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The Cold Chain for Agri-food Products in ASEAN

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Overview

The cold chain system, or low-temperature storage and transportation system, is indispensable for Southeast Asian countries as they mostly have tropical climates. There is an even more pressing need for the cold chain due to the expansion in demand for perishable products, such as processed, livestock, and aquatic products, that has arisen from the population increases and economic growth in the region.

This report aims to contribute to spreading the cold chain with modern systems by revealing the actual condition of the cold chain in selected Association of Southeast Asian Nations (ASEAN) countries, namely Thailand, Viet Nam, Indonesia, the Lao People's Democratic Republic (Lao PDR), and Myanmar. Information on the cold chain is beneficial for detecting intervention points to improve connectivity in the region and each country by supplementing initiatives regarding logistics, such as the Master Plan on ASEAN Connectivity (MPAC) 2025, from a different angle.

We focus on three aspects to describe the actual condition of the cold chain in each country based on raw data obtained from interviews with stakeholders of the chain and secondary data. (i) First is the demand for the cold chain, expressed by the volumes or values of products requiring temperature control. (ii) Next, the activities of the main players in the cold chain, such as representative firms of storage services and transportation in selected cities are summarised. (iii) We also look at government policies, such as rules about the storage and transportation of products requiring temperature control, and policies to support the development of the cold chain. The study's results are summarised as follows.

Demand for the cold chain

We can observe common features in cold chain demand in the analysed countries: the growing international trade of many agri-food products requiring the cold chain, except for decreasing exports from Indonesia and imports of refrigerated and frozen food by Myanmar. Similarly, domestic consumption also drives demand for the cold chain, which is suggested from the rapidly expanding consumption of frozen products in Thailand, the production of livestock products and the number of large farmers in Viet Nam, and the production of agri-food products in Indonesia. Data on Myanmar imply there is a large potential that the modern cold chain can expand to the traditional chain or circulation under ordinary temperatures. The composition of products indicates that aquatic products take a large share in the total demand for the cold chain in most countries.

Activities of the main players

Cold warehouse and transportation companies take their roles in selected parts of the distribution chain split by producer or importer, distribution centre, wholesaler, retailer, and domestic final consumer or exporter, rather than the whole logistics of the chain. There are notable differences in the warehouses and transportation equipment depending on the trade purpose. Modern cold transportation logistics using refrigerated trucks are mainly used for international trade, according to the Lao PDR and Myanmar, while traditional methods using

crushed ice and plastic cases are widely used for products targeting the domestic market in those countries.

Companies using cold storage and transportation can be classified into two types. The first is food processing companies operating their own cold warehouses or transportation, particularly in the fishery sector, which accounts for large parts of the cold storage service in Viet Nam, Indonesia, and Myanmar. The other type is companies that rent cold warehouse or transportation services from other companies. There are two types of cold warehouse rental company: third-party cold warehouse and transportation services and other companies, such as food processing companies, providing cold warehouses.

The capacity of both public and private cold storages is 940,000 tons in Thailand. The capacity of the private sector in Viet Nam is larger than 500,000 pallets. The capacities in Indonesia and Myanmar are 370,200 tons and 88,148 tons, respectively, although these indicate only the capacities of major companies. The small capacity of cold storage compared with its demand suggest a substantial part of the cold chain demand is satisfied with supply from small and medium-sized enterprises or that it is not fulfilled, and there exists the significant potential for companies to provide cold chain services.

Government policies

The countries in this study do not have an integrated policy on the cold chain, although an economic and social development plan might be placed as a guide in a broad sense. Various policies affect the development of the cold chain, both directly and indirectly. A noteworthy voluntary regulation directly affecting cold storage and transportation is the service quality standard for truck operation, or the Q Mark standard, in Thailand tested in 2019, which set up a common quality standard of temperature-controlled transport. We can learn from the advanced efforts of the Thai government to standardise cold transportation and develop human resources. Other regulations affecting the cold chain include regulations on cold storage and transportation and food standards. The government can also directly support facilities and markets that can be nodes of the cold chain by conducting credit support to purchase cold chain facilities and support developing commodity markets with modern cold storages.

Several policies would indirectly affect the improvements in the cold chain, such as investment promotion for cold chain businesses, tax exemption for investment, and the permission of ownership for foreign investors. Infrastructure development, including roads and seaports crossing the Greater Mekong Subregion, led by the government would also affect the environment of cold logistics. As well, customs operations have been improved in many countries, although some challenges have also been reported.

Policy implications

Governments have already implemented or considered countermeasures for cold chain issues. Despite this, the discussions in each chapter aim to provide further insights for improving the cold chain.

Hard assets, such as warehouses and trucks, in specific regions or parts of the chain are insufficient in terms of quantity and quality. For example, Viet Nam reports that both refrigerated vehicle resources and refrigerated warehouses are not enough in the areas that produce agricultural products. The modified cold vans with attached air conditioners widely used by small transportation companies have room to reinforce their equipment to ensure the quality of transported products. In addition, home delivery using cold insulation boxes attached to motorbikes are thought to be a potential investment area. Investment in agriculture and fishery, which are affected by natural conditions, is risky and costly. A clear vision from the government showing the development priorities of the cold chain and the public–private partnership mechanism would ease investors' decisions about entry into those sectors.

This report often stresses the insufficient soft assets in the cold chain, especially human resources. This includes the shortage of truck drivers in the cold chain and the insufficient English skills and knowledge for working across borders. There is a need for training for different types of vehicles before issuing driving licences, and the expectation for universities to educate the staff and managers of companies involved in the cold chain.

The lack of quantity and quality of infrastructure, including roads, railways, waterways, ports, and electricity supply, can cause high logistics costs and damage perishable products. The challenges for roads include the availability of short-distance roads, the quality of roads, and traffic conditions. This argument contains a wide range of issues, such as investment to fulfil highway equipment, road maintenance, traffic safety, traffic control, substitutional transportation modes, and methods of road construction. Stable electricity supply in the routes of the cold chain is also needed to reduce the costs of cold storage and transportation.

Integrative management of the cold chain would decrease the risks and costs during the preservation and transportation of products. Strengthening the vertical relationship between companies or achieving further vertical integration could be measures to realise such integrative management. Another essential factor is individual technologies, such as the sensor and transmitter systems used to send data or communication networks between the actors of supply chains.

Connectivity in terms of international trade through customs is also a notable issue. In particular, the Lao PDR and Myanmar are paying attention to transit trade as a key driver to develop the cold chain, since it can expand without being restricted by the scale of domestic production. Although the high connectivity of international trade requires efficient customs operations, there would be still several issues in customs in the reported countries. The Lao PDR argues the need for decreasing customs procedures and releasing a clear statement about the time and fees of customs operations. The cold chain should accordingly improve in various aspects since progress in international connectivity suggests an intensification of international competition in cold chain industries.

Chapter 1

Introduction

Eiichi Kusano[1]

1.1. Background

The cold chain, or low-temperature storage and transportation system, is indispensable for countries in Southeast Asia (SEA) as they mostly have a tropical climate. There is an even more pressing need for the cold chain due to the expansion of demand for perishable products, such as processed, livestock, and aquatic products, due to population increases and economic growth in the region.

The cold chain is a key factor in modernising the distribution system of agri-food products and developing the food value chain (FVC). Some case studies on dairy and fishery products in SEA suggest that the cold chain is necessary for increasing the value of products and also extending distribution channels.[2] Nevertheless, the cold chain has been less emphasised in the context of FVC studies, which tend to focus on the cost–benefit structure of actors in the chain and the industrial structure in line with arguments in the literature on value chain development (VCD) and global value chains (GVCs).[3] We need to cast light on the actual state of the cold chain and complement the arguments to improve the FVC.

The importance of logistics is mentioned as one of the central issues in the Association of Southeast Asian Nations (ASEAN) region by the Master Plan on ASEAN Connectivity (MPAC) 2025, a strategic document for guiding actions to improve connectivity in the region towards 2025.[4] One of the strategic areas discussed in the MPAC 2025 is 'seamless logistics', which is expected

[1] Economic Research Institute for ASEAN and East Asia (ERIA)/Japan International Research Center for Agricultural Sciences (JIRCAS).
[2] See Kusano (2019).
[3] See Stamm and Von Drachenfels (2011), Nang'ole et al. (2011), and Donovan et al. (2013) for value chain development (VCD), and Gereffi et al. (2005) and Gereffi and Fernandez-Stark (2016) for GVCs. Standards are another well-argued issue in global value chain and VCD studies focusing on agri-food industries (Humphrey and Memedovic 2006).
[4] The MPAC 2025 was adopted at the 28th ASEAN Summit in September 2016 as the successor of the MPAC adopted at the 17th ASEAN Summit in October 2010.

to be achieved by reducing the costs of the supply chain in each ASEAN member state.[5] However, there is a lack of detailed information on the key logistic networks in ASEAN for identifying specific bottlenecks and prioritising actions.[6] The MPAC 2025 shows a plan to implement an analysis of the time and costs of priority trade routes led by the Senior Economic Officials Meeting with the Senior Officials Meeting for ASEAN Ministers on Agriculture and Forestry and other implementing bodies/stakeholders as the first step to establishing the database of the land transport network in ASEAN.[7]

1.2. Aims and scope

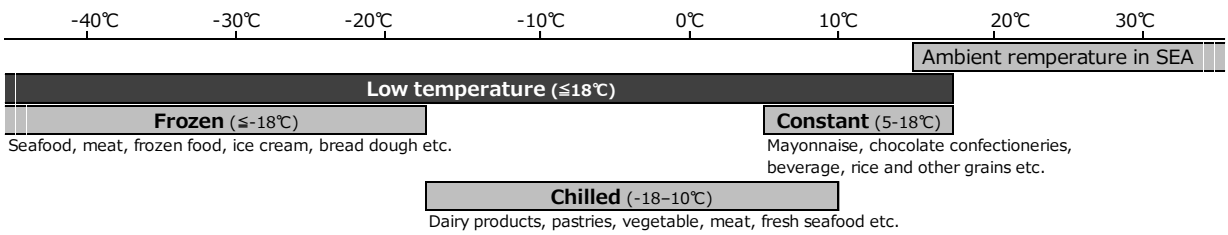
This report aims to contribute to spreading the cold chain with modern systems by revealing the actual condition of the cold chain in selected ASEAN countries. Information on the cold chain would be beneficial to detect intervention points to improve connectivity in the region and with each country by supplementing initiatives regarding logistics, such as the MPAC 2025, from a different angle.

We focus on three aspects to describe the actual condition of the cold chain in each country based on raw data obtained from interviews to stakeholders of the chain and secondary data. (i) The first is the demand for the cold chain, which is expressed by the volumes or values of products requiring temperature control. (ii) The activities of the main players in the cold chain, such as representative firms of storage services and transportation in selected cities, are also examined. (iii) We also look at government policies, such as rules about the storage and transportation of products requiring temperature control, and policies to support the development of the cold chain.

The cold chain is stipulated by the temperature zone in which products are processed, stored, and distributed. Although actual temperatures corresponding to each zone differ by company, Figure 1.1 shows a typical example. Many studies in this report suppose a chain at low temperatures, but some arguments put emphasis on chilled or frozen conditions.

[5] The MPAC 2025 indicates five strategic areas: sustainable infrastructure, digital innovation, seamless logistics, regulatory excellence, and people mobility.
[6] See MPAC 2025, p.56.
[7] The construction of the database has been called for by the ASEAN Economic Community Blueprint 2025 and the ASEAN Strategic Transport Plan 2016–2025.

Figure 1.1: A Typical Example of the Temperature Zone of the Cold Chain



SEA = Southeast Asia.

Source: ASEAN-Japan Transport Partnership (2018).

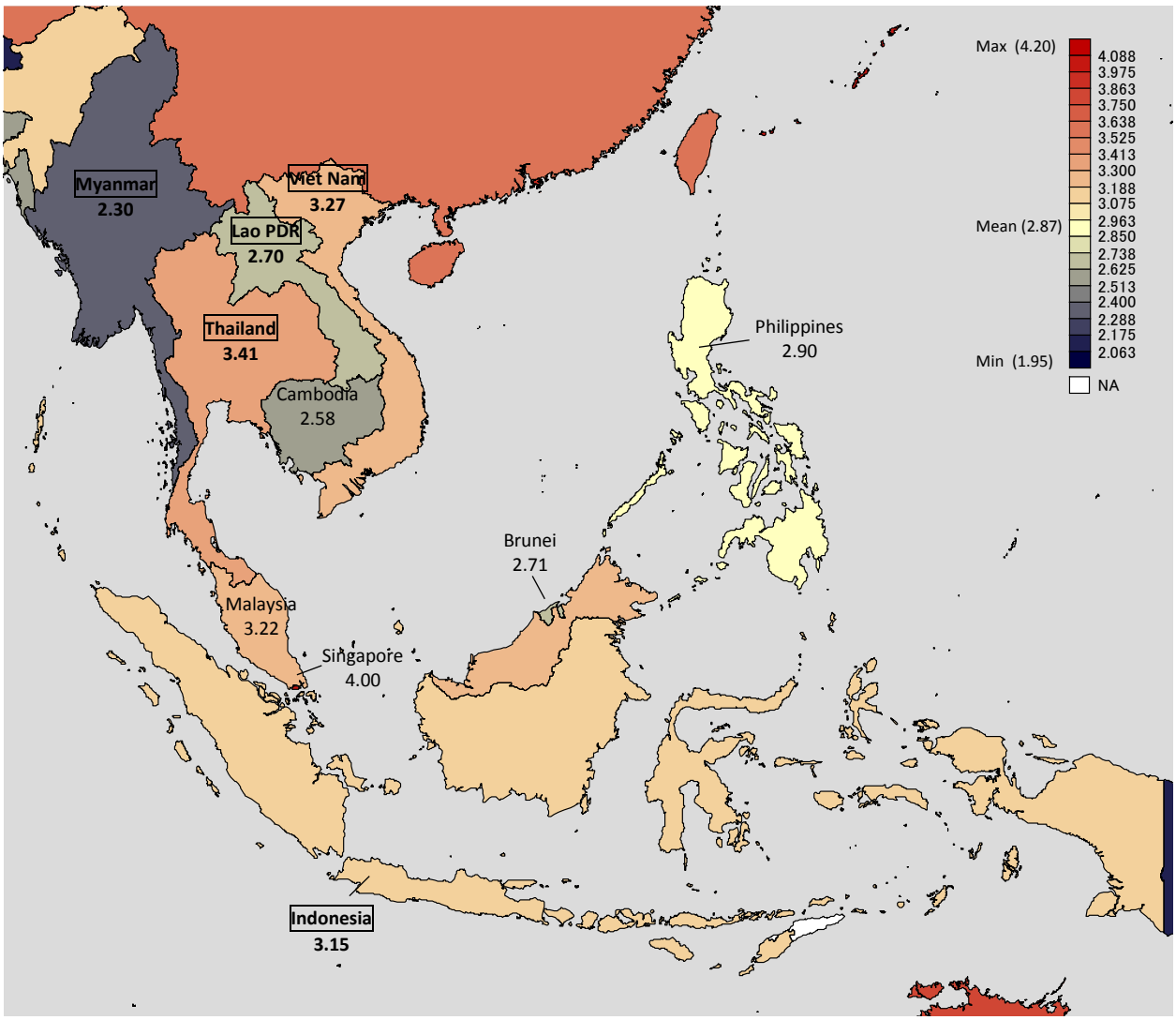
1.3. Study sites

The target countries in this report are Thailand, Viet Nam, Indonesia, Lao PDR, and Myanmar. Their level of development in logistics is different, according to the Logistics Performance Index (LPI), a benchmark of performance on trade logistics provided by the World Bank.[8] Figure 1.2 shows that trade logistics are evaluated at a similar level in Thailand and Viet Nam, followed by Indonesia. The LPI scores of the Lao PDR and Myanmar drop a certain degree from the aforementioned three countries and are scored lower than the world average.

The variety of the LPI implies that the obstacles to developing the cold chain are not the same in each country. Even while maintaining the three aspects of (i) demand for the cold chain, (ii) the activities of the main players, and (iii) government policies, the country-specific analyses on the cold chain in each chapter stress different issues based on different circumstances.

[8] Although the LPI does not reflect information about low-temperature storage and distribution, it is useful to grasp the general status of the logistics in each country compared to other countries.

Figure 1.2: Target Countries and Logistics Performance Index (LPI) Scores in 2018



Notes: The values denote the international LPI scores. Max, mean, and min denote those of the world. The names within boxes are the target countries in this report.

Source: World Bank. https://lpi.worldbank.org

Thailand

In Thailand, an increase in the number of supermarkets and restaurants has triggered the demand for cold storage and transport systems to keep the products fresh and maintain their quality. Modern cold chain systems have been rising in popularity and are utilised by various companies to meet the demand for different products.

Chapter 2 explores the issues of the cold chain, especially in the context of the improvement in the system through policy interventions based on statistical data and interviews as well as arguments in past studies, such by as the World Bank and APEC. It clarifies the comprehensive nature of the challenges to developing the cold chain, which are not limited to issues on infrastructure.

Viet Nam

Viet Nam's cold chain, particularly the storage market, is much larger in the south surrounding Ho Chi Minh City than the north near Ha Noi, given the concentration of the supply of agricultural and seafood supply. Conversely, this suggests large room for investment and development in the north.

Chapter 3 pays attention to the activities of representative players in the cold chain in both southern and northern areas with a list of major companies and their capacities. The list includes 27 cold storage companies, 13 pangasius or shrimp processing companies that operate their own cold storages, and 10 cold transportation companies by location and difference in domestic or foreign capital.

Indonesia

Indonesia is different from the other four countries in this report in terms of its geographical and demographical characteristics. It is an archipelagic country located out of the Greater Mekong Subregion (GMS) and has a vast population that far exceeds other ASEAN countries.

Chapter 4 summarises information on the various types of cold chain players with a list of 69 cold storage companies, 59 frozen fish and shrimp processing companies, and 55 sausage or nugget processing companies across the country. In particular, the activities of the companies in the metropolitan area around Jakarta, called Jabodetabek, are emphasised.

Lao PDR

The Lao PDR is characterised by a small domestic market with 7 million people in total and a strategic location surrounded by five ASEAN member states (AMS) and China. While the traditional cold chain, using plastic containers, ice, and pickup trucks, dominates domestic transportation, the modern logistics system is mainly used for the international trade of agri-food products.

Chapter 5 focuses on inter-state and transit trade with the highest level of the cold chain to respond to the large demand for agri-food products from neighbouring countries through the Lao PDR. It also discusses the factors determining trade, such as the locations of customs and trade routes, as trade values and quantities.

Myanmar

Myanmar is located at the western end of the GMS and neighbours China and India. Furthermore, it has the fifth-largest population among AMS and a growing economy to drive a steady increase in both the production and consumption of agri-food products. The use of the cold chain for agri-food products is still in its early stage but is expected to grow significantly in the future.

Chapter 6 describes the whole cold-chain landscape of Myanmar, including both the traditional and modern chains for fishery, livestock, and agricultural products in detail. The study explores sites mainly along the Ayeyarwady–Yangon and Yangon–Mandalay/Pyin Oo Lwin–Muse routes. The potential to expand the modern chain is estimated based on both trade statistics and case studies.

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Chapter 2

The Cold Chain in Thailand

Sumet Ongkittikul[9], Vari Plongon[9], Jitlaykha Sukruay[9], Kittiya Yisthanichakul[9]

2.1. Preface

Introduction

The cold chain in Thailand report is a part of the 'research project for policy recommendations to ASEAN countries on the realization of higher value added of agricultural products', aiming to provide information and analysis regarding prospects of cold value chains in Thailand, especially those of the consumption of food and products.

Thailand is known as an agricultural country as the agricultural sector has the largest share in the Thai workforce of 11.27%, or 37.60 million people (National Statistical Office, 2018). In addition, Thailand has been promoted as 'Kitchen of the World' since 2005, meaning that Thailand intends to be a hub of food. Therefore, Thailand can be considered as a hub of agricultural supply, which means its food and fibre products are adequate to serve both domestic and international demand and consumption. This demonstrates that the food value chain is essential to Thailand's economy.

The part of the food value chain that needs temperature control is known as the cold chain. The cold chain plays an important role in preserving quality, extending shelf life, and ensuring the quality of products. Its processes help reduce food spoilage and waste from producers' farms to customers' tables. This leads to the ability to transport products to customers over longer distances and increased customer satisfaction. Moreover, it is an opportunity for participants in the chain to gain more benefits and reduce their damages and costs. Most products in the cold chain are temperature sensitive and perishable, such as agricultural products, livestock products, fishery products, processed food, chemical products, and other temperature-controlled products.

[9] Thailand Development Research Institute (TDRI).

The cold chain consists of stakeholders from various sectors participating in the entire chain, from upstream to downstream, such as farmers, manufacturers, wholesalers, transportation services, warehouses, and retailers. The cold chain contributes a massive value to Thailand's gross domestic product (GDP), especially the small and medium-sized enterprise (SME) sector. Thailand's Office of Small and Medium Enterprises' Promotion Report revealed that in 2017, Thailand's SME GDP value was 42.39% (6.55 million baht) of the total GDP of 15.45 million baht. Apart from SMEs in the non-agricultural sector, the rest of the non-agricultural sector is comprised of large enterprises (LE) 43.04%, and other enterprises 5.87%. It is interesting that GDP from large enterprises mainly runs Thailand's economy. Meanwhile, SME value is continuing to increase closer to the GDP related to large enterprises. Furthermore, the SME GDP growth rate has increased higher than the total GDP and LE growth rate, as shown in Table 2.1.

Table 2.1: Thailand GDP

GDP	Value, Growth Rate, and Proportion	2013	2014	2015	2016	2017
Total	Value (million baht)	12.91	13.23	13.75	14.53	15.45
	Growth rate (%)	2.7	1.0	3.0	3.3	3.9
Large enterprise	Value (million baht)	5.56	5.77	5.99	6.30	6.65
	Growth rate (%)	3.2	1.2	3.6	3.4	3.1
	Proportion to overall GDP (%)	43.07	43.61	43.56	43.36	43.04
Small and medium-sized enterprise	Value (million baht)	5.13	5.32	5.68	6.12	6.55
	Growth rate (%)	3.2	1.1	5.3	4.9	5.1
	Proportion to overall GDP (%)	39.74	40.21	41.31	42.12	42.39

Source: Office of SMEs Promotion (2018).

The cold chain has opportunities and challenges to gain greater value and development. However, there are also problems and obstacles that need to be regulated and supported for maintaining standards and improving operations. Thus, this research aims to conduct a case study of the cold chain in Thailand and summarise its results in this report.

The following part of the report consists of seven sections: 2.2. A general overview of the cold chain in Thailand that will show the current situation and demand in Thailand. 2.3. A compilation of the issues and challenges facing the development of cold chain production, including

government policies involved in Thailand's cold chain. 2.4. Statistics on imported and exported cold chain products showing the demand for cold chain logistics. 2.5. A discussion on the cold chain market in Thailand and the current temperature-controlled transportation and warehouse conditions in the country. 2.6. A business model of the cold chain with information from interviews as an overview and connection with the main players and users. 2.7. The expectation of government policy from an interviewees perspective on policy to control, regulate, and support the cold chain stakeholders, including their gathering. 2.8. A concluding summary of the report and issues that may encourage the utilisation and development of the cold chain.

Research methodology

This research is discussed with each stakeholder along the cold chain by focusing on three elements, including the developments, challenges, and policies in Thailand. The approaches of the research can be identified as follows.

