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**Asia-Pacific
Economic Cooperation**

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

Insights on the Regulatory Environment within APEC Economies and Its Impact on Trade in Services in Food Value Chains

APEC Policy Support Unit

August 2019

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EXECUTIVE SUMMARY

1. Introduction

- Services are a critical component of the food system. They are supporting different stages of the food value chain and facilitating the smooth functioning of the entire system to deliver food worldwide.
- According to the OECD Trade in Value Added (TiVA) Database, the value created by foreign and domestic services together ranges from 17% to 59% of the total value added in exports across 20 APEC economies in the food products industry, and from 8% to 53% in the agriculture, hunting, forestry and fishing industry.

2. Food and Financial Services

- Financial services enable companies to obtain sufficient funds, manage their assets, upgrade machineries, and enhance their resilience to external shocks. Various financing tools have been developed along the food value chain such as contract farming, warehouse receipts financing, trade finance, and factoring, but their availability depends on the maturity of the market, regulatory environment, as well as the capabilities of the individual food players.
- Inadequate financial infrastructure, lack of credit reporting system, limited collateral management and warehousing capacity, underdeveloped financial market and limited financial products, and strict regulatory regimes are the common barriers for food companies to access to finance.
- Natural disasters are common in the APEC region and they place the food system in a vulnerable position. Food producers are also experiencing other risks related to assets, market, business and regulatory environment. Insurance, as a major tool to manage risk, is of great need to protect the livelihoods of millions of food producers, help them swiftly recover after a disaster, and ensure the regional food security. However, food companies, especially small businesses, usually find insurance services less accessible or affordable due to reasons such as high premium and complex and lengthy claim process.

3. Food and Logistics Services

- Logistics services assist in planning, coordinating and implementing the proper storage, handling and transport of food from the point of production to the point of consumption. They include activities such as: 1) transportation, which involves moving products across various nodes in the food value chain; 2) storage, which provides warehousing, packing, manufacturing and processing services, to prolong the shelf life of food products; 3) coordination and inventory management, which ensures the smooth and efficient operation of the overall logistics processes; and 4) regulatory compliance, which guarantees that food traveling across the value chain meets safety and quarantine standards.
- Emerging trends in logistics services include the use of new technologies. Automation and data analytics increase the handling capacity and efficiency of warehouses. Radio frequency identification (RFID) and blockchain increase transparency in the food value chain, helping monitor sensitive processes such as cold-chain transport and ensure compliance to regulatory standards. Nevertheless, the diffusion of new technologies has

been slow due to financial constraints and regulatory uncertainties. Moreover, the growing importance of data in coordinating logistics processes are raising issues on data standardization and security.

- Strengthening the logistics sector to make the food value chain more efficient involves several aspects including the need for better stakeholder engagement, more infrastructure investment, upgrading workforce skills and improving regulatory issues. Regulatory restrictions on foreign entry, competition and domestic operations affects the logistics sector. Similarly, the implementation of unnecessary sanitary and phytosanitary measures affecting trade could increase costs against logistics operators.

4. Food and Distribution Services

- The efficiency of the distribution services, including wholesale and retail services, is key to make food reach final consumers and ensure availability of a good variety of food products. Vertical and horizontal consolidation is a major trend as many distributors are acquiring or investing in either upstream suppliers or downstream outlets, or horizontal competitors, in order to broaden their product ranges, streamline warehouse operations, and therefore gain stronger market power.
- Specialization is another trend, as focusing on one specific category of products gives retailers or wholesalers a unique value proposition in the competitive market. E-commerce implies both challenges and opportunities for distribution services. It drives distributors to adapt themselves to the new business model by either developing their own e-commerce strategy or cementing existing advantages.
- Small farms usually find themselves in disadvantage when working with large distribution services providers. No solid business plan or distribution strategy, limited production capacity, poor quality control, inadequate infrastructure, and disconnected location are the major reasons.
- Regulatory restrictions on distribution services could impede fair competition, new retail forms and more variety of food products. Such constraints include licenses to enter the market or sell specific products, restrictions on the location and size of stores of new market entrants, limitations on business operating hours, and price controls.

5. Role of ICT in Food Value Chain

- The Food and Agriculture Organization (FAO) estimated that global food production would have to increase by about 70 percent to feed the growing population, expecting to reach 9.1 billion by 2050. Considering the falling farmland acreage per capita, advances in technology, including precision agriculture, could be a key enabler to increase yield. Precision agriculture is the use of a set of ICT/data-driven technologies to manage and optimize the production of crops.
- Approximately one-third of the food produced for human consumption is lost or wasted globally throughout the entire value chain from production to final household consumption. Enhancing food security is, therefore, not only about boosting agricultural yield, but also about promoting reduction in food loss and waste. There are many ICT-related solutions that APEC economies can explore, including connecting various parties (e.g. food establishments, NGOs, buyers and sellers) using e-commerce and other apps; improving post-harvest handling and storage through technology such as global data standards (GDS), single windows systems (SWS) and blockchain; and adoption of smart manufacturing/processing technologies.

- Challenges such as limited awareness and capacity, state of infrastructure and limited supportive regulations may affect the adoption of ICT technology. Consequently, policymakers can play an important role by: 1) providing technology grants and incentives; 2) being a trailblazer in the use of ICT to facilitate processes; 3) organizing training and information sharing sessions; 4) mobilizing both public and private sector investment in infrastructure; and 5) ensuring that regulations are responsive and relevant to the changing economic landscape.

6. Final Remarks and Recommendations

- The improvement of the regulatory environment affecting the provision of services in the food value chain requires a “whole-of-government” approach effort, as the formulation of services-related regulations usually entails the participation of several agencies. There is no “one-size-fits-all” solution, as the most urgent necessities that each APEC economy needs to address are different.
- The adoption of international standards and best practices in regulatory issues affecting the food industry and services sectors associated to it can also be beneficial for food value chains. It is important to avoid situations in which compliance costs related to new regulations are too high, affecting negatively the provision of goods and services across the food supply chain.
- Development strategies need to be in place to upgrade existing or build new infrastructure. The returns from infrastructure investment could be high for agriculture and benefit rural areas significantly. However, the high cost involved, as well as restrictions to foreign entry and competition, could make it more difficult to channel resources to relevant infrastructure projects.
- Restrictions to foreign entry and competition affect not only big transport and telecommunications infrastructure, but also other important sectors linked to the food value chains.
- In general, the use of technology and modern ICT services is becoming a game changer in the food value chain. These tools are modernizing agriculture and food processing. They are also improving the provision of other services relevant for the proper functioning of the food value chain.
- However, the optimal use of technology is dependent on the availability of supportive regulations. For instance, economies can remove restrictions that only allow locally registered sellers to offer their products in e-commerce platforms. Similarly, financial institutions would not be able to offer their clients new digital applications if regulations establish the need to apply for permits that are troublesome to obtain before the launch of any application. In addition, full interoperability of different ICT systems used in logistics require the development of data sharing standards.

CHAPTER 1: INTRODUCTION¹

1.1 Global Food Overview

The global food system has been playing a critical role in the effort to eliminate hunger and improve accessibility to sufficient and nutritious food. In the past two decades, the number of hunger has decreased by around 100 million. However, there are still more than 800 million people in a chronic state of undernourishment,² and climate change, conflicts and the trends of anti-globalization and protectionism have been placing a constant threat on food production and people's accessibility to food. As more people are lifted out of hunger, changes in dietary preference require sustainable supply for a greater diverse set of food products. With the projection of world population to rise by 2.2 billion to 9.8 billion by 2050,³ the outlook for global food security and sustainability is plagued with many challenges. How to better sustain the population is and will still be a long time concern.

Challenges and Uncertainties

Food challenges persist. Despite the growing production of food on the global level, the food system still fails to deliver enough food onto countless people's hands. The trend of global hunger reversed in 2016 after nearly a decade of consecutive decline, a result of persistent conflicts and droughts. Down from 900 million in 2000 to 777 million in 2015, the number of undernourished people globally rose to an estimate of 815 million in 2016, equating to about 11% of world population. The picture is also grim when it comes to achieving global nutritional needs. While the prevalence of stunting fell from 29.5 percent to 22.9 percent of children under the age of five, 155 million children were stunted between 2005 and 2016. Moreover, 52 million children under the age of five suffered from wasting, which accounted for 7.7% of all.⁴ Malnutrition also comes in the forms of obesity, overweight and other health problems. An estimated 41 million of child under five were overweight in 2016 (6%), increased from 5% in 2005. The world adult obesity rate rose from 9.6% in 2005 to 12.8% in 2014. Anemia in women of reproductive age is another indicator for poor health and nutrition and has raised greater concern. In 2016, 32.8% (613 million) of women of reproductive age globally were affected by anemia, showing a slight increase of 2.2% from 2005.⁵

Climate change aggravates the situation by adding greater uncertainty and vulnerability into the food system. It exerts a major impact on the food system through both extreme weather events such as droughts and floods and long-term gradual climate change such as sea level rise and melting glaciers. Such change could not only interrupt agriculture production and reduce yields, but will also destroy infrastructures, spread diseases, which in turn will directly impact affected-people's ability to access and afford the food and meet their nutritional need, thus

¹ This chapter is an adapted version of Gloria O. Pasadilla and Crystal Jiquan Liu, "PSU Policy Brief No. 21: Services and the Food System" (APEC-PSU, May 2018), <https://www.apec.org/Publications/2018/05/Services-and-the-Food-System>.

² FAO, IFAD, UNICEF, WFP, and WHO, *The State of Food Security and Nutrition in the World: Building Climate Resilience for Food Security and Nutrition* (Rome: FAO, 2018), <http://www.fao.org/3/i9553en/i9553en.pdf>.

³ UN DESA, "World Population Projected to Reach 9.8 Billion in 2050, and 11.2 Billion in 2100," June 21, 2017, <https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html>.

⁴ FAO, IFAD, UNICEF, WFP, and WHO, *The State of Food Security and Nutrition in the World: Building Climate Resilience for Food Security and Nutrition*.

⁵ FAO, IFAD, UNICEF, WFP, and WHO.

develop into food crises.⁶ According to the World Food Programme (WFP), global hunger and malnutrition could surge by up to 20 percent by 2050 if a more climate resilient and adaptable world is failed to be built.⁷

Conflicts and anti-globalization pose further threats to the global food security and sustainability. Around 65% of the stunted children in the developing world are from conflicted-affected regions, showing a striking increase of 19% over the past two decades. Moreover, conflicts and food insecurity could reinforce each other and be caught in a vicious circle. Anti-globalization, a recent trend to put stricter barriers on free flow of goods, information, investment and people, intensifies food insecurity, as it is indisputable that the battle with global hunger and poverty has long been benefited from a more open, stable and inclusive trade environment. To ensure continued progress, stronger global and regional cooperation will be crucial.⁸

Emerging Trends and Opportunities Reshaping the Food System

Luckily, technology is revolutionizing the food system and has brought about many innovative solutions in tackling the barriers that the system has faced for decades and connecting every dot of the food chain to deliver food worldwide. Automation and artificial intelligent has enabled higher production with less human labor. Digital financial instruments make payments more convenient than ever and have allowed farmers and food companies access to credit and insurance by just a click of a button. Information such as agriculture techniques, market trends, and real-time weather forecasts can reach farmers' hands with no delay through mobile phones. Simplification and digitalization of custom procedures has allowed commodities to enter an economy's border within hours or minutes. E-commerce, connects buyers and sellers in every corner of the world. Cold chain logistics made it possible for perishable food such as fish and seafood to remain fresh while being transported worldwide.

However, not everyone is enjoying the benefits of technology. Small farmers and businesses, as well as numerous least developed economies still face barriers to integrate into the global food system due to insufficient infrastructure, technical knowledge, and business information. As such, these economies are greatly disadvantaged in the game. If the food system is inclusive of such players, only then can it become more vibrant and sustainable.

Global and regional cooperation has been strengthened on the whole. The past decades have seen greater flow of goods, information and people among regions, and new collaborations on issues such as regional single window to enhance trade efficiency. Moreover, food security is still the center of many policy dialogues and negotiations. The United Nations Sustainable Development Goal #2 targets to end hunger and malnutrition by 2030 and calls for further collective commitment and endeavor. Such international efforts are crucial towards fostering trust, and forming a healthier food trading environment, which is key to building a more sustainable and secure food system.

⁶ UN WFP, "Climate Impacts on Food Security," accessed January 26, 2019, <https://www.wfp.org/climate-change/climate-impacts>.

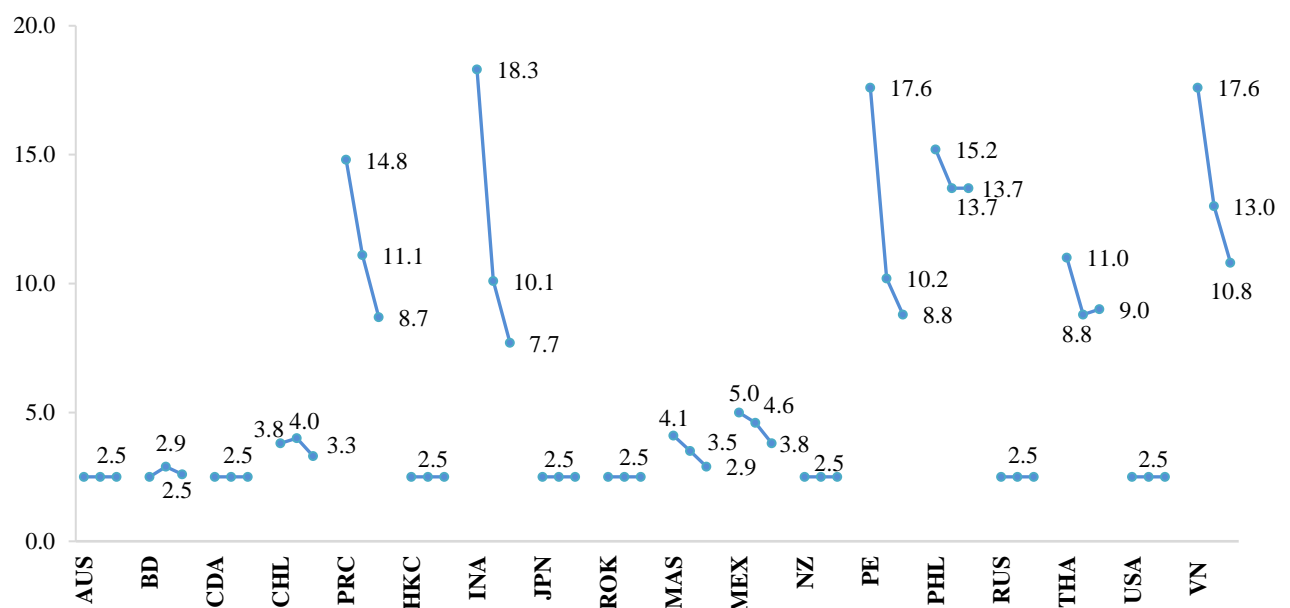
⁷ UN WFP, "Climate Action," accessed January 26, 2019, <https://www1.wfp.org/climate-action>.

⁸ IFPRI, "Conflict and Migration," accessed July 19, 2018, <http://www.ifpri.org/topic/conflict-and-migration>.

1.2 APEC FOOD SNAPSHOT

Home to 38% (2.9 billion) of the world’s population, food security has always been the primary concern for the APEC region. APEC attaches great importance to the food security agenda, and has adopted APEC Food Security Road Map Towards 2020 and the goal of building an APEC Food System that “efficiently links together food production, food processing and consumption to meet the food needs of our people as an essential part of achieving sustainable growth, equitable development and stability in the APEC region.”⁹ For the past decade, tremendous progress has been made in eliminating hunger as the prevalence of undernourishment in APEC economies dropped dramatically (Figure 1.1). However, the absolute number of people suffering from hunger remains striking and malnutrition is still prevalent.¹⁰ To progress further on this issue, challenges faced includes not only producing enough food but also empowering small farms and producers improving nutrition as well as coping with risks such as climate change.

Figure 1.1: Prevalence of Undernourishment (% of population) in APEC Economies, 2006, 2011, 2016



Source: World Bank Database, 2019;¹¹ APEC Secretariat, Policy Support Unit calculations

Note: Data for Papua New Guinea, Singapore, and Chinese Taipei are not available.

⁹ APEC, “APEC Food System,” accessed January 26, 2019, <https://www.apec.org/Groups/Other-Groups/APEC-Food-System>.

¹⁰ FAO, *Regional Overview of Food Security and Nutrition: Asia and the Pacific* (Bangkok: FAO, 2017), <http://www.fao.org/3/a-i7930e.pdf>.

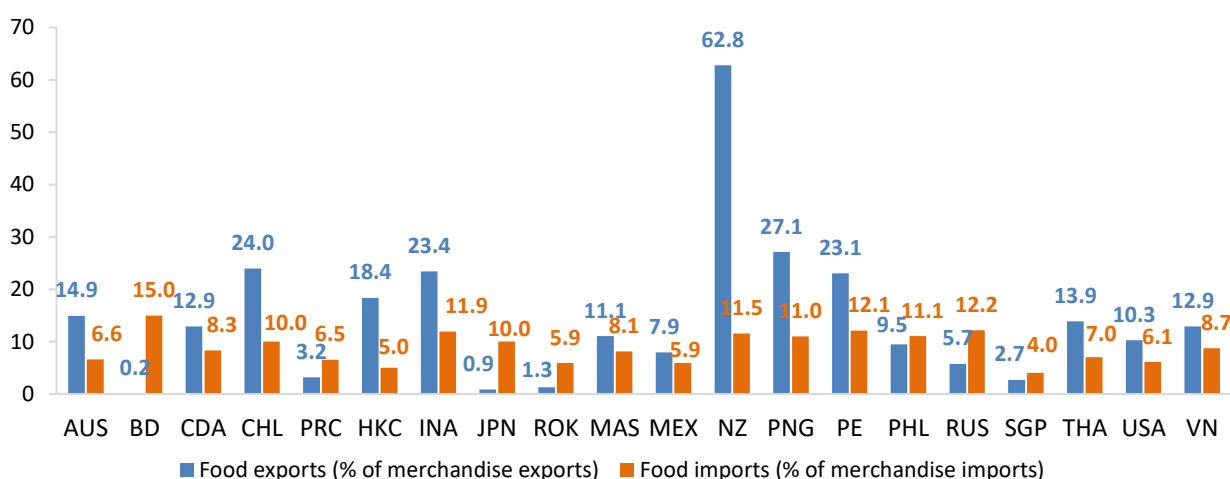
¹¹ World Bank, “World Bank Open Data,” accessed July 5, 2018, <https://data.worldbank.org/>.

Box 1: APEC – The World’s Major Food Producer

- As the world major food producer, APEC economies hold a great share of the world’s crop and livestock production. In 2016, the world cereal production was 2.8 billion tonnes, of which 1.5 billion came from APEC members, accounting for 54% of the world total.¹²
- APEC region is also the major supplier of both aquaculture and capture fisheries. Among the top 10 major aquaculture producers, 6 are APEC economies. In 2014, China alone produced 45.5 million tonnes of aquatic animals, making up more than 60 percent of global fish production from aquaculture (73.8 million tonnes). For 27.3 million tonnes production of aquatic plants from aquaculture in 2014, China and Indonesia made up for 23.4 million of that. Moreover, among the 10 major marine capture fisheries producers, 7 are APEC economies. Global total capture fishery production in 2014 was 93.4 million tonnes, while more than 65 percent are from APEC economies.¹³

Trade in food takes up a considerable share of the total trade among APEC economies. As shown in Figure 1.2, the percentage of food import to total merchandise imports ranges from 4.0% (Singapore) to 15.0% (Brunei Darussalam). The share of food in total merchandise exports, however, shows greater divergence ranging from 0.2% in Brunei to 62.8% in New Zealand.

Figure 1.2: Food Import and Export, APEC Economies, 2017¹⁴



Source: World Bank Database, 2019;¹⁵ APEC Secretariat, Policy Support Unit calculations

Note: Data for Chinese Taipei are unavailable. Data for all economies are from the year of 2017, except for China 2016, Papua New Guinea 2012, Thailand 2016, and Viet Nam 2016.

Small family-run farms are one of the major characters of agriculture industry in the Asia and Pacific region. Though small in scale, these farms have made great contribution to the battle against global hunger in the past. However, in this new round of technology transformation,

¹² World Bank. "World Bank Open Data."

¹³ FAO, *The State of World Fisheries and Aquaculture: Contributing to Food Security and Nutrition for All*, 2016 (Rome: FAO, 2016), <http://www.fao.org/3/a-i5555e.pdf>.

¹⁴ Food in this figure by the World Bank are noted as “commodities in SITC sections 0 (food and live animals), 1 (beverages and tobacco), and 4 (animal and vegetable oils and fats) and SITC division 22 (oil seeds, oil nuts and oil kernels).”

¹⁵ World Bank.

such small farms are being left behind. They are limited in the financial and technological resources to invest in land, as the nature of small scale limits many machines and technologies as they are too expensive to be adopted. Therefore, when comparing to large farms and companies, the small firms are disadvantaged in adopting new technologies that might help them improve their product quality and competitiveness.

The food system in Asia Pacific region is particularly vulnerable to climate change due to its dense population, highly natural-disaster exposed geography, climate-sensitive agriculture, as well as weak disaster resilience of the vulnerable small farms. According to Asian Development Bank, climate change would cause a decrease in rice yields in the Philippines, Thailand, and Viet Nam by up to 50% by 2100, and USD 50 billion loss of the reef-related fisheries in Southeast Asia from 2000 to 2050.¹⁶

1.3 The Trend of Increasing ‘Servicification’

The definition of food system goes beyond mere agricultural production. It covers all activities that are involved in the food value chain such as research and development, production, processing, storage, transportation, distribution, sales, as well as the legal, social, and economic environments where all these activities occur. It is an ecosystem which encompasses farmers, enterprises, business associations, governments and many other actors in the agriculture, manufacturing and services industries.

Services are a critical component of the food system. Various kinds of services are involved in supporting the production process and other stages of the food value chain and facilitating the smooth functioning of the entire system. Services providers are also major actors in the system, working closely with farmers and food manufacturing companies. By providing innovative solutions and professional advices to various barriers faced by farmers and food companies, services providers can assist those farmers and companies in building better resilience towards both external and internal shocks.

Leveraging new technologies, the services sector is playing a more crucial role than ever before and has brought unprecedented opportunities to transform the food system and deliver food worldwide. As manufacturing has been experiencing ‘servicification’, or the increased role of services in the value chain (from design to maintenance and repairs), the food system, too, is increasingly being ‘servicified’. Therefore, constructing a healthy environment for the development of services and improving access to services by all players would be vital towards ensuring a more smooth-functioning and productive food system.

1.4 Services in a Generic Food Value Chain

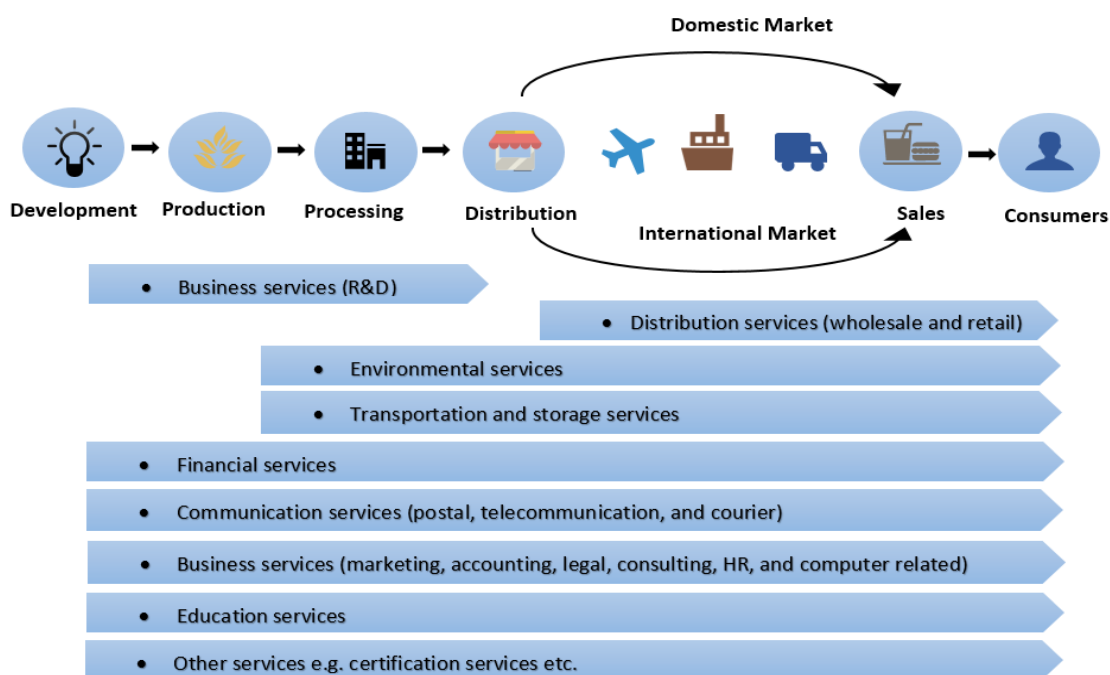
Figure 1.3 depicts a generic food value chain. The value chain begins from the development stage, moving on to the production, then the processing, distribution to domestic or international market, and sales, ending at the consumers. The figure also illustrates a standard combination of services involved in this generic food value chain and the stages those services are associated with. Research and development services are usually involved in the first few stages before the products are ready to enter the market, while distribution services (i.e. retail and wholesale) come in after the production and processing stages. Environmental services and

¹⁶ ADB, “Unabated Climate Change Would Reverse the Hard-Earned Development Gains in Asia,” *ADB*, July 14, 2017, <https://www.adb.org/news/unabated-climate-change-would-reverse-hard-earned-development-gains-asia-new-report>.

transportation and storage services start from the production stage. Besides those services attached to specific stages, there are plenty of other services which support the whole value chain, such as financial services, communications services, business services and education services. Together, these services complete the whole value chain and deliver all kinds of food onto the consumers' hands.

Services perform three major functions in this typical food value chain: 1) vital stages (development, distribution, sales services) in the value chain; 2) linkages (transport, storage services) between different stages; and 3) provision of key inputs (telecommunications, financial services) in the food producing, manufacturing and distribution process.

Figure 1.3: Services in a Generic Food Value Chain



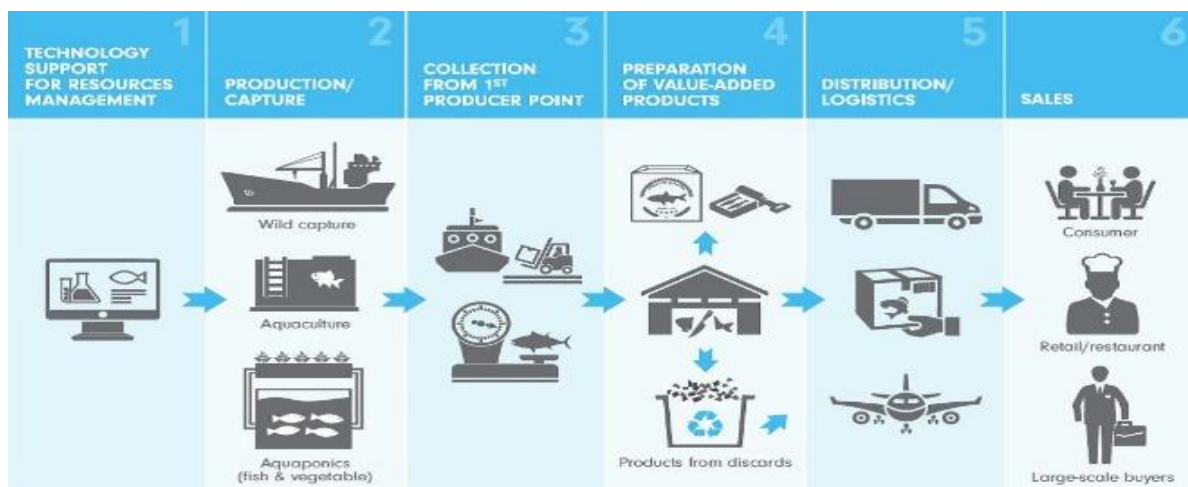
Source: APEC Secretariat, Policy Support Unit calculations

In reality, value chains are generally more complex than what is depicted in the figure as the value chain of a particular product is entwined with the chains of others. On the other hand, for some products, the actual value chain might be simpler as one or two stages can be skipped. For example, the processing stage may not be required in a fresh fish or seafood chain. Moreover, the order of different stages in the chain is not fixed. For example, coffee beans can be exported straightaway after being produced, and then processed in the foreign market before they are sold in the market. The range and combination of services involved in each value chain also vary across different types of food and their production modes.

Example #1: Services in the Fisheries Value Chain

Figure 1.4 shows a general fisheries value chain from which we can understand the main services involved. It begins with resources management, where technical support and R&D are vital. Wild capture, aquaculture and aquaponics are the three major modes of fisheries production where satellite-based technology, telecommunications, renting of machinery and equipment, and environment services together ensure the productivity and quality of the fish, and safety of the fishermen especially in the case of wild capture. The fish produced or captured are then either collected by an aggregator or directly sold to factories, restaurants or consumers through contract or direct sale. During this stage, distribution services, sales and cold chain logistics would have already come into play before most of the fishes go into the next processing stage. After being processed, the final products are packaged and transported to either the domestic or international market where they are sold to retail outlets or restaurants, or to wholesale buyers who subsequently sell them to small buyers or retailers. However, many services are invisible in this figure, such as financial services and business services, which are also indispensable parts of the chain.

Figure 1.4: A General Fisheries Value Chain



Source: European Commission, 2017¹⁷

Example #2: Services in an Australian Livestock Export Roadmap

Figure 1.5 depicts a picture of the export roadmap of a typical livestock from Australia. The journey begins when licensed exporters transport the animals from producers to a feedlot for quarantine where the animals' health and welfare will be examined. After that, the livestock is transported to the port where a final examination of the animals will be conducted before loading. Animals that pass this stage will then be sent through ship or plane to their destination markets. After being discharged at the foreign port, some will be sent to farms for breeding purposes, while others will be sent to feedlot for another round of quarantine services and consequently transported to processing factories.¹⁸

¹⁷ Monica Veronesi Burch and Stephanie Maes, *Boosting Business along the Fisheries Value Chain* (Brussels: European Commission, 2017), https://webgate.ec.europa.eu/fpfis/cms/farnet2/sites/farnet/files/publication/en_farnetguide12.pdf.

