, to build sustainability and resilience for future similar shocks?**

*To accelerate transformation of small-scale aquaculture may include the following considerations:*

- A. *Availability of a properly funded and competence extension service organization to provide technical support and mentorship to farms in applying technology and good aquaculture practices for responsible and sustainable farming. Having a knowledge-based farming approach would help farmers understand the basics of farm care and husbandry, good and responsible practices for better management of farm operations and production through training and education.*
- B. *Build a farming network for farms to share their farming success, issues and resources. A support scheme for addressing common issues across farms.*
- C. *Encourage start-ups with support and guidance from accelerator program and funding schemes as well as financial investment in addition to mentorship in their farming journey.*
- D. *Allocation of suitable sites with ready infrastructure for supporting super intensive farming, post-harvest technology and processing with efficient cold chain management.*
- E. *Provide locally produced fry and feeds customized for local warm water species.*

**9. Do you have any other suggestions that could help in the development of small-scale aquaculture?**

*Singapore has done a good job in trying to transform local small scale aquaculture through various incentives and funding schemes for them to equip farms and to adopt technologies for production. In order for the industry to become sustainable in farm productivity and for meeting the 30% of the total nutritional needs for local consumption, the following suggestions that could be considered would include:*

- A. *Developing a support ecosystem involving:*
  - a. *Insurance companies to cover production losses; and banks to provide loan with low interest rates for enabling farm developmental needs;*
  - b. *Suppliers for cold chain management for storage of farm produce;*
  - c. *Alliance farming groups per zone whereby farms in the same area agree to cooperate and collaborate in strategic farming for better support and gain;*
  - d. *Greater support for off-take of the farm produce through working with government, farm and business association or federation to promote local produce uptake amongst consumers, major supermarkets and retailers and regional countries.*
- B. *Strategic farming using only identified species suitable for thriving in certain water quality conditions along the East and West Johor Straits.*
- C. *Developing hatcheries for reducing overseas import so as to reduce risk of export ban or restriction from overseas fry suppliers in times of crisis or pandemic. Having local hatcheries would enable better control of the health and quality of fry.*

- D. Developing feed mill that caters for selected fish species farmed in local waters. Encouraging farms to grow only a few species would help create volume for sustainable feed production.*
- E. Developing infrastructure with tanks and support systems on lease basis for start-ups and interested small scale farms without having them worry about capital investment or cost incurred. They could focus more on developing good farming practices and efficient operations.*
- F. Contract farming between small-scale producers and major aquaculture farms whereby small-scale farms could benefit by growing the species with technology support and investment from major farms. The latter could gain from the extension of farm space and manpower resources available at the small-scale farms.*
- G. Continuous knowledge and skill upgrading for farming development and better productivity through training and education.*
- H. Continue to invest in R&D for developing low cost but efficient energy resource utilization and management; aquaculture waste management; efficient water utilization and management; stress tolerant and faster growing fish species suitable for local water conditions and low cost feed that could support effective growth performance of a few species.*