Firstly, to review international research to gain an overview of the importance as well as the recent developments in the global cold chain network. There are many reviews of temperature management on agri-food products, so this step is helpful to understand the cold chain in detail.

Secondly, to identify the current situation of both demand and supply in Thailand by gathering secondary data. This data can show the trends and growths from the past until the present.

Thirdly, to interview cold chain stakeholders and related government agencies to identify major elements in the cold chain: namely, the demand for frozen foods and cargo, the activities and challenges of the main suppliers, as well as national policies in Thailand.

Finally, the information will be analysed and policy recommendations in the context of Thailand are provided. The research team hopes to investigate and find useful information on the cold chain that can provide beneficial guidelines for policymakers.

Survey

The research team conducted survey interviews from December 2018–January 2019. The sample comprised five enterprises, two government agencies, and one federation.

The five enterprises were of different sizes, large, medium, and small, and comprised those in the chilled/frozen food industry, logistics providers, and a trader, as shown in Table 2.2 and Table 2.3 below.

Table 2.2: Interview Survey of Logistics Providers and Logistics Users

Size[1]	Enterprise[2]		
	Producer	**Logistic Provider**	**Trader**
Small	–	• Rujoran Transport Co., Ltd.	–
Medium	–	• Eagles Air & Sea Co., Ltd. • CTI Logistics Co., Ltd	• Harmony Life International Co., Ltd.
Large	• Thai Union Group PCL.	–	–

Note: 1. Classified sizes by fixed asset criteria in Appendix: Table A.1.

2. Details of interviewees are in Appendix Table A.2.

Source: Authors.

Table 2.3: Interview Survey of Supporters

Government Agencies
Port Authority of Thailand
Department of Internal Trade
Federation
Thai Federation on Logistics

Note: Details of interviewees are in Appendix: Table A.2.

Source: Authors.

Information from the survey interviews will be analysed and reported in further sectors. The details include the demand for the cold chain, the government policies on the cold chain, and the activities of the main players of the cold chain in Thailand.

2.2. General overview of the cold chain in Thailand

The cold chain is the supply chain that requires the control of temperature, humidity, and environments. The control provides the proper conditions for particular products in the processes of the supply chain. Reviews describe definitions of the supply chain and logistics as follows, showing their connection to the core of cold chain logistics.

Waters (2003) states that a supply chain consists of a series of activities and organizations through which 'materials' (raw materials, components, finished products, people, information, paperwork, messages, knowledge, consumables, energy, money, and anything else needed by operations) move through on their journey from initial suppliers to final customers. Lummus et

al. (2001) describe a definition of logistics that involves planning, implementing, and controlling the flow and storage of goods and services from the point of origin to the point of consumption for serving customer requirements. In addition, Thipkaisorn (2010) refers to Stock and Lambert (2001) to show that logistics comprise of activities that include logistics communications, customer service, order processing, demand forecasting, procurement, inventory management, transportation management, warehousing and storage, reverse logistics, parts and service support, plant and warehouse site selection, material handling, and packaging and packing. Michigan State University (2016) concluded that logistics is a part of the supply chain process. The supply chain focuses on competitive advantage, while logistics focuses on meeting customer requirements.

Hence, cold chain logistics is the process of transporting perishable and temperature-sensitive products from producers to consumers. Products of the cold chain are mainly agricultural and food products. Therefore, the cold chain can refer to the food value chain with temperature control. The processes of cold chain logistics consist of post-harvest, warehouse and storage, distribution, retail, transportation, and management, as detailed in Table 2.4. The main parts of the processes are chilled and frozen transportation and cold storage. The goals of cold chains are extending shelf-life, keeping quality, and adding value. The benefits of cold chain logistics are for both producers and consumers. The cold chain also helps producers to reduce waste and the cost of operations. Moreover, it helps to enhance competitiveness through high-quality products, which results in higher revenues. The high-quality products serve customers' requirements and satisfaction and are of benefit to customers as well.

Table 2.4: Cold Chain Processes

Order	Parts	Processes
1	On-farm cooling	Shade, evaporation cooling, misting, and protective cover
2	Initial cooling	Forced air cooling, hydro-cooling, crushed ice, and vacuum cooling
3	Storage	Cold storage, compartmentalised chambers, and controlled atmosphere storage
4	Transportation	Air, marine, controlled atmosphere pallet, reefer containers, and modified atmosphere packaging
5	Distribution	Refrigerated trucks and small chilled vans
6	Retail	Chilling display cabinets
7	Consumer	Home refrigerators

Source: Kasetsart University (2016) referred to by Mahajan and Frias (2012).

The cold chain also plays an essential role in the food value chain through the enhanced delivery of temperature-sensitive food products from producer to consumers. The cold chain helps people to live with a better quality of life by enabling access to varieties of fresh, frozen, and ready-to-eat foods that are produced and prepared at longer distances from where they live. As such, the cold chain has an important role in ensuring food security.

Thailand has potential for the temperature-controlled food value chain. According to 'Thailand's Advantages', an article written by the Board of Investment of Thailand (BOI 2017a), Thailand's geographical and location advantages make Thailand a gateway to fast-growing country markets that have a massive demand for food, such as China, India, Viet Nam, Malaysia, and Singapore. The country also has a growing economy, competitive human capital, world-class infrastructure, and strong government support that make it one of the most attractive investment destinations.

In addition to being a gateway to fast-growing country markets, Thailand is also situated at the heart of Southeast Asia, which prospers from land connections with Cambodia, the Lao PDR, Malaysia, and Myanmar through various modes of transportation, such as road, river, sea, and rail. In addition, it is surrounded by the Pacific Ocean and India Ocean. Moreover, future infrastructure that is currently undergoing upgrading and construction include new international road networks, double-track railways, high-speed trains, and other routes. Meanwhile, it is located among plenty tropical food resources.

Thailand is an attractive investment destination due to its growing economy, as can be seen from its GDP growth, which has been increasing, and foreign direct investment (FDI) which was at 21% over the past six years. In addition, competitive human capital gives the benefits of the free flow of skilled labour, services, investment, and capital across the ASEAN Economic Community (AEC) as a single market since 2015. Moreover, the government's tax support has ranked Thailand as the 2nd lowest corporate tax rate in ASEAN and led to numerous free trade agreements (FTA).

Apart from these, the government designated the food industry (BOI, 2017b) as one of the 10 key growth engines for its "Thailand 4.0" economic model. The government has also cooperated with the private sector to set Food Innopolis as a district of investment for research, development, and innovation for promoting and enhancing the competitiveness of Thailand's food industry. In this way, Thailand aims to serve both domestic demand and demand from

countries around the world, especially for seafood and agricultural products, which are increasing in the volume of cold chain products, as will be discussed in detail in the following sections.

The current situation of cold chain logistics in Thailand

The study of the cold chain logistics situation is based on general logistics. Thailand's Ministry of Industry attaches great importance to logistics to be a part of the five targeted industries, called the 'New S-Curve Industry', namely robotics; aviation and logistics; biofuels and biochemicals; digital; and medical hub. The New S-Curve Industry is propelling Thailand's new engine of growth as part of its 20-Year National Strategy and National Economic and Social Development Plan No.12, which establishes a strategy for advancing infrastructure and logistics. Thus, logistics has been emphasised as an area for better performance by Thailand's government agencies and private sectors.

According to Thailand's Logistics Report, 2017, by the Office of the National Economic and Social Development Council (NESDC, 2018b), the logistics cost component consists of transportation costs, inventory holding costs, and logistics administration costs, respectively, by size regarding the value of each component.

The value of the total logistics cost has increased after the country's economic growth and the recovery of export and domestic demand as a result of increasing of industrial agricultural product and private investment. The proportion of the total logistics cost to nominal GDP has slightly decreased due to the decrease in inventory holding costs because of the better performance of inventory holding by entrepreneurs and the low interest rate from a monetary easing policy. Meanwhile, transportation costs have been increasing because entrepreneurs mainly use road transportation, which has a high unit cost. Moreover, infrastructure development projects, such as railways, waterways, and multimodal facilities, are under construction. Apart from these, the logistics administration costs are stable, as shown in Table 2.5.

Table 2.5: Logistics Costs

Logistics Cost	2013	2014	2015[r]	2016[p]	2017[e]
Proportion of total logistics cost to nominal GDP (%)	**14.2**	**14.2**	**14.0**	**13.9**	**13.8**
Total logistics cost (billion baht)	**1,776.6**	**1,876.7**	**1,917.7**	**2,020.6**	**2,125.0**
Logistics cost components					
● Transportation costs					
- Proportion to nominal GDP (%)	7.4	7.5	7.4	7.5	7.5
- Value (billion baht)	953.4	994.9	1,019.3	1,091.6	1,155.80
● Inventory holding costs					
- Proportion to nominal GDP (%)	5.5	5.4	5.3	5.1	5.0
- Value (billion baht)	713.9	711.2	724.1	745.3	776.0
● Logistics administration costs					
- Proportion to nominal GDP (%)	1.3	1.3	1.3	1.3	1.3
- Value (billion baht)	166.7	170.6	174.3	183.7	193.2

Note: e = estimated data, p = preliminary data, r = revised data.

Source: NESDC (2018b).

As can be seen in the above table, in 2017, Thailand's proportion of the total logistics cost to nominal GDP was estimated at 13.8% and showed a declining trend over the years through a reduction in inventory holding costs, while the international average was 10.9%. North American and European countries had the lowest percentages, at 8.6% and 9.5%, respectively, and the average for Asian countries was 12.7%.

The World Bank (2018) has been reporting a Logistics Performance Index (LPI) every two years. It stimulates awareness of developments in logistics performance and serves as a reference to propel policy. The LPI is the weighted average of six critical dimensions to benchmark the performance of countries through surveys of their partner countries' satisfaction, which is then analysed and presented as an overall LPI index score. The NESDC (2018a) reveals that Thailand's LPI rank improved by 13 places in 2018 compared with 2016. This ranks Thailand as 32nd of 160 countries overall as shown in Table 2.6, and 2nd of 10 countries in ASEAN after Singapore.

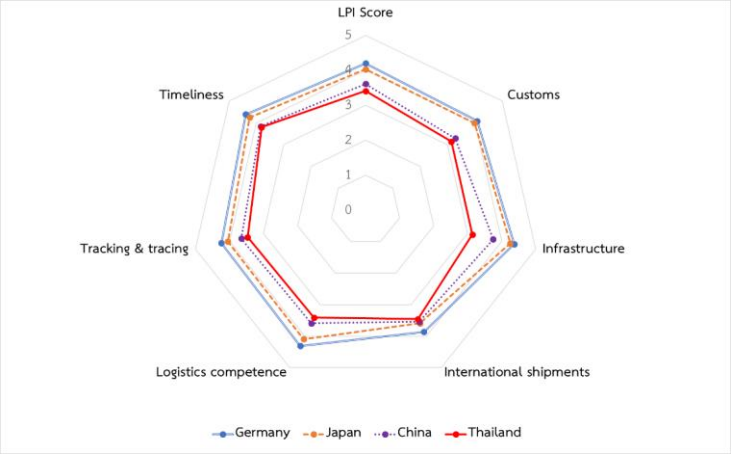
Table 2.6: Logistics Performance Index of Thailand in 2018

Index component	Rank /160	Score (1–5)
Logistics Performance Index (Overall)	**32** $^{+13}$	**3.41**
Policy Regulation (Input)		
1. Customs: The efficiency of the clearance process (i.e., speed, simplicity, and predictability of formalities) by border control agencies, including customs	36 $^{+10}$	3.14
2. Infrastructure: Quality of trade and transport-related infrastructure (e.g., ports, railroads, roads, information technology)	41 $^{+5}$	3.14
3. Logistics quality and competence: Competence and quality of logistics services (e.g., transport operators, customs brokers)	32 $^{+17}$	3.41
Service Delivery Performance (Output)		
4. International shipments: Ease of arranging competitively priced shipments	25 $^{+13}$	3.46
5. Timeliness: Timeliness of shipments in reaching a destination within the scheduled or expected a delivery time	28 $^{+24}$	3.81
6. Tracking and tracing: Ability to track and trace consignments	33 $^{+17}$	3.47

Source: World Bank (2018).

The highest LPI countries have high incomes and are located in Europe, such as Germany, the Netherlands, and the United Kingdom. The lowest LPI countries are mostly low-income countries, such as African countries. Germany remained first for three years from 2014–2017. Japan is the top performer in East Asia and the Pacific region. China has the best performance of the upper-middle income group, and Thailand ranks second after China. The LPI scorecard shown in Figure 2.1 presents a comparison of Thailand with countries that perform the best overall, by region, and by income group.

Figure 2.1: Thailand's LPI Scorecard Compared with Best Performance Countries



Source: World Bank (2018).

Thailand was evaluated in the Logistics Friendly Group (the first of five groups) but was still ranked last in the group. Thus, Thailand should take the World Bank's suggestion for the Consistent Group (second group). The Consistent Group should place priority on developing human resources skills, urban logistics, a dedicated logistics body, and a national data system. A second priority should be transportation infrastructure, green logistics, spatial planning, resilience, and a specific legal framework (NESDC, 2018a).

The suggestion conforms to the problems and obstacles of the cold chain in Thailand as stated by Kasetsart University (2016). There are five issues:

- Human resources: Cold chain staff lack the knowledge and skills for handling the proper conditions for keeping and transporting products with both Good Distribution Practice Standards and Good Storage Practices Standards.
- Infrastructure: There is insufficient and inefficient infrastructure for the demand for the cold chain in Thailand.
- Temperature control: Temperature tracking and checking need more organizing to achieve concrete systems.
- Standard of transportation: Cold chain products usually touch external air during transfer and transport. This may affect the quality of products and cause damage.
- Electricity control: Power distribution systems are unstable. This leads to unstable electricity, which is a resource of temperature control.

The suggested approaches for logistics performance development are expected to resolve the main problems and obstacles. The developed performance will serve logistics demand better, especially cold chain logistics, which is continuing to increase with the demand for cold chain products.

Demand for the cold chain in Thailand

The demand for fresh food and processed food is expected to increase due to high competition in the food industry. In order to support competition, effective logistics management is required. The food industry is interested not only in transportation cost reduction but also in food quality control for perishable goods. The cold chain is a logistics tool that is applied to extend the

saleable lifecycle of perishable goods and ensure that they do not perish in storage or in transit to their end destinations. As a result, the cold chain industry has increased over the years.

An increase in food demand requires more food transportation. The NESDC (2018b) reported that the growth rate of freight in Thailand in 2016 increased by 1.3%, as shown in Table 2.7. Service providers in the country have tended to increase because the domestic and international shipment types have increased slightly. This has been due, in particular, to road transportation, which is the main way of transporting domestic freight, followed by waterway, coast, railway, and air, respectively, while the marine way is the main method of international freight transportation followed by road, airway, railway, and mail, respectively. Cold chain logistics is a part of freight transportation. Therefore, cold chain logistics tends to increase.

Table 2.7: Freight Transportation Rate

Years	2012	2013	2014	2015	2016
Freight transportation growth rate (%)	**3.0**	**-1.0**	**4.0**	**3.3**	**1.3**
Freight transportation volume (1,000 tons)	**782,189**	**774,779**	**805,345**	**831,826**	**842,536**
● **Domestic**	**562,446**	**561,772**	**572,750**	**596,610**	**600,056**
- Road	458,781	458,828	465,020	482,358	486,743
- Railway	11,849	11,920	10,829	11,356	11,970
- Waterway	47,422	45,413	50,113	50,907	50,327
- Coast	44,263	45,441	46,673	51,872	50,894
- Air	68	120	115	117	122
● **International**	**219,743**	**213,007**	**232,595**	**235,216**	**242,480**
- Road	24,574	26,142	27,525	32,297	32,293
- Railway	103	97	80	126	222
- Marine	194,318	186,087	204,293	202,104	209,226
- Air	746	679	696	688	736
- Mail and others	2	1	1	2	3

Source: NESDC (2018b) referring to Ministry of Transport (2017).

For parts of customer demand, the demand for cold chain products has increased, as shown in Table 2.8. The average growth rate of imported cold chain products from 2013 to 2018 was approximately 5%, and the average rate of exported cold chain products also increased (by approximately 2%). As can be seen from the table, the increases in imported and exported cold

chain products change in the same direction as freight transportation. Therefore, the increase in cold chain products influences the increase in cold chain logistics.

Table 2.8: Growth Rates of Imports and Exports of Cold Chain Products (%)

Years	2013	2014	2015	2016	2017	2018	Average
Imports	0.55	3.47	3.44	11.34	6.55	3.31	4.78
Exports	-7.47	6.47	0.56	8.96	5.18	0.92	2.44

Note: Cold chain products consist of fresh, chilled, and frozen products of agriculture, livestock, pharmaceutical products, and fishery products and processed foods that are required to be kept at low temperatures. See Tables 12 and 13 for more details.

Source: Information and Communication Technology Center with Cooperation of the Customs Department (2018).

2.3. Development of cold chain production

Issues and challenges of cold chain logistics

As the second-largest exporter in ASEAN, Thailand plays an important role in the increasing supply chain in the region (ITA 2018), especially in terms of meeting the rising demand for cross-border logistics services. Additionally, Thailand's government vision for making Thailand the 'Kitchen of the World' has also led to significant investment in the development of a complete supply chain for food logistics. It has also led to an increase in the number of supermarkets and restaurants and triggered the demand for cold storage and transport systems to keep the products fresh and maintain their quality. Therefore, cold storage systems have been rising in utilisation by various companies to meet the demand for different products, such as meat, fisheries, and agricultural and food products.

According to the Agricultural Technical Cooperation Working Group of APEC's report, the High-Level Public–Private Forum on Cold Chain to Strengthen Agriculture & Food's Global Value Chain (2015), cold storage distributors in Thailand are growing in number. Thailand's cold chain operations are 'good' in fisheries and dairies/milk products, but 'poor' in fruits/vegetables. The implementation of the cold chain requires an enormous amount of capital to develop infrastructure, transfer knowledge, and change the management and operational practices of the entire supply chain to ensure success (Kitinoja, 2013). This is mostly lacking in the agricultural

industry of Thailand and other developing countries. The challenges facing cold chain development are as follows.

- Human resource development: Employees lack knowledge in cold chain transportation.
- Insufficient infrastructure: The infrastructure of the cold chain system is inefficient, e.g. inconsistencies in the power supply system and tracking temperature systems in storage and transportation are not enough to meet demand.
- High transportation costs: Temperature-controlled logistics cost approximately 3% more than normal transportation.
- Inappropriate and lack of institutional systems: There are issues on the inconvenience of customs clearances and unclear guidelines for temperature-controlled products.
- Lack of investment: Cold chain businesses use a large amount of money for starting their businesses.

From the issues and challenges mentioned above, there is a need to find ways to erase the weaknesses, improve the strengths, and compete with the challenges of cold chain development. The Agricultural Technical Cooperation Working Group of APEC's report (2015) raised ways to develop the cold chain in Asia–Pacific economies as follows:

- Assist small-scale farmers (support for traceability systems and capacity building for participation in the global value chain).
- Improve infrastructure and develop a distribution services system.
- Train staff in the logistics field to obtain handling skills and knowledge for cold chain products and systems.
- Create an enabling environment for the private sector, especially SMEs, to lead businesses and create an environment connecting farmers, industries, and markets.

Cold chain development is strenuous, and it needs to be empowered by government policy and support.

Government policies

The Thai government gives priority to economic growth, which is affected by the value of products. Thus, the government is concerned about product quality and standards for enhancing value. At present, the government legislates acts and provides strategic plans as a policy for regulating and supporting the country's activities. The policies related to cold chain operations are in categories as follows.

- Guiding and Supporting Plan: A path for participants to be followed

Twelfth National Economic and Social Development Plan (2017–2021): The main plan for Thailand development from 2017 to 2021. The strategies responding to economics and logistics development are the four following strategies:

Strategy 3. Strategy for Strengthening the Economy and Underpinning Sustainable Competitiveness: Important keys to this strategy are building economic strength and competitiveness and emphasising the stabilisation of macroeconomic management, improving the efficiency of the financial sector, and maintaining fiscal discipline. In addition, the strategy also focuses on strengthening the sectors of the real economy, including agriculture, manufacturing, and services as both conventional income sources and the means of diversifying to new products and service activities in the future.

Strategy 7. Strategy for Advancing Infrastructure and Logistics: The goal of strategy 7 is to expand the capacity of infrastructure and logistics in the country, both in terms of quantity and quality, to support the expansion of urban areas and key economic zones, and to help improve the quality of life. Connectivity within the sub-region and the ASEAN community will also systematically be increased by building infrastructure networks to support areas alongside the economic corridors. Systems of management and regulation will be upgraded to meet international standards in order to increase operational effectiveness and safety whilst ensuring consumers' rights and providing equal and widespread access to basic infrastructure. Lastly, the country will support infrastructure-induced industries as well as logistics entrepreneurship and organisations that have the potential to expand their businesses internationally.

Strategy 9. Strategy for Regional, Urban, and Economic Zone Development: Key developments and activities are: (1) strengthening the existing production and service bases; (2) creating new production and service bases to generate income for people in all regions; (3) supporting the quality growth of urban areas; (4) developing and reviving the Eastern Seaboard areas to accommodate future industrial expansion; (5) enabling the sound management of border economic areas to attain sustainable growth and competitiveness; and (6) enhancing the efficiency of urban and regional development implementation mechanisms to deliver concrete outcomes.

Strategy 10. Strategy for International Cooperation for Development: This strategy focuses on adjusting domestic mechanisms towards integration; promoting creative, fair, and inclusive mechanisms at the sub-regional and regional levels; and refining Thailand's role with its neighbours in sub-regional and regional development.

The Third Strategy Plan for Logistics Development (2017–2021): This plan was created under the Twelfth National Economic and Social Development Plan (2017–2021) and aims to upgrade the logistics system in Thailand for becoming a centre of trade, service, and investment in the region. It consists of three strategies: (1) the development of value added in supply chain systems; (2) infrastructure and facilities improvement; and (3) development of logistics support factors for supporting the competitiveness and implementation of an organisation.

Supporting Plan for SMEs (2017–2021): There are three strategies for SME operation guidelines as follows: (1) support and development in separate issues, including upgrading technology, innovation, productivity, funding source support, promotion of national and international market access, and entrepreneur development; (2) support for SME capability in specific groups, including high-value start-ups, and encouraging SME network establishment and improvement of the SME foundation; (3) development and promotion of the SME mechanism to drive SMEs as a system, including improving tools for high-performance SME promotion.

- Product Producers: Rules to be regulated for making quality and standard products

Agricultural Standards Act, B.E. 2551 (2017): This act describes the meaning and requirements of the agricultural standard and explains the role of related organisations.

Agricultural Economics Act, B.E. 2522 (1979): Defines the wording of agricultural economics, agriculture development, agricultural economic area, agriculture policy; and explains the role of related organisations in agricultural economics regulation.

- Factories/Warehouses: Regulations for controlling operations in factories and warehouses

Regulation of the Ministry of Industry: Security Measurement Regarding Cooling System Using Ammonia as a Refrigerating Substance in Factory, B.E. 2554 (2011): This report provides details about cooling systems, such as the design, manufacturing, and installation of refrigeration systems, repair and modification of the systems, safety and maintenance of the systems, emission control, and emergency preparedness and response.