¹⁸ Australian Livestock Export Corporation (LiveCorp), "An Overview: Industry Information," accessed April 10, 2018, <http://www.livecorp.com.au/industry-information/an-overview>.

Two major regulatory systems are highlighted in the figure. The Australian Standards for the Export of Livestock (ASEL) stipulates the animal health and welfare requirements for the livestock from farm to the point of discharge at the overseas ports, while the Exporter Supply Chain Assurance System (ESCAS) regulates that Australian exporters must have control over the entire value chain to the point of slaughter in the foreign markets to make sure each stage meets international standards. The two systems require great amount of certification and inspection services, which are important in ensuring the smooth movement of animals along the export chain.¹⁹

Figure 1.5: Australian Livestock Export Map



Source: Australian Livestock Export Corporation (LiveCorp)²⁰

Example #3 Services in Chilean Fresh Cherry Industry

Figure 1.6 shows the key stages and services involved in the fresh cherry industry in Chile, the largest cherry exporters in the world.²¹ The value chain starts with establishing and preparing the farm where R&D, plantation and construction services such as roofing and irrigation are conducted. During the production stage, technical assistance and supervision are required to ensure high quality. Major services required include agronomic, pest control and certification services. Moving to the packing stage, packing and selection, testing and certification, and information technology services are key inputs. After fresh cherries are selected and packaged, they move on to the last stage where logistics, transportation, marketing and sales services become vital and enable the realization of profit and completion of the whole chain. Exporters are a key stakeholder in Chile's export-driven cherry industry, as they centralize many services described above and link both local producers and overseas importers. Besides the services directly related to a specific stage of the cherry value chain, there are many transversal services that support the whole value chain, such as finance and accounting, human resources, legal

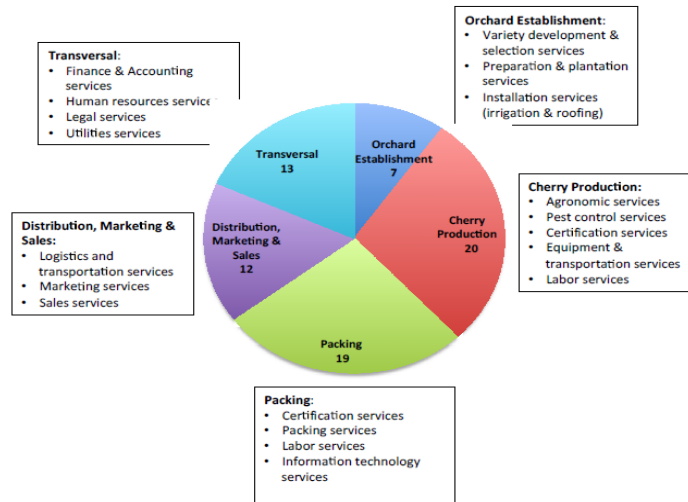
¹⁹ LiveCorp. "An Overview: Industry Information."

²⁰ LiveCorp.

²¹ IndexBox, "Global Cherry Market 2019 - Chile Emerged As The Largest Exporter," <https://www.indexbox.io/blog/global-cherry-market-2019-key-insights/>

services and information system management. In total, 88 separate services were identified by the study in the Chilean fresh cherry industry.²²

Figure 1.6: Key Services in Chilean Cherry Industry



Source: Bamber & Fernandez-Stark, 2015²³

The above three cases show that a wide range of services are involved in each food chain and each service plays its own unique role in the system. **Financial services**, particularly credit and payment, allow all actors in the value chain, not only farmers and food companies, to be able to obtain working capital and invest in technology, talents and management resources. Moreover, financial services, specifically insurance, can help farmers and companies manage risks and recover quickly after natural disasters. **Information and communications technology (ICT) services** enable the flow of information among everyone in the food system through phone, internet, satellite system, remote sensor and others. Many mobile apps and software have provided innovative solutions to connect food producers with one another, with weather or price information sources, and with the outside market. **Transportation and storage services** account for the movement of food from production to storage to sales. The rapid development of cold chain logistics for the past decade has greatly facilitated the long-distance trade of perishable food -such as seafood and fruits- and has decreased food losses and waste. **Distribution services** include wholesale and retail services, which connect food producers with the end market. An efficient distribution system is undoubtedly critical to avoid food shortage or waste and link products to the right customers. **Business services** such as R&D, human resource, legal, marketing and accounting services improve the farmers' and companies' core competitiveness by providing professional knowledge and individually tailored advice. In addition, other services such as environmental services, educational services and certification services complete the food value chain and help it function effectively and efficiently.

1.5 Identifying Key Services

Not all services are equal. Some services have greater contributions in the food system than others. This section tries to provide some insights on which services are critical in the food

²² Penny Bamber and Karina Fernandez-Stark, "Fresh Cherry Industry in Chile," in *Services in Global Value Chains: Manufacturing-Related Services*, ed. Patrick Low and Gloria O. Pasadilla (Singapore: World Scientific, 2016), 701–41.

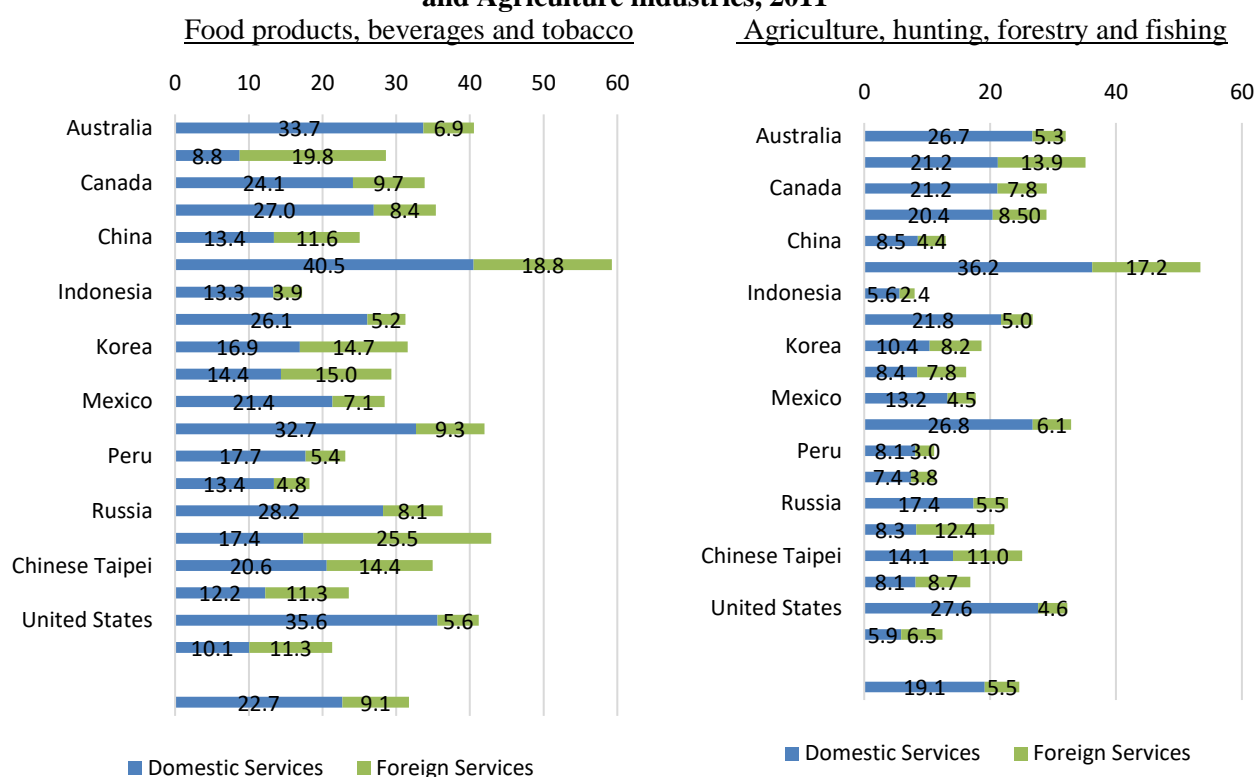
²³ Bamber and Fernandez-Stark, "Fresh Cherry Industry in Chile."

system. It analyses statistics on APEC economies' domestic and foreign services value added share of gross exports as well as the major value-creating services using OECD Trade in Value Added (Tiva) Database.

Figure 1.7 shows the domestic and foreign services value added share of gross exports in food products, beverages and tobacco industry, and similarly, in agriculture, hunting, forestry and fishing industry. The value created by foreign and domestic services together ranges from 17% to 59% of the total value added in exports made by 20 APEC economies in the food products industry. While in the agriculture, hunting, forestry and fishing industry, the range is from 8% to 53%.²⁴

A pattern can be observed from the figure is that the share of services value-added differ across economies of different development levels, as the industrialised APEC economies (Australia; Japan; New Zealand; and the United States) tend to have greater share of services value added in both agriculture and food industries than in developing APEC economies (such as China; Indonesia; Malaysia; the Philippines; Thailand; and Viet Nam). Domestic services remain dominant in both agriculture and food industries, and the share between domestic and foreign services depend in each economy largely on factors such as their development and market openness levels.

Figure 1.7: Domestic and Foreign Services Value Added Share (%) of Gross Exports in Food and Agriculture industries, 2011



Source: APEC Secretariat, Policy Support Unit calculations based on OECD Trade in Value Added (TiVA) Statistics²⁵

Note: Data on Papua New Guinea is not available.

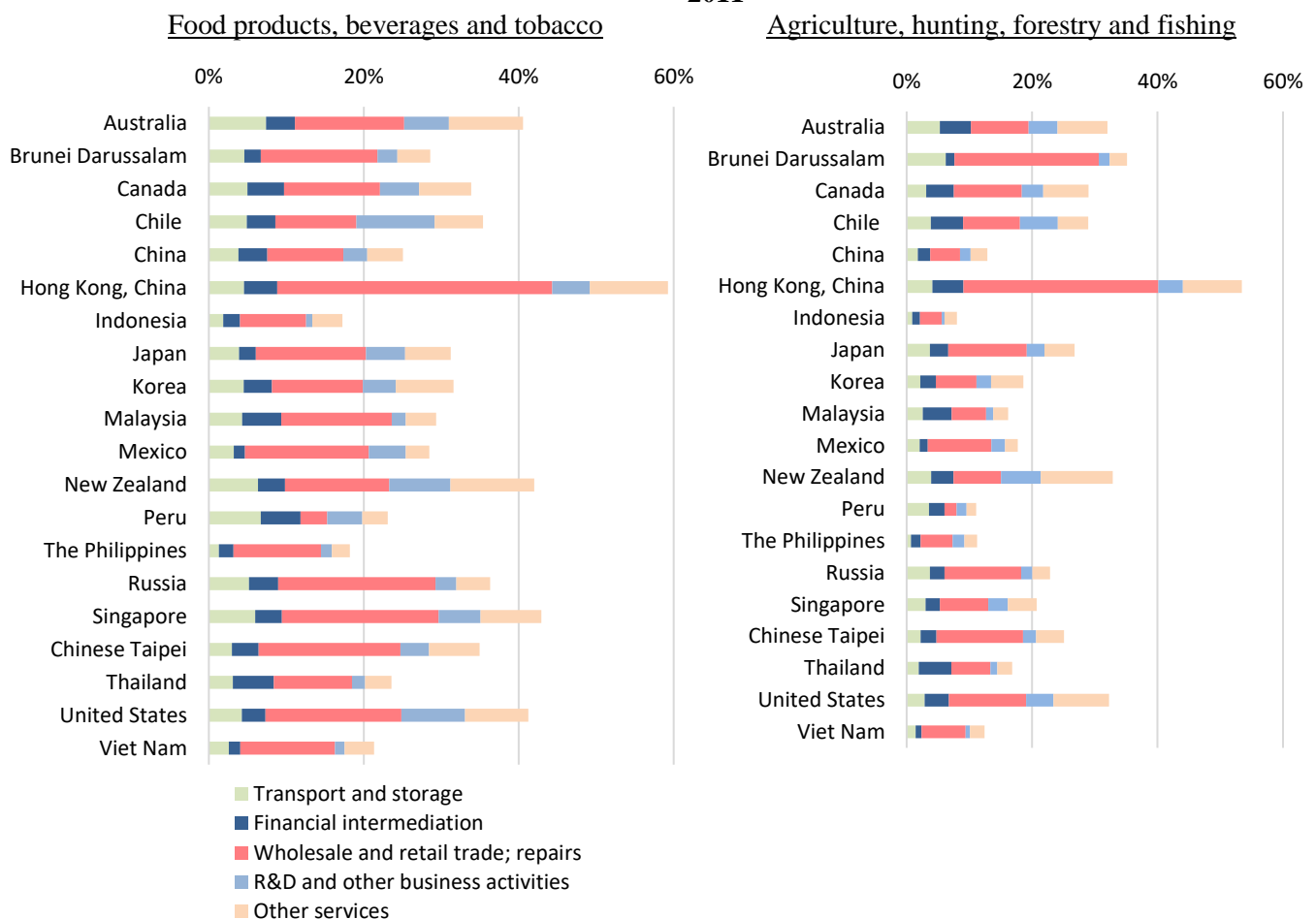
²⁴ The average in APEC of the value added by services in the total value added in exports was equal to 32%. In the case of imports, the average value added by services was equal to 25%.

²⁵ OECD, "Trade in Value Added Database," 2018, <https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm>.

Are there any key services in the food system? Do all the services sector make equal contribution to the food value chain? Figure 1.8 shows the detailed composition of the services input and the major value-creating services in the aforementioned two industries.

The top four key services identified in the charts are wholesale and retail services, R&D and other business activities²⁶, transport and storage, and financial intermediation. Particularly, wholesale and retail services take up a good amount of total services input for both industries for almost all APEC economies. Together, the four major services inputs account for more than three quarters of the total services input for most APEC economies.

Figure 1.8: Services Value Added Share of Gross Export in Food and Agriculture Industries, 2011



Source: APEC Secretariat, Policy Support Unit calculations based on OECD Trade in Value Added (TiVa) Statistics²⁷

Note: Data on Papua New Guinea is not available.

Identifying key services input in the food and agricultural industries provides implications for both food producers and policy makers. It calls for more attention on these closely food-related services sectors as food companies are concerned about the cost and efficiency of such key input for their production. While policy makers need to reexamine the regulatory and business environment of these service sectors as they play an important role in promoting productivity and competitiveness of the food exports.

²⁶ Other business activities here include legal, accounting, market research, business and management consultancy and advertising.

²⁷ OECD, "Trade in Value Added Database."

However, the OECD TiVA has certain limitations when identifying key services in the food value chain. For example, communications and computer services do not stand out in the calculation, possibly because at the time the data was collected in 2011, the transformation of ICT was not as deep and widespread as it is now. Moreover, in today's digital era, services are not only value-creating activities. They are also redefining the way companies produce food and how the whole value chain works. Services innovations have impacted all stages of the value chain, either in production stage, or distribution and sales. Given the fact that how much technology has developed for the past seven years, we could only sense that services are making a much more important impact on food value chains than what data in the graphs are showing.

Against this backdrop, this report is taking a close look at the role in food value chains of the services sectors identified above, namely financial services, transport and logistics, wholesale and retail services, and other services such as R&D and business services. Issues such as the scope of the services in food value chains, current trends, regulatory constraints and challenges faced by both services providers and services users are examined. The report also reviews the transformation brought by Internet and ICT technologies, which have become an enabler for other services. Good practices and policy recommendations are also mentioned throughout the report.

CHAPTER 2: FOOD AND FINANCIAL SERVICES²⁸

2.1 INTRODUCTION

A healthy financial status lies in the foundation of the competitiveness of actors in the food system and their ability to function well. The availability and affordability of the financial services are crucial towards the smooth operation of the food value chain and ensuring food productivity, promoting food quality and food security. The scope of financial services in a food value chain encompasses all categories of finance that are required to sustain and develop the chain from the beginning of its development and production, all the way to distribution and sales end. It includes but is not limited to: 1) **banking services** such as lending, leasing, asset management, cash flow management; and 2) **insurance and insurance-related services** such as disaster, life and accident insurance.

Banking services enable companies to obtain sufficient funds, manage their assets and attain financial flexibility, which is essential and a prerequisite to access to other services such as ICT and research services. Sufficient funds allow companies to upgrade their machineries, adopt new technologies, and hire top talents, which in turn will increase productivity and profitability as well as create more cash flow in the long run. Agriculture typically suffers from seasonal cash-flow shortage due to its inherent nature, and therefore credit becomes exceptionally important. Convenient payment and money transfer systems has led to the actualization of global business. Other services such as asset management, financial advisory similarly help companies to better manage their financial asset and improve their financial literacy and financial status.

Insurance services, on the other hand, provide a safety net for companies and individuals in the food system in various situations. The profitability of the food sector, especially agriculture, relies greatly on numerous external factors such as weather, market price, outbreaks of pests and disease, which are out of farmers' control. Besides, events that affect individual producers (e.g., health problems, accidents) or companies (e.g., theft of assets) may cause devastating consequences and expose farms or companies to greater risks if no sound and affordable insurance services are provided.²⁹ Generally, the vulnerability decreases as the supply chain reaches towards the end, as the production stage is more exposed to external factors and is mostly compromised of smaller farms or companies with a weak ability to withstand risks. Nevertheless, the accessibility of financial services is frequently less obtainable at the start of the chain (i.e., production stage) and more obtainable to the businesses involved in activities adding value farther along the chain (such as processing, distribution stages).³⁰

However, accessing to financial services remains a great challenge for many farms and enterprises across Asia and the Pacific region, especially for small farms in rural areas. This chapter examines the performance of financial services, the challenges faced by food value chain actors to access these services in APEC economies, and presents some policy implications.

²⁸ This chapter is an adapted version of Gloria O. Pasadilla and Crystal Jiquan Liu, "PSU Policy Brief No. 22: Financing the Food Value Chain" (APEC-PSU, July 2018), <https://www.apec.org/Publications/2018/07/Policy-Brief--Financing-Food-Value-Chain>.

²⁹ IFC, "Scaling Up Access to Finance for Agricultural SMEs: Policy Review and Recommendations" (IFC, October 2011), http://www.gpfi.org/sites/gpfi/files/documents/G20_Agrifinance_Report%20%28FINAL%20ONLINE%29.pdf.

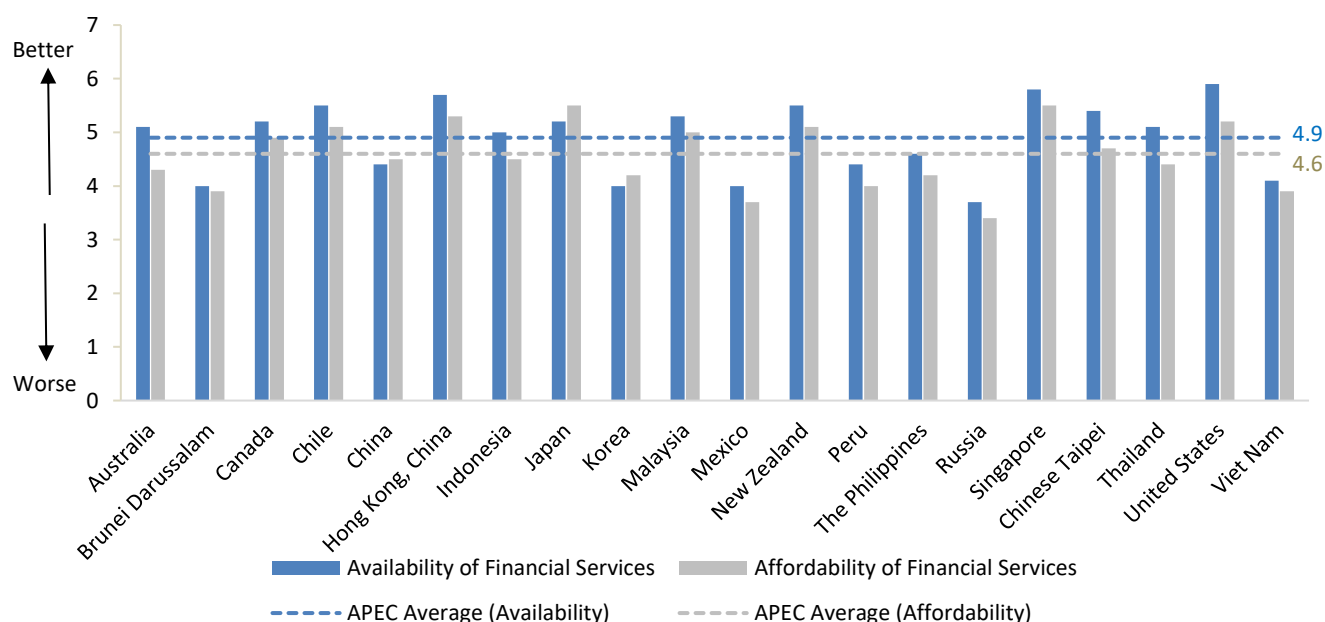
³⁰ IFC.

2.2 Performance of Financial Services in APEC

The performance of financial services varies across the APEC region as some economies enjoy the best financial infrastructure and mature financial markets in the world, while others are still developing their financial systems. According to the Global Competitiveness Index (GCI) Report 2017-2018 by the World Economic Forum, the financial market development of New Zealand, United States, and Singapore are ranked top three, among 137 economies covered by the report. Six of the top ten economies are APEC members.³¹ However, disparity exists as nine economies are ranked amongst the 10th to 50th place, four economies are ranked between the 50th to 100th position, and one economy ranked below the 100th position.³²

GCI also provides an insight on the availability and affordability of financial services among APEC economies, shown in Figure 2.1. Measured on a scale from 1 to 7, the scores on availability of financial services ranges from 3.7 to 5.9 for 20 APEC economies. When it comes to affordability of financial services, the scores ranges from 3.4 to 5.5. Both indicators show the significant gaps of the development of financial services sector among APEC economies and room for progress to be made.

Figure 2.1: GCI Scores on Availability and Affordability of Financial Services, APEC Economies, 2017-2018



Source: World Economic Forum, 2017;³³ APEC Secretariat, Policy Support Unit calculations

Small and medium enterprises (SMEs) commonly face more challenges when accessing financial services, as compared to larger enterprises in the supply chain. Unlike large

³¹ The Global Competitiveness Report does not cover information for Papua New Guinea.

³² WEF, *The Global Competitiveness Report 2017-2018* (Geneva: WEF, 2017), <http://www3.weforum.org/docs/GCR2017-2018/05FullReport/TheGlobalCompetitivenessReport2017%E2%80%932018.pdf>.

³³ WEF.

companies, SMEs are less resourceful and informed of the availability and varieties of financial services available in the market.

Financial services are generally inadequate and less available in rural or remote areas. It is costly for financial services providers to operate in areas with low population densities. Factors like poor transportation infrastructure and backward communication facilities all disconnect rural areas with the outside world, and make it highly difficult for financial services to be delivered. Moreover, rural companies generally lack suitable collaterals and credit history, and this increase the risk borne by the financial institutions when providing services such as loans. Therefore, profit-seeking financial institutions typically try to avoid rural and agriculture finance but rather explore less risky opportunities in the urban areas.³⁴

2.3 Access to Banking Services

Demand for Finance Varies in Different Stages of the Food Value Chain

At each stage of the value chain, different actors require different types of financing and reasons for seeking it. The suppliers of finance likewise change at each stage, and financing tools become usually more sophisticated towards the end of the chain, particularly if the product is for export. Using a coffee value chain as an example, Figure 2.2 illustrates the typical credit providers and those seeking finance, types of finance and the reasons for financing in the different stages of the value chain.

In the production stage, farmers, producers and cooperatives typically need credit for land preparation, purchase of inputs like seeds, fertilizers, pesticides, machinery, farm operation and harvest activities. At this stage, the borrowers are a mix of small or medium sized farms, as well as large plantations or factories. The amount of loan they seek may be relatively small, for example: for purchasing seeds or fertilizers; or large and long-term loans for investment on machinery or up scaling their business. Various lenders involved can be banks, credit unions, microfinance institutions, as well as informal lenders like private moneylenders and input suppliers.³⁵

After harvest, traders, middlemen, exporters or cooperatives purchase or collect the coffee beans from independent farmers and producers, before transporting them in bulks to subsequent buyers. Integrated coffee farms will harvest and collect their own coffee themselves and store them for processing. In this stage, coffee purchasers may need financing to buy coffee beans and pay for expenditures related to storage and transport. Exporters can also get involved in granting finance from this point forward.

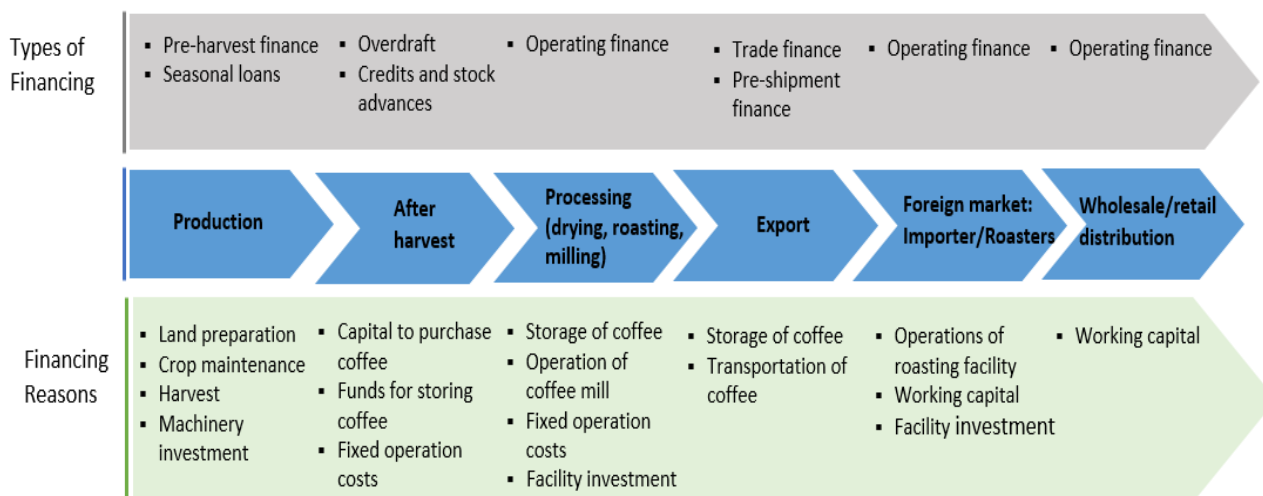
The chain then moves to processing (drying, roasting, and sometimes even milling). Sometimes, coffee beans – either dried and/or roasted – are exported directly and milled in the overseas market. The need of financing at this stage is for purchase, storage and transport of the coffee beans, as well as other operational costs. For processing factories, they may need financing for investment in facilities and equipment. Credit providers at these phases are

³⁴ IFC, "Scaling Up Access to Finance for Agricultural SMEs: Policy Review and Recommendations."

³⁵ Roy Parizat et al., "Risk and Finance in the Coffee Sector : A Compendium of Case Studies Related to Improving Risk Management and Access to Finance in the Coffee Sector" (World Bank, February 2, 2015), <http://documents.worldbank.org/curated/en/742751467997014983/Risk-and-finance-in-the-coffee-sector-a-compendium-of-case-studies-related-to-improving-risk-management-and-access-to-finance-in-the-coffee-sector>.

typically formal financial institutions (FIs) like banks and credit unions, as well as large coffee exporters, multinational buyers and importers. The credit seekers tend to be also larger in size and possess more financial resources, compared to the independent farmers in the production stage.

Figure 2.2: Examples of Financing Activities along Coffee Value Chain



Source: APEC Secretariat, Policy Support Unit calculations based on World Bank, 2015³⁶

The domestic value chain may end with the export of coffee (either unmilled or milled). If unmilled beans are exported, the chain continues in the foreign market with either roasting or milling, then packaging and selling to either retailers or wholesalers. In this stage, the financing demanders (as well as suppliers) are relatively large and more sophisticated in the use of financing structures, including different types of trade financing. In some cases, they are very capable of financing their own operations.

Variety of Available Financing Instruments Depends on Regulatory Landscape and Market Sophistication

The availability of financing tools differs across the different stages in a food value chain, and their level of sophistication vary depending on the maturity of the market and the existing regulatory landscape. Credit demanders at the later stages (e.g. storage, processing, distribution) of the value chain often find it easier to get funds compared to finance seekers in the early stages, especially production stage. Partly, this is because of lack of bankable collateral, particularly when talking about independent coffee farmers. While for players in the latter stages, the harvested coffee beans are already usable as collateral thus bringing down the risk for credit suppliers. This section takes a look at the various financing tools that are typically used in the food value chain.