Warehouse, Silo and Cold Storage Act, B.E. 2558 (2015): Provides explanations about the authority of the committee for supervising warehouse silo and cold storage and serves as a guide for warehouse business, silo, and cold storage business operations, including: (1) the establishment of and applications for licences and the granting of licences; (2) supervision of warehouse business, silo business, and cold storage business operations; (3) liability of the operator of warehouse business, silo business, and cold storage business, and (4) appeal; detail of warehouse business, silo business, and cold storage specifically for maintaining good of subsidiary; and penalties.

- Transportation: Acts for the constraint of the transportation system, both domestically and internationally

Carriage of Goods by Sea Act, B.E. 2534 (1991): This act mentions the carriage of goods by sea, including: (1) defining the words that correspond to the carriage of goods by sea, (2) rights and duties of the carrier, (3) bills of lading, (4) rights and duties of the shipper, (5) liabilities of the carrier, (6) exclusions to liabilities of the carrier, and (7) limitations of the liabilities of the carrier and the calculation of damages.

All the policies mentioned above are summarised in Table 2.9. It provides information about the policies, related organisations, and the authorities of the organization. This information will be useful for stakeholders.

As can be seen, there are various government agencies responsible for control, regulation, and support activities related to the cold chain. This shows that the government places importance on the cold chain. Even though there is no specific agency in charge of it, the policies encourage cold chain development.

Table 2.9: Summary of Policies

Government Agencies	Sub-organizations	Acts and Policy Documents	Responsibility
Ministry of Transport	Port Authority of Thailand	Carriage of Goods by Sea Act, B.E. 2534 (1991)	Details of implementation of transportation by sea. For example, refrigerators and cold rooms need the arrangement to remain in proper conditions and ensure safety for the reception, carriage, and preservation of goods.
Ministry of Commerce	Department of Internal Trade	Warehouse, Silo, and Cold storage act, B.E. 2558 (2015)	Guidelines of warehouse, silo, and cold storage business operation.
Ministry of Agriculture and Cooperatives	The National Bureau of Agricultural Commodity and Food Standards	Agricultural Standards Act, B.E. 2551 (2017)	Q Mark standard for commercial vehicles for transporting products.
		Agricultural Economics Act, B.E. 2522 (1979)	The role of related organisations is in agricultural economic regulations for the efficacy of agricultural products. The scope of the role is to study and analyse the market system, transportation, market development, price, and demand of the products.
Ministry of Industry	Department of Industrial Works	Regulation of ministry of the industry: Security Measurement Regarding Cooling System, B.E. 2554 (2011)	Guidelines of the cooling operating system.
The Office of SMEs Promotion	–	Supporting Plan for SMEs (2017–2021)	Three strategies for guiding SME operation.
Office of the National Economic and Social Development Council	–	Twelfth National Economic and Social Development Plan (2017–2021)	Setting up four strategies responding to economics and logistics development.
	–	The Third Strategy Plan for Logistics Development (2017–2021)	Three strategies to upgrade the logistics system in Thailand for becoming the centre of trade, services, and investment in the region.

Source: Collected by authors.

2.4. Demand for the cold chain

Thailand's frozen food industry has grown in terms of market revenue due to the high sales of chilled and frozen canned products, especially seafood, with different fish types, shrimp, crustaceans, and others, such as processed chicken, processed fruits, and vegetables.

Thailand's frozen food market in term of consumption has been growing continuously by a yearly average of 9.8%, with a value of B15,700 million in 2015, an increase from 2011 of B10,800 million, as shown in Table 2.10.

Table 2.10: The Total Value of the Frozen Food Market in Thailand, from 2011 to 2015

Year	2011	2012	2013	2014	2015	Growth rate (%)
Frozen food market value (B million)	10,800	11,898	13,182	14,635	15,700	9.8

Source: Food Intelligence Center Thailand (2016).

The changing lifestyle of Thai consumers has also affected the increase in frozen food demand, especially in urban areas. This has been driving the demand for packaged convenience foods (including chilled canned products), as they are stored for a longer period of time because convenience foods are easy to make and take less time to cook. Additionally, rural areas have a high demand for convenient packaged food because the people there work outside, and they do not have time for cooking. Therefore, the demand for convenient packaged food options has been rising.

Statistics of imported and exported cold chain products

Cold chain product revenues have tended to grow on account of a rise in user demand. As seen in Table 2.11, the exported value of cold chain products increased from B444,904.96 million in 2012 to B509,779.07 million in 2018. Meanwhile, the import value also increased from B251,152.31 million to B331,261.48 million. The demand for cold chain products is expected to expand in the future. Leading frozen food manufacturers in Thailand have started to invest and expand their production capacity in order to meet the growing demand for cold chain products.

Table 2.11: Import and export values of cold chain products in Thailand

Years	**Value of cold chain products** (B million)	
	Imports	**Exports**
2012	251,152.31	444,904.96
2013	252,528.00	411,692.32
2014	261,293.44	438,331.63
2015	270,286.94	440,770.69
2016	300,935.91	480,247.42
2017	320,640.65	505,146.29
2018	331,261.48	509,779.07
Average	284,014.10	461,553.20

Source: Information and Communication Technology Center with Cooperation of the Customs Department (2018).

- Import of cold chain products

Considering the different types of imported cold chain products, as shown in Table 2.12, pharmaceutical products (hormones, vitamins, and medicines) are the most imported with an average of B99,002.01 million from 2012 to 2018. The majority of pharmaceutical products are imported from Germany (B13,745.70 million in 2018), followed by the United States (B13,178.8 million) and China (B12,670.60 million). Fresh, chilled, frozen, and processed aquatic animals have imports of B88,626.24 million on average, including (1) tuna at B42,602.59 million; (2) salmon, cod, trout, and mackerel at B9,706.34 million; (3) shrimp at B3,982.56 million; (4) squid at B10,440.03 million; (5) crab at B790.88 million; and (6) other processed aquatic products at B21,103.84 million. Tuna accounts for a large part of imports because manufacturers import tuna to produce canned and processed tuna products. The majority of imports are from Taiwan (B8,051.90 million). In addition, agricultural products have a high average import value; the average is B55,781.92 million. However, livestock and live plants have small import values of B39,726.22 million and B877.71 million, respectively.

- Export of cold chain products

In terms of exported cold chain products, as presented in Table 2.13, canned and processed food products have the highest average export value (B207,609.97 million), followed by livestock products (B106,148.64 million), aquatic products (B69,042.94 million), agricultural products

(B59,856.11 million), pharmaceutical products (B15,170.01 million), and live plants (B3,725.54 million), respectively. Thailand is a production base for fisheries and chicken. The majority of exported livestock products are chilled, frozen, and processed chicken exports (B82,176.18 million). The main suppliers of chilled and frozen chicken products in 2018 were Japan, China, and Malaysia, accounting for around half of the exported value. The majority of exported fishery products were chilled, frozen, and processed shrimp. The United States was the biggest importer of the products in 2018, followed by Japan and China, respectively.

As previously mentioned, the cold chain industry in Thailand is needed for food transportation in both imports and exports. As a result, Thai food processors are also developing more packaged, convenient foods (e.g. chilled, frozen, and instant food) to meet the demand of domestic and foreign consumers, leading to the growth of cold chain logistics businesses, which will be explained in the next section.

Table 2.12: Import Value of Cold Chain Products in Thailand

Cold Chain Products	Imports Value of Cold Chain Products (B million)							
	2012	2013	2014	2015	2016	2017	2018	Average
Aquatic products	87,263.83	87,538.18	79,398.55	75,459.30	90,802.14	98,828.98	101,092.73	88,626.24
Tuna	51,609.52	49,257.18	36,695.96	30,562.08	41,168.26	45,424.29	43,500.85	42,602.59
Salmon, cod, trout, and mackerel	9,494.95	8,844.58	9,668.94	9,048.45	9,437.01	11,326.50	10,123.95	9,706.34
Shrimp	2,359.84	3,482.72	4,029.18	3,688.46	4,275.27	5,003.69	5,038.75	3,982.56
Crab	321.54	277.14	447.85	565.33	905.98	1,241.00	1,777.31	790.88
Squid	6,267.34	9,155.93	9,911.42	10,450.93	12,679.14	12,064.76	12,550.72	10,440.03
Other aquatic products	17,210.64	16,520.63	18,645.20	21,144.05	22,336.48	23,768.74	28,101.15	21,103.84
Agricultural products	39,743.54	42,395.69	44,182.04	58,351.07	69,094.81	70,359.70	66,346.59	55,781.92
Fresh and processed fruits	22,982.49	24,143.25	24,877.97	32,260.22	36,621.25	36,083.32	32,284.37	29,893.27
Fresh and processed vegetables	14,648.32	15,880.84	17,149.77	23,913.99	29,862.28	31,945.58	31,764.32	23,595.01
Fruit and vegetables juice	2,112.73	2,371.60	2,154.31	2,176.86	2,611.27	2,330.80	2,297.90	2,293.64
Livestock products	33,098.81	33,681.41	41,833.74	37,235.95	38,564.22	45,205.77	48,463.62	39,726.22
Meat	14,268.62	13,872.01	15,897.13	17,421.59	22,149.36	24,631.05	28,127.77	19,481.08
Dairy products	18,830.19	19,809.40	25,936.61	19,814.36	16,414.86	20,574.72	20,335.85	20,245.14
Live plants	785.50	680.00	593.30	693.10	1,064.10	1,077.40	1,250.60	877.71
Pharmaceutical products	90,260.63	88,232.72	95,285.81	98,547.52	101,410.64	105,168.80	114,107.94	99,002.01
Total	251,152.31	252,528.00	261,293.44	270,286.94	300,935.91	320,640.65	331,261.48	284,014.10

Note: Live plant consist of HS 0601, 0602, and 0603

Source: Information and Communication Technology Center with Cooperation of the Customs Department (2018).

Table 2.13: Export value of cold chain products in Thailand

Cold Chain Products	Export Value of Cold Chain Products (B million)							
	2012	2013	2014	2015	2016	2017	2018	Average
Aquatic products	87,225.40	63,581.28	67,557.27	59,207.44	70,814.94	71,515.07	63,399.02	69,042.92
Fishes	25,453.20	19,938.06	21,984.29	19,956.00	20,332.98	18,897.54	17,429.55	20,570.23
Shrimp	46,285.91	29,924.15	29,594.72	25,368.39	36,887.16	38,148.70	33,173.26	34,197.47
Other crustaceans	2,081.34	2,848.29	4,019.21	3,541.44	3,139.63	1,255.29	1,146.55	2,575.96
Squid	13,118.85	10,694.85	11,775.31	10,186.95	10,307.07	12,006.94	10,949.38	11,291.34
Other aquatic products	286.11	175.93	183.74	154.65	148.10	1,206.60	700.27	407.91
Agricultural products	36,878.33	38,756.89	48,087.22	52,137.05	62,565.28	85,679.56	94,888.44	59,856.11
Fruits	29,635.69	32,012.66	40,725.41	44,635.26	54,492.24	76,700.49	85,181.35	51,911.87
Vegetables	7,242.64	6,744.23	7,361.81	7,501.79	8,073.04	8,979.07	9,707.09	7,944.24
Livestock products	83,906.94	85,363.02	98,035.88	108,276.68	114,352.19	119,767.33	133,338.46	106,148.64
Meat	68,058.46	67,300.53	74,909.50	81,913.30	89,908.10	96,981.13	101,568.00	82,948.43
Chicken	67,751.36	66,799.69	73,965.21	81,190.02	89,112.92	96,024.68	100,389.40	82,176.18
Duck	136.75	211.66	589.33	455.02	526.43	654.92	700.04	467.74
Pork	170.35	289.18	354.96	268.26	268.75	301.53	478.56	304.51
Dairy products	4,763.51	5,544.15	5,904.29	6,605.52	7,123.23	7,506.63	7,742.18	6,455.64
Other livestock products	11,084.97	12,518.34	17,222.09	19,757.86	17,320.86	15,279.57	24,028.28	16,744.57
Canned and processed foods	220,960.19	207,070.73	207,221.96	202,453.82	212,209.51	207,020.53	196,333.05	207,609.97
Live plants	3,426.00	3,461.40	3,585.10	3,637.40	3,979.80	3,904.30	4,084.80	3,725.54
Pharmaceutical products	12,508.10	13,459.00	13,844.20	15,058.30	16,325.70	17,259.50	17,735.30	15,170.01
Total	444,904.96	411,692.32	438,331.63	440,770.69	480,247.42	505,146.29	509,779.07	461,553.20

Note: Several items listed in the table are inconsistent with Table 2.12 due to the issue of data unavailability. Other livestock products include bones, eggs, and edible parts of animals. Canned and processed foods include fruits, vegetables, and seafood.

Source: Information and Communication Technology Center with Cooperation of the Customs Department (2018).

Demand for Cold Chain Logistics

Laemchabang Port and Bangkok Port are the two main transhipment ports of Thailand that offer universal services in order to exchange goods worldwide. The Port Authority of Thailand reported that from 2007 to 2017, the volume of reefer containers from those two ports, both imported and exported, was fluctuating. The exported volume was greater than the imported volume by on average 1.6 times. If we consider both the imported and exported volume from 2015 to 2017, the volume slightly increased, which means the import and export values tended to rise. Trends in the import and export volume are shown in Table 2.14.

Table 2.14: The Volume of Imported and Exported Reefer Containers

Years	Total of the Reefer Volume (TEU[1])	
	Import	Export
2007	133,193.50	216,593.00
2008	152,877.75	228,188.00
2009	159,118.00	248,012.00
2010	134,578.25	229,090.00
2011	131,360.00	233,234.00
2012	152,590.00	254,876.25
2013	152,340.00	238,446.75
2014	120,526.00	203,257.00
2015	129,466.00	187,398.00
2016	139,378.00	215,968.00
2017	152,103.00	233,438.00

TEU = twenty-foot equivalent unit (1 TEU≈2.16 tons).

Source: Port Authority of Thailand (2018).

As mention above, imported and exported values of cold chain products from 2012 to 2017 tended to increase because consumer behaviour changed. The increase in chilled and frozen food demand led to the growth of cold chain logistics, including cold storage, reefer containers, and freight transportation. The Port Authority of Thailand reported the numbers of reefer containers as follows in Table 2.15. As can be seen, the total number of reefer containers increased in the last three periods, both for imports and exports.

The cold chain logistics market is expected to grow in volume terms on the back of the transportation of food, pharmaceuticals, and healthcare products. Moreover, the demand for food products is also increasing across the globe, which will further create demand for cold chain logistics.

Table 2.15: Number of Import and Export Reefer Containers (Box)

Years	Import				Export			
	20-ft container	40-ft container	45-ft container	Total	20-ft container	40-ft container	45-ft container	Total
2007	12,416	60,382	6	72,804	15,737	100,419	8	116,164
2008	12,013	70,411	19	82,443	13,520	107,334	–	120,854
2009	13,802	72,658	–	86,460	15,736	116,138	–	131,874
2010	9,716	62,421	9	72,146	13,280	107,815	80	121,175
2011	9,964	60,698	–	70,662	12,906	110,164	–	123,070
2012	10,596	70,997	–	81,593	13,910	120,473	9	134,392
2013	9,678	71,313	16	81,007	12,849	112,791	7	125,647
2014	6,726	56,900	–	63,626	8,795	97,231	–	106,026
2015	6,365	59,698	–	66,063	7,810	89,794	–	97,604
2016	8,652	65,363	–	74,015	10,168	102,900	–	113,068
2017	10,319	70,892	–	81,211	12,598	110,420	–	123,018

Note: The payload of the 20-ft reefer container is around 20 tons; the 40-ft reefer container is around 25 tons, and the 45-ft reefer container is around 29 tons.

Source: Port Authority of Thailand (2018).

2.5. The cold chain market in Thailand

This section consists of two parts: chilled and frozen transportation and cold warehouses. Both parts focus on the current business overview and the results obtained from interviews to provide an understanding of the cold chain market in Thailand.

Chilled and frozen transportation

Chilled and frozen transportation is a major activity that delivers raw materials and products to the production process or customers in good quality. According to the Department of Business Development, as shown in Table 2.16, active companies that provide chilled and frozen transportation by road numbered 51 companies with a total registered capital of B122 million

in 2019. Four companies had foreign joint investment and the other companies were local companies. There was significant annual growth in total revenue of 43% from 2015 to 2016. It is possible that chilled and frozen transportation will grow significantly in the future.

Table 2.16: Overview of the Chilled and Frozen Transportation Business Group in 2019

Business Profile	Detail
Active company	51 companies
Registered capital	B122 million
Joint investment	**Foreign:** 4 companies (8%) **Local:** 47 companies (92%)
Revenue of active companies	**Year 2015:** B3.31 million **Year 2016:** B6.36 million **Year 2017:** B6.03 million

Note: Data as of 24 January 2019, business code: 49331.

Source: Department of Business Development (2019).

Table 17 presents the number of cold transport operators in Thailand by vehicle type. Most operators use a refrigerated mini truck, which accounts for 96%, including those with a tail lift and without tail lift at 23% and 72%, respectively. The other types (trailer and semi-trailer) only comprise 5%, implying that the refrigerated mini truck is the most common vehicle.

Table 2.17: Number of Refrigerated Vehicles Operators in 2019

Vehicle Type	Number of Operators
Refrigerated trailer	8
Tail-lift refrigerated semi-trailer	4
Refrigerated semi-trailer	3
Refrigerated mini truck	244
Tail-lift refrigerated mini truck	79
Total	**338**

Note: Data of cold transport companies that were certified Q-Mark by Department of Land Transport in Thailand.

Source: Department of Land Transport (2019).

According to an interview with a small-scale logistics provider who operates chilled and frozen transportation and makes body trucks, the proportion of frozen and chilled trucks accounts for

83.5% and 16.5%, respectively. There are two types of vehicle, which are six-wheel and ten-wheel trucks. The purchase price of a new six-wheel one starts from B2.10 million to B2.50 million; the ten-wheel one is around B3.5 million to B4.1 million. In addition, second-hand trucks are also in use, with a price for a six-wheel from B0.85 million to B1.2 million, and ten-wheel from B1.50 million to B2.20 million.

Thailand also has a tool to promote a level of service in freight transport, known as the service quality standard for truck operation, or Q Mark. If operators have already registered their vehicle with the Department of Land Transport (DLT), they can voluntarily request the DLT to certify for the Q Mark certificate. Furthermore, DLT has implemented a Q Cold Chain program, which is an extended standard of the Q mark, to enhance the quality of transportation of agricultural and food products. The Q Cold Chain is about setting up a common quality standard of temperature-controlled transport. The Q mark statistics, however, are not published at present. If the related body improves their data collecting methods and makes them open to the public, this will be a great benefit in the future.

The cold warehouse

In 2015, the total capacity of both public and private warehouses in Thailand was approximately 18.62 million metric tons. Conventional warehouses were dominant, accounting for 82%, while silo and cold storages were around 13% and 5%, respectively, as shown in Table 2.18 below.

Table 2.18: Capacity of Warehouse, Silo, and Cold Storage in 2015 (million metric tons)

Type	Warehouse	Silo	Cold Storage	Total
Private	9.52	0.62	0.18	10.33
Public	5.81	1.73	0.76	8.30
Total	**15.33**	**2.35**	**0.94**	**18.62**

Source: Transportation Institute Chulalongkorn University cited from the Department of Internal Trade (2015).

Moving on to the number of operators, half of them were warehouses, cold storage was about 34%, and silos were 12%, as shown in Table 2.19. When compared to the capacity of cold storage, it is implied that each operator has a little capacity.

Table 2.19: The Number of Total Warehouse, Silo, and Cold Storage Operators in 2019

Type	Number of Operators
Warehouse	976
Silo	226
Cold Storage	632
Total	**1,834**

Note: Data as of January 2019.

Source: Department of Internal Trade (2019).

There are 165 active companies with a registered capital of B10,218 million. Of these, 13% are foreign joint ventures, and the rest are local companies. The nations that jointly invest the most in Thai companies are Japan and China. The revenue of this business group decreased by approximately 9% per year from 2015 to 2017. The details are shown in Table 2.20.

Table 2.20: Overview of the Cold Warehouse Business Group in 2019

Business Profile	Detail
Active company	165 companies
Registered capital	B10,218 million
Joint investment	**Foreign:** 23 companies (13%) **Local:** 142 companies (87%)
Revenue of active companies	**Year 2015:** 20.77 million baht **Year 2016:** 17.32 million baht **Year 2017:** 17.60 million baht

Note: Data as of 24 January 2019, Business Code: 52101.

Source: Department of Business Development (2019).

As seen in interviews with the companies, there are variations in the capacity and size of the companies. In the case of the frozen seafood exporter sample, the area was 36,705 square meters with a maximum weight of 15,412 tons, while the space of the cold chain logistics provider sample was 4,788 square meters with a weight of 3,320 tons. In this context, the cold

chain logistics provider is a company that provides controlled-temperature transport. Table 2.21 shows that the area and the capacity of the logistics provider are higher than the frozen seafood exporter.

Table 2.21: Details of the Cold Warehouses from Respondents in 2019

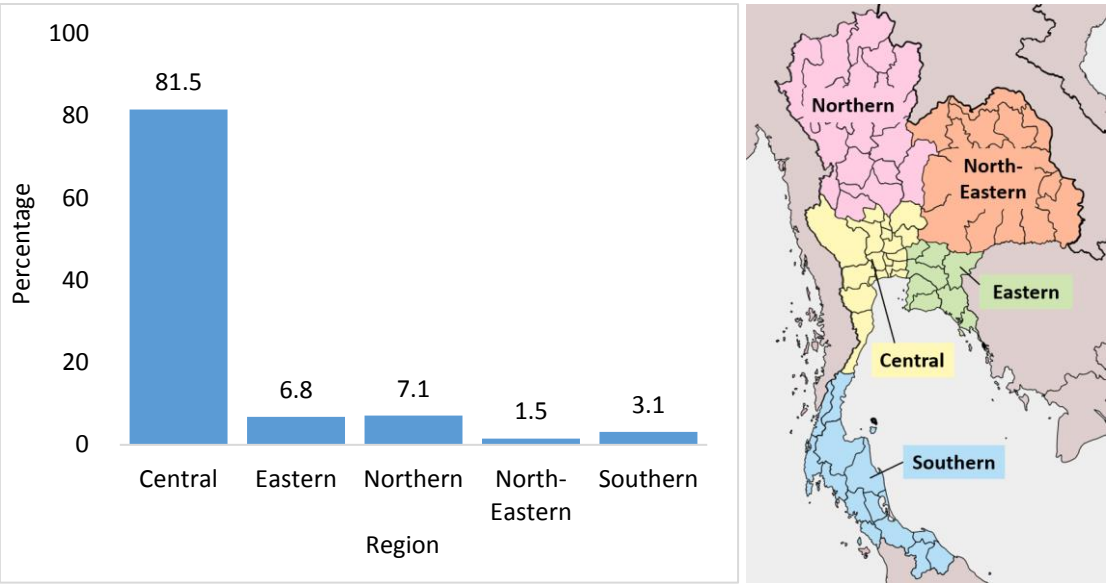
Detail	Chilled	Frozen	Ambient	Total
The frozen seafood exporter				
Area (Sq. metres)	1,186	2,655	947	4,788
Capacity (tons)	824	1,844	652	3,320
Cold chain logistics provider				
Area (sq. metres)	–	12,385	24,320	36,705
Capacity (tons)	–	4,377	11,035	15,412

Source:-Authors.

The main technology used in the company is the systems, applications, and products (SAP) system and Warehouse Management Software (WMS) program to control stocks. The system's function is to allow the organisation to manage the business operations across procurement, financial, inventory, manufacturing, and relating activities. In addition to the SAP, the internal organisation is able to share related information within the organisation as well. Similarly, the WMS facilitates users to manage stocks efficiently and is compatible with a barcode system.

According to the geographical warehouse data in Figure 2.2, cold warehouses are mainly in the Central part; then the North and the South in Thailand. The Central region is the commercial area because it is near a source of production and international ports. The Central region has a number of cold storage facilities and chilled and frozen transport services that can facilitate cold chain production, import, and export. Furthermore, the cold warehouse will increase significantly in 10 years, especially in the Northeastern region (Transportation Institute Chulalongkorn University, 2015).

Figure 2.2: The Capacity of Cold Storage in Thailand by Region



Source: Transportation Institute Chulalongkorn University (2015).

In conclusion, the number of registered cold chain businesses in Thailand is low, both in the transport and warehouse industries. For cold chain transport, a refrigerated mini truck is a common vehicle. Meanwhile, the capacity of cold storage is less than the warehouse largely, and most of the storage is located in the Central part of Thailand. This is because the main ports that are shipment hubs are located mostly in the Central part. For more on the business model overview of the cold chain, the next section will consider the process of each stakeholder from upstream to downstream.

2.6. A business model of the cold chain

There are various types of enterprises or companies that need temperature control in their operations. These are the stakeholders of the cold chain. The research plan separates stakeholders into three groups for the interview. The stakeholder groups are representatives of parts in the chain from upstream to downstream, including producers, logistics providers, and traders. Each group has a different core operation.

Business model overview

The information from the interview shows how each type of stakeholder needs temperature control and demonstrates the business model of the cold chain in Thailand. An overview of the business model will be described in three topics consistent with the stakeholder group as follows.

- Producer

The producer is in the upstream part on the chain and is the agriculturist and food manufacturing industry that produces agricultural products. The agriculturist is a first producer, such as a farmer, fisherman, or rancher. They are responsible for producing, harvesting, and collecting supplies of fruits, vegetables, aquatic animals, and livestock for manufacturing. The manufacturer is the next producer receiving the supply from the agriculturist, who then processes it into a processed and final product.

Thai Union Group PCL is a representative sample of the producer group as a large producer due to having numerous subsidiaries and associated companies domestically and internationally. The subsidiaries and associated companies are Thai Ruamsin Patana Industry Co., Ltd., Songkla Canning PCL., Okeanos Food Co., Ltd., Chicken of the Sea brand, King Oscar brand, John West brand, and other subsidiary companies. The principal factory is located in Samutsakorn province. The factory mainly produces canned tuna, pouch tuna, and canned sardines.

The cold chain is necessary for manufacturing for preserving the input supply in transportation from the shore and customs to the factory and keeping them in cold storage during the production process. The main input supply, which is fish, mainly comes from the Republic of Korea, Japan, and Taiwan. The company mostly uses factory-owned normal temperature trucks. As the fish supply is usually frozen as a pack of ice at the boat at the origin, the factory typically keeps a supply in their cold storage. However, the factory uses third-party logistics companies (3PLs) in oversupply periods. At that time, the supply is greater than the capability of the trucks and cold storage. The selection criteria for the 3PLs are quality of service, price, responsibility, and traceability. The expectations of the 3PLs are timeliness, accuracy, and completeness. The factory emphasises human resource development by training on transportation and product management both for normal and temperature-controlled products. Moreover, the factory also creates the work instructions in various languages for the nationalities of its labour force to

ensure understanding. This affects the accuracy of their work. Additionally, the company is working with local fishermen to support them.

- Logistics provider

The logistics provider is in the midstream part of the chain. They provide transportation and warehouse services. The core business of transportation is providing the service of sending a supply, material, or product between the producer, warehouse, distribution centre, shipment, and customer. Also, the core business of the warehouse is the service of storage of products for producers and traders that do not have suitable space or warehouses to store their products.

Representative samples of the logistics provider group are Rujoran Transport Co., Ltd. as a small provider, Eagles Air & Sea Co., Ltd. and CTI Logistics Co., Ltd. as a medium provider. The size of the enterprises tells us the capital size, which indicates the capacity of the service operations. The logistics providers have different kind of services, such as trucks and warehouses in various temperatures, such as ordinary temperatures, refrigerating, and freezing. Even though the type of service does not depend on the enterprise size, the cost of temperature-controlled trucks and warehouses are higher than ordinary ones.

The logistics providers are usually located in the city centre, manufacturing area, border, sea-river port, airport, or other significant locations. They typically make contracts with large traders. Standards are essential to the logistics provider as a guarantee of their services. Thus, they are incentivised to make their services along with the standards that are required by the client and authority. The client requires standards for the contract, while the authority requires standards as a regulation. The standards control and regulate hygiene, laws, driver qualifications, and necessary technology, such as temperature controllers and GPS. Nowadays, most of the trucks used in transporting goods are location traceable by GPS and have temperature traceability. They are controlled and operated by well-trained staff.

- Trader

The trader is in the downstream part of the chain. Moreover, it is the closest group to the consumer as the core business of the trader is selling products to the consumer directly. The

traders are modern traders, shops, restaurants, and producers that sell their products to the consumer without an intermediary. The products that traders sell are final products, semi-finished products, ready to cook products, ready to eat products, and other consumable products.

Harmony Life International Co., Ltd. is the representative sample of the trader group as a medium trader. The company has owned an organic farm in Nakhon Ratchasima province. The products of the company are fresh vegetables and processed products, such as herbal tea, noodles, jams, soaps, and other goods. The products are mainly sold domestically at their shop and restaurant in Bangkok, called Sustaina Organic Shop Restaurant. Also, they send products to other modern trade shelves, such as Big C, Lotus, the mall, Tops Supermarket, and local health shops. Moreover, their noodle product is an ingredient for the MK restaurant. The company mainly exports herbal tea, spice, and processed organic product to Singapore, Hong Kong, Taiwan, and the United States.

Their temperature-controlled products are fresh vegetables and jams. Thus, the company only uses a company-owned truck to transport their products domestically from the farm to their warehouses, offices, restaurants, and partners' places in Bangkok. There are two zones separately in their warehouse; the normal temperature zone and chilled zone. The company uses large freight forwarders as 3PLs for transporting unperishable products. The selection criteria for 3PLs are hygiene, timeliness, accuracy, and safety. The company is exceedingly concerned about their products. Thus, they train staff to use trucks and storage that are both normal and temperature controlled.

The above are details of each type of business model that is obviously connected by temperature control. Next will be a discussion on its connection.

Connection of the cold chain

The cold chain connects stakeholders by temperature control in different ways due to the different core operations of each stakeholder as a tool to maintain the condition of supply from the origin to the end of the chain.

The temperature control process properly begins at the farm or in the middle of the ocean right after the supply is picked up from its origin, to maintain the original condition as much as possible. Then, it is sent to a receiver, who has an influence on valuing and pricing the supply. A supply in good condition gets high compensation or payment. The receivers could be the manufacturing industry, warehouses, distribution centres, traders, or consumers.

The manufacturing industry receives materials supply as an input. It is then processed into an output, which is the processed and final product. While waiting for processing and sending, they keep the supply and product in the cold storage. After the process ends, they send the output to the warehouse, distribution centre, trader, and consumer. The trader receives the processed and final food product from the producer. They keep the products in cold storage for stocking. They put the products on a temperature-controlled shelf to display and wait for selling to the consumer.

Temperature-controlled transportation and warehouses are intermediate in the chain. Thus, they are in the middle between stakeholders. The operator of the transportation and warehouse could be the producer, trader, or logistics provider depending on the deal and contract since some producers and traders play the transportation and warehouse operator roles at times. This is to support their core operations, unlike the logistics provider, whose core business is providing transportation and warehouse services. The producers and traders that own numerous temperature-controlled transportation and warehouse facilities are mostly large- and medium-sized as the standard temperature control needs high capital or investment and operation. Thus, they only use 3PLs when there is an oversupply for their capacity.

Because of the high investment costs in the chain, stakeholders are finding ways to reduce the operating costs. In the case of a farm, the farmer tends to have temperature control by using natural cold weather at night and dawn and protects the supply with leaves to save costs. In addition, stakeholders reduce their costs by taking advantage of locations by building an office, manufacturing, distribution centre, and warehouse near the origin of supply, infrastructure facility, and customers.

This describes the connection of the cold chain, which shows that each stakeholder could play more than one role. Each part in the chain adds value to the product by processes. Thus, the consumer at the end of the chain can get the product from stakeholders who are playing in any

part of the chain, such as farmers, factory shops, modern traders, restaurants, and others, depending on their needs on the value of commodities.

Main players and users of the cold chain

The interviewees provided the names of player and user companies of the cold chain in Thailand, such as JWD, SCG, the Heritage, Harpers, Excel, and other companies. Also, the research team studied the Data Warehouse of the Department of Business Development (DBD) to find the main players and users of the chain. The methods focused on sorting the revenue which is declared in the financial budget together with the business type reported by registered legal persons in the latest year.

The DBD applies the Thailand Standard Industrial Classification (TSIC) from the Ministry of Labour, which referred to the United Nations Statistics Division's International Standard Industrial Classification (ISIC). This is a principle to establish a TSIC business code into 21 sections from A to U. Transportation and storage are in section H, which consists of the various types of businesses involved. However, this study focuses on road transport services of freight by refrigerator vehicles, which in H49331, and Refrigerated storage activities in H52101.

The road transport services of freight by refrigerator vehicles activity (H49331) refer to the main players of transportation in the chain as shown in Table 2.22. In 2017, this activity earned a total revenue of B587 million, and there are 29–56 operators declaring their revenue to the authority.

Table 2.22: Main Players of Transportation in the Cold Chain

Order[1]	Legal Person Name	Legal Person Type[2]	Size[3]	Location (Province)	Revenue (baht)[4]	Proportion[5] (%)
1	P.M. Distribution	Co., Ltd.	S	Nonthaburi	128,898,353	21.97
2	Paramee Logistics	Co., Ltd.	S	Chiang Mai	111,788,683	19.05
3	2299 Trading	Co., Ltd.	S	Chiang Mai	68,766,000	11.72
4	Konoike Asia (Thailand)	Co., Ltd.	S	Samut Prakan	48,861,610	8.33
5	3G Shipping Agent	P'ship. Ltd.	S	Surat Thani	40,529,740	6.91
6	Pattara Logistics	Co., Ltd.	S	Bangkok	32,356,394	5.52
7	Teerasak Transport	P'ship. Ltd.	S	Bangkok	26,119,970	4.45

Order[1]	Legal Person Name	Legal Person Type[2]	Size[3]	Location (Province)	Revenue (baht)[4]	Proportion[5] (%)
8	R.P.A.168 Transport	P'ship. Ltd.	S	Nakhon Pathom	21,996,194	3.75
9	NTP Fishery Enterprise	Co., Ltd.	S	Phangnga	15,602,885	2.66
10	Lan Ya Mo Transport	P'ship. Ltd.	S	Saraburi	13,709,878	2.34

Note: 1. Order by revenue sorting in the same business from large to small amounts, 2. Co., Ltd.: Company Limited, P'ship. Ltd: Partnership Limited, 3. Classified by DBD referred to criteria in Appendix: Table A.1., 4. The revenue of 2017, 5. The Proportion of the legal person's revenue to total revenue of the business (%). Data as of 1 March 2019.

Source: Department of Business Development (2019), and Bank of Thailand (2019).

The main players in cold storage as shown in Table 2.23, are the refrigerated storage activities (H52101). In 2017, total revenue was 8,355 million baht, and there are125 of 168 operators that declared their revenue to the authority.

Table 2.23: Main Players of Storage in the Cold Chain

Order[1]	Legal Person Name	Legal Person Type[2]	Size[3]	Location (Province)	Revenue (baht)[4]	Proportion[5] (%)
1	Chiangmai Frozen Foods	Pub. Co., Ltd.	L	Bangkok	1,407,707,964	16.85
2	Bangkok Seafood	Co., Ltd.	L	Samut Sakhon	832,099,337	9.96
3	Pacific Cold Storage	Co., Ltd.	L	Samut Sakhon	581,400,591	6.96
4	Thai Yokorei	Co., Ltd.	L	Bangkok	459,649,107	5.50
5	JWD Pacific	Co., Ltd.	M	Bangkok	268,884,471	3.22
6	Piti Center Cold Storage	Co., Ltd.	L	Ayutthaya	227,605,624	2.72
7	Bangkok Cold Storage Service	Co., Ltd.	L	Samut Prakan	225,554,787	2.70
8	Thai Max Cold Storage	Co., Ltd.	L	Samut Prakan	204,587,773	2.45
9	Thepmanee Cold Storage (Mahachai)	Co., Ltd.	M	Bangkok	191,135,459	2.29
10	Konoike Cool Logistics (Thailand)	Co., Ltd.	L	Samut Prakan	176,967,353	2.12

Note: 1. Ordered by revenue in the same business from large to small amounts; 2. Pub. Co., Ltd.: Public Company Limited, Co., Ltd.: Company Limited; 3. Classified by DBD referring to criteria in Appendix: Table A.1.; 4. Revenue for 2017; 5. The proportion of the legal person's revenue to total revenue of the business (%). Data as of 1 March 2019.

Source: Department of Business Development (2019), and Bank of Thailand (2011).

Regarding the mentioned main players by interviewees and the report from the Data Warehouse, it appears that the common main players are JWD Pacific (5) and Pacific Cold Storage (3). They are subsidiaries of JWD InfoLogistics Public Company Limited, as shown in their Annual Report 2018. Therefore, the research team explored the cold chain clients of JWD InfoLogistics as shown on their website to demonstrate the main users of the chain in Table 2.24.

Table 2.24: Main Users in Cold Chain, Clients of JWD InfoLogistics

Legal Person Name[1]	Legal Person Type[2]	Size[3]	Location	TSIC Business Code[4]	Business Type[4]	Registered LP.[5]	Revenue Declared LP.[5]	Legal Person Revenue[4,6]	Total Revenue in the Business(baht) [6]	Proportion[7] (%)	Order[8]
Kingfisher Holding	Co., Ltd.	L	Bangkok	C10210	Processing and preserving of fish and fish products, fresh, chilled or frozen	8	7	1,677,278,789	6,192,548,417	27.09	2
DuckKing	Co., Ltd.	M	Chacho-engsao	C10120	Slaughtering and packing of poultry	65	55	1,483,992,727	115,305,598,946	1.29	14
Kibun (Thailand)	Co., Ltd.	L	Bangkok	C10292	Manufacture of fish, crustaceans and molluscs sausages, ball and other similar products	29	20	2,112,544,969	6,809,262,623	31.02	5
Uni-President (Thailand)	Co., Ltd.	L	Bangkok	C10303	Manufacture of fruit or vegetable juices	265	213	1,812,713,612	20,242,452,223	8.96	5
Thai Union Group	Pub. Co., Ltd.	L	Samut Sakhon	C10751	Manufacture of frozen prepared meals and dishes	132	81	27,547,974,282	66,520,650,597	41.41	1
C.P. Group: CPF (Thailand)	Pub. Co., Ltd.	L	Bangkok	C10802	Manufacture of prepared feeds for farm animals	299	214	139,997,608,000	393,894,362,839	35.54	1
C.P. Group: Charoen Pokphand Foods	Pub. Co., Ltd.	L	Bangkok	C10802	Manufacture of prepared feeds for farm animals	299	214	45,825,743,000	393,894,362,839	11.63	2
Betagro	Pub. Co., Ltd.	L	Bangkok	C10802	Manufacture of prepared feeds for farm animals	299	214	43,233,729,269	393,894,362,839	10.98	3
Siam Winery	Co., Ltd.	L	Samut Sakhon	C11029	Manufacture of other wines	71	51	3,080,826,981	3,319,177,947	92.82	1
Maruha Nichiro (Thailand)	Co., Ltd.	S	Bangkok	G46312	Wholesale of fish and fish products	876	523	531,448,100	56,218,014,232	0.95	19
Thai Green Nation Corporation	Co., Ltd.	S	Bangkok	G46319	Wholesale of other food products	3,462	2,013	510,235,552	200,004,465,549	0.26	61
Sea Value	Pub. Co., Ltd.	L	Samut Sakhon	G46109	Wholesale on a fee or contract basis of a variety of goods	6,120	3,316	137,238,240	38,764,497,720	0.01	651
Damco Logistics (Thailand)	Co., Ltd.	S	Bangkok	H52292	Freight forwarding and customs agent activities	3,616	2,460	1,643,840,386	92,274,544,852	1.78	9
The Minor Food Group	Pub. Co., Ltd.	L	Bangkok	I56101	Restaurants activities	13,874	7,761	5,370,712,446	215,511,144,881	2.49	8

Note: 1. Legal Person data is general data for public services and cannot be used for reference in a law; 2. Pub. Co., Ltd.: Public Company Limited, Co., Ltd.: Company Limited.; 3. Classified by DBD referring to criteria in Appendix: Table A.1.; 4. Collected from the financial budget report that the legal person declared in the latest year; 5. The number of registered legal persons with operating status; 6. Revenue for 2017; 7. The proportion of the legal person's revenue to the total revenue of the business (%); 8. Ordered by revenue in the same business from large to small amount. Data as of 3–4 March 2019. Source: Department of Business Development (2019) and Bank of Thailand (2011).

The main players mentioned above are Betagro, CPF, Kingfisher, Thai Union, and Sea Value, which correlate with key players in the food processing companies in Thailand's food industry as reported by BOI (2017b). The main users mostly are large-size enterprises for the main players of cold storage. Meanwhile, the main players of temperature-controlled trucks are small-sized enterprises. This conforms to the interview that mentioned that large transportation providers make subcontracts with small and medium logistics providers. This is how the different size players support each other to serve the demand for services from users, which is continuing to rise as shown in the demand for cold chain logistics. Moreover, it could imply that cold storage needs a higher investment cost than temperature-controlled trucks.

A considerable amount of Thai and foreign investment by users gives more opportunities to the players, especially the small and medium players. In addition, the opportunity and support to solve problems and overcome obstacles may encourage these companies to be more successful and grow to be large companies in the future.

2.7. Expectations of government policy

There are numerous Thai government agencies involved in providing comprehensive policies to support the cold chain. The agencies separately work on their mission and plan to consult, promote, and provide services for the entire cold chain's stakeholders. This section will discuss the cold chain policies in terms of regulation and support in three parts: regulatory policy, supporting policy, and private sector networking. The main ideas are according to the survey interviews given by the stakeholders' perceptions.

Regulatory policy

There is no specific agency responsible for the cold chain. However, there are integrated policies to regulate the chain and unite the agencies for working together. There are main agencies that take the core responsibility and there is a committee from other agencies involved. The regulatory policy regarding the cold chain was established with objectives to raise the standards and quality of the products. It enhances the competitiveness of enterprises. Moreover, it

ensures food safety and security. Examples of outstanding cold chain regulatory policy are the Q Cold Chain Standard project and the Warehouse, Silo, and Cold Storage Standard policy.

- The Q Cold Chain Standard Project

The DLT affiliated with the Ministry of Transport takes the core responsibility of the Q Cold Chain standard project. It is a further extended policy of the Quality Standard for Truck Operators, known as the Q Mark standard. The Q Mark standard for commercial vehicles is used in transport goods and products. The Q Cold Chain standard is a pilot plan tested in January 2019. Eligible in the pilot plan are Q Mark certified enterprises. They were evaluated by the draft of Quality Standards for Temperature Control Truck Operators. Logistics Time Magazine (2019) refers to the director of the DLT's statement and reveals that the objectives of this project are to develop the potential and create an opportunity of competitiveness for operators of temperature-controlled transportation to achieve higher efficiency and sustainability. The evaluation approach of the Q Cold Chain standard focuses on four key factors: the operation of transport, hygiene, the standards and maintenance of cold storage, and human resource development.

- Warehouse, silo, and cold storage policy

The Market System Promotion and Administration Division subordinate of the Department of Internal Trade affiliated with Ministry of Commerce takes the core responsibility regarding the Warehouse, Silo, and Cold Storage Act (2015). This act leads the division's work on issuing the standards for warehouse, silo, and cold storage. Moreover, the division is ordered to study, analyse, and provide advice to support and develop entrepreneurs to reach the standard. The standard helps to reduce the cost of waste and gain competitiveness. Also, the duty of this division includes the issuing and withdrawal of licences for operating, and it also regulates and controls warehouse, silo, and cold storage enterprises under the laws. The standard is now still at the department level, which is being administrated and pushed by the department to be at the national level in the near future. The national standard must be agreed by stakeholders in the country and administrated by a central organisation, which could be private or public. Currently, there are more than 100 operators certified by this standard. The certified operators consist of approximately 75% of Thai SMEs.

The mentioned regulatory policies are voluntary regulations. They contribute to positive results and consequences. However, there are still problems and obstacles that affect the stakeholders regarding regulatory policy enforcement, insufficiency of concrete support, and entrepreneur's administration and management. Details referring to the survey interviews are listed in seven categories as follows.

Human resources

- Lack of efficient human resources in cold chain operation.
- Small entrepreneurs and farmers rarely use cold storage to help in handling and seasonal value adding. Most of them sell agricultural products immediately after being harvested, due to liquidity necessity.
- Drivers have deficient English skills and legal knowledge for working across borders.

Operation costs

- Operation costs are high due to fluctuations in the gasoline price, but the logistics service price cannot be adjusted along with the gasoline price consistently.

Infrastructure

- The random product check area is not a temperature-controlled area, which causes discontinuities in products' temperature-controlling.
- Road construction causes congestion on roads. This affects delays in product delivery, especially cold chain products that are affected by timeliness.
- The delays may result in higher transportation costs and the disorder of management.
- Traffic jams in urban areas affect the timeliness of product transportation in many routes, such as factory–distribution centre, port–distribution centre, distribution centre–retail, and other routes.

Investment

- Cold storage and its facilities need high capital investment.
- There is uncovered special support by the Office of the Board of Investment (BOI) in terms of tax exemption for investment in temperature-controlled trucks and cold

storage. The BOI exemption depends on the investment amount/expenditure for enhancing competitiveness.

Customs

- The inconvenient and complicated import declaration process partly causes delays during the shipment process from the port to the factory in some cases.
- Clear numbers of export products, such as herbs, spices, and tea, are usually not consistent among staffs' discretion. The wasted time and loss of tax refund benefits the partners of exporters.

Institutional systems

- Certified enterprises get excessive examinations and regulations to achieve and maintain the certification. Meanwhile, some uncertified enterprises claim their products as organic. This makes it unequal for certified enterprises.
- There is a problem in collecting data on cold storage as some enterprises are not co-operating to reveal information.

Logistics prohibition

- For certain time periods, such as the new year holidays and Thai new year holiday (in April), the government has prohibited ten-wheeled trucks and more from providing transport services in five major routes to reduce accidents. If the transport operators want to use trucks in these periods, the operator must seek permission on a case-by-case basis. This affects the cold chain in terms of the lack of products on shelves in a regional area.

As can be seen, the problems and obstacles from the stakeholder's perspective are related to the concerned issues on the report of the Logistics Performance Index (World Bank, 2018) and the High Level Public–Private Forum on Cold Chain to Strengthen Agriculture & Food's Global Value Chain (Agricultural Technical Cooperation Working Group of APEC, 2015). Apart from that, hearing stakeholders' perspectives and expectations will be useful for further additional supporting policies.

Supporting policies

Regarding the problems and obstacles mentioned above, the entrepreneurs from the survey interviews are expecting the following supporting policies.