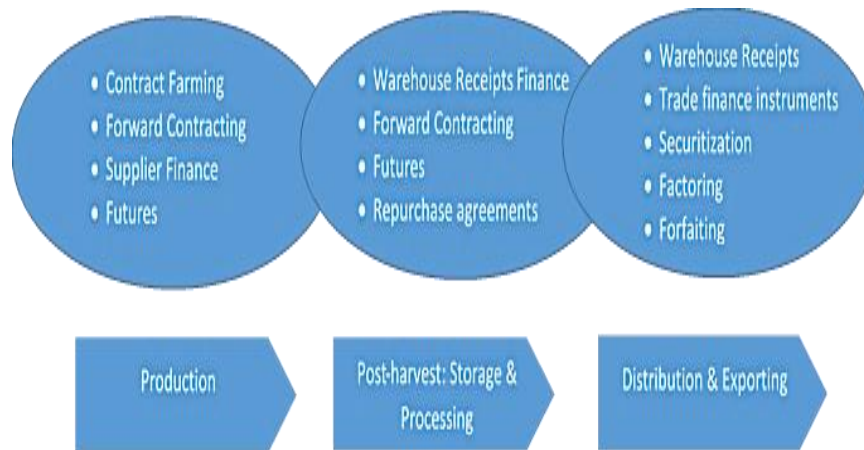
Direct finance, or the conventional idea of getting loans from banks, is the most common and straightforward finance model. When approached for a loan application, banks and other FIs approve the loan based on its assessment of the financing risk, usually considering the applicant’s risk profile (e.g. credit history), its balance sheet (if it exists), repayment probability

³⁶ World Bank, “Risk and Finance in the Coffee Sector : A Compendium of Case Studies Related to Improving Risk Management and Access to Finance in the Coffee Sector.”

based on projected cash flows, collateral values, etc. A desirable and qualified applicant for such direct finance normally have diversified income sources in terms of commodities and/or activities, possesses a sound cash flow status, as well as basic ability to withstand risks and uncertainties, experiences strong market demand for its products and owns proper collateral which allows the FI to reduce loss in the event of default.³⁷ A problem in many developing economies is that, besides the fact that the geographic location of banks is usually far from where farmers live, farmers themselves may be anything but ‘desirable and qualified’ bank client. Hence, often farmers look for alternative sources of funding, including from informal lenders.

Along with direct finance, there are other financing models that are available at different stages of the value chain. These alternative funding options provide funds for buying inputs and finance operations relying on securities such as receivables or invoices, rather than on traditional physical collateral (for example land or equipment). They also focus not so much on traditional non-movable collateral but on the performance and viability of the whole transaction that is being funded.³⁸ Figure 2.3 lists a variety of finance instruments applicable to each stage of a food value chain.

Figure 2.3: Variety of Finance Instruments along the Food Value Chain



Source: APEC Secretariat, Policy Support Unit calculations; FAO, 2009³⁹

Four of the most popular instruments used to finance agricultural activities nowadays are described as follows:

1) Contract farming is an agreement between farmers and buyers (usually large food processing companies or traders), for the buyers to take an agreed quantity of the product, say kilos of coffee, at a set price at the time of harvest. The contract can also require the buyers to provide specific inputs (seeds, fertilizers, etc) and financial assistance to the farmers and set quality standards for the products. This model improves efficiency and reduces risks for both

³⁷ Rachel Freeman, “Agricultural Lending: A How to Guide” (Washington D.C.: World Bank, January 1, 2015), <http://documents.worldbank.org/curated/en/114491484035995184/Agricultural-lending-a-how-to-guide>.

³⁸ Michael Winn, Calvin Miller, and Ivana Gegenbauer, “The Use of Structured Finance Instruments in Agriculture in Eastern Europe and Central Asia” (Rome: FAO, 2009), <http://www.fao.org/3/ap294e/ap294e.pdf>.

³⁹ Winn, Miller, and Gegenbauer.

parties, as it helps the buyers to secure their supply while also solving the input supply and financing problems of the producers.

2) Warehouse receipts financing provides financing to a commodity seller based on an independent warehouse system's receipt. An FI extends credit to the commodity seller based on the valuation of goods, say coffee, that are deposited with an authorized warehouse. The issued warehouse receipt becomes a form of security and used as collateral for the financing. The warehouse management is accountable for the safety, quality and quantity of the goods deposited. The FI gets its money back with interest, either directly from the buyer or from the original commodity owner, after the product is sold. Once paid, the FI instructs the warehouse management to release the deposited goods to the buyer. However, if the loan were to default, the FI can use the receipts to gain control over the goods and sell them off to recover the amount it loaned to the original owner.⁴⁰

3) Trade finance consists of a variety of short-term financing instruments that facilitate import and export. They can take the form of letters of credit (LCs), credit guarantees, factoring or other export/ import finance. The problem with some of these instruments is the length of time for shipment to take place and the possible conflicts that can arise from minimal discrepancies in the export documents like letters of credit. Conflicts like this can lengthen the payment process to the detriment of small producers. Box 2 shows how block chain technology is paving the way for future streamlining of trade processes, thereby also lessening the risk of non-payment arising from document conflicts.

Box 2: Blockchain and Trade Finance

In May 2018, the world's first trade finance transaction using a single blockchain platform was claimed to have been completed by HSBC and ING Bank NV, backing a shipment of soybeans transported from Argentina to Malaysia. Originally, the exchange of paperwork and the issue of letter of credit (LC) could take five to ten days, while with this single blockchain platform, which keeps all parties updated and connected in real time and removes steps of paper reconciliation, the exchange was completed in 24 hours.⁴¹

The adoption of blockchain technology⁴² in the financial industry has many advantages, including real-time access and review of financial documents for different parties; reduced risk of fraud in LCs; decentralized contract execution, which means once the contract term has been met, the status will be updated in real time in the system without the need for human resources to monitor the delivery.⁴³

4) Factoring is a financial transaction in which a commodity owner sells its accounts receivables or invoices at a discount to a third party (called the factor). It can sell with or

⁴⁰ Winn, Miller, and Gegenbauer; Bernadette Cenon, "Guidebook on Trade and Supply Chain Finance" (APEC-PSU, November 2015), <https://www.apec.org/Publications/2015/11/Guidebook-on-Trade-and-Supply-Chain-Finance>.

⁴¹ For more details, see Alfred Liu, "HSBC Says Trade Deal Shows Blockchain Viable for Trade Finance," *Bloomberg*, May 14, 2018, <https://www.bloomberg.com/news/articles/2018-05-14/hsbc-says-trade-deal-shows-blockchain-viable-for-trade-finance>.

⁴² Blockchain technology is based on the concept of a decentralized, distributed and public ledger which allows all parties to see relevant transactions. Records in the blockchain are, in principle, secured and thus impossible to forge.

⁴³ Deloitte, "How Blockchain Can Reshape Trade Finance" (Deloitte), accessed July 19, 2018, <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/grid/trade-finance-placemat.pdf>.

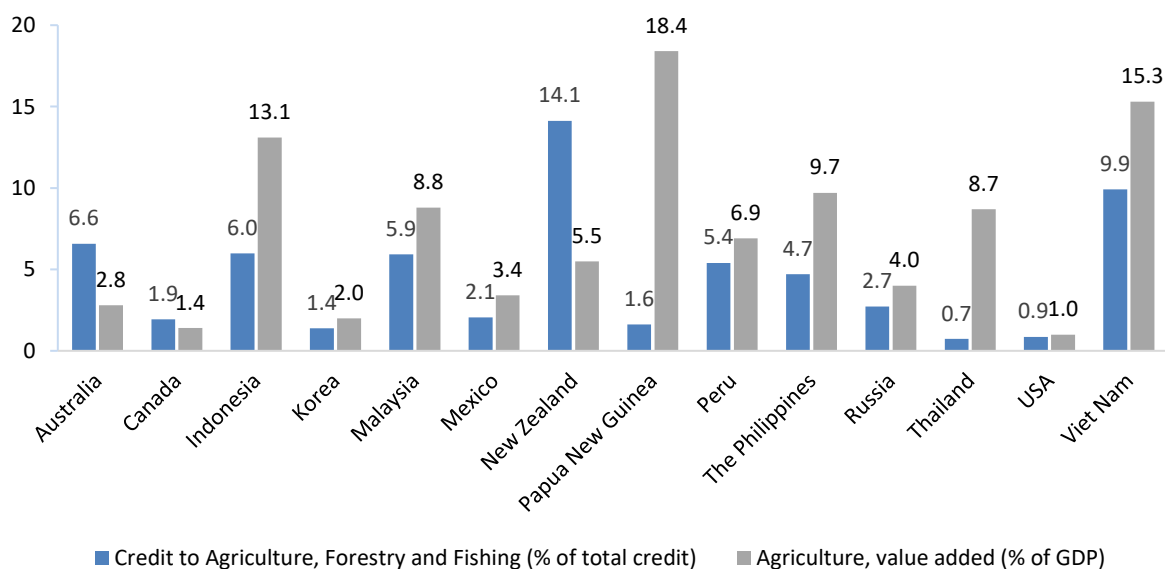
without ‘recourse’ depending on whether the factor would take the loss from non-payment or inadequate payment of the invoice or not.

The examples of the four finance instruments illustrate how finance can be obtained from various sources with the involvement of FIs and different value chain players. There are many more variations of different financing models that can be designed as Figure 2.3 illustrates, depending on the commodity, the situation or the risks involved in the transaction, as well as the regulatory regimes in the financial system. For example, in some jurisdictions, warehouse receipts may not be acceptable as collateral; therefore, it is not possible to offer warehouse receipts financing. In others, accounts receivables are not allowed to be sold or used as collateral.

Challenges of Getting Finance

Are farmers and those in agriculture underserved when it comes to receiving credit? Figure 2.4 attempts to answer this question by comparing agriculture loans as share of total credit with the share of agriculture’s value added to GDP in 14 APEC economies. In most developing economies, particularly where investment in agriculture is more critical and urgent, the share of credit to agriculture is relatively low, compared to the contribution made to the economy by the agriculture sector. Very few APEC economies, such as Australia, Canada and New Zealand, experience a share of agricultural credits proportionally larger than the size of agriculture in their economies.

Figure 2.4: Credit to Agriculture (% of total credit) and Agriculture Value Added (% of GDP), 2017



Source: World Bank Database, 2019;⁴⁴ FAOSTAT, 2019;⁴⁵ APEC Secretariat, Policy Support Unit calculations
 Note: Credit to agriculture data for Indonesia are from 2014, Malaysia and Peru from 2015, the Philippines from 2013. Agriculture value added data for Canada are from 2014, New Zealand and Papua New Guinea are from 2013, Peru and USA from 2016.

⁴⁴ World Bank, “World Bank Open Data.”

⁴⁵ FAO, “FAOSTAT,” accessed July 19, 2018, <http://www.fao.org/faostat/en/>.

While this ratio can also indicate that the industrial sector in some economies is just very large and thus absorbs most of the financing, it may also point to some existing challenges in getting agriculture credit in some economies. Below are some of the challenges farmers are facing in getting credit, particularly in developing APEC economies.

1) Inadequate financial infrastructure

A sound financial system consists of good regulatory and legal mechanisms, as well as the availability of institutions and infrastructures that support its smooth functioning. Credit bureaus and credit registries are examples of support institutions that facilitate obtaining credit, while best-practice bankruptcy and insolvency laws balance the interests of credit providers with the needs of enterprises to be given temporary respite especially during business downturns.

Table 2.1 shows the diversity of financial infrastructure in APEC. For example, the percentage of population with bank account range from a low of 30 percent of the adult population to a perfect score of 100 percent. Same goes with credit and debit card ownership showing significant variation. In some economies, automated teller machines (ATMs) can be found all over, especially in city centers, while in some APEC economies 100,000 people share only 8 ATMs.

Accessibility of financial infrastructures also requires convenient and efficient transportation and communication infrastructure. Especially in some remote or rural areas where physical financial branches are not available, transport and communications infrastructure are vital as they enable connections between the rural farms and financial services providers. Long distances, inadequate infrastructure, low population density, high operational cost together imply that the financial products available to the disconnected areas would be expensive.

Table 2.1: Financial Infrastructure in APEC Economies, 2017

	Lowest Value	Highest Value
Automated teller machines (ATMs) (per 100,000 adults)	8	276 (Korea)
Financial institution account (% age 15+)	30	100 (Australia, Canada)
Financial institution account, rural (% age 15+)	25	100 (Canada)
Debit card ownership (% age 15+)	21	97 (Canada)
Debit card ownership, rural (% age 15+)	14	97 (Canada)
Used a mobile phone or the internet to access a financial institution account in the past year (% age 15+)	4	74 (New Zealand)
Credit card ownership (% age 15+)	2	83 (Canada)
Credit card ownership, rural (% age 15+)	1	78 (Canada)

Source: World Bank Database;⁴⁶ World Bank Global Findex Database;⁴⁷ APEC Secretariat, Policy Support Unit calculations

⁴⁶ World Bank, “World Bank Open Data.”

⁴⁷ Asli Demirgüç-Kunt et al., *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution* (Washington D.C.: World Bank, 2018), <https://globalfindex.worldbank.org/node>.

Note: The ATM indicator does not include Chinese Taipei. Except for the ATM indicator, the rest of the indicators do not include Brunei Darussalam and Papua New Guinea. Singapore has zero rural population and it is not included in all rural indicators.

2) Information asymmetry and lack of credit reporting system

A flourishing financial market relies on a comprehensive and reliable credit reporting and information sharing system. To be able to evaluate the risk profile of borrowers, credit providers need the clients' credit history and other credentials. The credit market is prone to adverse selection risk which is exacerbated under a non-transparent system. To minimize risk, financial organizations must spend time and effort collecting information and conducting background checks, which increase transaction costs and delay loan disbursements. Currently, to reduce this bottleneck, the digital era is helping to solve the lack of transparency in the credit market and is creating credit opportunities to firms, in particular SMEs (see Box 3).

Box 3: Transparency Using Digital Information

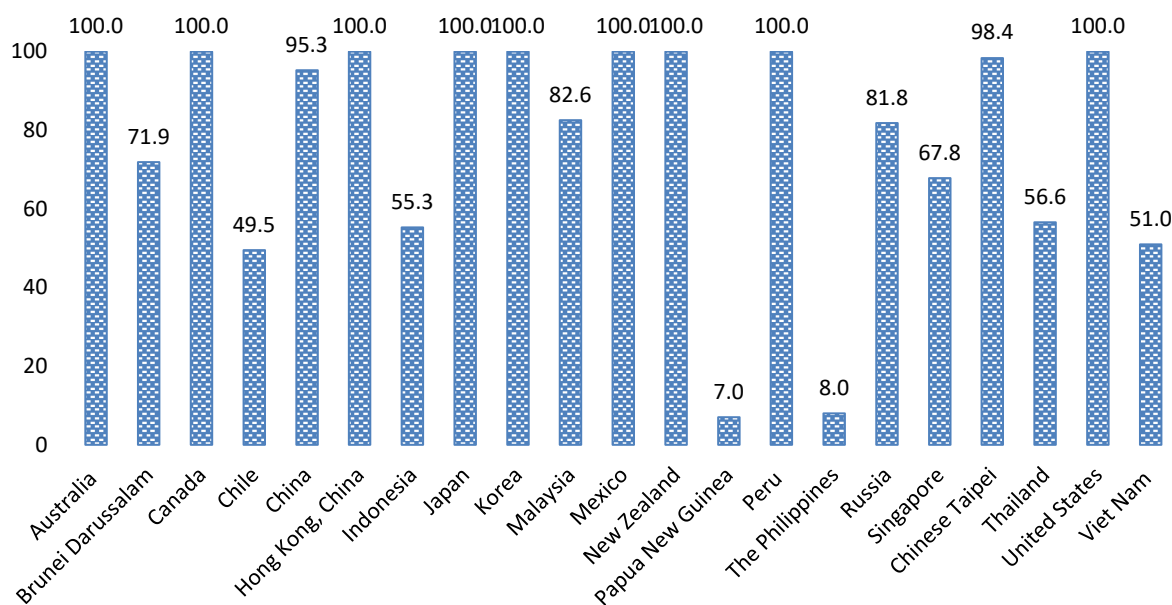
In 2015, Ant Financial, China's e-commerce giant Alibaba's financial arm, launched its social credit score system, Sesame Credit, which is a credit score scheme for individuals and small and micro enterprises. This system was based on cloud computing and data analytics, using the data collected by Alibaba through its e-commerce platform and other information provided by the user. With Sesame Credit, Ant Financial invented a "310" credit model for its users: 3 minutes to apply for credit, 1 second to approve, and 0 people involved in the decision. Loans can be granted quickly and without human intervention because of the 'transparency' derived from the wealth of data collected.⁴⁸

The Sesame credit and this "310" model shows how technology can improve the efficiency of the loan approval process. However, this model has its own limitations. Sesame credit is based on a credit calculation algorithm created by Alibaba, but how Alibaba gathers the information and how the credit score is created is non-transparent. Moreover, this service is only open for Alibaba users on whom the platform has some information of previous transaction history. Nonetheless, the use of such digital information to create credit scores for financing purposes is an alternative tool, especially in places where there are no credible credit bureaus which can provide the needed transparency for making loan decisions. In economies where credit information system is developed, credit information from private e-commerce platforms can be utilized as a complementary measure when deciding on granting loans.

An effective credit information and reporting system can provide FIs access to accurate and complete credit information on individuals and firms, which can significantly reduce information asymmetries, lower transaction cost, and minimize risks. These systems include information about the creditworthiness of individuals or firms and enables the exchange of credit information between creditors. In addition, they could be a depository of the records of mortgaged collaterals with the corresponding security interests or liens. This facilitate the granting of the loan on the basis of whether the offered collateral is unencumbered or not as recorded in the credit registry. Amongst APEC economies, several developed economies have established their credit information systems with full coverage, i.e. covering 100% of the adult population, while other economies are still in their early development phase or have none of either, as shown in Figure 2.5.

⁴⁸ Gloria O. Pasadilla, Andre Wirjo, and Crystal Jiquan Liu, "Promoting E-Commerce to Globalize MSMEs" (APEC-PSU, November 2017), <https://www.apec.org/Publications/2017/11/Promoting-E-commerce-to-Globalize-MSMEs>.

**Figure 2.5: Coverage of Credit Information and Reporting Systems in APEC Economies, 2018
(as % of the adult population)**



Source: World Bank Doing Business Report;⁴⁹ APEC Secretariat, Policy Support Unit calculations

Note: The maximum coverage in an economy between the percentage of adults with their credit information available in public credit bureaus and private credit registries is used for this graph.

3) Limited collateral management and warehousing capacity

For new financing structures to be available, a strong system has to be in place. For example, for warehouse receipt financing to become a financing vehicle in more economies, economies need to have trustworthy warehouse operators and collateral managers and a legal system that preferably recognizes warehouse receipts as asset or document of title. However, in many economies, good warehouse operators are either not available or inadequately competent for the task. Besides lacking collateral management capabilities, there are also few warehousing facilities in developing economies and lack of clear government regulations on standards of grading commodities. Overall, warehousing or collateral management is still a nascent industry in APEC.⁵⁰

4) Underdeveloped financial market and limited financial products

In developing economies where the financial market remains underdeveloped, financial products are typically limited and lacking in variety. When options are scarce, credit seekers are likely to find financing costly and not always suitable for their financial needs. An enabling business environment and regulatory system are both critical in developing more diversified financial products.

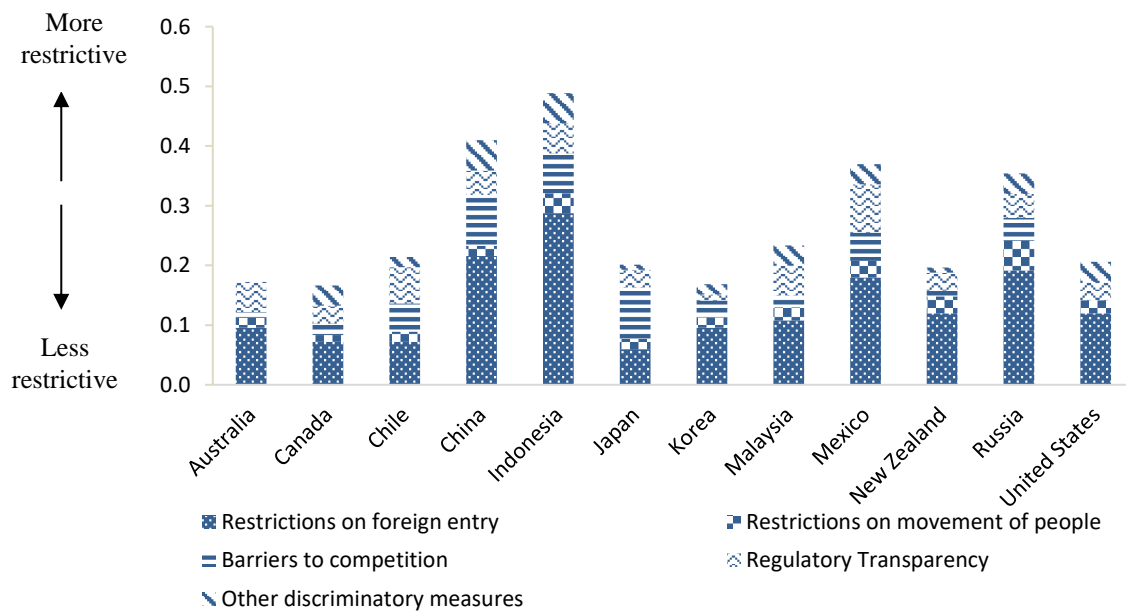
⁴⁹ World Bank, *Doing Business 2018: Reforming to Create Jobs*, Doing Business (Washington D.C.: World Bank, 2017), <https://doi.org/10.1596/978-1-4648-1146-3>.

⁵⁰ Gloria O. Pasadilla, “Regulatory Issues Affecting Trade and Supply Chain Finance” (APEC-PSU, November 2014), <https://www.apec.org/Publications/2014/11/Regulatory-Issues-Affecting-Trade-and-Supply-Chain-Finance>.

5) Strict regulatory regimes on trade in banking services

Strict restrictions on trade in services could restrict the availability of banking products. Open and transparent regulations can facilitate healthy competition and improve the quality and availability of the services. On the contrary, regulatory restrictions on services hinder the development of the services sector. The OECD Services Trade Restrictiveness Index (STRI) scores on financial services show the restrictiveness of one economy's regulation on financial services trade. The higher the index, the more restrictive the financial sector is. For commercial banking services, the restrictiveness ranges from 0.148 to 0.476 among APEC economies, with developed economies in general being less restrictive than developing economies. Restrictions on foreign entry, barriers to competition and regulatory transparency are the major contributors to the restrictiveness.

Figure 2.6: STRI Scores on Commercial Banking Services, APEC Economies, 2018



Source: OECD, 2019;⁵¹ APEC Secretariat, Policy Support Unit calculations

The OECD STRI regulatory database provides examples of common restrictions in the trade of banking services.⁵² Limits on maximum foreign equity shares, quotas or economic needs tests required for licences, restrictions on the branch network and services scope, and cross-border mergers and acquisitions are typical barriers to the foreign entry of banking services in APEC economies. Moreover, many other restrictions have also been put in place restricting competition and distorting market. For instance, in one APEC economy (Indonesia), only banks whose core capital have reached certain amount are allowed to provide internet banking services. Two out of 12 APEC economies (China, Indonesia) regulate interest rates on deposits. Three out of 12 APEC economies (Mexico, China, Indonesia) require approval by government authorities for financial institutions to release new financial products or services. Two economies (Canada, USA) offer less favorable taxes and subsidies policies for foreign services suppliers.

⁵¹ OECD, "Services Trade Restrictiveness Index Regulatory Database," accessed July 19, 2018, <https://qdd.oecd.org/subject.aspx?Subject=063bee63-475f-427c-8b50-c19bffa7392d>.

⁵² OECD.

Programs and Policies Supporting Agriculture's Accessing to Finance

Various supporting mechanisms have been adopted and implemented to improve access to finance to farms and agri-food companies in the APEC region. Such measures include providing capacity building and technical assistance to microfinance institutions (MFIs) and rural banks, establishing credit guarantee systems, and many other credit programs that target underserved agricultural and food-related companies.

MFIs have been playing a crucial role in providing credit and other financial services to small farms and rural companies. Governments could promote this by building an enabling policy and regulatory environment to expand the outreach of MFIs and improve the competitiveness of their products; and ensuring that MFIs are serving the right customers. Such facilitating policies include allocating direct funding, favorable subsidies or tax policies for MFIs or small borrowers in rural areas; guiding on risk management and client protection; encouraging innovative financial products; and linking MFIs to small farms and companies.

There have been some successful cases of MFI in the APEC region. For instance, DAR-LANDBANK Microfinance Capacity Development Program in the Philippines links small farms with acknowledged MFIs and provide capacity building to develop rural cooperatives into more formal and efficient microfinance providers. The Micro-Agri Loan Product (MALP) Development Program, another program under the Philippines' Department of Agrarian Reform, intends to improve financial accessibility by encouraging more diverse micro-agri credit loan products offered by bank-assisted cooperatives and rural financial institutions. The program also provides a series of capability building support including market assessment, product review and development, and pilot testing, among others.⁵³

Credit guarantee schemes provide risk mitigation to lenders by partially or fully covering the default risk of the borrowers. Korea is a good example of an early adopter of this system. It established the Korea Credit Guarantee Fund (KODIT) in 1976, with a market share of 57% in 2015. Around 45% of KODIT's fund comes from government budget, and another 50% of the fund are from mandatory donations from commercial banks. KODIT has 106 branches in the economy, providing from 70% to 85% (up to 100% for Start-ups) guarantee cover on loans lent to over 200,000 SMEs. Korea also established a Federation of 16 regional credit guarantee foundations in 1999 (KOREG), which has a market share of 19% in 2015.⁵⁴ The Philippines Agriculture Guarantee Fund Pool (AGFP) is another example. Established in 2008, the fund pool provides up to 85% guarantees of the loans lent to small farmers and fishers.⁵⁵

International organizations, such as the World Bank, have been providing technical assistance and capacity building programs for financial institutions to improve their performance and better serve small farms and agricultural companies. They also provide guidance for economies to establish more facilitating policy regimes. The International Finance Cooperation (IFC)'s Agri-Finance Advisory Program, for instance, supports worldwide financial institutions through agri-finance expertise and knowledge, helping them improve their risk management

⁵³ For more details, see The Philippines' Department of Agrarian Reform, "Credit and Microfinance Programs," accessed July 26, 2019, http://old.dar.gov.ph/index.php?option=com_content&view=article&id=294.

⁵⁴ For more details, see Jong-goo Lee, "Korean Experience in Credit Guarantee Scheme to Enhance Financial Accessibility of MSMEs" (May 12, 2017), https://www.unescap.org/sites/default/files/Panel%202-2.%20KODIT_Mr.%20Jong-goo%20Lee.pdf.

⁵⁵ For more details, see Edna A. Atienza, "Agricultural Guarantee Fund Pool (AGFP)," (November 2014), <http://rbap.org/wp-content/uploads/2014/11/Atienza.pdf>.

and design new products. The intention is to better integrate small farms and companies into the food supply chain as well.⁵⁶

2.4 Insurance Services

Asia and the Pacific region is highly exposed to natural disasters such as typhoons, floods, droughts, earthquakes, volcanic eruptions and tsunamis.⁵⁷ According to World Risk Report 2017, 4 APEC members (Philippines; Japan; Brunei Darussalam; Chile) were listed among the top 15 economies with the highest exposure worldwide.⁵⁸ The high exposure to disasters places the food system in a vulnerable position. Deadly disasters could not only devastate the food production stage, but also break down the logistics and distribution chains. Besides natural disasters, actors in different stages of the supply chain could also experience other unexpected adversities, which will put the farms or the firms on the edge of failure. Therefore, insurance, as a major tool to manage risk, is of great need to establish resilience and to swiftly recover after a disaster. It is also of great importance to ensure the livelihoods of millions of food producers and the regional food security.

Over the last decades, the insurance sector has seen a rapid growth as public awareness has been improved. An estimate by Swiss Re in 2013 showed that the global agriculture insurance premiums increased from \$8 billion in 2005 to \$23.5 billion in 2011.⁵⁹ Among APEC members, economies such as Australia, Japan and New Zealand have a long tradition of agriculture insurance, while in other economies, the idea of agriculture insurance is relatively new and the sector is still in development.⁶⁰

Risks in the Food Value Chain

For investors, risks associated with the food value chain are a major consideration in agriculture. Those risks are also the biggest consideration for FIs in offering financial services to firms involved in agriculture. Generally, the risks can be categorized into production risks, market risks, risks associated with assets, risks from natural causes and risks from the regulatory environment (see Figure 2.7).

1) Production risks: Such risks include situations where the production input becomes unavailable or extremely expensive that it interrupts the production process or renders production unprofitable. Likewise, pests and diseases could cause unexpected losses. Moreover, technical and managerial ability directly decides the quality and smooth operation of all production process. Limited capability or human error could lead to great losses during harvest.

⁵⁶ For more details, see IFC, “Agriculture Finance,” accessed July 19, 2019, https://www.ifc.org/wps/wcm/connect/Industry_EXT_Content/IFC_External_Corporate_Site/Industries/Financial+Markets/Retail+Finance/Agriculture+Finance/.

⁵⁷ Charles Stutley, *Agricultural Insurance in Asia and the Pacific Region* (Bangkok: FAO, 2011), <http://www.fao.org/3/i2344e/i2344e00.pdf>.

⁵⁸ Peter Mucke et al., “WorldRiskReport Analysis and Prospects 2017” (Bündnis Entwicklung hilft, 2017), https://reliefweb.int/sites/reliefweb.int/files/resources/WRR_2017_E2.pdf.

⁵⁹ Kurt Karl, ed., “Partnering for Food Security in Emerging Markets” (Swiss Re, 2013), https://www.swissre.com/dam/jcr:dbafcfed-d5c7-406b-a2e1-d2ea4ad020e0/sigma1_2013_en.pdf.

⁶⁰ Stutley, *Agricultural Insurance in Asia and the Pacific Region*.

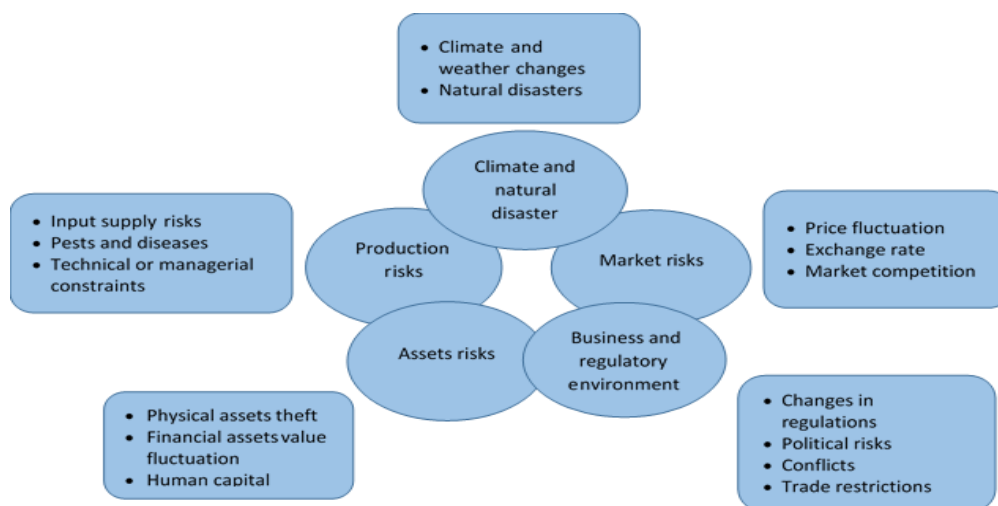
2) Climate and natural disaster: Asia and the Pacific region is highly exposed to natural disasters such as typhoons, floods, droughts, earthquakes, volcanic eruptions and tsunamis.⁶¹ High exposure to these disasters places the food system in a vulnerable position. Deadly disasters not only devastate the food production stage, but also break down the logistics and distribution chains.