- Research for value-adding to cold chain products regarding accrediting qualifications and R&D development.
- Support small and medium-sized enterprises to participate in commodities trade fair exhibitions abroad. Regarding the high cost of participation, this support will enhance the competitiveness of SMEs in promoting their products.
- Approach and attract skilled staff working in the cold chain to solve the lack of human resources in the business.
- Achieve prompt road construction facilitates to improve the timeliness and costs of cold chain transportation products.
- Attract investment support for logistics SMEs in the cold chain, such as low-interest loans for purchasing temperature-controlled trucks and building cold storage.
- Regulation for the cold chain is necessary, but entrepreneurs think that more regulation will create more complications for their operation. Thus, entrepreneurs currently prefer supporting policies more than regulatory policies, especially for SMEs.
- Plans for handling unexpected situations, for example airport disruptions for trading and transportation, particularly cold chain products that matter by the hour.
- Need a specific agency to support the cold chain, especially SMEs. This can be a group of government staff, government outsourcing, cooperation between government agencies, finance organisations, or the private sector.
- Require more convenient customs processes, such as e-payments and e-documents for simplicity and speed of operations.
- Consider building resting spots for truck drivers so they can take a rest. That may help to reduce the accident rate and human resource cost.
- Intense investigation and control of uncertified standard enterprises and products to prevent impersonation and falsifications.

Most of the expected policies are recognised and emphasised by the government. This can be seen in Table 2.25, which refers to seven categories of problems and obstacles.

Table 2.25: Policies Supporting the Cold Chain in Thailand

Problems and Obstacles	Supporting Policy
1. Human resources	● Thailand Professional Qualification Institute is a public organisation coordinated between the private and public sectors. The institute creates frameworks and evaluation criteria to standardise each level of professional qualification. In addition, it strengthens all occupation groups to make their standards a reference for human resources development in each group. Its aims are improving the Thai workforce's competitiveness in terms of skill and knowledge and preparing the workforce to meet the market's qualification requirements (Thailand Professional Qualification Institute, n.d.). According to the interviews, currently, the Thai Federation on Logistics, the Ministry of Internal Trade, and network companies are participating in developing the professional cold chain course.
2. Operation costs	● The Fuel Fund is a fund for solving oil and gas problems organised by the Energy Fund Administration Institute. The aim is ensuring a beneficial outcome for all stakeholders, especially low-income citizens, as Thailand is a fuel importer that is unable to adjust fuel price, and fuel price is naturally fluctuating. (Energy Fund Administration Institute, n.d.) (General Prayut Chan-o-cha, 2014)
3. Infrastructure	● The Eastern Economic Corridor (EEC) is a strategic plan under Thailand's economic model called Thailand 4.0. The EEC is an area of development that extends from the Eastern Seaboard Development Program. The main objective of this plan is the incentive to investment which upgrades Thailand's industries and leads to Thailand's economic growth in the long term. The Infrastructure Development Implementation program is one of eight programs in the plan. It focuses on development and introducing seamless transportation. The approach provides the necessary linkages for air, land, rail, and sea routes. The outcome supports transportation in terms of cost and time reduction. (Eastern Economic Corridor, n.d.)
4. Investment	● The BOI is a government agency responsible for incentive investment, both inbound and outbound. The aim is enhancing Thailand's competitiveness and overcoming the 'middle-income trap' and sustainable growth challenges to Thailand's competitiveness. The approach is or incentive investments that are tax incentives and non-tax incentives. Tax Incentives are exemptions from income tax and reductions in duties for specific materials and machinery with conditions. Non-tax incentives are related to permission for ownership for foreign investors and bringing skilled experts into the kingdom. (BOI, n.d.)
5. Customs	● The National Single Window (NSW) is a policy organised by the sub-committee of the National Logistics Development Committee. The NSW facilitates electronic data and information sharing. Moreover, it is integrated between government to government partnerships (G2G), government to business partnerships (G2B) and business to business partnerships (B2B). Its goals are reducing the national logistics cost, increasing competitiveness, facilitating inland and cross border goods' transportation, and supporting import, export, and logistics. (Thai Customs Department, n.d.)

Problems and Obstacles	Supporting Policy
	● Port Community System development at Laemchabang Port, Bangkok Port, and Suvarnabhumi International Airport, this project is under the Strategy Plan for Logistics Development. The objectives of this project are setting the main system to administrate and manage products and container status traceability, certification documents and license examination, transaction, products, and containers moving permission in electronic form. (Phensawang, 2018)
6. Institutional systems	● The SMEs Promotion Act established the Office of SMEs Promotion (OSMEP) in 2001 as a government agency. The office's responsibility is coordinating the working system and leading policy to promote SMEs, focusing on issues such as the following: - Improve laws and regulations for SMEs according to the SMEs Promotion Master Plan and SMEs Promotion Action Plan - Ensure the achievement of SME operation for both public and private sectors, domestically and internationally - Develop knowledge and databases for SMEs as policy recommendations and promotion (Office of SMEs Promotion, n.d.a)
7. Logistics prohibition	● Reliability of the logistics system is part of the approach of Thailand's logistics development stated by NESDC. The reliable approach is public relations, obstacle adjustment to international trade, and risk management, as detailed as follows: - Public relations: participating in international logistics seminars for present significant logistics development and increasing public relations channels, such as making media projects and the Strategy Plan. - Obstacle adjustment to international trade: Government to government trade negotiations, such as cross-border transport agreements, bilateral free trade negotiations, and trade facilitation agreements. - Risk management: Plan for handling unusual situations for continuous operations, such as political, natural disaster, and neighbouring country policy changes. (NESDC, 2018a)

Sources: See citations in this table.

This may imply that those policies are unrecognised or inaccessible by stakeholders. Meanwhile, some supporting policies are planned for further adoption. Apart from the policy regulation and support, the private sector networking of the entrepreneurs in the businesses can help reduce problems and obstacles. This can lead to development by giving practical information, negotiations, and the network's agreement to policymakers.

Private sector networking

Apart from the policies, government agencies have been encouraging entrepreneurs to gather as groups, associations, federations, unions, cooperatives, and other networks. However, some of them are driven to gather by entrepreneurs themselves. The main objectives of networking are connecting and empowering enterprises in the same business. Examples of interesting private sector networking in the cold chain are the Thai Federation on Logistics and the Warehouse, Silo, and Cold Storage Association.

- The Thai Federation on Logistics

The Thai Federation on Logistics (2010) narrated their history and was founded to be responsible for the national logistics development of the private sector in 2004 by a recommendation from the Thai Chamber of Commerce and the Thai National Shippers' in the national seminar of the Chamber of Commerce. The aims of its founding are to enhance efficiency and the concrete benefits of Thailand logistics. The federation was founded from a cooperative between organisations that perceives the importance of the logistics role for the nation's development. In addition, it is equipped with the intention to improve the quality of the logistics system concerning equality and competitiveness in the international market. The federation consists of 16 organisations, which are listed in Table 2.26.

Table 2.26: Organizations Comprising the Thai Federation on Logistics

1	Thai National Shippers' Council
2	The Thai Chamber of Commerce
3	The Federation of Thai Industries
4	The Thai Bankers' Association
5	Thai International Freight Forwarders Association
6	Bangkok Shipowners and Agents Association
7	Thai Airfreight Forwarders Association
8	Thai International Cargo and Container Terminals Association
9	Thai Shipowners' Association
10	Thai Authorized Customs Brokers Association
11	Thai Transportation & Logistics Association
12	Association of Thai Software Industry
13	Thai Logistics and Production Society
14	Foundation of Logistics and Transportation (Thailand)
15	Supply Chain Management Association of Thailand
16	Airline Cargo Business Association

Source: Thai Federation on Logistics (2010).

- The Warehouse, Silo, and Cold Storage Association

The Warehouse, Silo and Cold Storage Association is a non-governmental organisation. The association was founded in 2008 by five leading companies: Chainavee Coldstorage Co., Ltd., Nim See Seng Cold Storage Co., Ltd., Passapop 999 Co., Ltd., CTI Co., Ltd., and Tong Hua Buayai Co., Ltd. The association was approved as a registered association under the Trade Association Act (1966) with excellent support from the Department of Internal Trade. The main objectives of the association are promoting, supporting, and developing the warehouse, silo, and cold storage business. An election is conducted every two years by members to decide the management committee of the association (Thai Franchise Center, 2014). An interview with the Director of Promotion and Market Mechanism Development Unit, the Department of Internal Trade revealed that nowadays, members of the association comprise approximately 50% of registered enterprises in the warehouse, silo, and cold storage business. Most of the members are SMEs. The department plans to convince more enterprises to participate in the future, especially, large enterprises. The department is open to listening to voices from the association and other entrepreneurs in the business, especially in the process of deciding on the policy that affects them.

Networking leads to developments. It helps to strengthen bargaining power with superior power organisations concerning policy and finance, such as governments and clients. The benefits of networking provide more advantages to small size enterprises than large size ones. This relates to the study on the Participation in Development by Goulet (1989). Thus, the networking of enterprises cooperating with supervision support from policymakers will drive efficient development.

In conclusion, policies play a dominant role in providing support and enforcing regulations to the cold chain. Moreover, private sector networking strengthens it. Hence, regulation, support, and private sector networking are essential factors for cold chain development.

2.8. Conclusion

After collecting primary data by interviewing five enterprises, two government agencies, and one federation, and secondary data by conducting research on useful sources, the result appears that Thailand has potential in the temperature-controlled food value chain, which is the cold

chain. However, there are strengths to be enhanced, a weakness to erase, an opportunity to reach, and a threat to eliminate.

The strength is the advantage of the country's location, a growing economy, competitive human capital, infrastructure, and strong government support. This is implied by a rising GDP and FDI growth rate, the flow of skilled labour over the AEC, the construction of international infrastructure networks, and planning for development under the 20-year national strategy framework and Thailand 4.0 model. These strengths aim to promote Thailand to be a nation of stability, prosperity, and sustainability, and a developed country according to the Sufficiency-Economy philosophy, which is propelled by innovations. They encourage Thailand to be a gateway to massive food demand in the region, a destination of investment, and a kitchen of the world. The strengths also support the cold chain potential of the country. As evidenced by the LPI, Thailand is a logistics friendly country, and it has occupied the 2nd rank in ASEAN and 32nd among 160 countries. Also, the value of the total logistics cost was expected to continue to increase to B2,125 billion in 2017, which means a rise in demand for logistics. Moreover, 338 certificated temperature-controlled truck operators and 632 cold storage operators are serving demand domestically and internationally.

The rising demand for food products that induces demand for cold chain logistics is an interesting opportunity. From 2013–2018, the cold chain's import growth rate was 4.78%, and the export rate was increasing at 2.44%. In 2018, the import value of cold chain products was B331,261.48 million, while the export value was B509,779.07 million. The highest value of imports was for pharmaceutical products, while canned and processed food products, including fruits, vegetables, and seafood had the highest value of exports. Stakeholders of the chain have been getting benefits from this opportunity. The stakeholders that are the main players of cold storage and the main users of cold chain logistics are large-size entrepreneurs, while the main players of the temperature-controlled trucks are small enterprises, which make subcontracts with the large players. Thus, more investment in the cold chain provides many opportunities for players and users, especially the main players, which are the SMEs.

The high cost of logistics is evidently a weakness of the cold chain in Thailand. In 2017, the logistics cost to nominal GDP was 13.9%, which was higher than Asia's average (12.7%) and the international average (10.9%). However, Thailand's cost has been decreasing over the years.

This is because stakeholders are finding ways to reduce it by taking advantage of natural cold weather at night and dawn and locating near suppliers and consumers.

Examples of threats or obstacles to the cold chain in Thailand mentioned by stakeholders from the interviews were insufficient and inefficient of skilled human resources, infrastructure, institutional systems, customs, and investment. The expectations on supporting policy regarding those obstacles included R&D development for adding value to cold chain products, supporting small and medium-sized enterprises to participate in the trade fair, and making skilled human resources. Others included low interest for investment, plans for handling the unexpected situations, specific agencies to support the cold chain, more convenient customs processes, and resting spots for truck drivers. In addition, uncertified standard enterprises may cause low-quality products due to intense investigation and control. Most of the expectations are currently noted and emphasised by the government. The outstanding regulatory policies are the Q Cold Chain Standard Project and Warehouse, Silo and Cold Storage Policy, which is a voluntary regulation.

Examples of supporting policies that affect the cold chain are developing the professional cold chain course of the Thailand Professional Qualification Institute and infrastructure development of Eastern Economic Corridor. In addition, incentive investments of the Office of the Board of Investment, the National Single Window (NSW), the Office of SME Promotion, and Logistics Development Plan would be favourable, as well as private sector networking to engage the benefits of activities in the business. However, some policies are unrecognised or inaccessible by the stakeholders. Meanwhile, some supporting policies are in the plans for further adoption. Also, the private sector networking of enterprises cooperating with supervision support by the policymakers and proper regulation will drive efficient development. Outstanding private sector networks are the Thai Federation on Logistics and the Warehouse, Silo and Cold Storage Association.

Regarding the study, there are issues and suggestions that may encourage the cold chain's utilisation and development. They may be useful to policymakers for considering supporting the stakeholders and consumers:

- Educate consumers to realise the nutritional value of varieties of food and how the cold chain works for them, especially the utilisation of traceability.
- Encourage consumers to classify products among certified standards products and normal products to prevent confusion between certified and uncertified standards products. For example, nowadays many consumers are confused about organics vegetables and hydroponic vegetables.
- Establish a specific organisation to support stakeholders in the cold chain. Due to the current situation, numerous agencies are taking part in it. Thus, the specific organisation will be a one-stop service, which would reduce the cost of time and processes of the cold chain operation. Moreover, it will stimulate the fast growth of development.
- Save costs through resource management and through sharing. Separating resources in temperature-controlled trucks and cold storage into various temperature zones to handle more than one type of product at a time could save operation costs. For example, in one trip, a truck could carry many kinds of products that need a different temperature to control. In addition, sharing the resources with other companies will make a value backhaul and prevent from a trailer from being empty, known as “deadhead”.

The cold chain utilization and development provide benefits to the cold chain stakeholders as financial compensation, primarily to SMEs, especially agriculturists. They are in the upstream part of the chain and usually struggle with financial problems and seasonal fluctuations. The cold chain value-adds their products so they can get higher returns, which helps to reduce poverty. Consumers also get the benefits of cold chain utilisation and development in terms of better life quality regarding food accessibility, availability, utilisation, and stability for food security. This is consistent with the objectives of Thailand’s national strategy development, the ASEAN Integrated Food Security Framework and Strategic Plan of Action – Food Security (SPA–FS) and Vision and Strategic Plan for ASEAN Cooperation in Food, Agriculture and Fisheries 2016 – 2025 (VSP–FAF).

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Appendix

Table A.1. Size of Enterprises

Enterprise	Number of employees (person)			Fixed asset (million baht)		
	Small	Medium	Large	Small	Medium	Large
Production	≤50	>50 – 200	>200	≤50	>50 – 200	>200
Wholesale	≤25	>25 – 50	>50	≤50	>50 – 100	>100
Retail	≤15	>15 – 30	>30	≤30	>30 – 60	>60
Service	≤50	>50 – 200	>200	≤50	>50 – 200	>200

Source: Small and Medium Enterprises Promotion Act. B.E.2543 (2000) cited by the Department of Business Development (n.d.b).

Table A.2. List of interviewees

No.	Enterprise	Type	Address	Interviewee Name & Position
1	Thai Union Group PCL.	Producer	72/1 Moo 7, Sethakit 1 Rd., Tambon Tarsrai, Amphur, Muangsamutsakorn, Samutsakorn 74000	- Suwan Pusrichan: Assistant General Manager - Chaiyaporn Saksupanara: Assistant Plant Manager
2	Rujoran Transport Co., Ltd.	Logistic Provider	81/1 Moo 9, Bang Kaew, Muang Samut Songkhram, 75000	- Pirach Siripermpool: Chief Executive Officer
3	Eagles Air & Sea Co., Ltd.	Logistic Provider	12 Soi ICD 5, Chaokunthaharn Road, Khlong Sam Prawet, Ladkrabang, Bangkok 10520	- Wallapa Stirachavarn: Chairperson
4	CTI Logistics Co., Ltd.	Logistic Provider	CTI Tower 31st floor, 191/2-5 Ratchadapisek Rd., Khlong Toei, Bangkok 10110	- Pasu Unhanandana: Chief Operation Officer
5	Harmony Life International Co.,Ltd.	Trader	16/3-4, Soi On-Nut 74/1 On-Nut Rd, Kwan Pravej, Khet Pravej, Bangkok 10250	- Export and Delivery Manager
6	Port Authority of Thailand	Government Agency	444 Tarua Road, Klongtoey, Bangkok 10110	- Pol.Sub.Lt.Montree Lergchumniel: Managing Director, Laem Chabang Port and Acting Director General Port Authority of Thailand - Mr. Komol Sribangplinoy: Director Bangkok Port

				- A representative of Chiang Saen Port
7	Department of Internal Trade	Government Agency	563 Nonthaburi Rd. Bang Krasor, Muaeng Nonthaburi 11000	- Somchai Rattanasupa Director of Promotion and Market Mechanism Development Unit, Ministry of Internal Trade
8	Thai Federation on Logistics	Federation	99/126 Moo 16, Bang Kaeo, Bang Phi, Samut Prakan, 10540.	- Wallapa Stirachavarn: President

Source: Authors.

Chapter 3

Overview of the Cold Chain for Agriculture in Viet Nam

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3.1. Introduction

This research aims to provide an overview of the key agricultural cold chains in Viet Nam by identifying the main related stakeholders in Viet Nam's cold storage and transportation system and their capacity, analysing the associated issues/problem related to the development of Viet Nam's cold chain, reviewing the relevant policies and regulations to Viet Nam's cold chain development, and discussing the mid-term prospects of the cold chain in Viet Nam. Fruit and vegetables, livestock, fishery, and processed foods are the main agricultural products considered in this research.

The research methodologies include desk study, in-depth interviews, and expert consultations. Desk study provides basic information and data on the demand drivers of cold services, including agricultural trade, the development of modern retail and the food sector, and changes in dietary habits from fresh foods to chilled/frozen foods for Viet Nam's consumers. This methodology was also used to collect fundamental information on the main stakeholders and their characteristics. Meanwhile, in-depth interviews with some main stakeholders in cold storage and transportation services help to map out the main cold chain flows and figure out key issues to foster cold services in the nation. Currently, a national database related to household food consumption and production is collected by the General Statistic Office via two main surveys: the Viet Nam Household Living Standard Survey every two years (VHLSS) and an annual enterprise survey. Nevertheless, both datasets have no specific information on chilled/frozen food products and there is also no official information or dataset to estimate cold storage and transportation capacities in Viet Nam. Therefore, in-depth interviews with various stakeholders and expert

[10] Institute of Agricultural Market and Institution (AMI), Viet Nam National University of Agriculture.

consultations with senior managers from different companies and organisations are used to estimate these numbers.

The results indicate that the cold chain in Viet Nam is in the early stage of development and has a great potential for new investment. Specifically, the seafood sector seemingly outpaces other sectors in terms of capacity, integrity, and continuity regarding cold-chain utilisation. In addition, the emergence of domestic modern retail, fast-food services, and high-value food consumption has created new demand for cold services in Viet Nam and is regarded as a key factor to accelerate Viet Nam's cold chain development in the medium term and long term. However, Viet Nam so far has not established specific policies and regulations for the cold chain sector. In most cases, provisions for cold services are derived from food safety, post-harvest, and logistics policies as well as TCVN.[11] This situation would open various opportunities for related stakeholders to implement policy advocacy activities to set up a comprehensive policy framework for Viet Nam's cold chain.

3.2. The current situation of the cold chain in Viet Nam

The development of the cold chain in Viet Nam, including cold storage and cold transportation, can be seen from both the supply and demand sides.

Demand drivers of cold chain development in Viet Nam

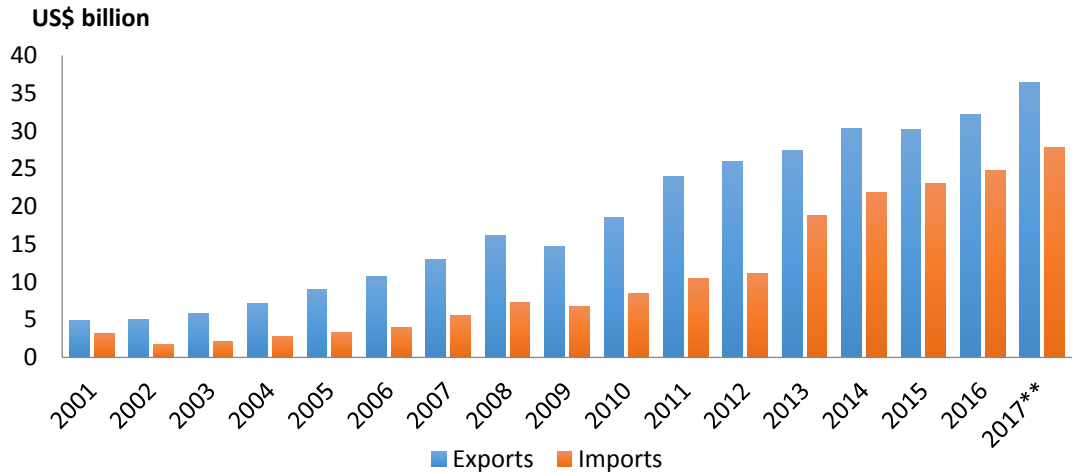
- Viet Nam's agricultural trade growth

Over the last two decades, Viet Nam's agricultural trade growth has experienced a fast pace, with a compound average growth rate (CAGR) of export value from 2001–2017 of 12.5%/year and that of import value in the same period of 13.6%/year. Wooden furniture, shrimp, cashew nuts, fruits and vegetables, coffee, rice, rubber, and pangasius are the top agricultural exported products, for which fruit and vegetables enjoyed the most significant increases from under US$500 million in 2010 to US$3.5 billion in 2017. Meanwhile, livestock and its related products,

[11] TCVN (or Tieu Chuan Viet Nam) means Standards of Viet Nam.

intermediate seafood for further processing, and fruits and vegetables account for notable shares in the national agricultural import structure.

Figure 3.1: Viet Nam Agricultural Trade Growth, 2001–2017



Note: **Preliminary data.

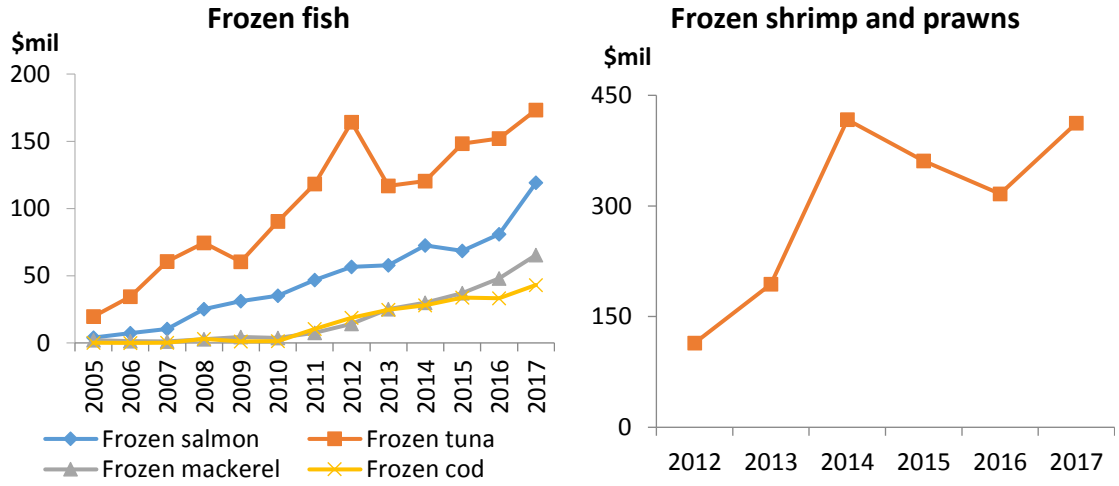
Source: General Statistic Office of Viet Nam (2018).

Seafood, fruit and vegetables, and meat are perishable goods that create major demand for cold services, in which seafood plays a dominant role (Nomura Research Institute 2016). From the export side, finished products of chilled/frozen shrimp and pangasius, which in total account for two-thirds of the seafood export value, control the demand growth of cold services. The production of raw materials and processing for seafood exports is concentrated in the Mekong River Delta, creating the leading role of the region in creating demand for cold storage services. According to Stoxplus (2016), the storage market is 14 times larger in the South compared to the North of Viet Nam.

In Viet Nam's seafood sector, in the last eight years, diseases and unfavourable weather have created some periodic shortages of shrimp materials for processing, triggering the import of unprocessed shrimp from India and Ecuador to fill the supply gap. An emergent phenomenon is that seafood manufacturers with ample processing capacity import intermediate seafood materials, conduct processing, and re-export to international markets. From 2005 to 2017, the total import value of frozen salmon, tuna, mackerel, and cod accelerated from around US$25

million to US$400 million, which brought Viet Nam to become a marked outsourcing hub for seafood processing in the world. The current United States–China trade conflict is expected to foster the shift of intermediate seafood flows from China to Viet Nam.

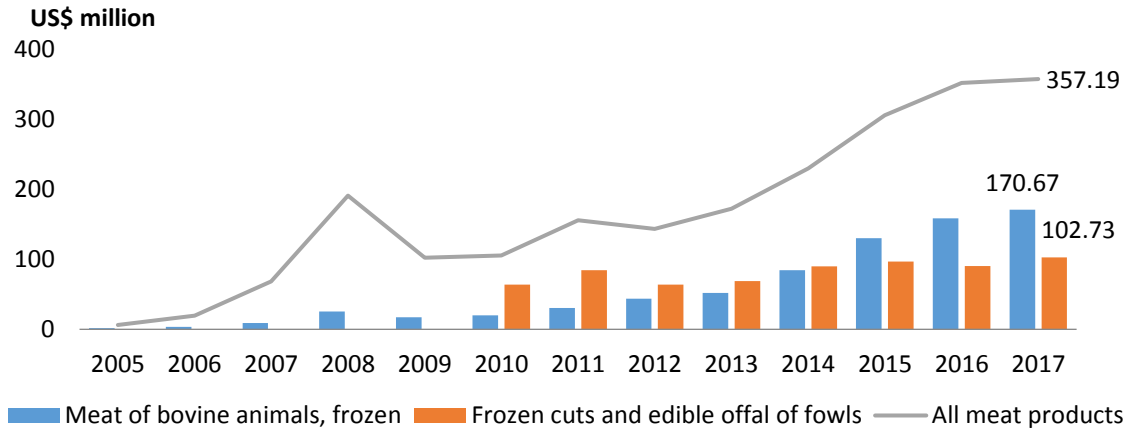
Figure 3.2: Intermediate Seafood Imports of Viet Nam (US$ million)



Source: Trademap (2018).

Meat imports are another important driver for the development of cold chains in Viet Nam. Urbanisation, higher income, and food safety perceptions also accelerate Viet Nam's meat imports for domestic consumption, in which fast-food services/full-service restaurants seem to play the main role. Frozen bovine and frozen cuts and edible offal of fowls made up over 75% of the total imported meat value in 2017. Not only international fast-food brands and full-service restaurants using imported meats but also street food vendors/kiosks also find higher profits when using cheap imported meat. International trade statistics show that during 2005–2017, the import value of frozen meat-related products increased significantly and reached the amount of US$357 million in 2017.

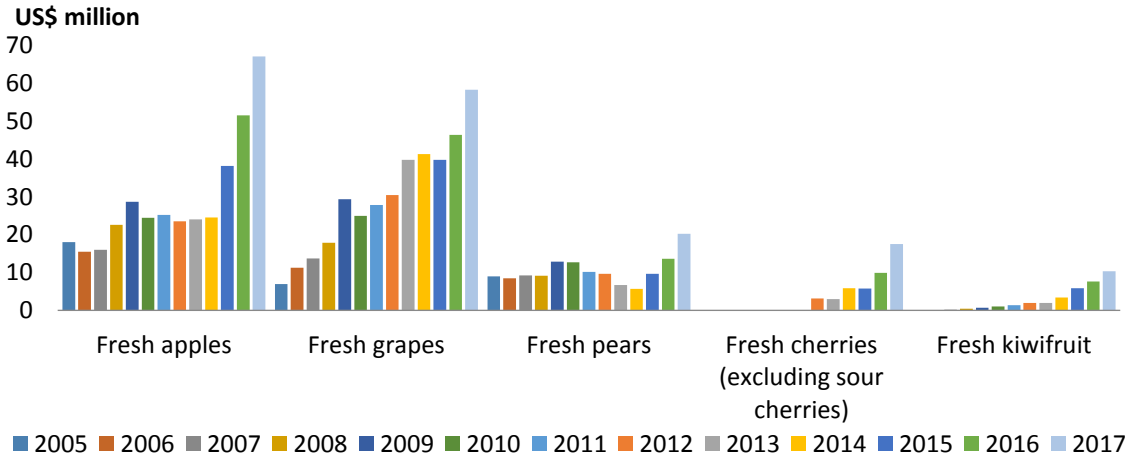
Figure 3.3: Viet Nam's Meat Imports by Value, 2005–2017



Source: Trademap (2018).

Viet Nam's imports of fruit and vegetables also increase demand for cold storage and transportation. During 2005–2017, the CAGR of import values of fresh apples, grapes, pears, cherries, and kiwifruit in Viet Nam reached significant amounts of 54%, 19%, 12%, 33%, and 57%, respectively. In 2017, the total import value of these five fruits in Viet Nam reached US$170 million.

Figure 3.4: Import Values of Selected Fruits in Viet Nam, 2005–2017



Source: Trademap (2018).

- The development of modern retail and fast-food services

Rapid urbanisation, higher incomes, and increasing awareness of food safety in the context of a highly integrated economy thanks to the participation of free trade agreements (FTAs) fuel the development of modern retail and fast-food services in Viet Nam. Although the retail market system is still dominated by traditional wet markets and small independent stores, the modern retail food sector has performed at a faster growth rate. The CAGR of sales of modern grocery retailers from 2012 to 2017 reached 14.6%, compared to 9.5% for traditional grocery retailers. Similarly, the number of modern groceries has grown 260% since 2012, compared to only 5% for traditional grocery outlets.

Table 3.1: Comparison between Traditional and Modern Grocery Retail Channels in Viet Nam, 2012–2017

Type		2012	2013	2014	2015	2016	2017
Sales (US$ million)	Modern	1,712	2,097	2,696	2,807	3,254	3,612
	Traditional	39,303	46,804	53,742	58,109	61,980	67,331
Number of Outlets	Modern	897	1,054	1,211	1,748	2,600	3,272
	Traditional	629,222	635,176	641,542	447,556	652,988	658,005

Source: USDA (2018).

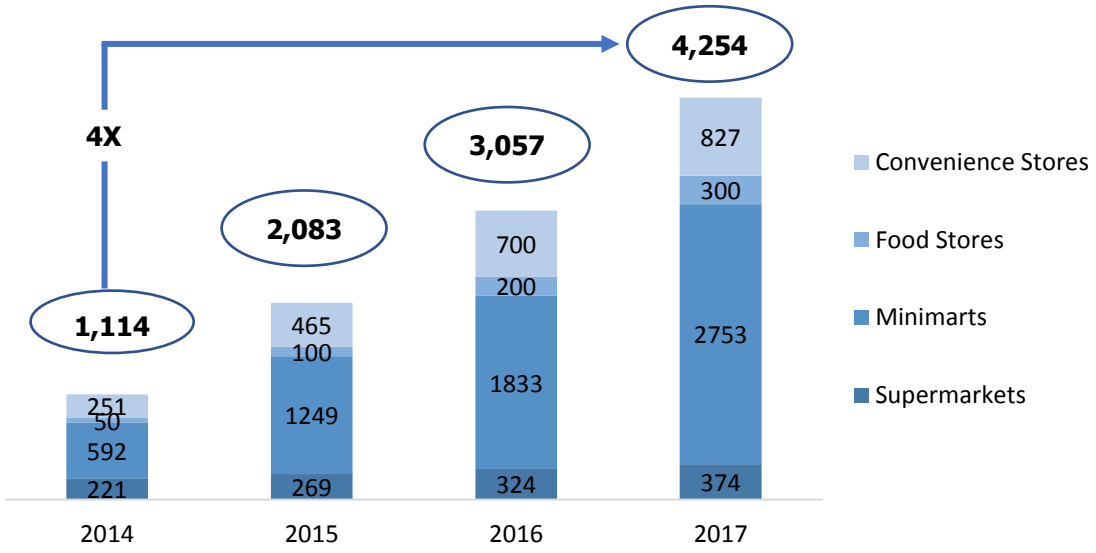
Modern retail food chains are in the process expanding their distribution networks, not only in first-tier cities[12] like Hanoi and Ho Chi Minh City but also in second-tier cities[13] and provinces across Viet Nam. The presence of modern supermarkets and convenience stores in lower-tier cities has gradually changed spending habits and the perception of local people, creating new experiences and helping consumers change their perspectives, diversify their choices, and direct their consumption from traditional retail channels to modern ones. In 2019, Vinmart+ even arrived in third-tier cities[14], making a pioneering role in the next round of competition in the

[12] First-tier cities are the economic centres of the nation, such as Hanoi, Da Nang, Ho Chi Minh City, and Can Tho.
[13] Second-tier cities are the economic centres of provinces, such as Nam Dinh, Vinh, etc.
[14] Third-tier cities are economic centres of districts, such as Ha Dong, Son Tay towns, etc.

modern retail chain in Viet Nam. This indicates that the demand for cold services in inter-provincial and regional levels have great potential for development.

Furthermore, in first tier-cities, the presence of mega malls, such as Big C, AEON, LOTTE, etc. and modern apartment complexes, such as Royal city, Times city, etc. with food courts, the steady growth of fast-food chains and the increasing popularity of quick-service restaurants also contribute to expanding demand for cold services. Fast food is one of the main users of Viet Nam's cold chain and accounts for 35% of the market share in Viet Nam's food-service sector, especially in the cases of imported beef and chicken meat cuts.

Figure 3.5: Number of Modern Retail Shops in Viet Nam, 2014–2017



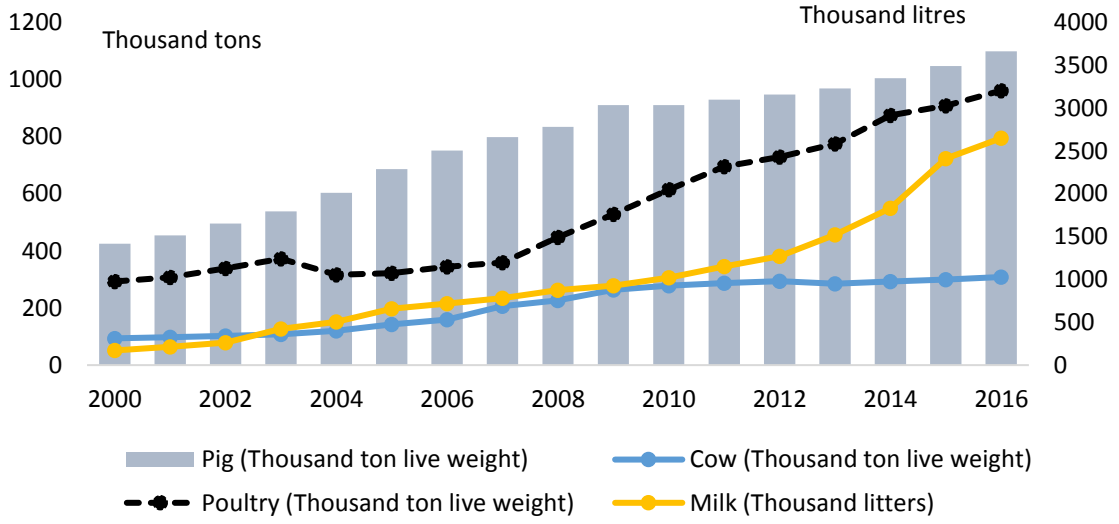
Source: Carrier (2018).

- Higher proportions of production of high-value and perishable agricultural products

Commercialisation in agriculture production, particularly the development of large farms, and the transformation of the farming system from low-value to higher-value products have formed a concrete base for cold-chain demand in the long-term. From 2000 to 2016, the total production of most agricultural products doubled, tripled, or increased even more. The production of beef (cow live weight) increased from 93,800 tons in 2000 to 308,600 tons in 2016 with an average annual growth rate of 7.73%. The poultry sector has witnessed a similar average

annual growth rate of 7.71%, but the evolution of this sector has fluctuated more because of bird flu outbreaks during 2003–2007. However, since 2008, the sector started to rocket and reach a very high growth rate in the following period of 11.58% per year. Over the whole period, pork is still the dominant type of meat for Vietnamese households. The production of pork in 2016 was 3.67 million tons, which was nearly three times higher than the production of cow and poultry combined.

Figure 3.6: Production of High-value Agricultural Products



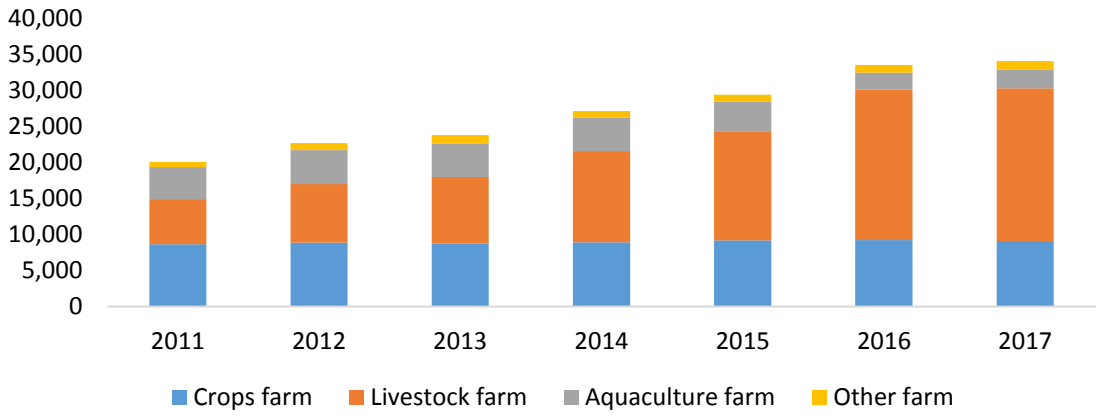
Source: General Statistic Office of Viet Nam (2018).

Calculations based on the VHLSS data show that the percentage of households selling their products increased constantly in the last decade. During the 2008–2016 period, the proportion of farmers selling high-value perishables increased rapidly, with vegetables rising from 2.54% to 6.96%, fruit from 1.60% to 7.62%, milk from 3.23% to 8.38%, pork meat from 14.02% to 30.9% and poultry from 6.27% 14.21%. It can be seen that all of these high-value products are more perishable than basic grain crops, such as rice and corn, and lead to an urgent need for the cold chain instead of regular fresh product storage and transportation services.

Moreover, the number of large farms in Viet Nam has increased steadily in recent years. Nearly 14,000 new farms were established in Viet Nam during the 2011–2017 period, which means on

average that about 2,300 farms are established every year (GSO, 2019). These farms who are commercialised producers are more likely to employ cold chain facilities to store and transport their products.

Figure 3.7: Number of Large Farms in Viet Nam, 2011–2017



Source: General Statistic Office of Viet Nam (2018).

- Higher proportion of consumption of chilled and cold products

The proportion of chilled and cold products in household food consumption has increased for three reasons. First, people spend more money on foodstuffs (meat, fruits and vegetables, etc.), which require cold-chain services more than grains, which do not require a strictly temperature-controlled environment. Statistics based on the VHLSS show that the share of household grain consumption (mainly rice) dropped from 11.7% of total household consumption in 2006 to only 6.4% in 2016, while that of foodstuff remained at about 28% of total consumption. Second, because of convenience and increasing awareness of food safety, more consumers choose supermarkets or minimarts (small supermarkets) to buy their foodstuffs rather than traditional markets. According to IPSARD (2013), only 8.3% of household-bought food and foodstuffs from supermarkets/minimarts, and these food/foodstuffs only accounted for less than 13.2% of their food consumption. In 2018, this number increased to 14.9% and 18.6% respectively. Many households now go to supermarkets once a week to buy food and foodstuff supplies for their whole week, and most of these meats/vegetables are chilled/frozen.

Thirdly, our value chain analysis and expert consultancy information show that most chilled/frozen foodstuffs are consumed in restaurants and public kitchens/canteens rather than in individual households. Currently, different types of chilled/frozen products are used in restaurants. On the one hand, high-quality imported chilled/frozen meat/vegetables (e.g., beef from Australia, United States, Japan; salmon from Norway) go to elegant restaurants, fine dining, fast-food restaurants, and casual restaurants. On the other hand, cheap imported frozen meats (especially chicken from the United States, Brazil, and Korea and buffalo from India) are used by Com Binh Dan restaurants, Noodle/Pho Restaurants, school kitchens, and office/factory canteens. Based on the author's calculations using the VHLSS, the proportion of out-of-home food consumption in total income has nearly doubled in the last 10 years from 7.1% in 2006 to 12.1% in 2016.

Supply drivers and the main cold chain channels in Viet Nam

The supply side of the cold chain for agriculture in Viet Nam consists of three main channels: (i) imports of finished food products for consumption, (ii) seafood products, and (iii) chilled fruits and vegetables in the domestic market. Each channel is characterised by its integrity, continuity, and affordability. Integrity refers to the fact that the whole channel is undivided and managed by a few stakeholders; thus, the fewer stakeholders in a chain, the higher the integrity of the chain is. Continuity describes the unbroken and consistent operation of cold services along a chain; so, the less interrupted chain shows the higher continuity. Affordability indicates the relative costs among chains, including fixed investments of cold service suppliers as well as price offered to achieve the client's acceptance.

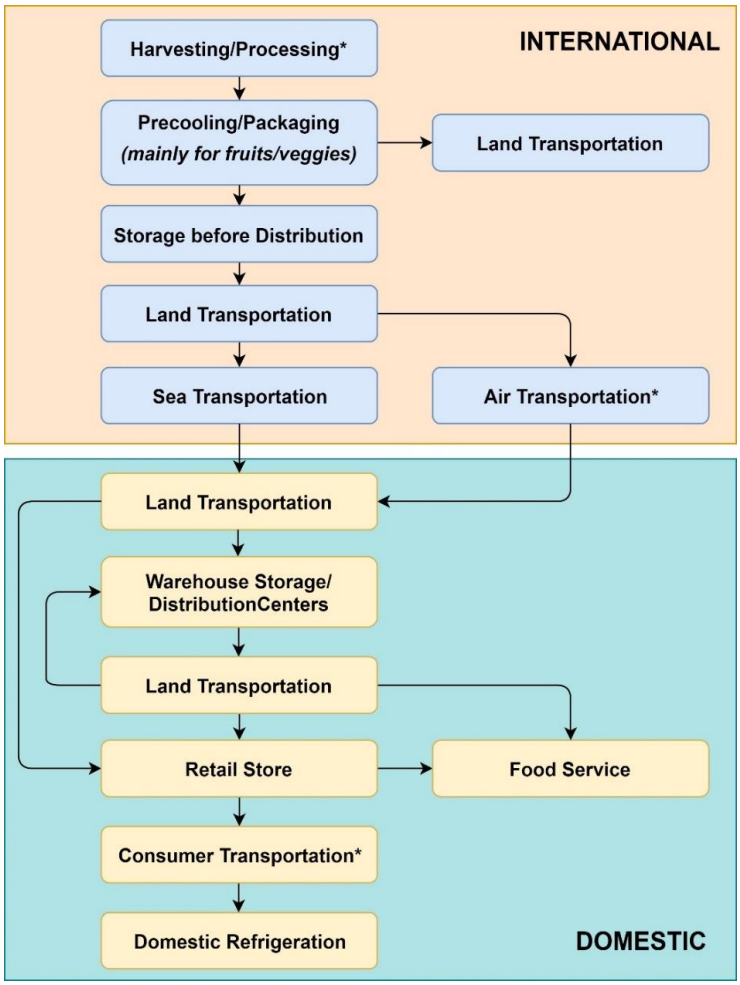
- The channel of imports of finished products for direct consumption

Finished products for direct consumption contain imported fruits and vegetables, and meat, seafood, and dairy products for either direct consumption or food services. The flow is characterised by high continuity, medium integrity, and low affordability aimed at high-quality, high-value food segments, mainly coordinated by distributors/retailers. Currently, the flow scale is small but still highly promising for further expansion thanks to the increasing demand for imported foods.

The flow starts from international material sources and penetrates to Viet Nam when refrigerated containers approach ports and arrive at warehouses/distribution centres by land transportation on trailer trucks. Containers are unloaded under temperature-controlled procedures in warehouses/distribution centres. Products are preserved and organised in cold/chilled facilities before being delivered to retail stores/food service suppliers via small temperature-controlled vans, usually under 2 tons in weight, which is easy to travel in crowded urban areas. From retailer stores, chilled/frozen foods are purchased and self-carried home by customers or delivered to homes in simple insulation boxes.

This channel shows clearly the high continuity in most stages, and foods are maintained in a strictly temperature-controlled and uninterrupted process. Meanwhile, its integrity is ranked as medium because a stakeholder could only provide services for up to two or three steps with a certain level of outsourcing along the flow. To maintain food quality in the channel, cold chain providers must equip high-tech facilities, professional services, and modern management systems. Therefore, both their fixed and variable costs are usually higher than average in Viet Nam, leading to high prices offered to customers. In other words, the affordability of the flow is low and only high-quality, high-value food importers/providers could cover the cost.

Figure 3.8: The Flow of Imported Products for Direct Consumption



Note: *Steps where no refrigeration is generally applied.

Source: Authors.

This channel is likely driven by distributors/retailers than cold service providers because the modern retail market is relatively small but highly concentrated. This means that professional cold chain services have to rely on a few big clients to cover their high costs. Moreover, most domestic value chains of agricultural and food products in Viet Nam are long and significantly diverse, building up various constraints to both local and international manufacturers to establish their own, direct sales channels. At the same time, higher income and lower tariffs led by different FTAs are favourable conditions for Viet Nam to import more foods in the future. As a result, distributors/retailers hold long-term advantages to create new demand and expand scale for the flow.

Box 1. Thang Long Logistic Center

The Thang Long Logistics Center opened in October 2018 in My Hao District, Hung Yen Province. It is the first modern multi-functional logistics centre in the province. The centre has a total investment capital of nearly D280 billion from Transimex Corporation, Vinafreight Joint Stock Company, VNT LOGISTICS Joint Stock Company, Cho Lon Investment and Import Export Joint Stock Company (CHOLIMEX), and Tuan Manh Trading and Investment Co, Ltd.