3) Business and regulatory risks: A friendly business environment promote the development of food value chains. Market access restrictions create unpredictability increase risks for agriculture producers as food products will be at disadvantage in foreign markets and any trade disputes could use these products as bargaining chip. Regulatory risks are out of the control of food chain players and could cause great uncertainties.

4) Market risks: These include fluctuations of commodity prices, exchange rate, interest rates and other risks at the market level. Situations of new market entrants and unfair competition or surge of imports are potential risks for the value chain.

5) Assets risks: Machineries and products can be lost, damaged, or stolen. Financial investment values can fluctuate. Health problems or accidents could affect the operation of the farms, warehouses, or mills.

Figure 2.7 : Risks in the Food Value Chain



Source: Authors based on various sources.⁶²

Risks in the food value chain are inherently connected as one risk could trigger other risks as well and affect the whole value chain. For example, a devastating natural disaster could result in loss or damage of physical assets, accidents or death of key personnel and extreme fluctuations of market prices. Vulnerability is high in the production stage because it is highly subject to the vagaries of the external environment and may be mostly comprised of small farms or companies which have weak ability to withstand risks. Higher risks in the production

⁶¹ Stutley, *Agricultural Insurance in Asia and the Pacific Region*.

⁶² World Bank, “Risk and Finance in the Coffee Sector : A Compendium of Case Studies Related to Improving Risk Management and Access to Finance in the Coffee Sector”; World Bank, “Agricultural Lending: A How to Guide”.

stage also explain why financing is more difficult to obtain at this stage, while it is more available further down the value chain (processing, export, distribution).⁶³

Various insurance products have been developed for the agriculture sector, falling into two major types: indemnity-based and index-based. The difference between the two types of insurance lies in how the claims will be calculated.

In the case of indemnity-based insurances, claim payments are calculated based on the actual damage caused by certain perils (e.g. hail, rainfall, frost) covered in the policy, and therefore requires a loss assessment at the firm level.⁶⁴ In contrast, for index-based insurances, claim payments are based on the value of a chosen index (e.g. average area yield or amount of rainfall) in a specific area (e.g. domestic economy, district), which means no firm-level assessment is needed. An index-based insurance is less administratively costly than an indemnity-based insurance.⁶⁵ However, its main limitation is that the claim payment might differ significantly from the actual loss of policyholders. Figure 2.8 shows the major types of the available insurance products for the agriculture sector.⁶⁶

Figure 2.8: Typical Types of Agriculture Insurance Products, 2017



Source: Adapted from Agroinsurance, 2017⁶⁷

Barriers of Getting Insurance

Mitigating risks and smoothing income can only be realized if insurance services are accessible and affordable to all. Actors in the food supply chain still face barriers accessing insurance services, including:

1) Inadequate infrastructure and technology

Same as credit services, a sound infrastructure including road, communication, and a smooth financial information exchange system is necessary to obtain insurance services. Advanced technologies such as remote sensing and satellite are also required to record real-time data,

⁶³ Stutley, *Agricultural Insurance in Asia and the Pacific Region*.

⁶⁴ Arup Kumar Chatterjee and Arman Oza, "Agriculture Insurance" (ADB, April 26, 2017), <http://dx.doi.org/10.22617/BRF178762-2>.

⁶⁵ Stutley, *Agricultural Insurance in Asia and the Pacific Region*; Chatterjee and Oza, "Agriculture Insurance."

⁶⁶ The complexity and application of insurance products could vary across economies and agricultural industries.

⁶⁷ Liudmyla Krychevska, Ian Shynkarenko, and Roman Shynkarenko, "Agricultural Insurance in China: History, Development and Success Factors" (Agroinsurance, April 2017), <http://agroinsurance.com/wp-content/uploads/2017/04/Agricultural-insurance-in-China-Agroinsurance-International.pdf>.

assess the risk, and monitor weather and climate. Lacking such resources indicates the absence or unavailability of many insurance choices in the agriculture sector.

2) Unaffordable premium

High premium remains another reason why many small farms and food companies are likely to be uninsured. In areas where the exposure to risks is high, the premium for insurance products will accordingly increase for the insurance providers to attain profit, if no government subsidies is offered. If premiums are to be reduced, deductibles to be imposed could make the insurance products unattractive.⁶⁸

3) Complex and lengthy insurance claim process

The complexity and long duration of the claim procedure could deter many people from acquiring insurance. Policy holders may opt to give up on the claims if it requires preparation of too many documents and other time-consuming procedures. By losing confidence in the claiming process, firms would be less likely to get insurance again.

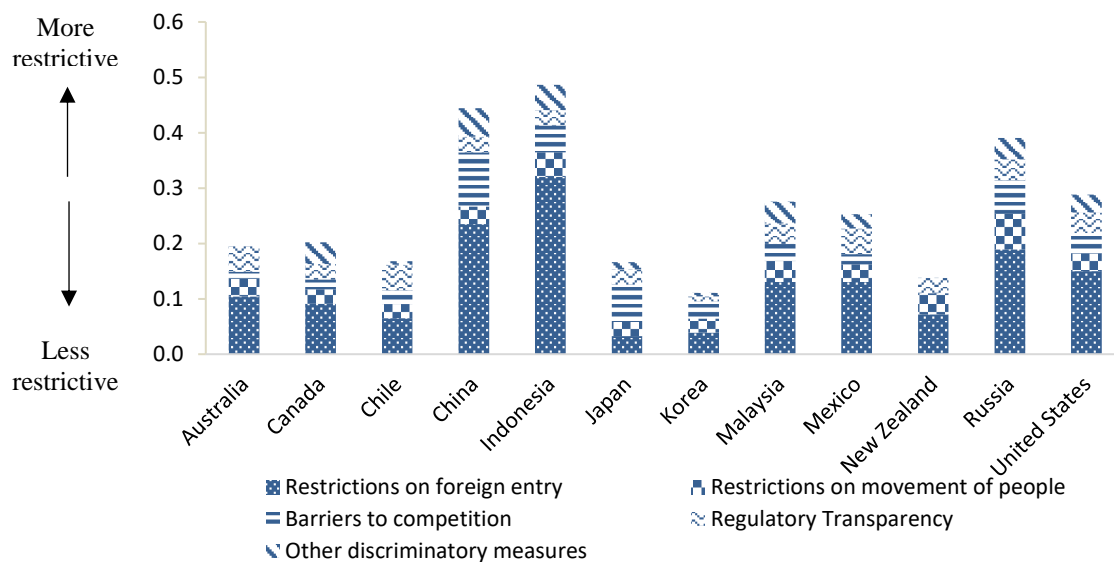
4) Lack of awareness and “behavior issue”

In many developing economies, especially in rural areas, farmers and firms still lack the awareness of risk management and understanding of insurance’s benefits. Some of them retain the belief that the possibility of disasters happening is slim, as such would rather take the risk of being uninsured than paying the premium.

5) Strict regulatory regimes affecting insurance services

Like banking services, restrictions on trade in insurance services put constraints on the development of insurance market and the affordability and accessibility of more diverse products. Common restrictions include local presence required for cross-border supply, specific insurance activities only reserved for statutory monopolies, and screening processes that considers economic interests. For instance, one out of 12 APEC economies included in the OECD STRI database stipulates that all export credit insurance products are reserved for a quasi-government institution established by law.

⁶⁸ Arup Kumar Chatterjee and Arman Oza, “Agriculture Insurance.”

Figure 2.9: STRI Scores on Insurance Services, APEC Economies, 2018

Source: OECD, 2019;⁶⁹ APEC Secretariat, Policy Support Unit calculations

Government Supporting Programs

Various supporting mechanisms are adopted to improve the insurance coverage for small farms and companies. Premium subsidies are one common form of policy intervention adopted by many economies. In Viet Nam, a new resolution provides up to 90% subsidies of agriculture insurance premiums for farmers from poor or near poor households, and up to 20% subsidies to agriculture cooperatives which adopt high-technological and environmentally friendly innovations.⁷⁰

Public insurance programs are another approach. Establishing insurance programs funded and controlled by the government can realize regulators' policy goals more easily. The Philippine Crop Insurance Corporation (PCIC) provides in the Philippines and the Federal Crop Insurance Corporation in the United States are two examples of government-owned organizations that provide agriculture insurance.

2.5 Policy Implications

There are a number of ways government and policy makers can guide and promote the development of the financial services sector, to better serve different actors in the food supply chain and contribute to the food security at both national and global level. Several policy implications are discussed here.

Develop an enabling regulatory framework. A supportive regulatory environment ensures the order and stability of the market and protects both consumers and services providers. The framework should be comprised of up-to-date regulations and laws with clearly defined responsibilities and rights of all parties, and an effective monitoring and enforcement mechanism.

⁶⁹ OECD, "Services Trade Restrictiveness Index Regulatory Database."

⁷⁰ Asia Insurance Review, "Vietnam: Farmers to Get Premium Subsidy for Agriculture Cover," Asia Insurance Review, June 2018, <https://www.asiainsurancereview.com/Magazine/ReadMagazineArticle?aid=40934>.

Build a credit reporting system for all. In economies where a complete credit reporting system is missing, governments should encourage and motivate the credit bureaus or credit registries to extend the coverage of their systems on both individuals and firms, especially in rural areas. Policies should also be created to facilitate secure and reliable flow of data among accredited parties.

Enhance infrastructure and connectivity. Governments play a key role in providing infrastructure, which is the foundation of all economic activities. Financial services rely on convenient transportation and reliable telecommunication and Internet connectivity to outreach to new clients and expand services coverage. Progress still can be made in many APEC economies to upgrade their infrastructure and promote better connectivity between urban and rural areas, and between different economic actors.

Encourage innovative financial models. Various financial models have emerged to cope with the traditional barriers faced by services providers and their consumers. For instance, models such as credit guarantee and warehouse receipt finance help to solve the problems of small companies having no collaterals, and decrease the risks borne by the financial institutions. Additionally, the rapid development of the digital economy has created great opportunities for financial services to develop. Mobile apps make branchless financial services possible and digital payments allow money transferring to be made in seconds. On many e-commerce platforms, countless financial products are listed just like any other real “goods” and are competing with one another. The providers of financial services have also expanded and are no longer limited to those traditional financial institutions. Many technology giants, e-commerce platforms, e-payment platforms all have started to provide various financial services such as credit, leasing, and insurance, among others. Taking into account these fast changes, governments and regulators should encourage innovations and at the same provide complementary guidance. In this regard, regulatory sandboxes could be useful to promote changes and encourage innovations.

Support SMEs and rural firms. Preferential policies such as subsidies and tax breaks and other supporting programs can improve SMEs and rural companies’ ability to access financial services. For insurance services particularly, public investments and subsidies are an effective way to ensure insurance products are more affordable for small farms.

Continued education on financial literacy and awareness. Governments share the responsibility of raising financial awareness and imparting financial knowledge among the public. Cooperation can be setup by businesses and public sectors to organize public campaigns and courses for individuals and SMEs, especially in rural and remote areas where awareness and knowledge on financial services are weak.

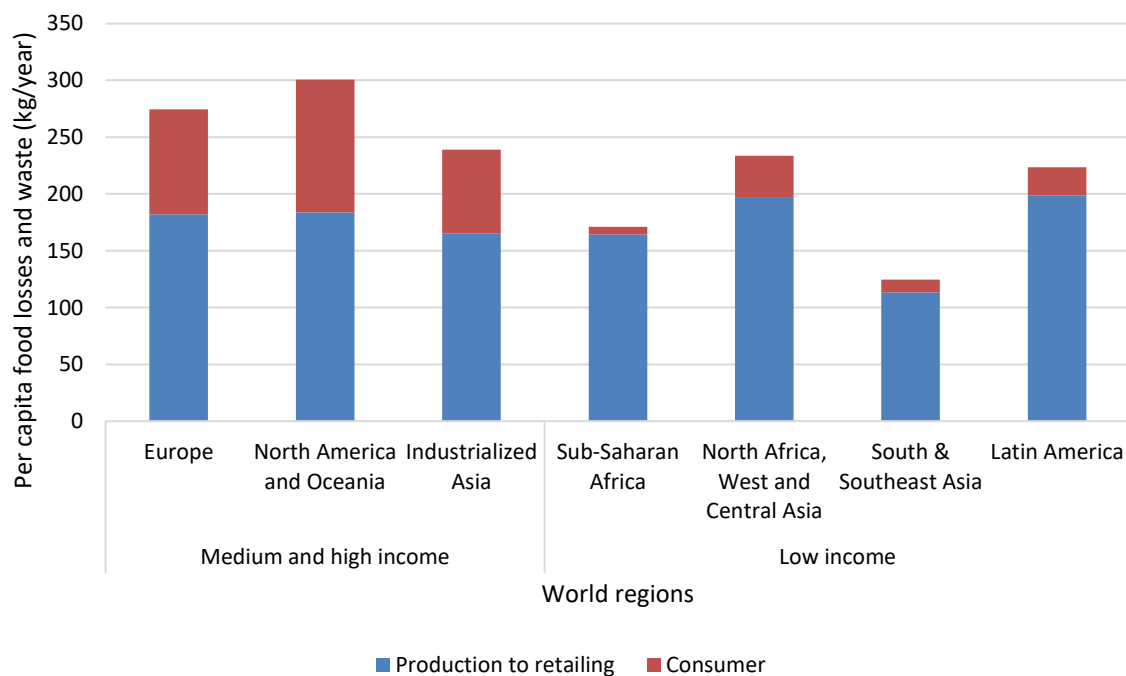
CHAPTER 3: FOOD AND LOGISTICS SERVICES

3.1 Introduction

Food is a highly sensitive commodity that has a long production time, requires significant investments and labor, is prone to damage and contamination, and is perishable. Moreover, as most food is designated for human consumption, to ensure safety, quality and edibility, it is subject to stringent sanitary and phytosanitary standards throughout its value chain.

Yet despite the substantial investments in food production, a study by the FAO found that one-third of the food produced for human consumption is squandered, resulting in approximately 1.3 billion tons of waste per year.⁷¹ However, the bulk of food waste is not caused by consumers – rather, most food loss happens in the pre-consumption phase, from production to transport to retail (see Figure 3.1). This fact is more pronounced among developing economies, where inadequate infrastructure and rudimentary food handling systems increase the possibility of food damage, contamination and spoilage.⁷² In low-income economies, up to 91% of food loss happens from production to retailing, compared to 67% in high and medium-income economies.⁷³ As such, to improve food security and reduce food loss, economies should focus on improving the logistics of storing, handling and transporting food.

Figure 3.1: Per Capita Food Losses and Waste, at Consumption and Pre-consumption Stages, in Different Regions, 2007



Source: FAO, 2011; Gustavsson et al., 2013⁷⁴

⁷¹ Jenny Gustavsson et al., *Global Food Losses and Food Waste: Extent, Causes and Prevention* (Rome: FAO, 2011).

⁷² John M Mandyck and Eric B Schultz, *Food Foolish: The Hidden Connection between Food Waste, Hunger and Climate Change* (Farmington, Connecticut: Carrier Corporation, 2017).

⁷³ Jenny Gustavsson et al., *The Methodology of the FAO Study: Global Food Losses and Food Waste - Extent, Causes and Prevention* - FAO, 2011 (SIK Institutet för livsmedel och bioteknik, 2013), <http://urn.kb.se/resolve?urn=urn:nbn:se:ri:diva-580>.

⁷⁴ Gustavsson et al., *Global Food Losses and Food Waste*; Gustavsson et al., *The Methodology of the FAO Study*.

Logistics is defined broadly by the Council of Logistics Management as the “part of the supply chain process that plans, implements and controls the efficient flow and storage of goods, services and related information from the point of origin to the point of consumption.”⁷⁵ It plays a crucial role in food trade and security. Recognizing the importance of logistics in food products, this chapter provides an overview of logistics services and the key challenges and opportunities in the sector. It begins by describing four main components of logistics – transportation, storage, management and regulatory compliance – before presenting emerging trends in these sectors. Then, it provides an overview of the state of logistics in APEC, highlighting the key challenges faced by food producers and logistics solutions providers. Finally, it presents some policy recommendations to help economies and companies improve logistics services in the region.

3.2 Main Activities in Logistics

The logistics sector can be divided into four main clusters based on their primary functions: transportation, storage, coordination and inventory management, and regulatory compliance.

1) Transportation

Transportation covers the task of physically shipping goods across various stakeholders (such as producers, manufacturers, storage providers and distributors) in the food value chain, whether domestically or across borders. Transportation services can be shouldered by the producer or be outsourced to a third-party provider. As various food items have distinct handling and storage requirements, transporters must tailor their services to suit the needs of the product. For example, live animals scheduled for slaughter are moved in specialized vehicles to ensure that animals are healthy when they reach the abattoir. Fresh produce are packed and moved carefully to prevent physical damage and rotting. Frozen or chilled products such as yoghurt and frozen meat are moved via cold chain, using specific equipment like climate-controlled containers and compartmentalized lorries, to prevent cross-contamination and ensure optimum quality upon delivery.

2) Storage

The wide variety of food products, ranging from fresh produce to dried goods to frozen meat, necessitates different storage conditions. Storage providers such as warehouses can assist in the food value chain by offering producers and manufacturers centralized hubs and depositories appropriate for their products. Moreover, they can also offer some value-added services such as washing, cooling and packing to small-scale businesses who may not have access to such facilities, thereby improving the life span of food products.⁷⁶

3) Coordination and Inventory Management

Logistics coordination and inventory management encompasses monitoring the location and the status of products and resources. Nodes in the logistics value chain rely on communication

⁷⁵ *Council of Logistics Management* (Oak Brook, Illinois: Council of Logistics Management, 1998), quoted in John T. Mentzer et al., “Defining Supply Chain Management,” *Journal of Business Logistics*, September 1, 2001, <https://doi.org/10.1002/j.2158-1592.2001.tb00001.x>.

⁷⁶ Timothy C. Lindsey, “Building Successful Food Hubs: A Business Planning Guide for Aggregating and Processing Local Food in Illinois” (University of Illinois, January 2012), <http://www.ngfn.org/resources/ngfn-database/knowledge/IllinoisFoodHubStudy-digital.pdf>.

to plan and facilitate the movement of goods.⁷⁷ Nonetheless, inventory management has applications beyond stock keeping. Real-time updates on the storage conditions and location of food improves transparency and secure food quality in the value chain process. Advancements in data analytics provides demand estimates for warehouses and retailers so that they can supply the right amount of product, which can be particularly useful for perishable food items.⁷⁸ Real-time database management systems allows stakeholders to make timely and informed decisions based on the most updated data available, increasing the overall efficiency of the value chain.

Coordination and inventory management ensure the allocation of resources to secure optimal delivery, packaging and storing. Moreover, it provides for the creation of contingency plans to ensure the resilience of supply chains in the event of disruption.

4) Regulatory Compliance

Regulatory compliance is also a major sector in logistics. As food items are produced for the purpose of consumption, food transportation along the value chain are subject to strict regulations to ascertain its safety and verify its compliance to set standards (i.e. halal certification, GMO (genetically modified) disclosures). Businesses and regulators utilize stepwise methods such as Hazard Analysis at Critical Control Points (HACCP), Good Manufacturing Practice (GMP), and Good Hygiene Practice (GHP) to monitor food handling practices.⁷⁹ Instead of monitoring each final product, food controllers scrutinize processes in the value chain to ascertain food safety standards.

Customs and quarantine also play a crucial role in logistics and regulatory compliance. Border authorities ensure that incoming food products are safe to consume, have the relevant sanitary and phytosanitary permits, and would not pose a biological threat to the receiving economy.

3.3 Emerging Trends in Logistics

The logistics sector is undergoing a profound transformation, mainly thanks to emerging technology. This section looks at key trends in logistics and how they improve the sector's efficiency.

1) Transportation

Transportation lies at the core of logistics services and is a priority area of improvement among businesses and economies. Improvements in ICT services enable real-time management systems, which allow firms to gather updated information on the status of their transport fleet, the demands of their clients, and location of drop-off/pick-up points.⁸⁰ The information collected can help transport providers maximize vehicle load rates by consolidating shipments

⁷⁷ Hau L. Lee and Seungjin Whang, "Information Sharing in a Supply Chain," *International Journal of Technology Management* 20 (January 1, 2000): 373–87, <https://doi.org/10.1504/IJMTM.2000.001329>.

⁷⁸ Jakob Huber, Alexander Gossmann, and Heiner Stuckenschmidt, "Cluster-Based Hierarchical Demand Forecasting for Perishable Goods," *Expert Systems with Applications* 76 (June 15, 2017): 140–51, <https://doi.org/10.1016/j.eswa.2017.01.022>.

⁷⁹ Okezie I. Aruoma, "The Impact of Food Regulation on the Food Supply Chain," *Toxicology, Nutraceuticals and Functional Foods Regulations in the United States and Around The World*, 221, no. 1 (April 3, 2006): 119–27, <https://doi.org/10.1016/j.tox.2005.12.024>.

⁸⁰ David Blanchard, *Supply Chain Management: Best Practices*, 2nd ed (Hoboken, N.J: John Wiley & Sons, 2010).

(such as food with same storage requirements) and optimizing delivery routes,⁸¹ thereby improving efficiency and reducing traffic. Moreover, such information also help employees plan backhauling – the carrying of goods on return trips – to maximize vehicle utilization.⁸² Some firms have even gone as far as investing in transportation management systems (TMS), which automate several processes such as vehicle selection, load management, routing, and scheduling.⁸³ For example, Coca-Cola procured a vehicle-routing software designed by ORTEC to facilitate deliveries in the US and Canada. While the initial investment is costly, the utilization of TMS enabled Coca-Cola to save \$45 million annually and improve the reliability of their delivery services.⁸⁴

Vehicles are the key building blocks of transportation, but are heavy pollutants. Estimates from the International Energy Agency showed that in 2018, transportation alone accounted for 24.3% of global CO₂ emissions, with road transport accounting for 18.1% of global CO₂ emissions.⁸⁵ In addition to vehicle optimization, some firms and economies have thus developed green technologies such as e-trucks to curtail their emissions.⁸⁶ Furthermore, aviation and maritime transport providers have been investing in upgrades to their airplanes and ships to make them more environmentally friendly. Back in January 2018, Qantas launched the world's first dedicated biofuel flight between Los Angeles and Melbourne, which saved 18,000 kg in carbon emissions, serving as a springboard for future research on greening the aviation industry.⁸⁷ Maritime service providers are also investing in emerging trends such as biofuel to help reduce emissions from cargo ships, and some governments are incentivizing firms to invest in more environmentally friendly fleets by setting environmental standards for ships docking in ports.⁸⁸

2) Storage

Improvements in food storage are being introduced on multiple fronts such as infrastructure development and storage facilities. Inadequate storage facilities can hasten the deterioration of food products, causing food losses and wastage.⁸⁹ As some SMEs may not have access to proper storage infrastructure, international organizations like the World Bank have thus

⁸¹ Abdelkader Sbihi and Richard W. Eglese, "The Relationship between Vehicle Routing & Scheduling and Green Logistics - A Literature Survey," March 2007, <https://hal.archives-ouvertes.fr/hal-00644133>; Blanchard, *Supply Chain Management*.

⁸² Blanchard, *Supply Chain Management*.

⁸³ Anuj Mittal, Caroline C. Krejci, and Teri J. Craven, "Logistics Best Practices for Regional Food Systems: A Review," *Sustainability* 10, no. 1 (January 2018): 168, <https://doi.org/10.3390/su10010168>.

⁸⁴ Goos Kant, Michael Jacks, and Corné Aantjes, "Coca-Cola Enterprises Optimizes Vehicle Routes for Efficient Product Delivery," *Interfaces* 38 (2008): 40–50, <https://doi.org/10.1287/inte.1070.0331>.

⁸⁵ IEA, "CO₂ Emissions from Fuel Combustion 2018 Highlights," IEA Webstore, accessed June 25, 2019, <https://webstore.iea.org/co2-emissions-from-fuel-combustion-2018-highlights>.

⁸⁶ Ayoub Aouad, "The Electric Truck Report: Why e-Trucks Are Surging and How Manufacturers and Logistics Firms Can Maintain the Growth," Business Insider, December 21, 2018, <https://www.businessinsider.com/electric-truck-report-2018-12>.

⁸⁷ Qantas, "Sustainable Aviation Fuel," June 26, 2019, <https://www.qantas.com/travel/airlines/sustainable-aviation-fuel/global/en>.

⁸⁸ Jasmine Siu Lee Lam and Theo Notteboom, "The Greening of Ports: A Comparison of Port Management Tools Used by Leading Ports in Asia and Europe," *Transport Reviews* 34, no. 2 (March 4, 2014): 169–89, <https://doi.org/10.1080/01441647.2014.891162>.

⁸⁹ Julian Parfitt, Mark Barthel, and Sarah Macnaughton, "Food Waste within Food Supply Chains: Quantification and Potential for Change to 2050," *Philosophical Transactions of the Royal Society B: Biological Sciences* 365, no. 1554 (September 27, 2010): 3065–81, <https://doi.org/10.1098/rstb.2010.0126>.

collaborated with economies like Bangladesh to construct public storage facilities to improve storage capabilities, prevent food deterioration and create resilient food banks.⁹⁰

Investments can also help economies and businesses invest in specialized facilities that can both provide handling and storage services, which can add value and prolong the shelf life of perishables. For example, packing plants can help store food such as rice and nuts in dry, ambient containers; whereas cold storage facilities can keep chilled and frozen food such as yoghurts and meat in climate-controlled environments that can prolong their lifespan. Where appropriate, public-private partnerships (PPP) also help economies with limited resources invest in the necessary infrastructure to improve food handling capabilities.

Another trend in some places is the creation of centralized logistics hub. This could be advantageous due to economies of scale, but centralization also pose substantial risks for businesses: one disruption can cause substantial parts of the supply chain to grind to a halt. In 2018, KFC were forced to shut some of their stores in the UK after their transport provider were unable to deliver fresh chicken due to traffic congestion and warehouse issues in their centralized hub (See Box 4).⁹¹ The location of production plants and customers matters for logistics, as logistics providers need to take into account geographical factors where a logistical hub and what type could be more efficient.

Efforts have also been taken to increase the sustainability of storage hubs. To reduce reliance on single-use plastics and containers, some researchers have looked into the development of green packaging. Fibers from plant and animal products are used to create biodegradable packaging, which can be recycled for future use.⁹² In terms of utilities, some logistics hubs such as warehouses in Singapore have partnered with electricity providers to install rooftop “solar farms” in their logistics hubs.⁹³ By investing in alternative energy sources, such warehouses increase their resilience to unexpected events like power outages, thereby improving their capabilities to store and handle food even in adverse circumstances. Meanwhile, a study in Mexico has shown that collecting rainwater on the roof of a logistics warehouse also has the potential to meet the water needs of the facility.⁹⁴ Rainwater can be useful for logistics hubs as they can be treated and used for some processes like washing and the storage of live seafood.

⁹⁰ World Bank, “Projects : Bangladesh Modern Food Storage Facilities Project,” December 30, 2013, <http://projects.worldbank.org/P120583/bangladesh-modern-food-storage-facilities-project?lang=en>.

⁹¹ Cat Rutter Pooley, “KFC’s UK Chicken Run Caused by Too Many Eggs in One Basket,” *Financial Times*, February 23, 2018, <https://www.ft.com/content/9613f7c8-1870-11e8-9376-4a6390addb44>.

⁹² Guirong Zhang and Zongjian Zhao, “Green Packaging Management of Logistics Enterprises,” *Physics Procedia* 24 (2012): 900–905, <https://doi.org/10.1016/j.phpro.2012.02.135>.

⁹³ Marissa Lee, “Sembcorp to Build Solar Farms atop Three Cache Logistics Trust Warehouses,” *The Business Times*, January 2, 2019, <https://www.businesstimes.com.sg/companies-markets/sembcorp-to-build-solar-farms-atop-three-cache-logistics-trust-warehouses>.

⁹⁴ Miguel Ángel López Zavala, Mónica José Cruz Prieto, and Cristina Alejandra Rojas Rojas, “Rainwater Harvesting as an Alternative for Water Supply in Regions with High Water Stress,” *Water Supply* 18, no. 6 (December 1, 2018): 1946–55, <https://doi.org/10.2166/ws.2018.018>.

Box 4: Centralized or Decentralized Hubs to Source Chicken Cuts? The Case of KFC in the United Kingdom⁹⁵

On February 2018, fast food giant KFC had to close temporarily more than half of its outlets in the UK after a logistical hiccup. KFC had previously delegated the distribution of fresh chicken to Bidvest, which used six logistics hubs to deliver chicken across the UK. However, when KFC signed a joint contract with DHL and QSL, the new third-party logistics (3PL) provider established one central hub to distribute chicken.

While the single hub benefits from greater economies of scale, thereby decreasing KFC's distribution expenditure, it also rendered KFC more vulnerable to disruptions to its supply chain. Within just two weeks of signing the new contract, KFC ran into delivery issues, forcing it to close most of its branches. Operational issues within the 3PL provider and external factors like traffic congestion contributed to the 3PL provider's inability to deliver fresh chicken.