The three-hectare project boasts a general storage system, freezer storage, an eight-storey racking system, humidity control, a camera system, a fire fighting system, and modern management software. The storage system meets ISO, HACCP, and CT–PAT standards. It will store and distribute fast-moving consumer goods (FMCG), fresh foods, and raw materials to local people and producers in industrial zones in Hung Yen and neighbouring provinces. The chilled and frozen storage is 5,000m^2, with a capacity of 12,000 pallets with temperature adjusted from 10–30°C.

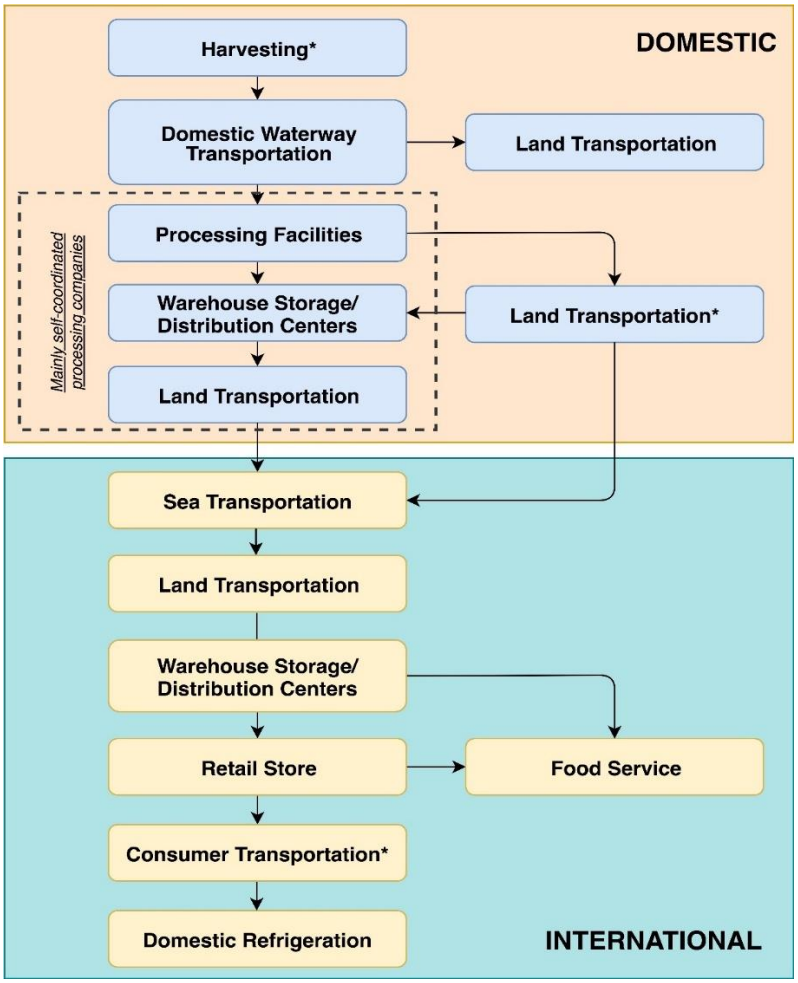
The multi-functional logistics segment generally, and cold services particularly, in the North is harder to penetrate than that in the South due to the limited scale of goods flows, land availability, smaller retail market, and higher institutional obstacles. More straightforward and higher price-sensibility demand by clients using cold services is also a restriction for cold chain development in the North. Foreign multi-functional logistics suppliers are using mergers and acquisitions as a strategy to join the North cold chain market and lower initial costs.

Source: Field trip conducted by authors.

- The channel of seafood products

There are two main channels of seafood products in the cold chain in Viet Nam: exported seafood products and intermediate seafood products. While the former uses sources from domestic raw materials, the latter exploits international raw material supplies. The phenomenon of importing intermediate seafood materials for extra processing and re-exporting to international markets has emerged since the last few years, creating more demand for cold services. These two flows are recognised to have the biggest shares in the cold chain demand structure in Viet Nam and featured by its high integrity, high continuity, and low affordability.

Figure 3.9: The Flow of Seafood Exports

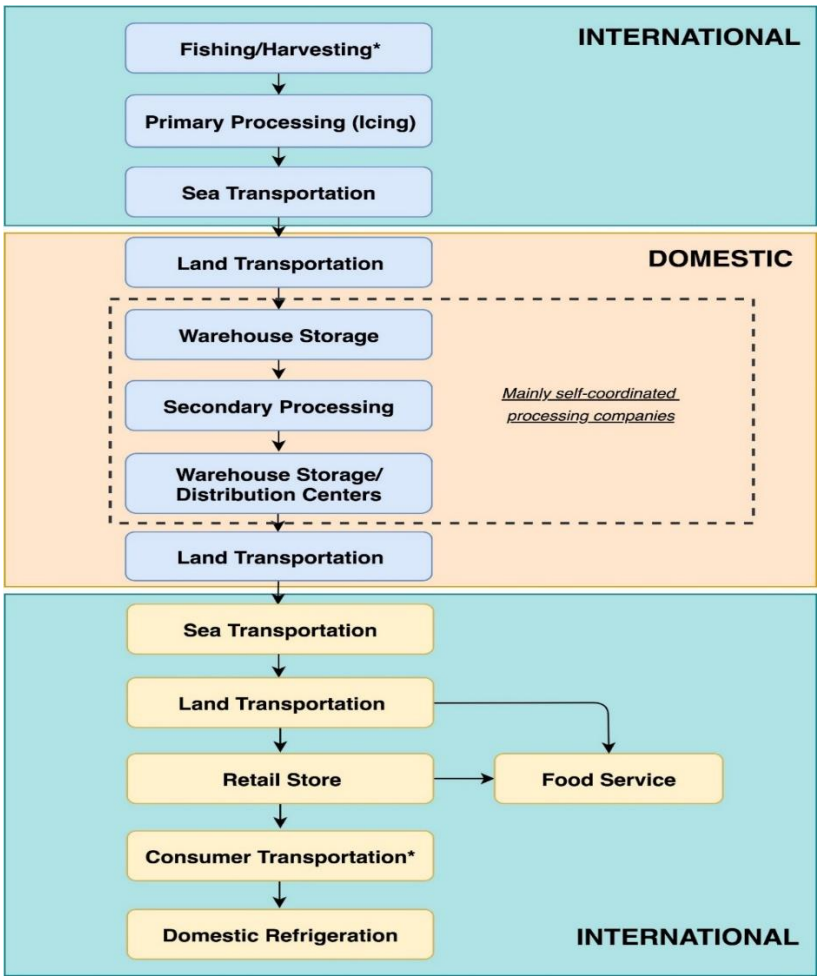


Note: *Steps where no refrigeration is generally applied.

Source: Authors.

The seafood export flow starts from the local harvesting and transporting of raw materials, mainly by domestic waterways either with or without temperature control, to processing facilities mostly equipped with freezer and cold storage. The finished products are land-transported to either warehouses/distribution centres or seaports to export. Meanwhile, the intermediate seafood flow has a similar route but begin with international fishing/harvesting and raw materials freezing before shipping by sea to Viet Nam for further processing. Right after entering the processing facilities, the raw materials are stored in constant temperature-supervised procedures to ensure their quality from the factory gates to the export markets.

Figure 3.10: The Flow of Intermediate Seafood Products



Note: *Steps where no refrigeration is generally applied.

Source: Authors.

These two channels demonstrate both high integrity and high continuity when cold services are exploited uninterruptedly along the chains, from the very early stage of raw materials in the case of intermediate seafood materials and run largely by seafood manufacturers. Cold storages are an integral part of seafood manufacturing, but in many cases, seafood processors face periodic capacity shortages when their businesses grow up. They could make investment decisions in either constructing upgraded self-operating cold storages or outsourcing cold services from professional providers. These flows are considered affordable because they have been utilising their own cold storage and services for a long time. Thereby, the fixed costs have depreciated significantly and the variable costs have been managed tightly. Thanks to the low operating cost of these flows, Viet Nam's seafood exporters can offer competitive prices in its international markets.

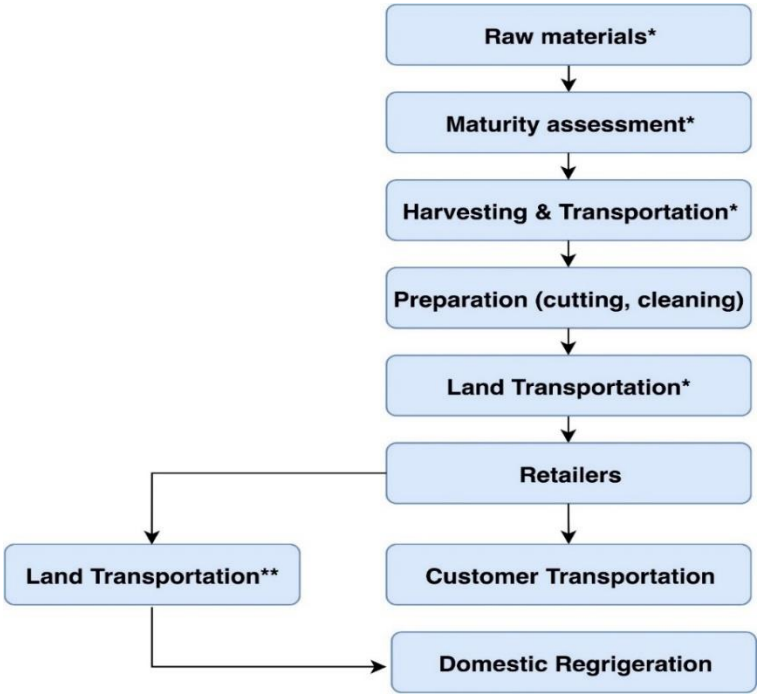
- The channel of chilled fruits and vegetables in the domestic market

This flow is hugely disrupted, and semi-professional cold services are significantly costly. Chilled fruits and vegetables in the domestic market are used mostly in modern retailers, including modern grocery stores, super/hypermarkets, and convenience stores. In other words, retailers dominate the chain and set rules for other stakeholders.

From raw materials to land transportation and assigned preparation facilities, fruits and vegetables are loosely temperature-tracked and preparation facilities have been installed with elementary temperature-controlled devices, mainly air-conditioners in closed rooms to maintain the quality of fruit and vegetable products on hot days. This situation demonstrates low integrity and continuity of the chain as it has recruited various stakeholders with different procedures and products that experience unstable temperature conditions along the chain. However, the flow is burdened with its high costs, especially variable costs, due to small and fragmented raw material production, and lack of demand as well as integrated management solutions. Stakeholders in the flow also practice high outsourcing rates to disperse costs and risks along the chain and, more importantly, and they do not consider their cold chain services as a significant part of their business. The low affordability of the chain is reflected in the high rates offered to retailers (D14,000/km) compared to uncontrolled-temperature services for

transporting the same type of products (under D10,000/km). Notably, the cold transportation service providers in the North in the flow are mainly active in relatively short distances.

Figure 3.11: The Flow of Chilled Fruit and Vegetables in the Domestic Market



Notes: *Steps where no refrigeration is generally applied. **A step where refrigeration is applied but in very basic form and with a lack of standards.

Source: Authors.

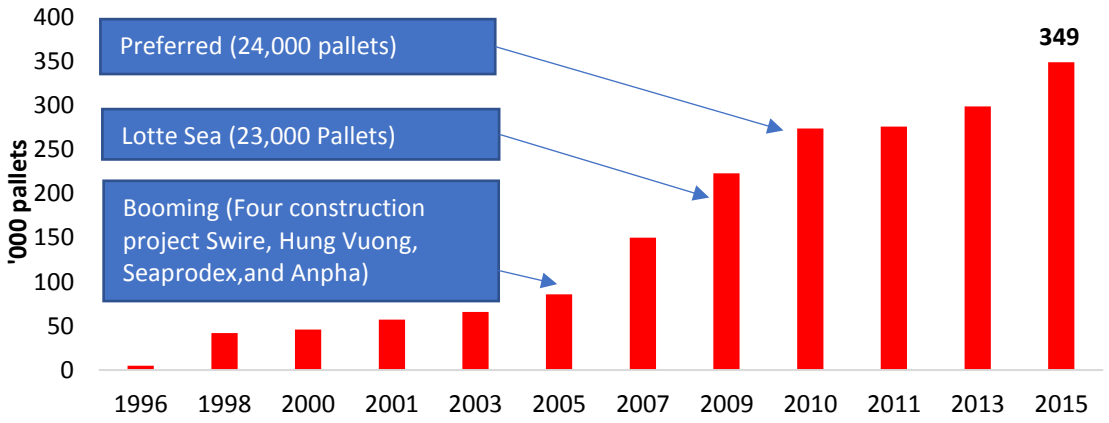
Cold service stakeholders in the chain seem not to be optimistic of the short-term growth prospects, but they enjoy a relatively low competitive market with few cold storage/transportation services providers. New players on the ground make efforts to attract clients to use their professional, advanced-tech, and transparent services instead of old-style, obsoleted-tech, and small-scale services from established providers.

Main stakeholders of cold chains in Viet Nam

- Main players in storage services

The cold storage services market in Viet Nam is divided into two major parts: commercial cold facilities and self-operating facilities, in which the self-operating segment is dominated by the seafood processing sector. StoxPlus (2016) estimated that in 2015, the total designed capacity of Viet Nam commercial cold storages was estimated at 349,000 pallets and dominated by domestic local players. In the last three years, both foreign and domestic companies have increasingly invested and expanded new storage facilities generally, and cold storage in particular, but the former are making bigger investments in cold storage industry than the latter. Therefore, they are gaining higher market shares. An unofficial estimation[15] has estimated the current total commercial capacity at 500,000 pallets, but it could be higher in the fact. The tables below have shown that domestic players and their foreign competitors are more or less equal in terms of market share in the situation of an incomplete dataset.

Figure 3.12: Cold Storage Capacity Growth in Viet Nam



Total designed capacity of Viet Nam commercial cold storages was estimated at 349,000 pallets in 2015

Note: The boxes indicate the notable additional capacities that were brought to market in those years. For example, in 2010, among many investments in cold storage development, the new cold storage built by Preferred with a capacity of 24,000 pallets was the biggest one.

Source: Stoxplus (2016).

[15] These numbers are derived from the presentations of some experts in the cold chain workshop in Ha Noi in January 2019.

Commercial cold storage services in the South have developed far ahead of the North, demonstrated by the outstripped number of both foreign and domestic cold services providers as well as their sizes in the former compared to the latter. According to expert estimation,[16] Mekong Logistics of Minh Phu–Gemadept, ABA Cooltrans, Emergent Cold, and Hoang Lai Group are the top leading cold storage providers, with the capacity of each being up to 45,000–50,000 pallets, followed by Meito (30,000 pallets), Lotte Logistics, Preferred Freezer Services (23,000–24,000 pallets), and New Land of Sojitz and Kokubu (15,500 pallets). Currently, paralleled with modern, advanced tech in terms of infrastructure and management, and professional cold storage services, many small, obsolete, and scattered cold storages are actively running to serve more spontaneous and basic demand.

The flow size of import and export goods, the higher competitiveness and support of the provincial government, land availability, and favourable transportation conditions have led to the supremacy of the South in the cold storage market (Mekong Logistics 2017). Among FDI investment flows, Japanese investors seem more sensible and determined in penetrating the cold storage market in Viet Nam having conducted a range of new launches, including Meito, CLK Cold Storage, Sojitz and Kokubu, Konoike Vina, especially in the medium scale. Meanwhile, United States players, notably Emergent Cold and Preferred Freezer Services, are likely to prefer a larger scale.

In the last two years, it is acknowledged that there is a shift up North of both domestic and foreign cold storage players. The potential thresholds in the South, lower agricultural exports growth, and optimistic prospects of the domestic market are likely to activate this shift. FDI players seem to consider mergers and acquisitions as a solution to penetrate the North's cold storage sector to lower fixed costs as well as some administrative obstacles, and the most outstanding case was the acquisition of Swire Cold Storage Viet Nam by Emergent Cold. Meanwhile, domestic players are seeking to expand their presence in the North via joint ventures and specialise their businesses in the South into more integrated services, notably Transimex Saigon Hi-Tech Park (SHTP).

[16] These numbers are derived from the presentations of some experts in the cold chain workshop in Ha Noi in January 2019.

Table 3.2: Information and Glossaries of Major Foreign Stakeholders in the Commercial Cold Storage Market by Region

	Company Name	Location	Services	Temp. (°C)	Capacity				Client Types	
					Area (m^2)	Weight (tons)	Pallets	Stores	Industry	Type
Foreign Capital										
	In the North									
1	Emergent Cold	Bac Ninh	Cold storage Distribution centre CS management	+25 to -25	22,000	n.a.	20,000	6	Hypermarkets, seafood manufacturers	B2B
2	FM Logistic	Bac Ninh	Cold storage Distribution centre CS management	n.a.	5,000	n.a.	n.a.	n.a.	Supply all Auchan stores in the northern half of Viet Nam	B2B
	In the South									
1	Emergent Cold	Binh Duong	Cold storage Distribution centre CS management	+25 to -25	42,500	n.a.	36,650	18	Fast food services, hypermarkets, seafood manufacturers and exporters	B2B
2	Konoike Vina	Ho Chi Minh City	Cold storage Re-packing CS management	+5 to -20	3,000	n.a.	1,000	n.a.	Fast food services, convenient stores	B2B
3	CLK Cold Storage	Binh Duong	Cold storage Distribution centre CS management	+25 to -25	9,300	n.a.	n.a.	n.a.	Food, seafood manufacturers	B2B
4	Sojitz and Kokubu New Land Co. Ltd.	Binh Duong	Cold storage CS management	n.a.	n.a.	n.a.	15,500	4	Food, seafood manufacturers	B2B
5	Kuehne Nagel	Dong Nai	Cold storage Logistic centre	15/4/-18	4,000	n.a.	n.a.	n.a.	Hypermarkets, seafood manufacturers and exporters	B2B

			CS management Custom clearance							
6	Preferred Freezer Services	Ho Chi Minh City	Cold storage Refrigerated Loading/unloading Dock	n.a.	n.a.	n.a.	24,000	n.a.	Fast food services, hypermarkets, seafood manufacturers and exporters	B2B
7	Sagawa Express	Dong Nai	Cold storage Logistic centre	+3 to -20	2,322	n.a.	n.a.	n.a.	Hypermarkets, manufacturers	B2B
8	Meito Viet Nam	Binh Duong	Cold storage Distribution centre CS management	-15 to -25	n.a.	30,000	30,000	8	Food/seafood manufacturers, exporters	B2B
9	Anpha–AG	Long An	Cold storage Distribution centre CS management	n.a.	n.a.	n.a.	n.a.	n.a.	Food/seafood manufacturers, exporters	B2B
10	Panasato	Binh Duong	Cold warehousing and logistics services	n.a.	5,200	n.a.	n.a.	n.a.	Fast food services, hypermarkets, seafood manufacturers, exporters	B2B
11	Lotte Logistics	Long An	Cold storage Distribution centre CS management	10 to -30	n.a.	n.a.	23,000	10	Fast food services, hypermarkets	B2B

Source: Collated by authors from official websites of companies.

Table 3.3: Information and Glossaries of Major Domestic Stakeholders in Commercial Cold Storage Market by Region

	Company Name	Location	Services	Temp. (°C)	Capacity				Client Types	
					Area (m^2)	Weight (tons)	Pallets	Stores	Industry	Type
Domestic Capital										
	In the North									
1	ABA Cooltrans	Ha Noi	Cold storage CS management	+22 to -25	n.a.	n.a.	15,000	17	Fast food services, hypermarkets, food manufacturers	B2B
2	Quang Minh	Ha Noi	Cold storage CS management	10 to -30	n.a.	n.a.	n.a.	5	Fast food services, hypermarkets, food manufacturers	B2B
3	Duc Tan - Sai Gon	Ha Noi	Cold storage CS management	0 to -25	1,100	n.a.	2,700		Fast food services, supermarkets;	B2B
4	Thang Long Logistics	Hung Yen	Cold storage CS management	10 to -30	5,100	n.a.	12,000	3	Fast food services, supermarkets	B2B
	In the South									
1	Transimex – ICD Transimex	Ho Chi Minh City	ICD, cold storage, CS management	10 to -30	3,000	n.a.	>5,000	n.a.	Food/seafood manufacturers, exporters	B2B
2	Transimex–Saigon Hi-Tech Park (SHTP)	Ho Chi Minh City	Integrated logistics services	10 to -30	9,000	n.a.	n.a.	n.a.	Fast food services, hypermarkets, food/seafood manufacturers	B2B
3	Depot Tan Cang – My Thuy	Ho Chi Minh City	Cold storage CS management	n.a.	37,400	n.a.	n.a.	n.a.	Food/seafood manufacturers	B2B
4	Hoang Lai Group-Hoang Lai I - II	Ho Chi Minh City	Cold storage CS management	15 to -30	n.a.	10,000	10,000	15	Food/seafood manufacturers, exporters	B2B

5	Hoang Lai Group-Hoang Phi Quan	Ho Chi Minh City	Cold storage CS management	15 to -30	n.a.	20,000	n.a.	n.a.	Food/seafood manufacturers, exporters	B2B
6	Hoang Lai Group-Long An	Long An	Freezing Cold storage CS management	15 to -40	n.a.	20,000	n.a.	n.a.	Food/seafood manufacturers, exporters	B2B
7	Satra	Ho Chi Minh City	Freezing Cold storage CS management	n.a.	11,545	n.a.	22,000	5	Food/seafood manufacturers, exporters	B2B
8	Phan Duy–Long An	Long An	Freezing Cold storage CS management	15 to -25	n.a.	30,000	n.a.	n.a.	Food/seafood manufacturers, exporters	B2B
9	ABA Cooltrans	Ho Chi Minh City	Cold storage CS management	25 to -25	n.a.	n.a.	30,000	8	Food/seafood manufacturers, exporters	B2B
10	An Phu	Binh Duong	Cold storage CS management	25 to -18	n.a.	3,000	n.a.	n.a.	Food/seafood manufacturers, exporters	B2B

Notes: The above tables list professional cold storage services providers, not including storages run by seafood/meat manufacturers/exporters. The capacity indicates the current situation, not including any under-construction capacity of each stakeholder. The tables were updated in January 2019.
Source: Collated by authors from official websites of companies.

Meanwhile, the seafood sector accounts for a significant part of Viet Nam's cold storage market (Mekong Logistic 2017). While all export-oriented seafood processors own their self-operating cold storages, some of them even run commercial cold storages, creating the flow of seafood exports and intermediate seafood products. Most cold storages for seafood exports in Viet Nam are for pangasius and shrimp products, which combined comprise two-thirds of Viet Nam's seafood export value. Due to the higher weights of pangasius products, the cold storage capacity in pangasius facilities is clearly higher than that in shrimp facilities, as shown in the below tables. Over the last two decades, the extraordinary emergence of pangasius exports from Viet Nam has created a boom in cold storage capacity serving the seafood sector. Meanwhile, the phenomenon of importing intermediate seafood products for further processing and re-exporting also requires additional capacity.