This example shows the trade-offs between centralized and decentralized logistics hubs especially in handling food products. While centralized hubs may be more profitable for businesses, they also render firms more susceptible to supply chain breakdown, which is extremely costly and risky especially when transporting perishable food items. On the other hand, decentralized logistics hubs can provide contingency options, but they may be too expensive to run. There is no all-purpose logistics model, and it ultimately depends on economies and businesses to identify whether a centralized or decentralized hub is better suited for their circumstances.

3) Coordination and Inventory Management

Technology is providing businesses with more sophisticated tools to plan and monitor the logistics of handling large quantities of food. Emerging technologies like radio-frequency identification, automated systems and blockchain technology can assist in coordinating transportation, inventory keeping, and increasing transparency. Thus, coordination and inventory management systems can improve resource allocation and enable employees to conduct more value-added labor.

Radio-frequency identification (RFID) allows firms to quickly register and record information from an item via tags/chips attached to items. Compared to traditional barcodes, RFID tags contain more information, can provide real-time updates on individual products, and can be read wirelessly; allowing firms and individuals to collate information on a wide-range of products stored quickly.⁹⁶

RFID can fulfill accounting and transparency requirements for specific products in the food value chain. In the context of animal-derived products, businesses can implant RFID microchips onto live animals to record information on breed, immunization record and disease treatment. Later, RFID can also record information on date of slaughter, packaging, and storage

⁹⁵ Pooley.

⁹⁶ Zou Zhuo et al., "Radio Frequency Identification Enabled Wireless Sensing for Intelligent Food Logistics," *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 372, no. 2017 (June 13, 2014), <https://doi.org/10.1098/rsta.2013.0313>.

temperature.⁹⁷ Fresh produce such as fruits and vegetables can also be tagged with RFID to identify storage conditions (temperature; humidity; presence of gases like oxygen, carbon dioxide, and ethylene).⁹⁸ Moreover, RFID systems enable companies to charge premiums for fresher products, backed with RFID data.

Automated systems have also been improving transport, storage, and employee management in food logistics networks. Automated systems can make warehouse optimizations without human interference, such as consolidating food products with similar storage requirements in one section of the warehouse. Moreover, automated systems can implement best practices in food management, storage, and transport such as first-expired-first-out for processed foods, and first-in-first-out for fresh produce.⁹⁹ Synergizing with progress made in RFID tags and database management, these systems can also expedite certain tasks in warehouses. For example, the use of drones in scanning RFID tags could reduce the time conducting inventories from a full day of work to just a few minutes.¹⁰⁰ Furthermore, as mentioned earlier, transport management systems (TMS) can automate the allocation of docking ports, scheduling, and employee management of food logistics hubs, reducing labor inefficiencies and minimizing coordination problems.¹⁰¹

Finally, blockchain technology can improve transparency and accuracy of data collated throughout the value chain. As blockchain stores information in a decentralized ledger, accurate and real-time information on the status of food products on the value chain can be transmitted across producers, suppliers, transporters, storage providers, laborers, and regulators. This transparent accounting method can help in a plethora of ways, such as organizing labor, identifying warehouse issues and ascertaining food standards.¹⁰² Furthermore, information stored on RFID and safeguarded by blockchain can also add a price premium or increased preference for food products as consumers will also be empowered to verify the quality and life cycle of a food item from farm to market.¹⁰³

4) Regulatory Compliance

Economies and businesses have also invested resources in improving and facilitating regulatory compliance for food items. Traditionally, food products when exported overseas require sanitary and phytosanitary permits to ensure they are meeting quarantine and food safety requirements. However, such requirements are often time-consuming, and can be a significant

⁹⁷ Wanjie Liang et al., “Modeling and Implementation of Cattle/Beef Supply Chain Traceability Using a Distributed RFID-Based Framework in China,” *PLOS ONE* 10, no. 10 (October 2, 2015): e0139558, <https://doi.org/10.1371/journal.pone.0139558>.

⁹⁸ Ki Hwan Eom et al., “The Vegetable Freshness Monitoring System Using RFID with Oxygen and Carbon Dioxide Sensor,” *International Journal of Distributed Sensor Networks* 8, no. 6 (June 1, 2012): 472986, <https://doi.org/10.1155/2012/472986>.

⁹⁹ Michael Lütjen, Patrick Dittmer, and Marius Veigt, “Quality Driven Distribution of Intelligent Containers in Cold Chain Logistics Networks,” *Production Engineering* 7, no. 2–3 (April 2013): 291–97, <https://doi.org/10.1007/s11740-012-0433-3>.

¹⁰⁰ Larry Hardesty, “Drones Relay RFID Signals for Inventory Control,” MIT News, August 25, 2017, <http://news.mit.edu/2017/drones-relay-rfid-signals-inventory-control-0825>.

¹⁰¹ Mittal, Krejci, and Craven, “Logistics Best Practices for Regional Food Systems.”

¹⁰² Feng Tian, “A Supply Chain Traceability System for Food Safety Based on HACCP, Blockchain & Internet of Things,” in *2017 International Conference on Service Systems and Service Management*, 2017, 1–6, <https://doi.org/10.1109/ICSSSM.2017.7996119>.

¹⁰³ Michelle Spence et al., “Exploring Consumer Purchase Intentions towards Traceable Minced Beef and Beef Steak Using the Theory of Planned Behavior,” *Food Control* 91 (September 1, 2018): 138–47, <https://doi.org/10.1016/j.foodcont.2018.03.035>.

burden for food producers and importers given that food logistics is expensive and time-sensitive.¹⁰⁴ While some economies have implemented single-window systems to facilitate the import and export of goods, systems that are in place may not be appropriate for food products.

New developments in ICT are assisting in improving regulatory compliance. For example, radio-frequency identification (RFID) attached on food products can provide real-time updates on the status and history of food items, thereby providing greater assurances that the food item meets food processing standards. A case study in Chinese Taipei for example has shown that applying new technologies such as RFID can expedite cargo receiving time and checking for incoming goods, contributing to reductions in shippers' inventory cost and operators' labor cost.¹⁰⁵ As food tracing technologies such as RFID and blockchain advance, it is now possible for food producers to accurately state the production process of food products and include an authentication tag onto their products. Regulators and port authorities can likewise harness information on RFID tags to ensure that food products are stored properly across the value chain, adhere to production standards, and have the relevant paperwork and permits necessary for import.

3.4 Performance of the Logistics Services in APEC

This section presents the regulatory performance of APEC economies in logistics services and the efficiency of logistics operations in the APEC region. In addition, it discusses the conditions facing infrastructure-related services linked to logistics.

Logistics services: cargo-handling, freight forwarding and storage and warehouse

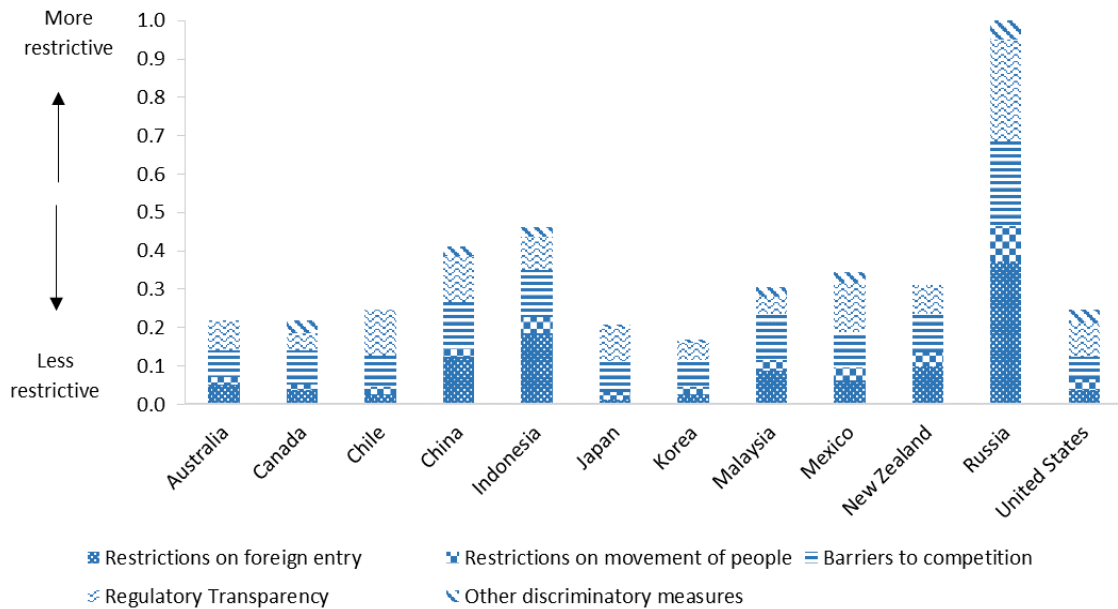
New technologies and practices help the logistics sector become more competitive, but regulatory barriers can impede firms and business from adopting these trends. Restrictions to foreign entry and competition as well as measures involving the lack of regulatory transparency are some of the main issues the sector is facing.

In terms of cargo-handling services, barriers to competition are the most critical. Data from the OECD STRI regulatory database, which includes information related to 12 APEC economies, shows that nine APEC economies do not have procurement regulation in which it is forbidden to discriminate against foreign suppliers. Similarly, restrictions on shares of foreign equity are present in five APEC economies. Barriers related to the lack of regulatory transparency are common. For example, licensing requirements. In addition, other practices affecting the non-discrimination principle are found, such as the fact that cross-subsidization is not prohibited in all these economies, and cargo-handling services in airports and ports are not awarded through competitive bidding in eight and six APEC economies, respectively.

¹⁰⁴ "Modernizing Sanitary and Phytosanitary Measures to Expand Trade and Ensure Food Safety" (Asian Development Bank, 2016), <https://www.adb.org/sites/default/files/publication/180517/modernizing-sanitary-measures.pdf>.

¹⁰⁵ Chaug-Ing Hsu, Hsien-Hung Shih, and Wei-Che Wang, "Applying RFID to Reduce Delay in Import Cargo Customs Clearance Process," *Computers & Industrial Engineering* 57 (September 1, 2009): 506–19, <https://doi.org/10.1016/j.cie.2008.02.003>.

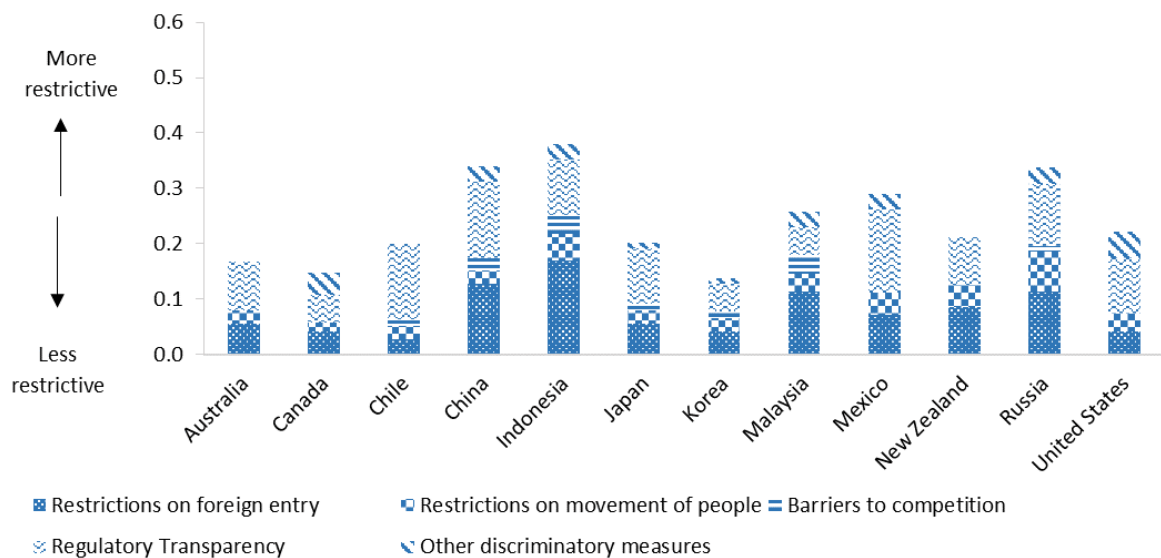
Figure 3.2: STRI Scores on Logistic Cargo-Handling Services, APEC Economies, 2018



Source: OECD, 2019;¹⁰⁶ APEC Secretariat, Policy Support Unit calculations

As for freight forwarding services, issues regarding regulatory transparency are mostly prevalent among APEC economies, in particular regarding the imposition of individual licensing or registration requirements. Also, restrictions in terms of foreign entry are found, such as the requirement of residents in the board of directors in Australia; Canada; Malaysia and New Zealand, as well as commercial presence requirements in Indonesia; Japan; Malaysia and Mexico to provide cross-border freight forwarding services.

Figure 3.3: STRI Scores on Logistic Freight Forwarding Services, APEC Economies, 2018



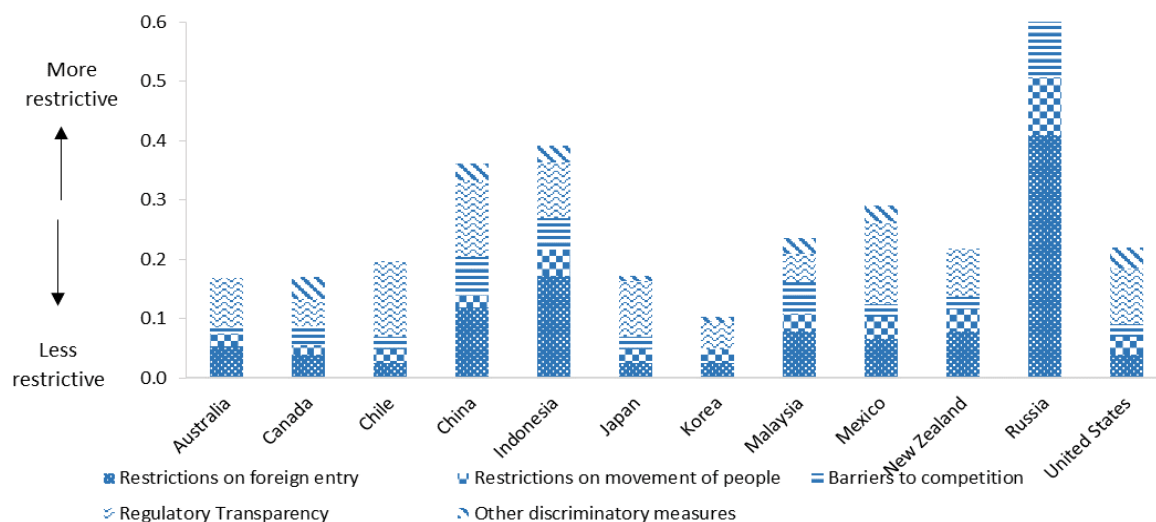
Source: OECD, 2019;¹⁰⁷ APEC Secretariat, Policy Support Unit calculations

¹⁰⁶ OECD, "Services Trade Restrictiveness Index Regulatory Database."

¹⁰⁷ OECD.

In relation to storage and warehouse services, issues concerning transparency are affecting these services. The process of obtaining a mandatory license and procedures affecting customs clearance are examples of obstacles affecting the provision of storage and warehouse services. In terms of restrictions of foreign entry, issues affecting cross-border transfers of personal data, as well as the acquisition and use of land by foreign firms is common among some APEC members. Indonesia, Mexico and Russia also impose limits on foreign equity participation.

Figure 3.4: STRI Scores on Logistic Storage and Warehouse Services, APEC Economies, 2018



Source: OECD, 2019;¹⁰⁸ APEC Secretariat, Policy Support Unit calculations

Infrastructure-related services linked to logistics

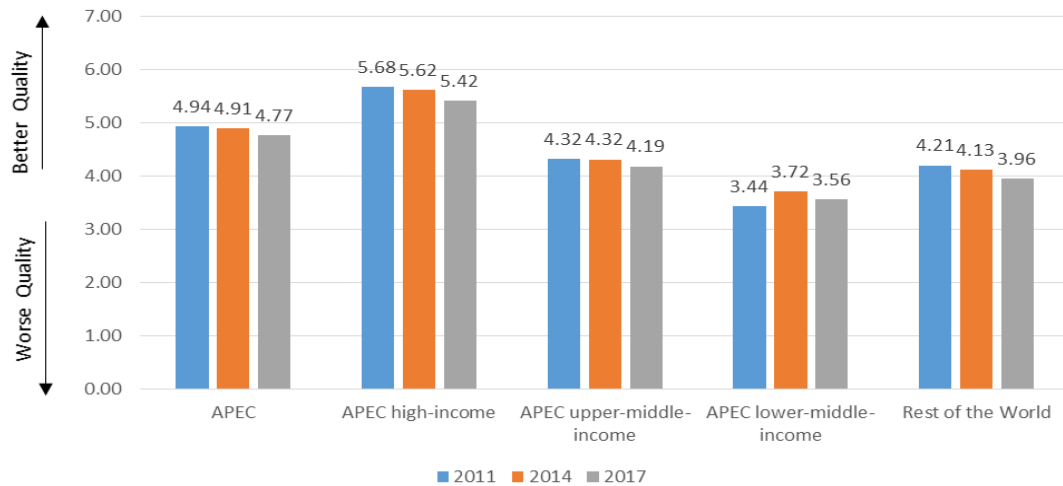
As evidenced in the previous section, infrastructure such as transport networks and power plants is paramount for logistics, especially in the context of food. However, economies have a huge disparity when it comes to infrastructure. Within APEC, the infrastructure gap in the transportation sector alone was equivalent to USD 8 trillion in 2018 and is projected to reach around USD 30 trillion by 2030.¹⁰⁹ The lack of proper investment in infrastructure is a challenge for the movement of food products, as it creates bottlenecks that affect the quality of the provision of logistics services.

An executive opinion survey conducted by the World Economic Forum among business executives from 140 economies suggested that business leaders perceive that between 2011 and 2017, the quality of overall infrastructure in APEC has been declining (Figure 3.5). This sentiment is stronger for the infrastructure in high-income and upper-middle-income economies. On the other hand, while the perceived quality of infrastructure in APEC lower-middle-income economies is still below that of the rest of the world, the gap is diminishing, showing that APEC lower-middle-income economies are catching up to the ROW.¹¹⁰

¹⁰⁸ OECD.

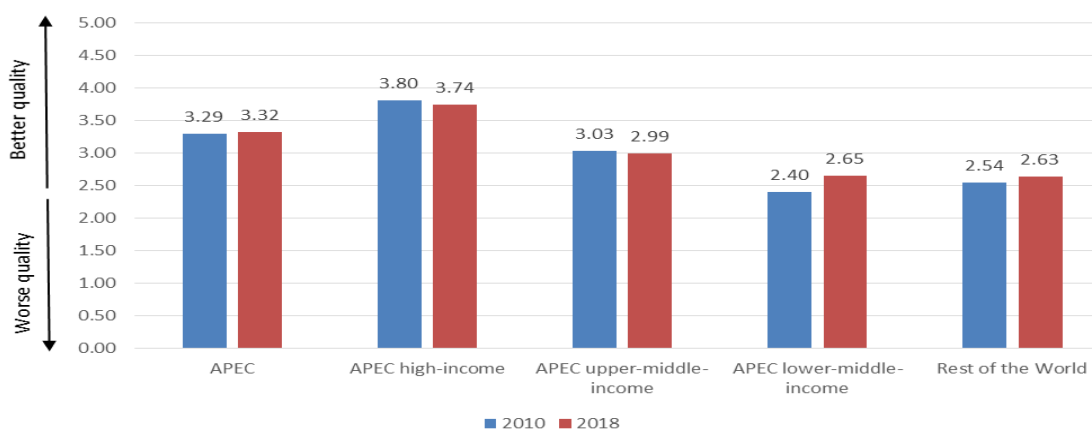
¹⁰⁹ Based on the Infrastructure Outlook database from the Global Information Hub. See Global Infrastructure Hub, “Global Infrastructure Outlook,” 2018, <https://outlook.gihub.org/>.

¹¹⁰ For this section, APEC economies have been classified by income levels, following the World Bank Atlas Method. Lower middle-income economies are those with a GNI per capita between \$996 and \$3,895 (Indonesia; Papua New Guinea; Philippines and Viet Nam); upper middle-income economies are those with a GNI per capita between \$3,896 and \$12,055 (China; Malaysia; Mexico; Peru; Russia and Thailand); and high-income

Figure 3.5: Quality of General Infrastructure in APEC

Note: The value of the index ranges from 1 (extremely underdeveloped) to 7 (extensive and efficient).
Source: WEF, 2017;¹¹¹ APEC Secretariat, Policy Support Unit calculations.

This declining perception in the quality of infrastructure refers mostly to transportation, in particular roads, port and air infrastructure for APEC high-income and upper-middle-income economies. Business leaders think that road, railroad and maritime infrastructure in APEC lower-middle-income economies have improved, while that of air infrastructure has deteriorated in recent years. Similar concerns are reflected in indicators from the World Bank's Logistics Performance Index, which measure the perceptions of employees of freight forwarding and express carrier companies on the state of the logistics sector. The index capturing the quality of trade and transport-related infrastructure recorded an improvement for APEC lower-middle-income economies, but also showed a slight deterioration for APEC high-income and upper-middle-income economies.

Figure 3.6: Quality of Trade and Transport-related Infrastructure in APEC

Note: The value of the index ranges from 1 (lowest) to 5 (highest).
Source: World Bank, Logistics Performance Index¹¹²; APEC Secretariat, Policy Support Unit calculations.

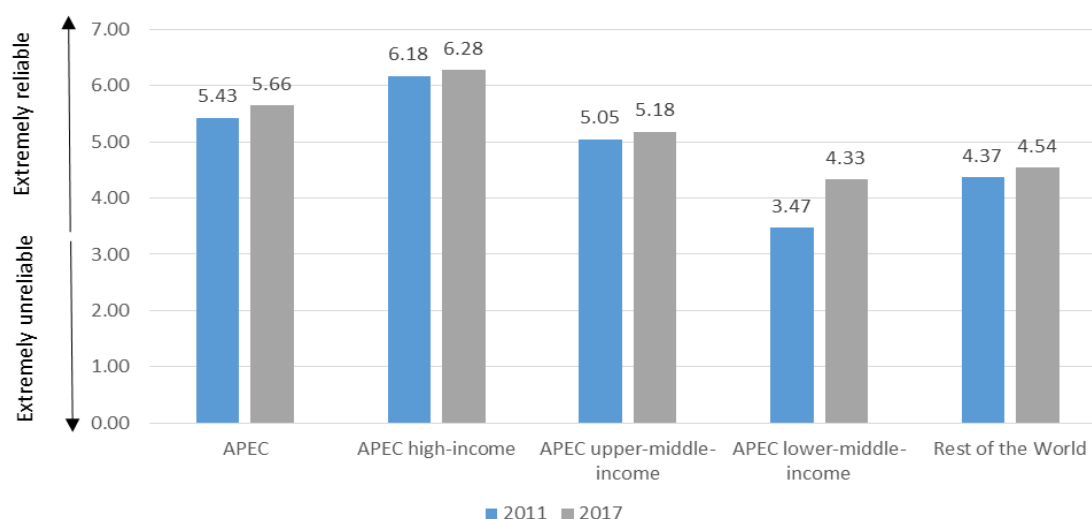
economies are those with a GNI per capita of \$12,056 or more (Australia; Brunei Darussalam; Canada; Chile; Hong Kong, China; Japan; Korea; New Zealand; Singapore; Chinese Taipei and United States).

¹¹¹ WEF, *The Global Competitiveness Report 2017-2018*.

¹¹² World Bank, "Logistics Performance Index," May 19, 2019, <https://lpi.worldbank.org/international/global>.

While APEC needs to improve transport-related infrastructure, it made progress in improving other infrastructure crucial to logistics. For example, regarding the supply of electricity, the APEC region has ameliorated the reliability of electricity supply, particularly in APEC lower-middle-income economies in recent years. In the same way, APEC’s telecommunications sector has increased its penetration rates and reduced its access cost. In 2016, around 98% of the APEC population had already been covered by a mobile network signal. Moreover, between 2008 and 2017, the average per minute cost of a mobile phone local call has fallen by more than half from USD 0.46 to USD 0.22.¹¹³

Figure 3.7: Quality of Electricity Supply



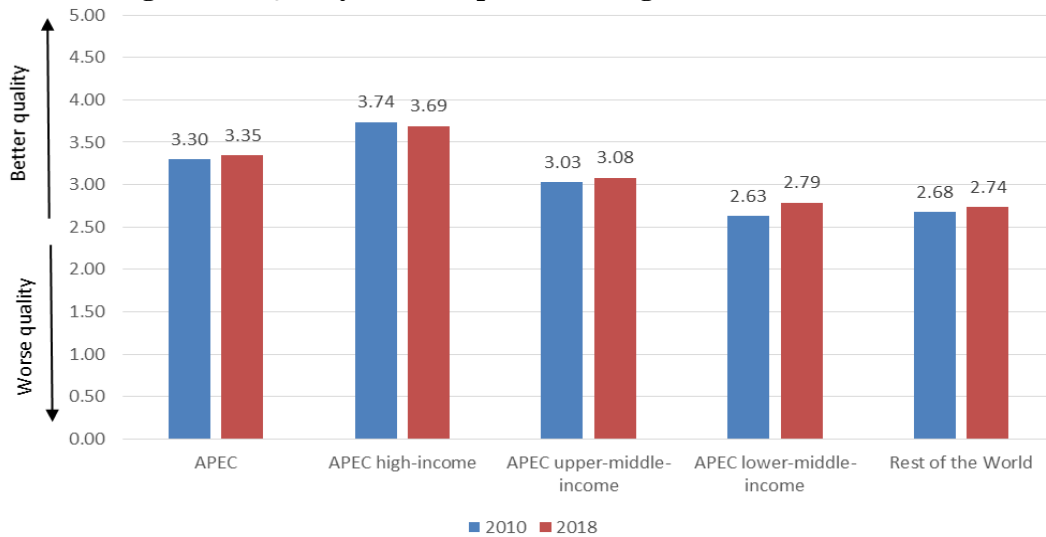
Note: The value of the index ranges from 1 (extremely unreliable) to 7 (extremely reliable).
 Source: WEF;¹¹⁴ APEC Secretariat, Policy Support Unit calculations.

Efficiency of Logistics Operators in APEC

The Logistics Performance Index also examines other important components of the global value chains, such as the quality of logistics services, which takes into account the capacity of transport operators, customs brokers and freight forwarders, among others. According to this index, the compliance and quality of logistics services among APEC high-income economies in recent years has fallen, while it has improved for APEC middle-income economies. The trend regarding the perception of the quality of the logistics services is similar to that related to the quality of available transport-related infrastructure.

¹¹³ Information from ITU, “World Telecommunication/ICT Indicators Database,” December 2018, <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx>. The information of the average per minute call is in Purchasing Power Parity terms.

¹¹⁴ WEF, *The Global Competitiveness Report 2017-2018*.

Figure 3.8: Quality and Compliance of Logistics Services in APEC

Note: The value of the index ranges from 1 (lowest) to 5 (highest).

Source: World Bank, Logistics Performance Index;¹¹⁵ APEC Secretariat, Policy Support Unit calculations.

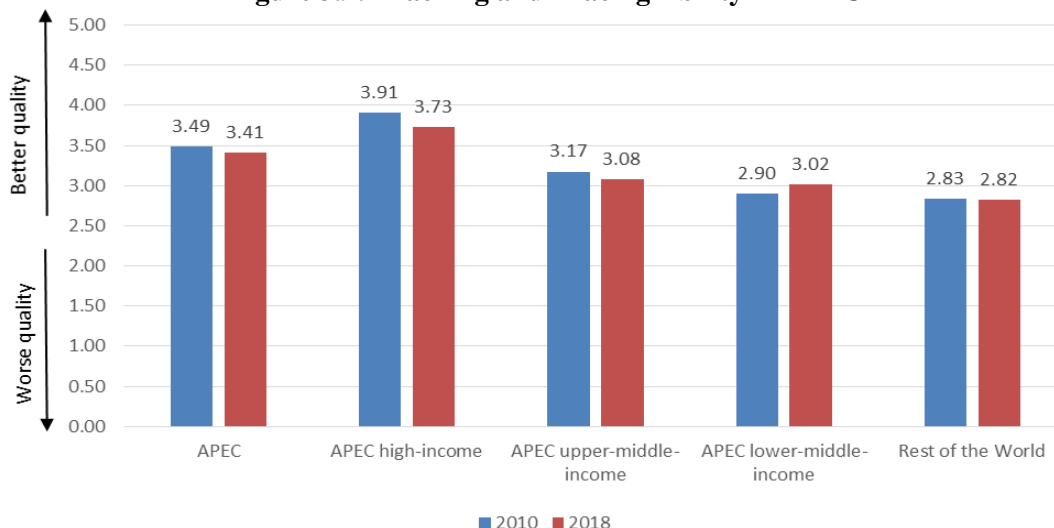
Logistics is becoming more data intensive. In this regard, data analytics play an important role in the development of the logistics sector. The World Bank (2018) mentions that as more logistics data has become more widely available, such developments could help to streamline international gateways and corridors, as well as improve supply chain connectivity within any economy.¹¹⁶ But it remains a challenge for economies to leverage on technology to improve logistics processes. One of the bottlenecks is that not all economies have the technical capacity and organizational skills to use and analyze big data properly. For example, APEC economies with lower incomes will have more difficulties than others in offering efficient tracking and tracing systems to firms and individuals (as reflected in Figure 3.9).

However, developed economies also face their fair share of challenges. The ability to provide appropriate systems to track and trace consignments within high-income and upper-middle-income economies in APEC has declined in recent years (see Figure 3.9). Growing volumes of consignments may be making it more difficult for firms to keep up with efficient tracking and tracing systems, and as such, economies and businesses need to develop novel solutions to keep up with the growth in the transport of goods.

¹¹⁵ World Bank, “Logistics Performance Index.”

¹¹⁶ Jean-François Arvis et al., *Connecting to Compete 2018: Trade Logistics in the Global Economy* (World Bank, 2018), 38, <https://doi.org/10.1596/29971>.

Figure 3.9: Tracking and Tracing Ability in APEC

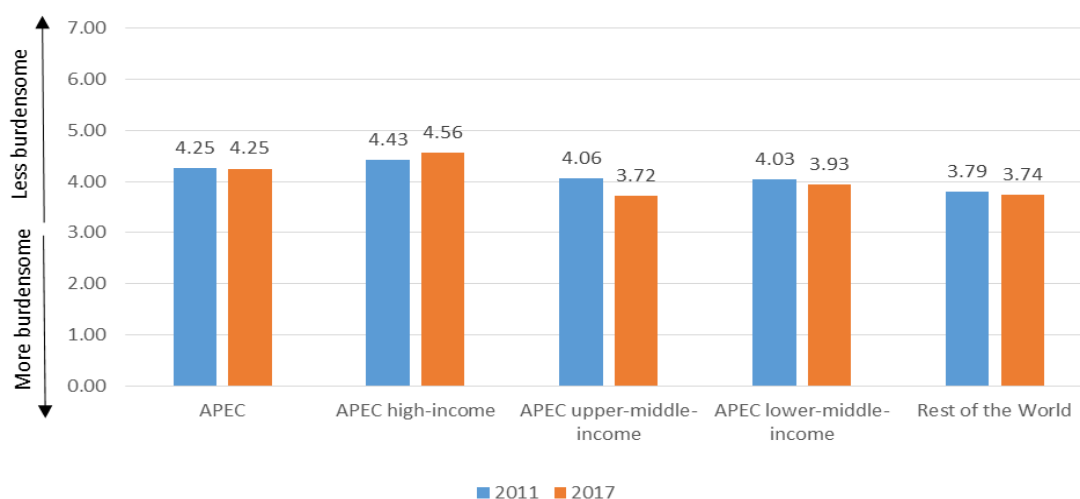


Note: The value of the index ranges from 1 (lowest) to 5 (highest).

Source: World Bank, Logistics Performance Index;¹¹⁷ APEC Secretariat, Policy Support Unit calculations.

In addition to infrastructure constraints, existing policies and proposed interventions in specific sectors can also hamper the provision of logistics services. For example, in the context of food, business executives think that agricultural policies in most APEC middle-income economies have become more burdensome from the fiscal perspective for economies in recent years. Such restrictive policies, like subsidies targeting farmers, can prevent businesses and governments from investing in the necessary interventions to improve agricultural processes and infrastructure. In addition to that, governments have been slow to address the growing challenges of logistics providers and outdated regulatory practices restricting investments in the sector may not be able to keep up with the growing flow of traded food products.

Figure 3.10: Agricultural Policy Costs for Economies



Note: The value of the index ranges from 1 (excessively burdensome to the economy) to 7 (balances with the interests of taxpayers, consumers and producers).

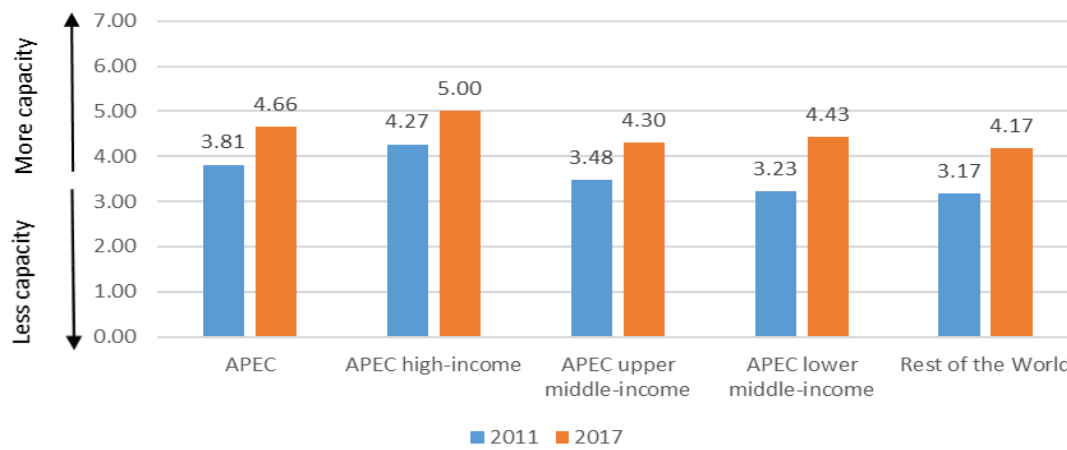
Source: WEF;¹¹⁸ APEC Secretariat, Policy Support Unit calculations.

¹¹⁷ World Bank, “Logistics Performance Index.”

¹¹⁸ WEF, *The Global Competitiveness Report 2017-2018*.

Logistics is evolving and innovating. In recent years, logistics companies have been developing new technology applications to improve efficiency by reducing costs and saving time. For example, it is becoming more common to use radio frequency identification (RFID) tags and drones in conducting inventories and sensors to detect any issues in the supply chain that require immediate attention. In addition, driverless vehicles like forklifts and robots are reducing the margin of human error and saving time in performing certain tasks. Within the APEC region, the capacity for innovation has increased in recent years in both industrialized and developing economies (Figure 3.11). This means that companies are not just obtaining technology through licensing or replicating similar technologies used by foreign firms, but also are empowered to develop proprietary technologies to improve their business processes.

Figure 3.11: Views on the Capacity for Innovation



Note: The value of the index ranges from 1 (technology obtained exclusively via licensing or imitating foreign companies) to 7 (companies conduct their own research and development and pioneer their own new products and processes).

Source: WEF;¹¹⁹ APEC Secretariat, Policy Support Unit calculations.

3.5 Challenges in Logistics Services

Despite promising trends and solutions in logistics services, economies still face many hurdles in this sector. This section looks at some key challenges.

1) Financing and Constructing Infrastructure

A strong and resilient infrastructure is necessary for the transport of food items. Quality road, rail, maritime and aviation infrastructure facilitate the movement of goods across the food value chain. Communities without access to resilient infrastructure may be unable to transport their products for further processing or distribution, which can impact food prices and security.¹²⁰ Warehouses and distribution points equipped with proper storage facilities are crucial to preserve the quality of food products. Robust ICT networks ensure that timely information is relayed to various points in the logistics sector, helping improve coordination and efficiency. As food products are time sensitive, failure to communicate can pose risks for the transported goods. Noting the existing infrastructure gap in APEC, APEC member economies have to

¹¹⁹ WEF.

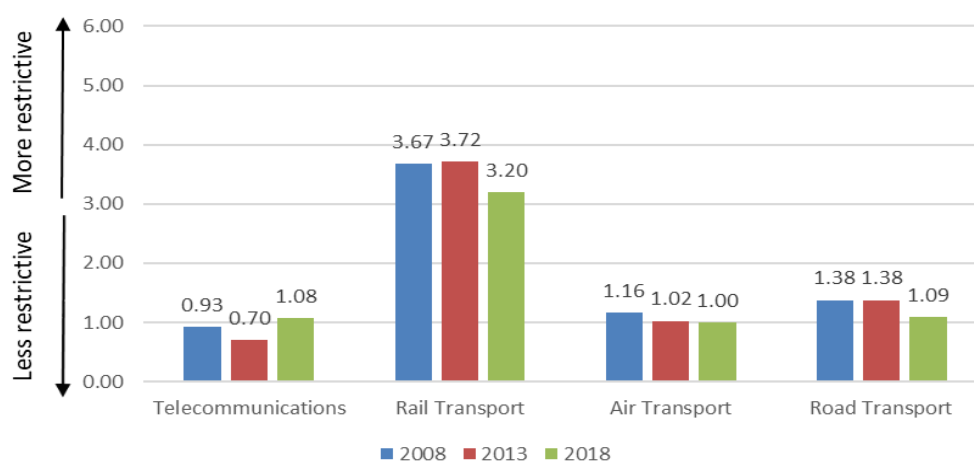
¹²⁰ Gerald Shively and Ganesh Thapa, "Markets, Transportation Infrastructure, and Food Prices in Nepal," *American Journal of Agricultural Economics* 99, no. 3 (April 1, 2017): 660–82, <https://doi.org/10.1093/ajae/aaw086>.

invest in reliable infrastructure to expedite logistics processes. Economies can construct or upgrade new transportation and telecommunications links. As infrastructure projects are expensive, governments could engage with the private sector via avenues like public-private partnership programs to build up public infrastructure.¹²¹

However, in some occasions, regulatory issues could restrict the participation of domestic and foreign firms, preventing potential investors from entering the market and building up infrastructure. Restrictions in terms of the number of services operators, foreign participation and price regulation could represent impediments against interested firms to invest in infrastructure. Specific sectors related to logistics like transportation could also face other particular regulatory restrictions as well. For instance, air and rail transport operators could only operate limited routes and frequencies, and freight transport services are sometimes licensed to operate in limited jurisdictions, preventing the integration of transport networks.

According to the OECD Product Market Regulation indices, regulations in APEC pertaining to transport infrastructure has become less restrictive in recent years, despite the fact that foreign equity limitations are common and certain activities are only allowed for domestic firms (e.g. cabotage in maritime transport). However, regulations affecting telecommunications are slightly more restrictive nowadays. Most of the restrictions in telecommunications are in relation to the participation of foreign firms and other competition-related issues.

Figure 3.12: Average OECD Product Market Regulation Indices in the APEC Region*



* The calculation of the indices for the APEC region only includes data from the APEC economies that are part of the OECD, namely: Australia; Canada; Chile; Japan; Korea; Mexico; New Zealand; and the United States. Data for year 2018 is not available for the United States. In the case of the United States, data from year 2013 was carried forward in order to make APEC averages comparable across time.

Source: OECD;¹²² APEC Secretariat, Policy Support Unit calculations

Closing the infrastructure gap is a challenge not just in areas that need massive infrastructure projects, like transportation and telecommunications, but also in other areas like warehousing and distribution that require investments of relatively lower value. Businesses such as third-

¹²¹ Michael Della Rocca, “The Rising Advantage of Public-Private Partnerships,” July 2017, <https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/the-rising-advantage-of-public-private-partnerships>.

¹²² OECD, “Indicators of Product Market Regulation,” May 17, 2019, <http://www.oecd.org/economy/reform/indicators-of-product-market-regulation/>.

party logistics (3PL) providers can build new hubs that can receive and process goods from the vicinity, but they need to construct warehousing facilities that are able to leverage on large-scale operations to improve profitability by economies of scale.¹²³ One of the problems 3PL providers could face is the accessibility of financing tools (see Chapter 2) to fund investment needed such as procuring new vehicles, constructing proper storage facilities or upgrading technology.

There is no one-size-fits-all solution to improve the overall logistics infrastructure of an economy. Therefore, APEC economies should identify priority infrastructure projects that increase both the coverage and resilience of their logistics services.

Box 5: Reducing Risk of Food Oversupply through the Construction of Storage and Processing Facilities¹²⁴

In the first half of 2019, the Philippines experienced an extended El Niño, causing a prolonged spell of dry and hot weather, which expedited the ripening process of mangoes, causing the Philippines to have an oversupply of 2 million kilograms of mangoes.

Supply gluts can provide more business opportunities, but the ability of economies to seize such unexpected opportunities is ultimately tempered by the quality of infrastructure and services. Unfortunately, in this case, vast quantities of mangoes were not able to be stored in acclimatized facilities, exported or processed in time into other value-added products (for example: juice, pulp, snacks, among others), and had to be sold at very low prices in the local market.

In order to avoid similar problems in the future, the Philippine Department of Agriculture is working with communities and mango growers to provide soft loans for the construction of mango storage and processing facilities. As such, economies and businesses looking to improve food security can also invest in new facilities that can provide value-added services by processing food products or prolonging their shelf lives.

2) Managing and Standardizing Data

The adoption of ICT systems among logistics providers varies, depending on the firm size and development levels. For example, a study in China shows that ICT has been widely adopted in 3PL firms, with small firms using basic systems to cut costs and reduce errors in daily operations, while medium and large firms incorporate ICT systems for planning and strategic purposes looking at business control, customer integration and services differentiation.¹²⁵

¹²³ Keith DeHaan and Chris Raines, “To Build or Not to Build: Lessons Learned from New Processing Ventures,” June 2011, <https://articles.extension.org/pages/59962/to-build-or-not-to-build:-lessons-learned-from-new-processing-ventures>.

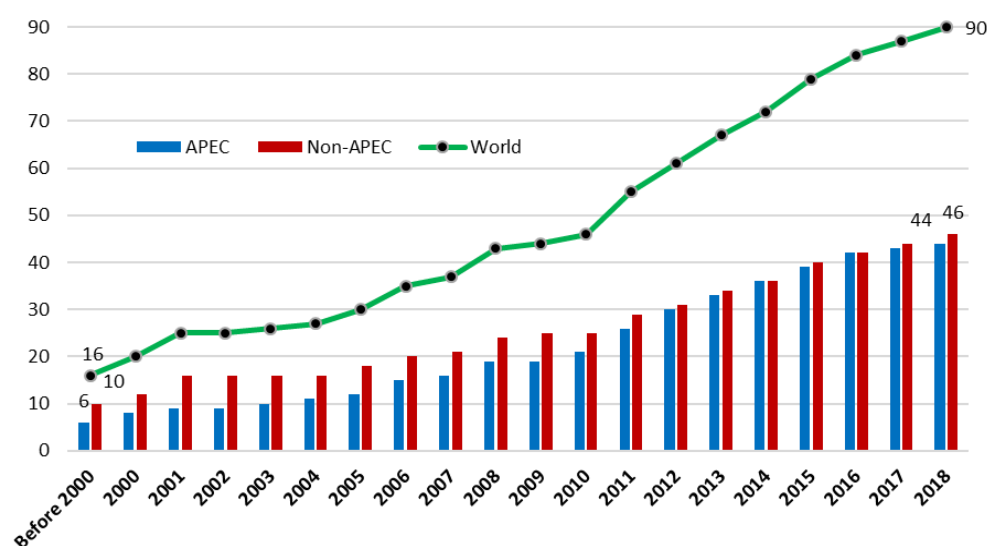
¹²⁴ Channel News Asia, “The Philippines Faces a 2 Million Kg Oversupply of Mangoes. What Does It Plan to Do?,” *CNA*, June 11, 2019, <https://www.channelnewsasia.com/news/asia/philippines-mango-prices-oversupply-2-million-kg-el-nino-11614348>.

¹²⁵ Kwok Hung Lau and Haibo Huang, “Adoption and Utilization of ICT in the Chinese Third-Party Logistics Industry,” in *Management Science, Logistics, and Operations Research*, ed. John Wang (IGI Global, 2014), <https://doi.org/10.4018/978-1-4666-4506-6>.

Another study on Indonesia found that most of the local logistics providers had only adopted ICT systems at the basic level.¹²⁶

ICT is becoming critical for logistics. In fact, logistics services are increasingly becoming data-driven, as evidenced by the growing adoption of RFID tags and e-management platforms. But while data help businesses and economies derive insights, such data also render businesses vulnerable to issues such as data overload and security threats.¹²⁷ For instance, RFID tags can store a treasure trove of information on food products, such as production, storage, and transport history; but ICT systems of some businesses, in particular in developing economies, may not be able sophisticated enough to process vast amount of information. To minimize these bottlenecks, firms could outsource processing this information, which could also help them to reduce costs. However, from the regulatory perspective, increasing restrictions in cross-border data flows could make outsourcing a more difficult task. For example, in APEC, the number of restrictions in cross-border data flows have been steadily increasing.

Figure 3.13: Cumulative Number of Restrictions in Cross-Border Data Flows



Source: European Centre for International Political Economy (ECIPE), Digital Trade Estimates Database;¹²⁸ APEC Secretariat, Policy Support Unit calculations

In terms of issues related to data standardization, RFID systems are not yet fully developed. Keeping information in RFID is not yet globally standardized, which can lead to difficulties in relaying accurate information on the products quickly for those with different data keeping methods.¹²⁹ Inconsistent methods of storing information on RFID impede the interoperability

¹²⁶ Kuncoro Harto Widodo, Joewono Soemardjito, and Yandra Rahardian Perdana, “The Capacity of Indonesian Logistics Service Providers in Information and Communication Technology Adoption,” in *City Logistics 3: Towards Sustainable and Liveable Cities*, ed. Eiichi Taniguchi and Eiichi Thompson (John Wiley & Sons, Ltd, 2018), 235–48, <https://doi.org/10.1002/9781119425472.ch13>.

¹²⁷ Richard Herschel and Patricia D. Rafferty, “Understanding RFID Technology within a Business Intelligence Framework,” *Intelligent Information Management* 04, no. 06 (2012): 407–14, <https://doi.org/10.4236/iim.2012.46046>.

¹²⁸ European Centre for International Political Economy (ECIPE), “Digital Trade Estimates Database,” accessed June 25, 2019, <https://ecipe.org/dte/database/>.

¹²⁹ Quan Z. Sheng et al., “Ubiquitous RFID: Where Are We?,” *Information Systems Frontiers* 12, no. 5 (November 1, 2010): 485–90, <https://doi.org/10.1007/s10796-009-9212-x>.

of ICT systems, which can reduce the efficiency of the logistics chain.¹³⁰ Standardization reduces the needs for ICT systems to translate data. Furthermore, standardization facilitates businesses and regulators monitoring the production and logistics history of food products. Establishing data standards may help easing the flow of products along the logistics chain.

3) Reskilling the Labor Force

New technologies are transforming logistics. Drones and RFIDs improve the inventory-taking capabilities of warehouses, while management systems can automatically transfer products with identical storage requirements from one part of the warehouse to another.¹³¹ However, adopting new technologies in logistics is also leading to new labor requirements. For example, warehouses now require individuals who can program, conduct maintenance checks and repairs on new equipment, instead of those who can handle inventories manually. Similarly, employees need to learn how to operate alongside with automated processes, such as implementing contingency protocols in case of ICT failure. As such, equipping the labor force with skills relevant to the digitized logistics sector is a key challenge for economies.

4) Regulatory Issues

Automation has changed the way businesses handle food products and could facilitate the verification of food safety and quarantine requirements. This is an advantage when trading time-sensitive products. However, outdated regulations could pose uncertainties for businesses from harnessing new technologies, hence impeding innovation. For example, in the context of e-grocers, who is ultimately responsible for regulating the labeling and transport of perishable food products? What types of permits should businesses require in order to transport food products purchased digitally? In the face of rapid transformation, economies should revise their regulations to accommodate emerging business models, and encourage firms to innovate and adopt good practices.¹³²

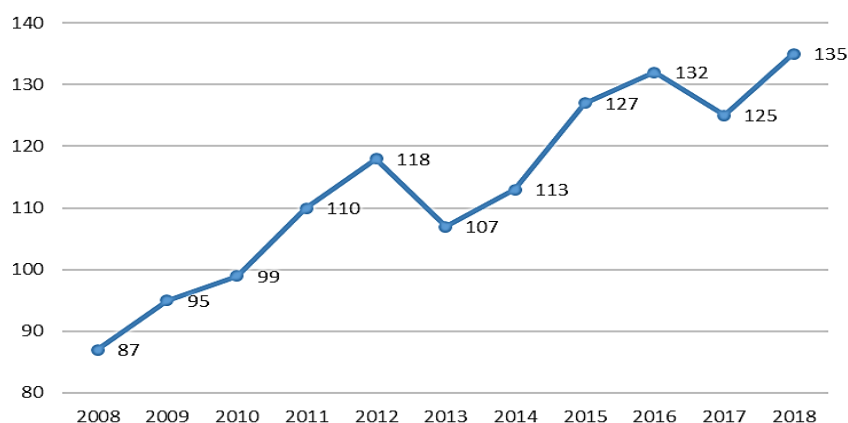
A growing concern affecting the logistics sector is the upward trend in unresolved specific trade concerns related to sanitary and phytosanitary measures. The figure below show the number of measures that at least one APEC member has been implementing and any WTO member considers that they have been misused in order to protect domestic producers, thus unnecessarily affecting trade. In many cases, these measures could prevent the release of goods at ports of entry (e.g. prohibition of importing a fruit if it does not meet a new requirement), or delay their release (e.g. new customs procedures for certain food products, requiring additional checks and inspections), therefore reducing the time food products could be processed or commercialized in stores.

¹³⁰ Martina Gerst, Raluca Bunduchi, and Ian Graham, "Current Issues in RFID Standardization," 2005, <https://www.york.ac.uk/res/e-society/projects/24/interop2005.pdf>.

¹³¹ Lütjen, Dittmer, and Veigt, "Quality Driven Distribution of Intelligent Containers in Cold Chain Logistics Networks."

¹³² William D. Eggers, Mike Turley, and Pankaj Kishnani, "The Future of Regulation: Principles for Regulating Emerging Technologies" (Deloitte Insights, June 19, 2018), <https://www2.deloitte.com/insights/us/en/industry/public-sector/future-of-regulation/regulating-emerging-technology.html>.

Figure 3.14: Unresolved SPS-related Specific Trade Concerns Reported in WTO against APEC Members



Source: WTO i-TIP Database.¹³³ APEC Secretariat, Policy Support Unit calculations.

3.6 Policy Implications

Logistics is a broad field with substantial room for innovation. Adopting new technologies and logistics practices can improve the efficiency and security of food trade. However, to make the most out of this opportunity, economies and policymakers should acknowledge the interdependencies between the public and private sector, and provide adequate regulation addressing public concerns without discouraging innovation. Furthermore, improving the regulatory environment affecting the work of logistics firms implies the need to include a wide range of public sector institutions, as many of the logistics operations rely on the provision of various services sectors.

In general, APEC economies could emphasize work on the following aspects to strengthen the logistics sector:

Improve stakeholder engagement. Given that logistics involves a wide range of actors such as producers, manufacturers and transporters, regulators must increase communication with these actors to ensure that policies are meeting their needs. Regulators can also aid in standardizing basic information on food products to make it easier for stakeholders to enable the interoperability of their systems, helping improve transparency along the food value chain.

Infrastructure Investment. Both developed and developing economies in APEC can do more to improve their infrastructure. Economies can leverage on new financing tools like public-private partnerships to invest in enhancing transportation and telecommunication infrastructure supporting the logistics sector. Moreover, businesses can themselves invest in new ways of making their operations less susceptible to external factors. For example, installing solar panels or investing in other alternative sources of energy can help warehouses be less susceptible to power outages from public electricity shortages.

Remove restrictions on foreign entry and other regulatory barriers affecting operations. Entering into the logistics market is difficult in some APEC economies, as licenses are commonly required and there are limits in the shares that foreign firms could take. In addition,

¹³³ WTO, “Integrated Trade Intelligence Portal (I-TIP),” accessed June 25, 2019, https://www.wto.org/english/res_e/statis_e/itip_e.htm.

cumbersome procedures in customs could affect operations of logistics providers, for example, procedures allowing the release of goods only after the determination and payment of import duties has taken place, removing any possibility to release food products immediately and conduct all those import verification and control measures ex-post subject to a risk assessment. Licensing requirements are also among other regulatory restrictions commonly found. Similarly, in terms of infrastructure supporting logistics providers, like telecommunications and transportation services, it is common to find cases in which it is not possible for foreign or private firms to invest due to restrictions in the participation of foreign firms and/or statutory provisions allowing the provision of a service to a monopoly.

Support reskilling initiatives. The logistics sector requires new skills, and as such, economies and businesses should look into equipping the workforce with the skills relevant to new logistics processes. Economies can introduce subject areas in education, such as computing, to ensure that the youth meet the future needs of businesses. Moreover, they can also help the current labor force pick up new skills through focused on-the-job trainings, workshops and other life-long learning initiatives.

Preventing unnecessary SPS-related measures affecting trade. Measures not proportional to the risk and/or providing undue protection to domestic food producers are detrimental for the food value chain. They could increase costs along the value chain, including logistics operators.

CHAPTER 4: FOOD AND DISTRIBUTION SERVICES

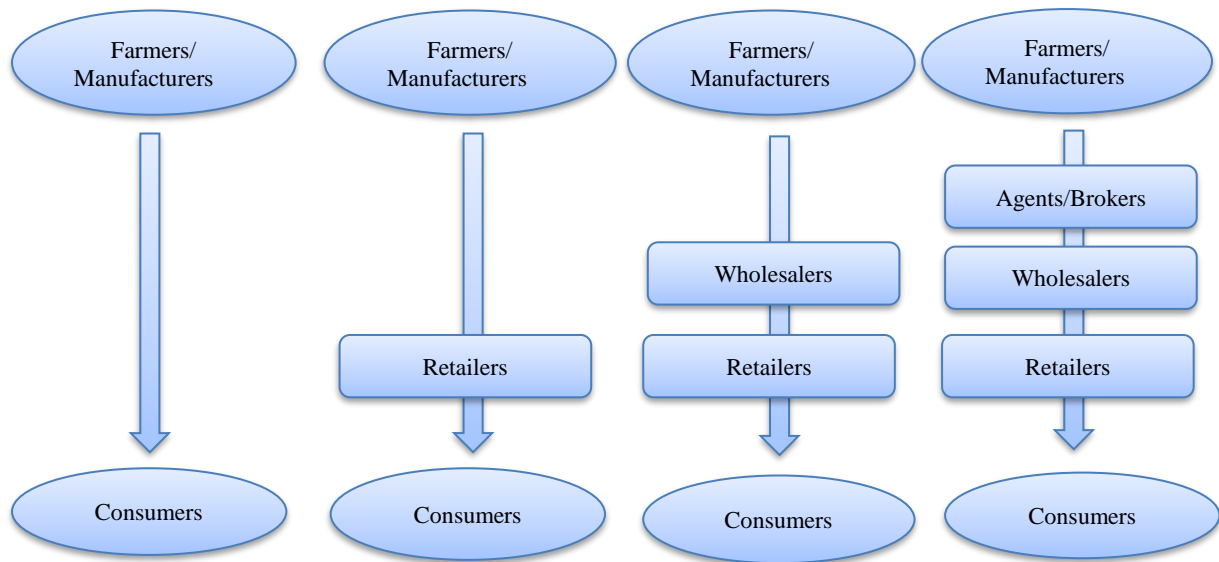
4.1 INTRODUCTION

Many argue that food security is in fact a matter of distribution. Though the global food production is abundant, the world fails to deliver food to people in many areas, due to facts such as income inequality, supply chain failures and trade barriers. Efficiency of the distribution channels, among others, is key to make food reach final consumers and to ensure the availability of a good variety of food products. Moreover, the distribution stage adds great value into the products.

Distribution services, include both wholesale and retail services, moving food from producers and manufacturers to wholesaler and retailers, and finally to end consumers such as households, hotels, food courts and restaurants. In a broader sense, distribution services also include related services that are being used throughout the distribution process, such as inventory management, assembling, packing, warehousing, quality control, and maintenance.¹³⁴ Actors at the distribution stages are usually food brokers or agents, wholesalers, and retailers, depending on the distribution model being used.

Distribution models vary by the nature of the food products, different business models and the geographical range of the distribution. As shown in Figure 4.1, the simplest model is direct selling from farmers or food manufacturers to the ultimate consumers. Consumers can either go directly to the farm or factory where the products are produced, or buy from a direct market, for instance a farmers market or a factory outlet. This model usually applies to large buyers who buy a large quantity of products from one or a few fixed suppliers, and by bypassing the “middleman”, the buyers could usually enjoy a price that is below market level. The popularity of direct markets, especially farmers markets, provide an additional selling channel for small farms and are favored by households as the produce is local and fresh. However, the model of direct market is restricted to buyers and producers from the same local area and the trade volume is very small.

¹³⁴ Nihal El-Mergharbel, “Efficiency of Wholesale and Retail Distribution Services in Egypt” (The Egyptian Center for Economic Studies, February 2010), http://www.eces.org.eg/MediaFiles/Uploaded_Files/%7BC93B58E2-C01D-4BF8-8D72-0C0DE83E0182%7D_ECESWP153-E.pdf.

Figure 4.1: Typical Food Distribution Models

Source: Adapted from Perner¹³⁵

Most of the time, food distribution involves an extensive global network and engages many intermediaries, such as wholesalers, retailers, agents, and brokers. They function as middlemen between producers and consumers, providing value by widening the product's geographic presence through their networks and reducing labor and resource cost of dealing with distributing issues for food producers.¹³⁶ Compared to the direct selling model, professional distribution services allow the products to access to a wider customer base and larger retail outlets. The “**farm-retail-consumer**” model describes when big retail stores such as Walmart and Carrefour buy directly from food farms and producers and sell to consumers through their own retail networks. Another model is “**Farm-wholesale-retail-consumer**”, where products are first bought by a wholesaler and then distributed to numerous retailers. A commission agent or food broker might be hired to represent food companies, market their products, and work with wholesalers or retailers to get the products into stores. This model is “**Farm-agents-wholesale-retail-consumer**”. Within each distributing model, food producers, distributors and consumers could vary in size and business models, spanning wide geographic areas.

Box 6: Food Loss at the Distribution Stage

According to FAO, more than one third of global food is wasted or lost during the value chain, as shown in Figure 4.2. Food waste in developed economies are more likely to happen at the consumption stage, while in developing economies, a large share of food is lost during harvest, processing, and distribution stages before reaching consumer's table.¹³⁷

There are many reasons why food is wasted at the distribution stages products or packaging may be damaged in transport and storage due to cold chain failures or handling mistakes; orders

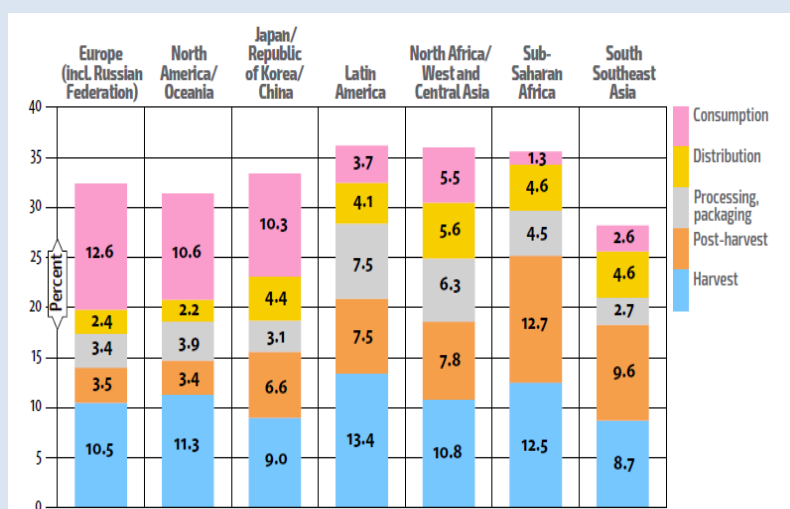
¹³⁵ Lars Perner, “Distribution: Wholesaling and Retailing of Food Products,” accessed June 28, 2018, https://www.consumerpsychologist.com/food_Distribution.html.

¹³⁶ Pratt Center for Community Development, “Distribution Challenges and Opportunities for NYC's Small, Specialty Food & Beverage Manufacturers,” August 2013, https://prattcenter.net/sites/default/files/pratt_center_food_distribution_study_august_2013_1.pdf.

¹³⁷ FAO, *The Future of Food and Agriculture: Trends and Challenges* (Rome: FAO, 2017), <http://www.fao.org/3/a-i6583e.pdf>.

are made incorrectly by warehouses and sent to wrong stores; expired food due to poor inventory control; food not meeting quality requirements get rejected by retailers and then wasted.¹³⁸ Modern and efficient distribution channels can improve food security through better waste control, warehouse management, advanced cold chain logistics, and precise temperature control.

Figure 4.2: Food Losses and Waste along the Supply Chain



Source: FAO, 2017;¹³⁹ Nielsen, 2015¹⁴⁰

4.2 Actors at the Distribution Stage

1) Commission agents/food brokers

A commission agent or food broker acts on behalf of food companies to market and sell products. Other than dealing with wholesalers and retailers by themselves, many brands choose to employ a professional agent or broker, who has already established long-standing relationships with a variety of wholesale or retail stores. Brokers do not buy or stock products, while profit from charging certain fees and commissions of the value of the products sold through them. Many brokers specialize in one typical type of products such as organic food and wine, possessing specialty expertise in the specific area, while others are more diverse, representing multiple types and brands of food products.

Food brokers make connections between food companies and wholesalers and retailers. They add value by marketing products, coordinating demos, managing store relationships, negotiating promotions or deals, and providing up-to-date market information and feedback on sales performance.¹⁴¹ In general, commission agents and food brokers help their clients to

¹³⁸ Helen Lewis et al., “Food Waste Opportunities within the Food Wholesale and Retail Sectors” (Institute for Sustainable Futures - University of Technology Sydney, 2017), https://opus.lib.uts.edu.au/bitstream/10453/115674/1/Lewisetal2017EPA_Food_waste%20report_2017-08-23.pdf.

¹³⁹ FAO, *The Future of Food and Agriculture: Trends and Challenges*.

¹⁴⁰ Nielsen, “The Future of Grocery,” April 29, 2015, <https://www.nielsen.com/eu/en/insights/report/2015/the-future-of-grocery>.

¹⁴¹ Zipline Logistics, “Difference between Food Broker, Distributor, and 3PL,” December 6, 2018, <https://ziplinelogistics.com/blog/difference-between-food-broker-distributor-3pl/>.

maximize sales by marketing their businesses and scale their products to more stores. Food broker services are mostly used by small and medium producers as it is most cost effective for them to focus on production and let a third party take over the distribution issues. A new brand or product could also benefit from broker services. Taking advantage of a broker's network, it gets broader exposure and breaks into the market more easily.

2) Wholesalers

A wholesaler buys products in large quantities upfront from manufacturers and producers and then resell to other wholesalers, retailers, and also to manufacturers, chains of hotels and individual buyers. A wholesaler usually connects with multiple farms or food manufacturers, and at the same time serves numerous retail stores and buyers in different sizes, and in different locations. Since a wholesaler consolidates suppliers and buys a variety of products in bulk upfront, it also holds inventory and manages its own warehouse. Retailers can then order some specific brands of their choice, in either large or small quantities, from the wholesaler. This function of a wholesaler is called "breaking of bulk", which greatly increase efficiency and convenience for retailers.

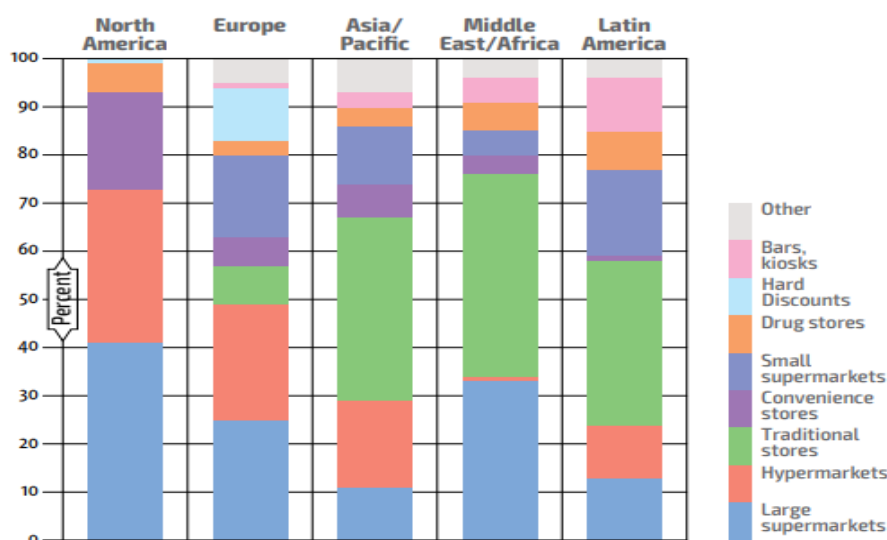
Wholesalers perform many other functions that are necessary to the smooth operation of the supply chain. They are risk bearers. Food products, especially perishable ones, are exposed to the risks of damage or spoilage when being stored or transported. As wholesalers connect both supply and demand, a sudden change in any side could cause a fluctuation of market price and a loss for them. Wholesalers are also finance providers to both food manufacturers and retailers. In many cases, wholesalers pay advance to farms or manufactures to secure supply and receive the goods later, and at the same time, they sell goods to retailers on credit. In this sense, wholesalers take the risks of default and bad debt on both sides. Wholesalers also work closely with small farmers in many areas such as adopting new technologies, equipment financing and leasing.

Wholesalers convey important information to both food producers and retailers. Like food brokers, wholesalers are sensitive about market preferences and trends and can inform food producers of the feedbacks from retailers. It can also negotiate on behalf of manufacturers for better shelf display and coordinate free sample demonstrations to increase sales. Meanwhile, wholesalers introduce new products to retailers, assist with returns and recalls, and place orders according to retailers' requests.

3) Retailers

Retailers buy products from either manufacturers or wholesalers, and then sell products directly to households and end consumers. Increasing urbanization, advanced technologies and diverse customer preferences have reshaped the retail landscape and inspired the emergence of many formats of retailing such as online stores and cashier-free stores to best suit consumers' needs. Traditional brick and mortar shops like supermarket, hypermarket, traditional stores, drug stores and convenience stores, however, are still making up the majority of the retail trade. For instance, a grocery retail survey by Nielsen in 2015 showed that the traditional stores shared more than one third of the total retail trade in Asia and the Pacific, Middle East, Africa and Latin America, as shown in Figure 4.3. While in more developed regions such as North America and Europe, hypermarkets and large supermarkets are the main retail outlets for groceries.

Figure 4.3: Share of Grocery Retail Trade, 2015



Source: FAO, 2017;¹⁴² Nielsen, 2015¹⁴³

In general, food products are sold through retailing via specialty or general retail stores. Specialty retail stores specialize on a specific category of products such as organic, health and wellness products. Their specialist knowledge and choices of brands are valued by consumers and their sizes vary from large international chain stores to small local family shops. In contrast, products at a general retail store are not limited to a specific brand or category, but mostly cater to market demands. As retail stores serve and face individual consumers directly, they are able to capture the slightest change in consumer taste and preference. Retailers’ liberty to customize their product portfolios and power to decide what to be displayed on the shelf give them a lot of bargaining leverage when negotiating with wholesalers or food manufacturers.

4.3 Emerging Trends in Distribution Services

1) Consolidation and Specialization

Vertical and horizontal consolidation is a major trend in distribution services. To improve their competitiveness and be better positioned in the value chain, we have seen many distributors, acquiring or investing in either upstream suppliers or downstream outlets, or horizontal competitors. Such merging and acquisition help distributors to broaden their product ranges, streamline warehouse operations, and therefore gain stronger market power. In this process of market concentration, we have seen many retailers, rather than wholesalers, stand out and quickly expand to become part of the world’s large multi-national companies. Some of the examples are Walmart, Carrefour, Tesco and etc. By acquiring or cooperating closely with upstream food manufacturing companies or farms, those retail giants are now able to offer exclusive products and even create their own private brands, shifting market power from suppliers to their own hands.¹⁴⁴

¹⁴² FAO, *The Future of Food and Agriculture: Trends and Challenges*.

¹⁴³ Nielsen, “The Future of Grocery.”

¹⁴⁴ Jane Drake-Brockman and Fan Ying, “China Structural Reform in the Retail Services Sector” (APEC-PSU, June 2017), <http://publications.apec.org/Publications/2017/06/China-Structural-Reform-in-the-Retail-Services-Sector>.

Specialization is another trend. Focusing on one specific category of products gives retailers or wholesalers a unique value proposition in the competitive market. In developed economies and many developing economies, where the middle class is quickly expanding, customers increasingly require products, especially food products, to be safer, more natural, and of higher quality. One example is the demand for natural, organic, and gluten-free food. As customers are willing to make effort doing homework before making a purchase, they also expect shops and sellers know their products and provide professional advice. This change at the retail end requires food distributors along the chain to change their strategies accordingly to differentiate themselves and stand out.

2) E-commerce Presents Both Challenges and Opportunities

E-commerce is now a global phenomenon. According to one estimate by eMarketer, E-commerce accounted for around 10% of global sales, and 15% of the sales in Asia and the Pacific region.¹⁴⁵ It allows consumers to browse, compare, and order products online, and directly get in touch with producers and sellers. This implies both challenges and opportunities for distribution services. Various e-commerce models such as Business to Business (B2B), Business to Customers (B2C), and Business to Business to Customers (B2B2C) enable buyers and manufacturers to find each other through easy and fast communication, with low human and monetary resources, cutting out traditional middlemen entirely. Online wholesale marketplaces, for instance, allow retailers to purchase products from a variety of brands across the world, bypassing wholesalers. Other shopping websites such as Taobao, Ebay and Amazon provide platforms for global manufacturers to sell online, and ship directly from factory or their regional stores to consumers, thanks to the increasingly efficient logistic and transport infrastructure.

This new trend drives distributors – both wholesalers and retailers – to adapt themselves to the new business model by either developing their own e-commerce strategy or cementing existing advantages such as close relationship with manufacturers, streamlined operations, rich market experience, and other value added services. Many large retailers such as Walmart now have opened their own websites, while also use e-commerce platforms set by Internet companies such as Amazon, Taobao and Ebay, among others.

E-commerce also brings new competitors into the distribution industry. Internet companies now are not content with being just platform providers but wish to take a larger bite of the retail market by setting up their own fulfillment centers and logistic systems and selling products directly. Some of the examples are Amazon, Taobao, Tmall. Such competition from e-commerce giants provides more options for customers but at the same time, put pressure to traditional distributors to improve the quality of their services in order to meet customers' growing expectations of their customers.

4.4 Challenges for MSMEs Accessing to Distribution Services

Though an efficient distribution network helps to scale businesses and expands any product's geographical presence, small farms and food manufacturers usually find themselves

¹⁴⁵ Corey McNair, "Worldwide Retail and Ecommerce Sales: EMarketer's Updated Forecast and New Mcommerce Estimates for 2016 - 2021" (eMarketer, July 18, 2017), <https://www.emarketer.com/Report/Worldwide-Retail-Ecommerce-Sales-eMarketers-Updated-Forecast-New-Mcommerce-Estimates-20162021/2002182>.

disadvantaged and squeezed when working with large distributors, limiting their growth opportunities. Some of the reasons are listed below:

1) Lack of solid business plan and distribution knowledge

Small farms and food companies usually neither have many dedicated staff to deal with distribution and marketing issues nor have a long-term business plan or a distribution strategy. Many SMEs start with self-distribution, and when transiting to third party distribution, profit margins are greatly squeezed due to the fact that distributor's margins are not factored into the product price in the first place.¹⁴⁶ As a result, SMEs sometimes struggle to employ distribution services due to their lack of business experience and distribution knowledge.

2) Limited production capacity, quality control and financial strength

Distributors make profit by buying products in large quantities and low price. As a result, limited production capacity becomes another constraint when SMEs are not able to meet distributors' need, as it is expensive for distributors to serve companies that produce in small scale. At the same time, small farmers may face difficulties to meet homogeneous quality required by distributors due to poor quality control. Moreover, compared to large companies, SMEs do not have sufficient budgets and resources to spend on marketing and to fully take advantage of the value added services provided by distributors such as arranging free samples and negotiating for better shelf display. This makes SMEs less attractive and gives them no bargaining leverage when negotiating with large distributors.

3) Disconnected areas and inadequate infrastructure

Farms and food companies located in disconnected and remote areas usually find it hard to access to distribution services. It takes distributors extra time and resources to send sales representatives, arrange transportations, and manage warehouses in areas where basic infrastructures are missing, which makes doing business with those SMEs unprofitable.

4.5 Regulatory Barriers in Distribution Services

Removing restrictions on trade in the distribution services sector allows foreign and domestic services providers to compete in a fair and healthy environment. Competition benefits local consumers as foreign distributors may bring more varieties of food, lower prices, better services, and new retail formats or innovations.¹⁴⁷ Figure 4.4 shows the STRI scores on distribution services in some APEC economies. Data shows that restrictions on foreign entry, barriers to competition and regulatory transparency are the major constraints affecting trade in distribution services.

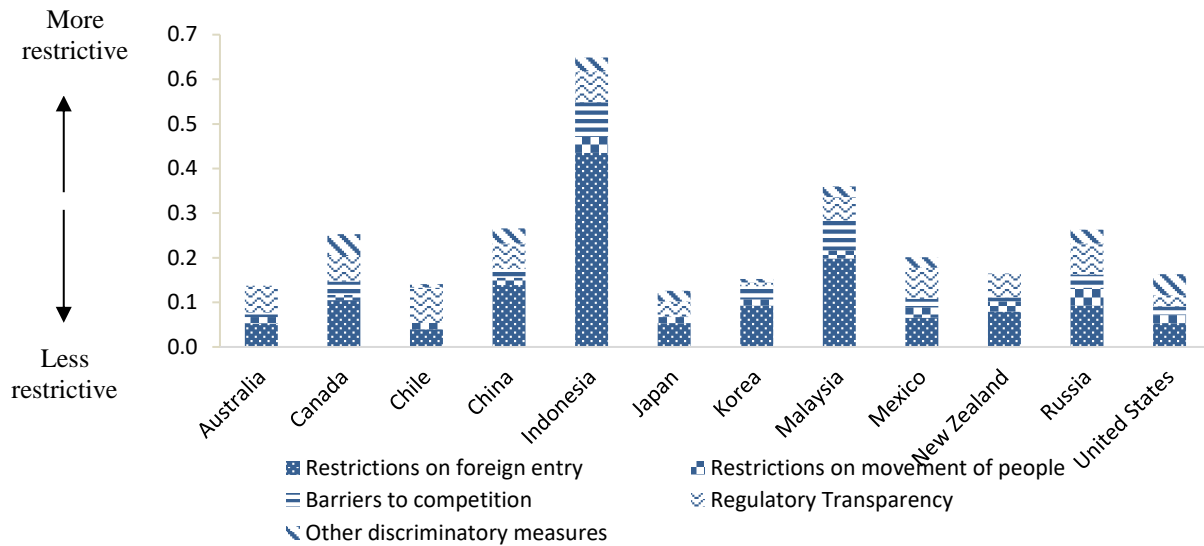
Restrictions on market entry come in various forms, including requirements on foreign ownership, licenses and type of products sold, among others. Data on the OECD STRI regulatory database, which includes information on 12 APEC economies, shows only two

¹⁴⁶ Pratt Center for Community Development, "Distribution Challenges and Opportunities for NYC's Small, Specialty Food & Beverage Manufacturers."

¹⁴⁷ Ying Fan, "China's Liberalization of Trade in Distribution Services" (Regulatory Reforms and Liberalization in Services: Examining Impacts on Inclusive and Sustainable Development, Bali, Indonesia: ADBI and UNCESCAP-ARTNeT, 2010), https://artnet.unescap.org/tid/artnet/mtg/reformservice_bp10.pdf.

economies (Indonesia and Malaysia) has restrictions on the maximum foreign equity share allowed in the distribution sector. Indonesia does not allow foreign investment in the retailing sector, while 67% maximum foreign equity share for the wholesale sector as of 2017. (increase from 33% in 2015). Malaysia has no maximum on foreign equity share for wholesale sector, while keeps a 70% cap for retail sector.

Figure 4.4: STRI Scores on Distribution Services, APEC Economies, 2018



Source: OECD, 2019¹⁴⁸

Licenses to enter the market or sell specific products are another type of regulatory barriers. As of 2017, nine out of 12 APEC economies requires a licence or authorisation to enter the distribution market. These economies (among the 12 in the OECD STRI; Japan, Korea, Indonesia) stipulated that licenses for certain products are subject to quotas or economic needs test. Three economies (China, Canada, Indonesia) requires that distribution of certain products such as alcohol, in wholesale or retail level, was only allowed through statutory monopolies.

Many other sector specific regulations could also impede the development and fair competition of the market. Examples are restrictions on the location and size of stores of new market entrants to protect existing local businesses, and limitations on business operating hours. Such regulations might be in place due to concerns about urban planning, worker rights and etc., but could possibly distort competition and cause inconvenience.¹⁴⁹

Price control is another common policy instrument used by governments in the distribution sector. Regulations related to price include restrictions on special sales or promotions, and fixed price on certain products. Though the motivation behind is to avoid vicious competition and maintain market stability, such regulations could discourage efficiency, protect inefficient players, and distort the market mechanism of “survival of the fittest.”¹⁵⁰ Fixed prices, in particular, could also discourage firms to produce certain products, affecting consequently their distribution to wholesalers and retailers.

¹⁴⁸ OECD, “Services Trade Restrictiveness Index Regulatory Database.”

¹⁴⁹ UNCTAD, “Enforcement of Competition Policy in the Retail Sector: Competition Issues in the Food Retail Chain” (Fifteenth Session Intergovernmental Group of Experts on Competition Law and Policy, Geneva: UNCTAD, 2016).

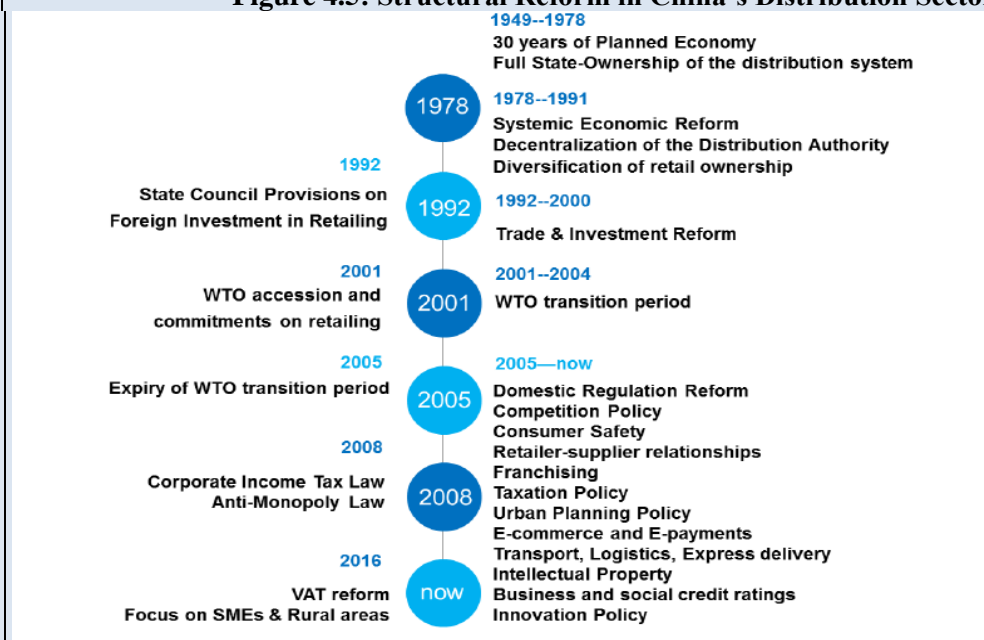
¹⁵⁰ UNCTAD.

Box 7: China’s Liberalization of The Distribution Sector

China has made an example of regulatory liberalization of the distribution sector. The distribution sector, used to be one of the most restricted and centrally controlled sectors in China, has witnessed a gradual liberalization and “opening up” of both wholesale and retail services, in particular since China’s accession to WTO. Regulatory reforms were phased in and made through a series of policies at both central and local levels (as shown in Figure 4.5), including removal of limitations on foreign investment, geographical locations, and the number and size of stores; ease on the entry of foreign retailers and associated products; establishment of regulations on franchise management, and relationships between retailers and suppliers; regulating promotional activities; clarifying distributors’ responsibilities in ensuring food safety and etc.

The reforms have achieved substantial progress and China’s distribution market is now the most dynamic in the world. It is expected to surpass the United States to be the world’s largest retail market.¹⁵¹ According to the National Bureau of Statistics of China, the total number of wholesalers and retailers increased from 100, 935 in 2008 to 200,170 in 2017. The actual use of FDI in the distribution sector tripled from USD4.4 billion in 2008 (4.8% of the total FDI into China) to USD11.5 billion in 2017 (8.8% of the total FDI).¹⁵²

Figure 4.5: Structural Reform in China’s Distribution Sector



Source: Drake-Brokman & Fan, 2017¹⁵³

4.6 Policy Implications

1) Enhancing infrastructure and connectivity

Like many other services, distribution services rely on convenient transportation and reliable telecommunication and Internet connectivity to outreach to both upstream and downstream

¹⁵¹ Daniel Shane, “China Will Overtake the US as the World’s Biggest Retail Market This Year” (Atlanta: CNN, January 23, 2019), <https://www.cnn.com/2019/01/23/business/china-retail-sales-us/index.html>.

¹⁵² National Bureau of Statistics of China, “国家数据 - National Data,” accessed July 20, 2018, <http://data.stats.gov.cn/easyquery.htm?cn=C01>.

¹⁵³ Drake-Brockman and Ying, “China Structural Reform in the Retail Services Sector.”

clients and expand service coverage. Improvement in basic infrastructure, in developing economies especially, allows food distributors services to be more accessible and affordable.

2) Developing an enabling regulatory framework

The global network of distribution services demands global cooperation on trade facilitation and removing restrictions on services trade. Likewise, an enabling domestic regulatory framework can promote competition and increase efficiency in the distribution industry.

3) Capacity Building and Support for SMEs Accessing to Distribution Services

Governments and business associations could support SMEs by providing business guidance and consulting services, assisting them in developing short-term and long-term business plans and distribution strategies.

4) Improving penetration and expansion of food distribution in rural and underdeveloped areas

Supporting outlet expansion and various distribution channels in the rural areas helps to meet the needs of an untapped market with huge potential. Establishing more supporting policies for distributors in places where retail chains are insufficient or lagged behind is one way governments can improve food security and availability in the area. Such policies could include tax incentives for distributors or establishing shopping centers or commercial areas in suburbs to attract crowds and businesses.

CHAPTER 5: ROLE OF ICT IN FOOD VALUE CHAINS

5.1 Introduction

The Food and Agriculture Organization (FAO) estimated that the global population would reach 9.1 billion by 2050. In the past, humanity had managed to meet the growing demand presented by population growth through several innovative mechanisms. For example, in the 19th century, growth in food supply was driven mainly by significant acreage growth and farm mechanization which collectively enable farmers to access greater plot of land with reduced labour force. In the 20th century, the green revolution led to cereal crops being transplanted in ‘new’ areas (e.g. wheat into Asia and Mexico). Over the past few decades, significant progress in seed genetics made possible the more than doubling of yields.

Using different assumptions such as the growth in per capita protein consumption, it was estimated that global food production would need to increase by about 70 percent to feed the growing population.¹⁵⁴ While some of the mechanisms mentioned above would still play important roles in meeting these needs, there are constraints which would limit their contribution. For instance, the locational differences between population and farming basins coupled with its physical landmass often mean that economies have to look beyond their borders to grow food. However, geopolitical conditions and increasing scarcity value associated with food may make future acquisitions of overseas farmlands challenging. Also related is the fact that with the exception of Sub-Saharan Africa, there are arguably no or little virgin lands which can contribute to significant increase in farmland acreage. Indeed, FAO estimated only a modest 4 percent increase in available acreage over the next 35 years or so.¹⁵⁵ Essentially, what we have is a zero-sum situation whereby an increase in farmland acreage for one is a decrease for another. Compounding this situation is the degradation of some farmlands which are contributed by various activities such as inadequate fallow periods, improper crop rotation and unbalanced fertilizer use. Hence, it would not be surprising to find the available acreage shrinking instead of growing over time.

In a world of falling farmland acreage per capita as well as falling productivity brought about by climate change, it appears that majority of the 70 percent growth in food production would have to come from yield increase. Advances in technology including precision agriculture could be a key enabler of the next chapter of food supply growth.

5.2 Precision Agriculture: What and How?

Precision agriculture is the use of a set of ICT/data-driven technologies to manage and optimize the production of crops. Among its benefits are efficient use of resources such as chemicals and fertilizers; improved quality and quantity of produce; minimization of environmental footprint; and mitigation of risks. Recognizing the potentials of agricultural technologies (agtech), AgFunder indicated in its AgTech Investing Report that global venture capital (VC) investments in these technologies have grown significantly from approximately USD 0.5

¹⁵⁴ FAO, “How to Feed the World in 2050” (FAO, October 12, 2009),

http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf.

¹⁵⁵ Goldman Sachs, “Profiles in Innovation: Precision Farming - Creating Malthus with Digital Agriculture” (Goldman Sachs, July 13, 2016), https://docdrop.org/static/drop-pdf/GSR_agriculture-N1sH6.pdf.

billion in 2012 to USD4.6 billion in 2015.¹⁵⁶ Goldman Sachs (2016) estimated that the total addressable market from their adoption ranges between USD15 billion and USD65 billion and can improve yield by between 4 and 18 percent depending on technology (Table 5.1). Several of these technologies are discussed in greater details below:

Table 5.1: Potential Addressable Market, Value-Add and Yield Improvement of Various AgTech

Technology	Potential addressable market (USD billion)	Potential value-add (USD billion)	Potential yield improvement (%)
Precision fertilizer	65	200	18
Precision planting	45	145	13
Compaction reduction via smaller tractors	45	145	13
Precision irrigation	35	115	10
Precision spraying	15	50	4
Field monitoring, data management and others	35	125	NA

Source: Goldman Sachs (2016)¹⁵⁷

1) Precision fertilizer

Fertilizers are usually applied uniformly across the field without due consideration to whether certain parts of the field have low or high degree of nitrogen run-off. As a result, farmers tend to over-fertilize to compensate for the possibility of nitrogen run-off. Several technologies have been introduced to reduce fertilizer consumption. One pertains to using an initial soil sample, weather inputs and geology to determine where the fertilizer would flow once applied. Such analysis allows farmers to increase the application rates of the fertilizers in parts of the field where nitrogen run-off occurs and at the same time, reduce application rates in the rest of the field. It was indicated that the application of this technology allows fertilizer consumption to be reduced while increasing the yield of farmers. Yet another technology pertains to mounting a sensor which is able to process ground fertilizer levels at the front of the tractor and based on the optimization algorithm, signals the fertilizer nozzles at the rear of the tractor to release the right quantity of fertilizer.

2) Precision planting

Similar to fertilizers, seeds are usually applied uniformly across the field. Differences in factors such as soil conditions, however, means that some parts of the field are more fertile than others. The soil make-up may also be more beneficial to one type of seeds over another. Precision planting technologies enable farmers to customize seeds that are planted in different parts of the field and therefore improve productivity. Using data on soil quality, water access and prior fungal history, the technologies allow for determination of the parts of the field where more seeds can be planted in contrast to other parts (which are arguably less arable), as well as the

¹⁵⁶ Louisa Burwood-Taylor et al., "Agtech Investing Report 2015," *AgFunder*, 2015, <https://research01.agfunder.com/2015/AgFunder-AgTech-Investing-Report-2015.pdf>.

¹⁵⁷ Goldman Sachs, "Profiles in Innovation: Precision Farming - Creating Malthus with Digital Agriculture."

right type of seed to be planted in specific parts of the field. Harvest data from different parts of the field are then integrated and analyzed to enhance the technologies.

3) Compaction reduction via small tractors

Size of tractors have increased over time to enable larger plots of land to be harvested with minimal labor. Although agriculture activities have been scaled up by these tractors, the weight of such heavy equipment running over soil have had the unintended consequences of damaging the soil structure and the consequent reduction in yield. It was estimated that reduction in soil compaction can lead to between 10 to 15 percent yield improvements. In response, autonomous driving technology with applications in agriculture equipment is currently being developed. It is thus possible for farmers to use smaller equipment but with the same effectiveness and scale as the heavy and large equipment. As an illustration, one farmer can operate a fleet of smaller tractors (e.g. under 100 horsepower) instead of 1-2 larger tractors (e.g. 600 horsepower) for the same job. More importantly, the use of smaller equipment reduces the pressure on the soil and the negative implications on yield. In the interim, there has been increased adoption of low inflation pressure tires, which is also intended to reduce the pressure on soil.

4) Precision spraying

The idea behind precision spraying is similar to that of precision fertilizer and planting. Uniform/blanket application of pesticide has the tendency to pollute the surrounding land and also waste product. By relying on regular data feeds from field monitoring systems, targeted pesticide application allows farmers to focus on specific areas that would benefit from in-season fungicide or other treatments. Although there are variations in terms of cost savings and yield improvements, they range between 4 and 60 percent for the former and about 4 percent for the latter.

5) Precision irrigation

Precision irrigation makes use of sensors to determine and apply the optimal amount of water to specific areas of the field which generates the highest return from incremental irrigation. It was indicated that the technology can increase yield by at least 10 percent while reducing water consumption by up to 50 percent.

6) Field monitoring and data management

Field monitoring is composed collectively of a group of technologies including satellites, drones, weather tracking algorithms and remote soil sensors. It is essentially an important enabling technology for most of the precision technologies indicated above. By monitoring and analyzing the fields as well as aggregating the data collected in a single data management platform/dashboard, the technology allows its users to spot issues early and respond accordingly such as determining the appropriate level of fertilizer, pesticide and water to name a few.

Moreover, in a case study conducted by USITC, it was shared that some service providers offer subscription-based packages which made possible interactive cycles of data collection and dissemination between farmers, equipment, farm product firms, local service providers as well as others in the agricultural community using wireless connections and mobile applications,

hence allowing different stakeholders to benefit from these data.¹⁵⁸ Indeed, besides informing direct users, data collected on these platforms can also be used to further enhance related technologies. For instance, it has been indicated that biotech firms viewed the data collected by platforms provided by Monsanto, John Deere and DuPont Pioneer as important to enhance their genetically modified crops.¹⁵⁹

Box 8: Use of Monitoring Technology in Animal Rearing

While the technologies mentioned above are presented from the agricultural perspective (i.e. how they can support agricultural activities), similar monitoring technologies can also be employed when rearing animals. Listed here are some examples.

Animal trackers in the form of smart collars are used to monitor cows in Scotland. The smart collars, which is similar to the wearable devices designed to track human health and fitness, monitors fertility by tracking activity (e.g. cows move more when they are fertile) and alert farmers by sending a message to his/her laptop or smartphone when a cow is ready to mate. The collars can also be used to detect early signs of illness. This is done by monitoring the average time each cow spends eating and ruminating, where warnings are sent to the farmer if either declines. Algorithms are currently being developed to analyze other data collected by the collars.

A camera system to monitor broiler chickens in sheds have been developed by Belgian researchers to track the movements of thousands of chickens individually so as to spot problems quickly. It was shared that analyzing their behavior can potentially allow over 90 percent of issues to be observed early. The researchers are also able to flag respiratory problems in pigs through the use of a cough monitor. The employment of microphone which is positioned above the animals in their pen can give a warning 12 days earlier than farmers or vets would normally be able to detect a problem. Another technology in development is downsizing a stress monitor designed for human so that they can be attached to a cow's ear tag. The monitor records about 200 physiological measurements a second and can alert farmers through a smartphone when there are problems.

Source: King, 2017¹⁶⁰

5.3 Using ICT Services to Reduce Food Loss and Waste

Despite the limited supply of food on one hand and increasing demand for food on the other hand, it is ironic that approximately one-third of food produced for human consumption (about 1.3 billion tons annually) is lost or wasted globally and along with it, the amount of resources which have been used in their production.¹⁶¹ Food is lost or wasted throughout the entire value chain from production all the way to final household consumption.¹⁶² The causes of these losses

¹⁵⁸ United States International Trade Commission, "Digital Trade in the U.S. and Global Economies, Part 2" (United States International Trade Commission, August 2014), <https://www.usitc.gov/publications/332/pub4485.pdf>.

¹⁵⁹ OECD, *Data-Driven Innovation: Big Data for Growth and Well-Being* (Paris: OECD, 2015), <https://doi.org/10.1787/9789264229358-en>.

¹⁶⁰ Anthony King, "The Future of Agriculture," *Nature*, April 26, 2017, <https://www.nature.com/articles/544S21a.pdf>.

¹⁶¹ Gustavsson et al., *Global Food Losses and Food Waste*.

¹⁶² Food loss refers to the decrease in edible food mass throughout part of the supply chain that specifically leads to edible food for human consumption. Food loss at the end of the food value chain is referred to as "food waste," as in Parfitt, Barthel, and Macnaughton, "Food Waste within Food Supply Chains."

or wastage vary. Besides those mentioned in Table 5.2, they can also include financial, managerial and technical limitations in harvesting techniques, absence of storage and cooling difficulties in challenging climatic conditions, infrastructure, packaging and marketing systems.

Table 5.2: Causes of Losses and Wastage at Various Parts of Value Chain

Part of value-chain	Vegetable commodities and products	Animal commodities and products
Production	Mechanical damage and/or spillage during harvest operation	Animal death during breeding, discards during fishing, and decreased milk production
Post-harvest handling and storage	Spillage and degradation in the process of handling, storage and transportation between farm and distribution	Death during transport to slaughter and condemnation at slaughterhouse, spillage and degradation during icing, packaging, storage and transportation after landing, and spillage and degradation during transportation between farm and distribution
Processing	Spillage and degradation during industrial/domestic processing	Trimming spillage during slaughtering and additional industrial processing, industrial processing including canning and smoking, and spillage during industrial milk treatment and processing
Distribution	Losses and wastage in the market system	Losses and wastage in the market system
Consumption	Losses and wastage during consumption	Losses and wastage during consumption

Source: Adapted from FAO, 2011¹⁶³

While it is challenging to avoid these losses and wastage altogether, some can be avoided or minimized. Considering that a billion people continue to go hungry, enhancing food security is therefore not only about boosting agricultural yield, but also about promoting reduction in food loss and waste. There are many solutions including those related to ICT that economies can consider introducing/enhancing to reduce food loss and waste. Several are discussed in greater details below:

Providing extension services/programmes

Extension services/programmes may be designed to pass information about new technologies including newly developed plant varieties as well as new practices to farmers and build their capacities. While programmes vary between economies, they usually involve different types of dissemination mechanisms such as through field schools or employment of extension agents. The use of ICT to deliver online courses is yet another mechanism through which extension programmes can be disseminated.

¹⁶³ Gustavsson et al., *Global Food Losses and Food Waste*.

Connecting sellers (including farmers) to buyers

Seasonality often leads to unsaleable gluts. Compounding the matter is the fact that farmers sometimes tend to plan production on the safe side to anticipate against unpredictable bad weather or pest attacks. Browsing through news articles, there is no lack of those documenting fresh produce being discarded simply because there are no demand for them from the usual distribution channels. The advent of internet and specifically e-commerce has therefore been a welcome respite to sellers including farmers as it opens a new and alternative channel for them to market their produce (Box 9). More importantly, e-commerce allows them to sell to a bigger market beyond their economy.

As the examples in Box 9 show, e-commerce is not a homogeneous channel for selling products. One can begin by posting products in Facebook, Instagram or other similar social networking sites. The primary advantage of such sites is that sellers can test the waters of selling without the rigid conditions usually put in place by platform-based e-commerce sites. Once sellers are ready, they may wish to join these platforms because despite conditions such as the need to use specific platform-accredited logistics providers and strict delivery timeline (e.g. products have to be shipped out within 24 hours from receipt of order), popular platforms have significant traffic, provide many supporting services to ensure seamless process from payment to delivery and generally have information on cross-border issues (e.g. tariffs, standards, prohibited/restricted items, etc.).

Box 9: E-commerce and Fresh Produce

In 2015, one farm coordinator of a village in Papua New Guinea used his smartphone to post about the challenges of selling onions from rural locations in his Facebook page. Specifically his village is one hour's drive on a rough dirt road to Kundiawa, the nearest town. Larger markets are even further away. He posted about the 6 tonnes of onions which was ready for the market then but without a buyer. The post was picked up by a national newspaper journalist who wrote about the situation and indicated the mobile number of the farm coordinator. Within a week, a buyer found him and purchased all 6 tonnes at a good price. The onions are sent to Alotau, which is all the way across the economy.

In China, e-commerce firms selling fresh produce can generally be grouped into 4 broad categories. The first category is composed of those termed as comprehensive e-commerce (e.g. Alibaba's Tmall and Tencent's JD) which sells other items beside fresh produce. The second category is made up of firms such as Benlai, Fruitday and Missfresh which only sell fresh produce. The third category is composed of fresh specialty online-to-offline (O2O) stores (e.g. Pagoda and Xianfeng) that have physical stores close to residential areas and can deliver produce to their customer within short period of time. The last category is termed as new retail in that they sell produce like regular supermarket but are built to support online activities (e.g. Hema, 7Fresh and Super Species).

Source: APEC-PSU, 2016;¹⁶⁴ FreshFruitPortal, 2018¹⁶⁵

¹⁶⁴ Bernard Hoekman, Robert Schuman, and Gloria O. Pasadilla, "2016 APEC Economic Policy Report," November 2016, <http://publications.apec.org/Publications/2016/11/2016-APEC-Economic-Policy-Report>.

¹⁶⁵ FreshFruitPortal, "E-Retail, Not e-Commerce: China's Fast-Changing Online Market for Fresh Fruit," May 2, 2018, <https://www.freshfruitportal.com/news/2018/05/02/e-retail-not-e-commerce-chinas-fast-changing-online-market-for-fresh-fruit/>.

ICT has also been used by social enterprise and non-profit organizations to minimize food waste. EIU (2018) noted that there are many apps whose purpose is to connect food establishments/buyers including hotels and supermarkets with NGOs which distribute food to the less well-off, and also to potential consumers. For instance, No Food Waste in India made it possible for organizations with large amount of waste to notify groups who would collect and distribute the food to slums, orphanages and elderly. Chowberry is an app which enables users to find products which are close to expiration and hence offered at discounts at Nigerian supermarkets. OLIO allows neighbours and local businesses in England to connect to one another and share surplus food.

Improved post-harvest handling and storage (including cold-chain logistics and blockchain)

Significant quantity of produce are lost during post-harvest handling, storage and transportation between farms and factories as well as distributors. While one primary reason for the losses and wastage is the lack of proper storage and cold-chain logistics, another reason is the long time taken to clear customs. Here, technology such as global data standards (GDS), single windows systems (SWS) and blockchain can be used to expedite clearance and therefore minimize losses.

By allocating common identifiers to goods, transport assets, locations, etc., GDS enables better tracking and sharing of information between relevant stakeholders and therefore, facilitates greater visibility along the entire supply chains. For example, it can assist with monitoring of freight, transport assets, storage and delivery locations as well as with event reporting such as traffic congestion and port delays. Specifically in the public sector, GDS can become an intrinsic tool for assurance and compliance verification by various agencies such as customs and food safety inspection agencies. In several pilots on GDS application conducted by PSU in 2017, the use of GDS (in the form of barcode data) to replace missing/damaged shipping marks on boxes of beef allowed the products to be cleared when it would normally have been rejected. Moreover, GDS allowed port authority to automatically notify approved wharf cartage operator of container availability, which expedited port clearance. Yet in another pilot involving durian, the full information and documentation visibility made possible by GDS led to shipment detention being reduced to zero percent.

Customs clearance processes often require traders to submit several documents to different relevant agencies. The concept of SWS is the provision of a single-entry/submission point so as to facilitate compliance by traders in an efficient manner. Moreover, SWS would technically allow for better coordination and connection among various agencies and hence ensure that customs clearance would be more seamless. Indeed, OECD estimated that automating trade and customs processes would reduce trade costs by between 1.5 and 2.4 percent depending on the level of development of economies and implementation scenario. World Bank noted that automation of customs processes can save as much as USD115 per container.¹⁶⁶

A blockchain is a decentralized, distributed ledger of transactions whereby the transactions are stored in a permanent and close to unalterable way using cryptographic techniques. Complemented with smart contracts (computer programmes that self-execute when certain conditions are met), blockchain technology could facilitate the administration of border

¹⁶⁶ Lauro Vives, Akhmad Bayhaqi, and Satvinderjit Kaur Singh, “Study on Single Window Systems’ International Interoperability: Key Issues for Its Implementation” (APEC-PSU, August 2018), <https://www.apec.org/Publications/2018/08/Study-on-Single-Window-Systems-International-Interoperability>.

procedures and single windows systems in a potentially more efficient, transparent and secure way, hence reducing trade costs. Specifically for the food industry, WTO indicated that major food and retail firms are also using blockchain both to improve the transparency of the food supply chain and to track affected products rapidly so as to restore trust in food quality.¹⁶⁷

Smart manufacturing/processing

Another major source of losses and wastage along the value chain is during the manufacturing/processing stage. Malfunctioning of machinery, for example, can lead to inputs being turned into products that cannot be sold and hence have to be discarded. Unexpected breakdowns and factory downtime may lead to spoilage of inputs that have been ordered and delivered in advance. These events could have been minimized via the adoption of a set of systems and tools commonly termed as “Industry 4.0” (Figure 5.1). For instance, Internet of Things (IoT) would allow various machines, devices and sensors to communicate with one another, hence allowing breakdowns to be detected, reported and rectified earlier. The significant amount of data collected technically also means that operators can analyze, identify and improve on inefficient steps. Furthermore, IoT can also be used to monitor inventories and for orders to be placed only when the current level is low.

Figure 5.1: Various Tools under "Industry 4.0"



¹Maintenance, repair, and operations.

Source: McKinsey, 2015¹⁶⁸

¹⁶⁷ Emmanuelle Ganne, *Can Blockchain Revolutionize International Trade?* (Geneva: WTO, 2018), https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf.

¹⁶⁸ Cornelius Baur and Dominik Wee, “Manufacturing’s Next Act,” McKinsey, June 2015, <https://www.mckinsey.com/business-functions/operations/our-insights/manufacturings-next-act>.

5.4 Challenges to Adopt ICT Services in Food Value Chains

1) Limited adoption rates

Despite the advantages provided by these ICT-related technologies and services in boosting yield, as well as in minimizing losses and wastage, adoption rates may be low for various reasons. Specifically on precision technologies, high upfront capital cost may impede adoption especially if the cost-benefit calculation does not make sense. For example, it has been indicated that the cost of drone fleet ownership may not be economical. Many of these technologies are still work in progress, which could also contribute to the relatively higher adoption cost compared to more mainstream technologies.

A paper by the McKinsey Global Institute (2015)¹⁶⁹ which covers broad range of sectors indicated that the US only captured about 18 percent of its digital potential despite its position as one of the most digitized economy. Looking at individual sectors, the study found that sectors such as agriculture & hunting, mining, construction, and entertainment & recreation had relatively low digitization compared to sectors such as ICT, media, and professional services. In addition, it was observed that the gap in adoption and utilization between sectors and firms on the frontier vis-à-vis the rest of the economy appears to have widened in certain areas. Mindset change may be required in order to raise the adoption rates of these technologies.

2) Limited awareness and capacity

Utilization of many ICT-related technologies and services requires users and operators to have certain level of technical know-how. On precision technologies, for instance, users have to be able to fly the drones to have aerial view of their farms and also to deliver inputs such as fertilizers. Specifically on data analytic skills, while not referring solely to agricultural sectors, KPMG (2017)¹⁷⁰ has observed that among some of the main challenges faced by firms in employing greater use of data analytics is the lack of skilled labour, particularly those with sufficient industry experience.

To sell produce via e-commerce, basic computer skills are needed at a minimum to check account, respond to enquiries and verify online orders among other things. On top of that, since buyers cannot touch and examine products physically, the second best options of relying on good pictures, videos and descriptions in decision-making process becomes important. Essentially, this means that sellers need to have the skills to write good descriptions and take good pictures among others.

For sellers intending to join marketplace platforms, conforming to its set terms and conditions may be challenging. Conditions can include requirements to use specific platform-accredited logistics providers; strict delivery timeline like shipping the product out within 24 hours from receipt of the customer order; and predetermined returns policy, often longer and more generous than the seller's own. Adhering to platforms' delivery policy entails that the SMEs

¹⁶⁹ James Manyika et al., "Digital America: A Tale of the Haves and Have-Mores," December 2015, https://www.mckinsey.com/~media/McKinsey/Industries/High%20Tech/Our%20Insights/Digital%20America%20A%20tale%20of%20the%20haves%20and%20have%20mores/MGI%20Digital%20America_Executive%20Summary_December%202015.ashx.

¹⁷⁰ KPMG, "Understanding the Data and Analytics Landscape in Singapore" (KPMG, August 16, 2017), <https://www.cccs.gov.sg/-/media/custom/ccs/files/media-and-publications/publications/occasional-paper/understanding-the-data-and-analytics-landscape-in-singapore--kpmg-16-aug-2017final.pdf>.

should have grown sufficiently able to supply products with a minimum scale, and that would may mean more financial capital, as well as investment in systems and technology to automate orders, keep track of inventories across platforms and respond efficiently to multiple customer enquiries. SMEs may not have the resources and ability to efficiently use these technologies, as well as financial resources to expand production.

3) State of infrastructure

Many of these technologies and services entail seamless communications between different parties including machines. Therefore, a certain degree of reliability and stability in the telecommunications infrastructure is a necessity. In the APEC Economic Policy Report 2018 on Structural Reform and Infrastructure, an estimate by the Global Infrastructure Hub indicated that the APEC region's infrastructure needs will increase to USD 1.75 trillion per year in 2020–2025, with high needs in several sectors such as transport, telecommunications and energy.

Seamless e-commerce experience also necessitates that different stakeholders in the e-commerce work with minimal friction. Challenges in any components will impact e-commerce and hence the market opportunities for MSMEs including food producers. In other words, ICT technology needs to be complemented with other services, including those indicated in other chapters, for its benefits to be optimized.

As an illustration, provision of payment services usually necessitates correspondent banking relationships or agreement between various stakeholders including banks and payment service providers. The presence of laws such as those pertaining to anti-money laundering and counter-terrorism financing have made discussions tedious. In some cases, cost-benefit analysis may not work out, hence limiting the available payment options and consequently, the sellers' possibilities to sell to markets where certain payment options are preferred (e.g. PayPal). MSMEs also find certain process and requirements laborious and costly. Examples include different onboarding process set by each bank, the need to provide reserves in case there are chargebacks (i.e. the amount a credit card merchant pays to the buyer after he/she successfully disputes a transaction on his or her statement), and inability to hedge foreign exchange receipts because exchange rates are dictated by payment service providers.

One appeal of e-commerce is the convenience of having products delivered to their location of choice. MSMEs' bottom line and competitiveness would be hurt by the high cost of logistics and delays in delivery, which may be contributed by low sales and shipment volume between locations, low availability of competent logistics providers in terms of security and safety measures put in place, and low frequency of cargo flights.

4) Limited supportive regulations

Finding out the various requirements on licenses and permits and dealing with various rules and regulations to set up and run businesses across economies may be challenging for food producers with limited financial and human resources. Fulfilling these regulations add another layer of challenges. For example, regulations that require that listed sellers on domestic-based e-commerce platforms be registered domestically effectively prevent foreign MSMEs from selling through that platform. Other regulations that vary across economies add to the difficulties. For example, the use of e-signatures (and by extension e-contracts) are regulated to varying extent by individual APEC economies, which may make online contract fulfillment more burdensome and costly. In fact, e-signatures are recognized for general business use in

the APEC region and are admissible in court, but some APEC economies have a tiered e-signature legal system in which only qualified electronic signatures (QES) or locally name equivalents are accepted for specific types of transaction (Table 5.3). QES has special legal status in terms of authenticity and economies imposing QES standards often face challenges promoting electronic business transactions across borders.¹⁷¹

Table 5.3: E-signature Legal Model in APEC Economies

Economy	E-signature legal model
Australia	Open
Brunei Darussalam	Tiered
Canada	Open
Chile	Tiered
China	Open
Hong Kong, China	Tiered
Indonesia	Tiered
Japan	Tiered
Korea	Tiered
Malaysia	Tiered
Mexico	Tiered
New Zealand	Open
Papua New Guinea	N.A
Peru	Tiered
The Philippines	Tiered
Russia	Tiered
Singapore	Tiered
Chinese Taipei	Tiered
Thailand	Tiered
The United States	Open
Viet Nam	Tiered

Source: DocuSign, 2019¹⁷²

To bring foreign products inside an economy requires product certification and registration (e.g. for standards/health reasons or for tax purposes) which may be burdensome for individual MSMEs to comply. Compounding the challenge is the inconsistency of applications of rules and regulations across economies, and even in the same economy across different officials from the same institution. MSMEs may find their expected margin disappear as the cost of complying with these regulations increases.

To expedite release of products from customs, logistics providers or platform operators begin self-regulating through different ways such as by limiting the number of products per container, as well as employing sophisticated x-ray machines or canine teams to screen packages before shipping them out of their facilities. These increase the cost of e-commerce which tends to be passed on to sellers and buyers. Recognizing these customs challenges from e-commerce, some

¹⁷¹ DocuSign, “eSignature Legality Guide,” DocuSign, July 29, 2015, <https://www.docusign.com/how-it-works/legality/global>.

¹⁷² DocuSign.

economies are experimenting with innovative ways, such as having a special lane specifically for e-commerce. However, the fact that these are on trial means that there are limitations to this type of solutions. For instance, the e-commerce lane may allow only a limited type of products, or the list contains description of products which is not based on the internationally accepted harmonized system of classification. De-minimis value to exempt products from taxes and proposed e-commerce taxes need to be revisited if e-commerce as an important channel to sell produce is to be further promoted.

The importance of data as a new asset class has brought to the fore concerns on how firms use and protect the data that they have. While both customers and firms benefit from targeted marketing and customized product offering in a sense that they are offered products which are more closely aligned with their preferences, the ability of firms to use these personal information has also led to concerns around data privacy. The increasing dependency of firms and the economy collectively on data means that there is an ever-present danger of cyberattacks aimed at exploiting them and causing massive damage to the economy. As much as data is an asset, it has arguably become liability as well.

In response, there have been increasing calls to ensure data protection and security for reasons such as improving privacy of individuals and protecting domestic security. Thrown into the mix are other data-related observations by policymakers, which arguably may not have anything to do with data protection and security in its most basic definition. For example, governments may wish to: 1) have rapid access to data in order to solve past crimes and/or thwart future crimes including terrorist attacks; 2) control huge amount of information which some firms may exploit to become a natural monopoly and potentially exert to gain certain market power; and 3) benefit more from the digital economy in terms of employment, innovation/technology know-how, etc.

Policymakers across the world have put in place or are in the midst of enacting various regulations aimed at data including its protection, privacy/security and access. These regulations usually pertain to the following non-exhaustive areas such as: those defining personal/sensitive data; those regulating data collection, storage, processing and transfer; those requiring firms to undertake certain procedures to ensure data protection and privacy are embedded in their operations (e.g. designating data protection officer) , and to put in place procedures that would be activated in the event of data breach (e.g. informing affected customers about their data being compromised within certain time from discovery). Such regulations may have implications on providers and consequently, users of agriculture precision technologies. For example, data localization requirements entail the setting up of a local data center, but if this is too costly and local firms cannot access overseas providers, this will deprive local users access to certain services and technologies.

Besides being an issue across economies, data flow is also an issue across organizations in the sense that many of them may face challenges accessing data due to non-interoperability and non-portability of data. As such, while the increased volume of agricultural data collected has led to the establishment of start-ups providing novel services,¹⁷³ the long-term

¹⁷³ For example, Dacom Farm Intelligence in the Netherlands provides tailor-made consultancy based on data and sensor technology to farmers across the world (see Richard Kootstra, "Dacom: Agriculture & Big Data," Founded in Groningen, June 7, 2017, <https://www.foundedingroningen.com/news/dacom-agriculture-big-data>). CrowdFarmX in Singapore provides a digital platform that allows farmers to monitor their farms around the world using their smartphones. It also uses blockchain technology to connect farmers directly to the global

viability/sustainability of these firms are very much dependent on whether they can access data collected by other firms in the ecosystem such as those equipping their machines and tools with IoT technologies.¹⁷⁴

5.5 Policy Implications

The previous section has provided a non-exhaustive list of challenges which implicate the adoption of ICT services by various stakeholders in the food value chain. To overcome the limited awareness and adoption rates, governments can provide technology grants and incentives. In government-related services such as customs clearance, governments can take the lead by being a trailblazer in the use of ICT to facilitate processes. Another possibility would be to facilitate their diffusion through information sharing sessions. Specifically on e-commerce, training can be tailored to the needs of the audiences. For example, for firms that are already familiar with e-commerce, training can focus on marketing in specific economies, while for those with no or little knowledge, training can focus on the basics of e-commerce.

On improving the state of infrastructure including telecommunications, public sector investment has certainly contributed significantly to its development and will likely remain so moving forward. However, considering the size of the gaps, private sector investment also need to be mobilized. Doing so may require sound infrastructure governance/institutional arrangements and project prioritization processes among others.

Hard infrastructures such as telecommunications and road networks are important, but regulatory infrastructures are also equally important. Where possible, regulations pertaining to different aspects of the value chain need to be made more transparent and less burdensome. Moreover, regulations need to be responsive to the changing economic landscape, lest they inadvertently act as barriers. The case about use of e-signatures in some economies provides one such example. Data localization requirements is yet another example because they may inadvertently prevent data sets from different economies to be combined and analyzed collectively for more inclusive insights. Last but not least, holistic approaches to regulatory reforms are necessary because as the previous sections have shown, ICT services is only one of the myriad of services needed to ensure that the food value chain functions efficiently.

market (Cheng Wei Aw, “Local Firms Set to Reap Harvests of High-Tech Farming,” *The Straits Times*, January 31, 2019, <https://www.straitstimes.com/business/local-firms-set-to-reap-harvests-of-high-tech-farming>).

¹⁷⁴ OECD, *Data-Driven Innovation*.

CHAPTER 6: FINAL REMARKS

Bringing food from producers to consumers is a complex process - it takes time, requires vast investments and involves different types of services along the value chain, each one of them with their own regulatory challenges.

The importance of services in food-related industries is significant. As mentioned in Chapter 1, the value created by services range from 17% to 59% of the total value added in exports in the food products industry across the APEC region. In addition, a recent study by Cucagna and Goldsmith (2018) covering 454 firms from 25 economies found that those companies in charge of the provision of services such as distribution, retail and other food services add on average USD 107 million in value per firm, contributing to 17.5% of the total economic value added by all firms in the study. Moreover, they have the highest rates of return of investment, at 3.43% per firm.¹⁷⁵ These rates of return are far higher than those rates obtained at other stages of the value chain such as food production and processing, as well as the provision of inputs and equipment.

The improvement of the regulatory environment affecting the provision of services in the food value chain requires a “whole-of-government” approach effort, as the formulation of services-related regulations usually entails the participation of several agencies.

The adoption of international standards and best practices in regulatory issues affecting the food industry and services sectors associated to it can also be beneficial for food value chains. It is important to avoid situations in which compliance costs related to new regulations are too high, affecting negatively the provision of goods and services across the food supply chain. For example, complex procedures to apply for organic certification can make it difficult for SMEs to sell their product with higher value-added.¹⁷⁶

Development strategies need to be in place to upgrade existing or build new infrastructure. The returns from infrastructure investment could be high for agriculture and benefit rural areas significantly. For instance, a study in China found that each yuan invested in roads could increase the agricultural output by 4.91 yuan, and each yuan invested in irrigation projects could increase output by 1.15 yuan.¹⁷⁷ Conversely, the inability to provide proper transport infrastructure could increase the cost of food substantially. A study in Papua New Guinea showed that for every additional hour of being away from accessing transport infrastructure, the trade store price of rice goes up by 3.4%.¹⁷⁸ However, the high cost involved, as well as restrictions to foreign entry and competition, could make it more difficult to channel resources to relevant infrastructure projects. In order to boost infrastructure investment, policymakers need to put in place supporting regulatory frameworks.

¹⁷⁵ Maria Emilia Cucagna and Peter D. Goldsmith, “Value Adding in the Agri-Food Value Chain,” *International Food and Agribusiness Management Review* 21, no. 3 (March 20, 2018): 293–316, <https://doi.org/10.22434/IFAMR2017.0051>.

¹⁷⁶ Laura Gómez Tovar et al., “Certified Organic Agriculture in Mexico: Market Connections and Certification Practices in Large and Small Producers,” *Journal of Rural Studies* 21, no. 4 (October 2005): 461–74, <https://doi.org/10.1016/j.jrurstud.2005.10.002>.

¹⁷⁷ Shenggen Fan, Linxiu Zhang, and Xiaobo Zhang, “Growth and Poverty in Rural China: The Role of Public Investments,” EPTD Discussion Papers (International Food Policy Research Institute (IFPRI), 2000), <https://ideas.repec.org/p/fpr/eptddp/66.html>.

¹⁷⁸ John Gibson and Scott Rozelle, “Poverty and Access to Roads in Papua New Guinea,” *Economic Development and Cultural Change* 52, no. 1 (October 2003): 159–85, <https://doi.org/10.1086/380424>.

Restrictions to foreign entry and competition affect not only big transport and telecommunications infrastructure, but also other important sectors linked to the food value chains. For example, financial services are limited in some APEC economies by barriers affecting the entry of foreign banks, insurance and other local firms. Similarly, distribution services face restrictions on competition by being subject to quotas or monopolies, and to requirements in terms of location and size of stores. Likewise, logistics firms in some APEC economies face restrictions in terms of maximum shares of foreign equity, commercial presence requirements and use of foreign land in activities such as cargo handling, freight forwarding and storage and warehouse.

In general, the use of technology and modern ICT services is becoming a game changer in the food value chain. These tools are modernizing agriculture and food processing (for example, precision techniques, field monitoring, and food selection and handling, among others). They are also improving the provision of other services relevant for the proper functioning of the food value chain. With new technologies and tools such as e-commerce, it is possible to access wider markets. Technologies are also facilitating farmers to access banking and other financial services nowadays, even when no physical bank branches are located in their communities. The utilization of acclimatized warehouses in logistics services extends food life, while the use of RFID technology facilitates tracking and improve transparency, as information regarding food products could be available to all parties involved in the value chain.

Of course, the optimal use of technology is dependent on the availability of supportive regulations. For instance, economies can remove restrictions that only allow locally registered sellers to offer their products in e-commerce platforms. Similarly, financial institutions would not be able to offer their clients new digital applications if regulations establish the need to apply for permits that are troublesome to obtain before the launch of any application. In addition, full interoperability of different ICT systems used in logistics require the development of data sharing standards.

In synthesis, the food value chain faces a broad number of regulatory challenges across all services sectors involved in the process. There is no “one-size-fits-all” solution, as the most urgent necessities that each APEC economy needs to address are different. However, as mentioned earlier, it is important for all APEC economies to take a “whole-of-government” approach, as the solutions require the participation of many sectors and institutions.