Most cold storages in seafood processing facilities were installed in the 2000s, and have degraded, inadequate capacity, and backward technologies (Mekong Logistics 2017). To address this, seafood companies have two choices: (i) companies with medium cash flow strength will build extra infrastructure for self-operating, equipped with energy-saving technologies and more professional management systems; (ii) companies with more abundant cash flow are spreading over commercial cold storage market by investing in more integrated logistics centres to offer cold services for other seafood companies. The latter's most noticeable cases are Hung Vuong Corporation with a new investment of a 60,000 tons cold storage in Ho Chi Minh City and the joint venture of Minh Phu and Gemadept to build Mekong Logistics JSC possessed a capacity of 50,000 pallets.

To sum up, cold storage services in Viet Nam have been solely serving B2B and are highly international-trade oriented. There is a vast market segment closer to the upstream chain, which belongs to agricultural production that is left unexploited due to its own constraints of high transaction and transportation costs as well as inadequate infrastructure.

Table 3.4: Information and Glossaries of Major Domestic Stakeholders in the Self-operating Segment of Seafood Cold Storage by Product

	Company Name	Location	Current Situation	Capacity		Usage		Note
				Weight (tons)	Pallets	Industry	Type	
	Pangasius							
1	Vinh Hoan Corporation	MRD	In operation	9,000	n.a.	Frozen fillet pangasius	Self-operation	
2	Hung Vuong Corporation	Ho Chi Minh City	In operation	12,000	n.a.	For rent	B2B, self-operation	
		Ho Chi Minh City	In operation	30,000	n.a.	For rent		Sold to ABA
		Ho Chi Minh City	Under construction	60,000	n.a.	For rent		
3	International Development &Investment Corporation (IDI)	Dong Thap	In operation	4,600	n.a.	Frozen fillet pangasius	Self-operation	
		Dong Thap	Under construction	10,000	n.a.	Frozen fillet pangasius		
4	Nam Viet Corporation	An Giang	In operation	6,000	n.a.	Frozen fillet pangasius	Self-operation	
5	Cadovimex II	Dong Thap	In operation	5,000	n.a.	Frozen fillet pangasius	Self-operation	
6	Mekong Fishery JSC	Can Tho	In operation	400	n.a.	Frozen fillet pangasius	Self-operation	
7	Godaco Seafood JSC	Tien Giang	In operation	8,500	n.a.	Frozen fillet pangasius	Self-operation, B2B	Updated by 2014
8	Hung Ca Co., Ltd	Dong Thap	In operation	>10,000	n.a.	Frozen fillet pangasius	Self-operation	
	Shrimp							
1	Minh Phu Seafood Corporation	Hau Giang	In operation	n.a.	50,000	Integrated logistics services	B2B	Mekong Logistics JSC
2	Sao Ta Foods JSC	Soc Trang	In operation	4,000	n.a.	Frozen shrimp	Self-operation	Parent company: Hung Vuong Corp
3	Camimex Group	Ca Mau	In operation	2,000	n.a.	Frozen shrimp	Self-operation	

		Ca Mau	Under construction	1,500	n.a.			
4	Seaprodex Minh Hai	Bac Lieu	In operation	1,000	n.a.	Frozen shrimp	Self-operation	Central cold storage
5	Au Vung I Seafood Processing JSC	Bac Lieu	In operation	>1,500	n.a.	Frozen shrimp	Self-operation	

Notes: The above tables are listing cold storages owned by seafood manufacturers/exporters. The tables updated by Jan 2019.

Source: Collated by authors from official websites of companies.

- Main players in transportation services

The cold transportation sector in Viet Nam is characterised by a high outsourcing rate and a small proportion of total transportation capacity and is seemingly dominated by local players (Luong 2018). There are no official estimations for total cold transportation capacity, and data are unlikely to specify leading players, market share structure in the sector, or report the number and capacity of cold trucks serving agricultural and food products. ABA Cooltrans, Tan Nam Chinh Logistics, Tan Bao An, and Binh Minh Tai possibly seize some big shares of the market, in which ABA Cooltrans is a relatively new, significant player that was established in 2008 and started as a cold transportation service provider before expanding to the cold storage market via acquisition. Their main clients currently are Big C, Vinmart, METRO, Unilever, Vinamilk, Kinh Do, and BEL.

There are four types of cold transportation. First, for imported, chilled, or frozen products, refrigerated containers are transported directly from ports to cold storage houses using container trucks. Second, to transport from cold storages to companies, such as supermarkets and restaurants, etc. (B2B), small cold trucks are usually used. This is because the urban road infrastructure in Viet Nam is characterised by small alleys and exceptionally high rates of using motorbikes.

There are two truck types: (i) professional trucks belong to new companies such as ABA Cooltrans, Tan Nam Chinh Logistics, etc; and (ii) modified trucks belong to small transportation companies. Professional trucks range from 1 ton to 14 tons with real-time updates on cargo to clients, global positioning system-enabled for real-time tracking, data loggers for temperature monitoring, and multi-temperature adjustment. Most importantly, the setting of the air conditioner systems of professional trucks is well designed and constructed to maintain the cool air spread evenly in the chambers. Most of these trucks are imported from Japan or Korea.

Modified cold trucks are mainly small for urban services and locally produced, notably by THACO Truong Hai Company, with prices ranging from D500 million–D700 million for trucks under two tons. A typical modified cold van is equipped with an air conditioner to control the temperature at the desired levels of each product category. However, according to experts, the setting of air conditioners without air tubes on the top do not spread cold air evenly inside the truck chamber, and thus do not ensure the quality of the transported products.

In addition, business-to-consumer (B2C) cold services carry out very flexible solutions to deliver goods to customers by using motorbikes attached with ice boxes on the back to keep food chilled/cold. However, on hot days, ice boxes are insufficient to maintain low temperatures, leading to the rapid deterioration of food. E-commerce and 'bricks-and-clicks' retailers[17] are in need of improving their home-delivery services for perishable products and foods.

[17] Bricks-and-clicks retailers refer to a business model in which retailers operate both offline and online stores and integrate the two into a single retail strategy.

Table 3.5: Information and Glossaries of Major Stakeholders in Commercial Cold Transportation Services

	Company Name	No of Vehicles	Capacity (tons)	Temp. (°C)	Services	Client Types	
						Industry	Type
Foreign Capital							
1	Konoike Vina	15 trucks as of Apr 2016	5 – 15	25 – -25	FCL, LCL temperature-controlled road and courier services Border temperature-controlled road transportation services	Food manufacturers/ distributors/ traders	B2B
2	Panalpina World Transport (Viet Nam)	n.a.	n.a.	n.a.	Temperature-controlled air freight Ocean reefer freight Temperature-controlled road and courier services	Food manufacturers/ distributors/ traders	B2B
3	Agility Logistics	n.a.	n.a.	n.a.	Integrated trucking network across ASEAN region linking major cities, ports and airports to one another and 150 destinations in China.	n.a.	B2B
4	Meito Viet Nam	n.a.	1.8 – 13	15 – -18	Temperature-controlled road transportation services	Food manufacturers/ distributors/ traders	B2B
5	Panasato	n.a.	n.a.	n.a.	Handling perishable-specialised in refrigerated cargo, big quantity agricultural products	n.a.	n.a.
Domestic Capital							
1	ABA Cooltrans	200	1 – 14	n.a.	North-South and vice versa temperature-controlled road transportation Small cold trucks for distribution in urban areas	Hypermarkets/ Food manufacturers, distributors, traders	B2B
2	Tan Bao An	35	n.a.	0 – 5; -25 – -18	Truck transportation for perishable products: meat, seafood, fruit and vegetables, milk, medical, pharmaceutical products	Food manufacturers, distributors, traders	B2B
3	Tan Nam Chinh Logistics	100	n.a.	n.a.	Nationwide temperature-controlled road transportation Integrated trucking network across the ASEAN region and China	n.a.	B2B
4	Duc Tan – Sai Gon	n.a.	1 – 1.25 – 2.5	n.a.	Truck transportation for perishable products for Hanoi and neighbouring areas	Food manufacturers, distributors, traders	B2B
5	Binh Minh Tai	30	1.4 – 18	n.a.	North-South and vice versa temperature-controlled road transportation for perishable products	Hypermarkets/ Food manufacturers, distributors, traders	B2B

Source: Collated by authors from official websites of companies.

3.3. Government policies related to the cold chain in Viet Nam

Currently, the Vietnamese government has not established a strategy or specific policy framework for promoting cold chain agriculture. Instead, cold chain related policies are scattered in various laws and regulations issued by different agencies, mainly derived from three policy categories: (i) food safety law and regulations; (ii) logistics development promotion policies; and (iii) food standards in Viet Nam.

In terms of strategy, in 2013, the government issued Decision 899/2013/QD-CP by the Government on Agricultural Restructure Program, in which Viet Nam would transform its agricultural sector towards a high-value, sustainable development model. Thanks to this policy, the Ministry of Agricultural and Rural Development (MARD) and 63 provinces have promoted the conversion from traditional grain crops, such as rice and maize, to high-value vegetable, flower, fruit, and aquaculture production, which are high value but also perishable and, thus, have indirectly pushed the demand for cold services.

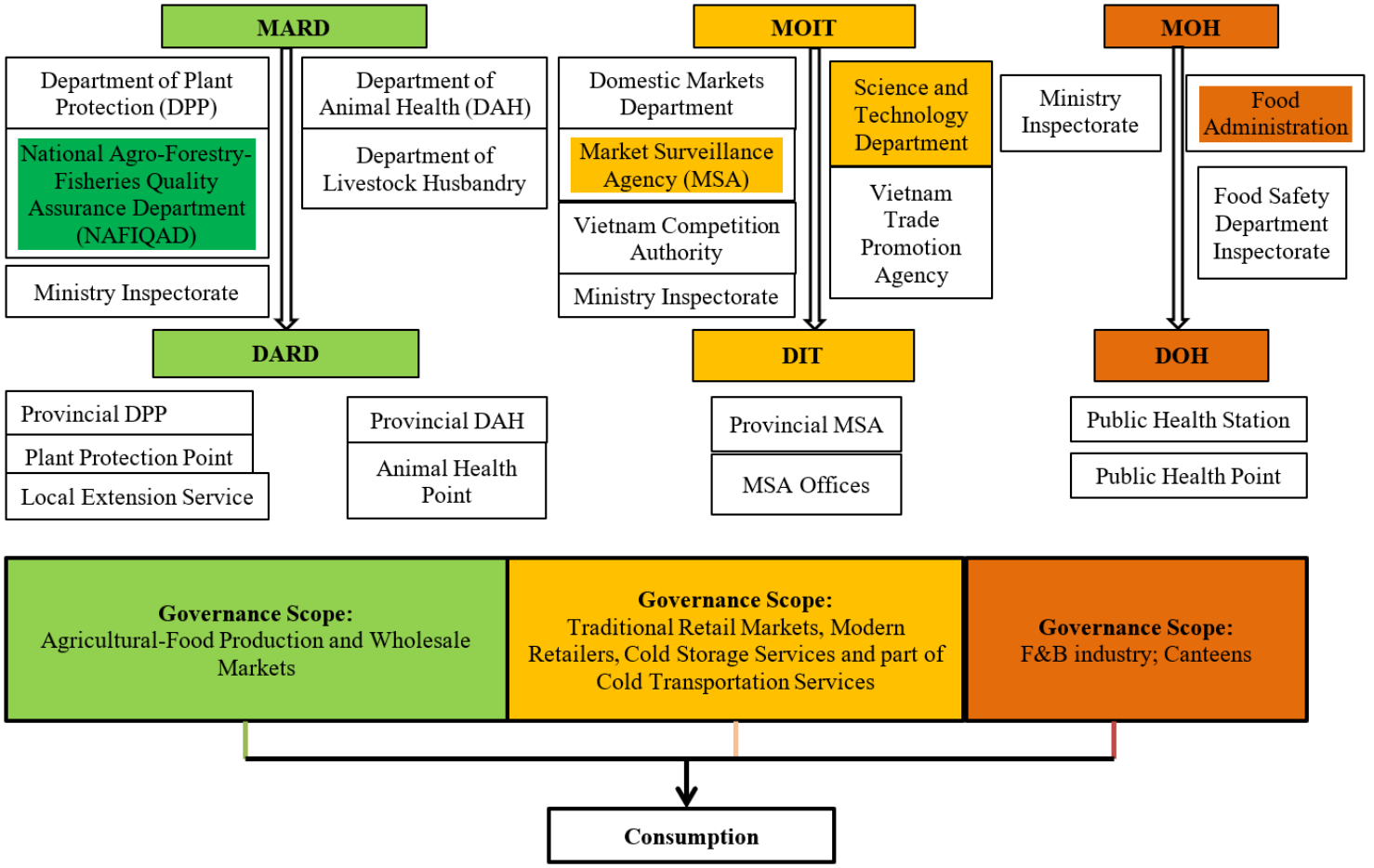
The top policy influencing cold chain service is the Food Safety Law, enacted in 2011; in which, temperature-related conditions are stated in Provision 1b of Article 20: “Food producers and traders must meet the following conditions for food preservation: Preventing the effects of temperature, humidity, insects, animals, dust, strange smell and negative environmental effects: guaranteeing sufficient light: having special-use equipment for adjusting temperature, humidity and other climate conditions, ventilation equipment and other special preservation conditions required by each type of food”. The provision was explained in detail in Joint Circular 13/2014/TTLT-BYT-BNNPTNT-BCT on the allocation of tasks and cooperation among regulatory agencies in food safety management, in which MARD is assigned the responsibility of managing meat, fisheries, fruit and vegetables, eggs, and raw milk. The National Agro-Forestry–Fisheries Quality Assurance Department (NAFIQAD) and its local branches (under MARD) are authorised to issue food safety certification to cold storage for agricultural products and foods. While the registration of cold transportation vehicles is the responsibility of Viet Nam Register under the Ministry of Transportation, the Ministry of Industry and Trade (MOIT) has been authorised to issue food safety certification to hypermarkets, supermarkets, and other modern retail channels.

The second policy category is logistics development promotion policies, notably Decree 163/2017/ND-CP by the government on the provision of logistics services. The decree has

decisive impacts on shaping the investment environment currently when creating more room for foreign investors to join logistics services in Viet Nam by specific regulations on the 'rights of foreign investors to acquire shares, contribute capital or establish an enterprise in sea transport, container handling services, customs clearance, inland waterway transport services, road transport services'. Directive 21/CT-TTg, issued in 2018 by the prime minister on promoting the implementation of solutions to reduce logistics costs and effectively connect transport infrastructure, attempts to link more effectively transport infrastructure and lower logistic costs, thereby encouraging integrated logistics services and motivating e-commerce retail, new ground for cold chain services in Viet Nam.

Specifically, to promote the post-harvest technology application for agricultural production, Decision 68/2013/QD-TTg targets mitigating losses in post-harvest stages through credit support to purchase machines and equipment, including refrigerated cargo; machines for producing ice; and cold storage facilities. However, the policy has not been appreciated due to low accessibility to targeted groups, especially farmers, cooperatives, and farming households. Meanwhile, the cold services providers surveyed and interviewed by the research team confirmed they were not aware of the policy.

Figure 3.13: Map of Government Agencies Related to Good Safety in Viet Nam



DARD = Department of Agricultural and Rural Development, DIT = Department of Industry and Trade = DOH: Department of Health, MARD = Ministry of Agriculture and Rural Development, MOH = Ministry of Health, MOIT = Ministry of Industry and Trade. Source: Authors.

The third policy category in supporting cold chain development is food standards applied in Viet Nam. To boost fishery exports, the nation has formed a range of technical requirements for frozen shrimp, pangasius, and raw fishery materials requiring temperature control. TCVN 4379 was the first standard on frozen fish exports and was issued more than 30 years ago in 1986. The most recent one is TCVN 12429:2018 issued in October 2018 on chilled meat and its technical requirements.

3.4. Opportunities and challenges of cold chain development for agriculture in Viet Nam

Within the cold chain

While investment in pre-cooling – getting perishable fruits and vegetables into a controlled environment as quickly as possible after harvest – helps to reduce food loss, perhaps the biggest challenge in developing economies like Viet Nam's, is a shortage of refrigerated vehicle resources and refrigerated warehouse space in material zones (Mercier et al. 2016). Small-scale and fragmented agricultural production in Viet Nam inhibits professional cold transportation companies. Given the fact that the average size of a household's farm in Viet Nam is less than one hectare and most farms are far away from cities with low-quality roads, it is excessively costly for cold trucks to come to collect agricultural products timely after harvesting. Depending on the products, farmers have to wait from one day to one week before their products are collected. Normally, for perishable products, such as shrimps or fruits, collectors or traders may come in one day. However, they usually use non-refrigerated vans and motorbikes to transport the products to wholesalers or to the market. In the Mekong River Delta, boats are the main transport vehicles of agricultural products in remote areas. This means the fragmented agricultural product and foodstuff flows from the upstream in cold chains have not favoured cold-chain development from the very beginning. They have also been discouraging new investments in the cold chains that directly serve farmers and rural areas.

For farmers, due to the lack of household-scale cold transportation and storage facilities, farmers usually harvest agricultural products when they are immature. Uneven maturity among agricultural products harvested and poor-managed household storage force farmers to sell their products with large volumes immediately in the peaks of their harvesting periods to maintain the product quality. The seasonality of agricultural production and abundant supply in short harvesting periods generate unstable flows of products and pose high risks for both agricultural producers and cold service providers at the early stage of cold chain flows. The market for agricultural household-scale cold storage technology and equipment, particularly for perishable products, such as high-value fruit and vegetables, is promising for cold chain suppliers in the future.

Traditionally, the cold chain logistics sector in Viet Nam has been fragmented with small and medium service providers that provide localised services that do not cover the end-to-end food supply chain. Except for highly integrated in-house seafood cold chains, commercial cold chains of other goods flows are highly fragmented in all stages. Even big companies rarely

offer integrated services in both cold storage and cold transport markets. The lack of long-distance cold transport services demonstrates high risks and high variable costs in operating the services.

Although retailers have expanded in Viet Nam in recent years, the distribution networks remain underdeveloped to provide a safe and efficient last mile distribution service. The phenomenon of e-commerce has been realised clearly year by year, and some retailers have been offering fresh foods and home-delivery services. The home delivery services have exploited mainly motorbikes attached with insulation boxes to control the temperature. However, this solution has appeared ineffective on hot days. This is also a potential investment area for cold chain suppliers in the future.

Outside the cold chain

Low connectivity in transport infrastructure, especially roads, domestic waterways, and seaports, is always considered as a main factor causing high logistics costs in Viet Nam (MOIT 2015; Dexion 2015). First, the lack of integration and connection between ports and material zones. For example, in Mekong River Delta, the main agricultural source of the nation, there are many small ports (37 ports), but few container ports where big ships can approach. Consequently, most agricultural products in the delta have to be transported to ports in Ho Chi Minh City or Vung Tau province for exports and this practice significantly increase the cost of Vietnamese products. Overloaded road transportation and under-developed railway transportation are other issues in Viet Nam. Most warehouses are located near big cities, such as Ho Chi Minh, Ha Noi, Da Nang, Can Tho and far away from agricultural material zones. Agricultural products are mainly transported via degraded, poor-quality roads with too many container trucks, while there is no internal railway system in intensive agricultural production zones, such as the Mekong River Delta, Red River Delta, Central Highlands, and Southern East Region. Energy also causes problems for cold chain development in Viet Nam. Interrupted electricity supply causes huge costs to cold chain storage suppliers in Viet Nam as they have to equip a standing by back-up battery system, which is very expensive.

In addition, professional cold storage and transport services would require high-qualified labour, with their own specific knowledge of the nature of perishable products and quality changes due to temperature (Asia Pacific Economic Cooperation 2015). Both the cold storage and cold transportation sectors are facing shortages of labour. At the moment, there are almost no university offering courses with curriculums related to cold chain logistics and management in agriculture. This is an important segment for universities to open new education programs and short-course training to staff and managers of companies using cold chain services in the near future.

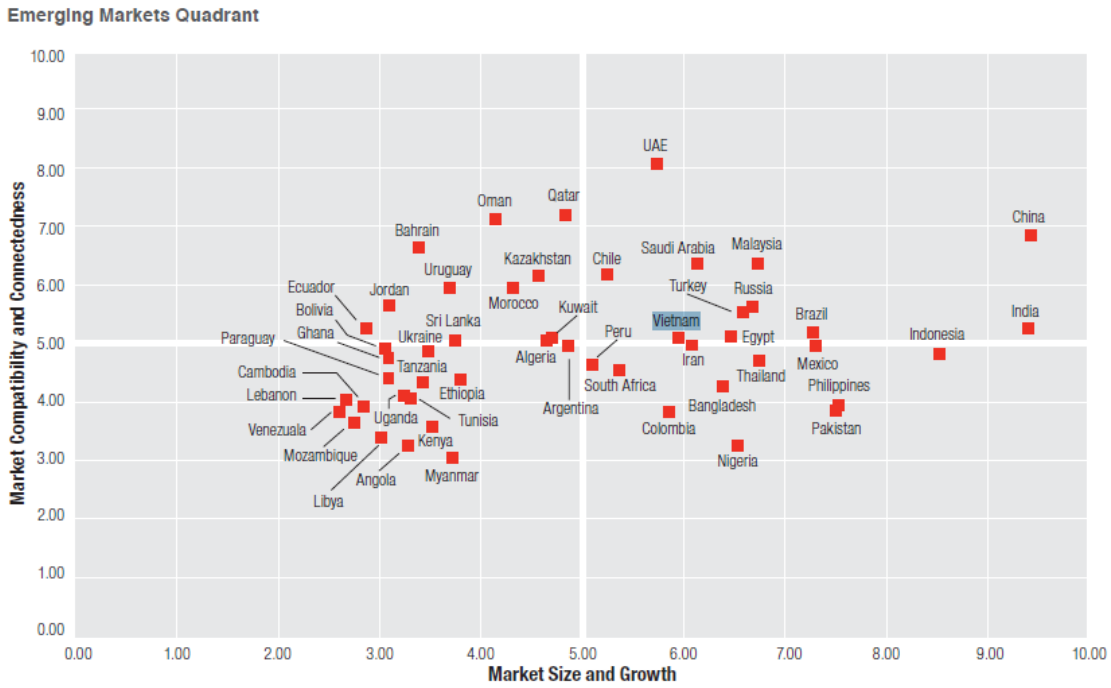
The lack of policy framework for cold chain development is among the notable issues and challenges. As discussed above, while the high logistics cost has attracted the attention of central government with the issuance of Directive 21, a specific policy framework or a development strategy of cold chain logistics does not exist in Viet Nam. One of the key policy priorities for the government is how to integrate the cold chain into the current logistics

infrastructure system of Viet Nam effectively and efficiently. Given the fact that the demand for cold chain development in agriculture is obvious but it is risky and costly to invest in agriculture, the government has to issue policies to promote investors to go to this sector. The absence of a vision for cold chain development and public–private partnership mechanism causes difficulties for investors to make their decisions matched with the government's development priorities.

3.5. The mid-term prospects of the cold chain

According to Agility (2018), India and China remain, by far, the leading investment destinations for the logistics industry. Viet Nam leads the second group, which includes the United Arab Emirates, Brazil, and Indonesia. This research selected Viet Nam as the market with the third-highest potential thanks to its impressive economic and trade growth over many years. Economic growth, foreign direct investment, trade volume, location, and transport infrastructure ahead of cheap labour are keys to making Viet Nam an important emerging market.

Figure 3.14. The Emerging Markets Logistics Index 2018



Source: Agility (2018).

These results have partly reflected the prospects of Viet Nam's logistics market in general, and the cold chain in particular. Especially, the strong commitments of Viet Nam to various free trade agreements (FTAs), notably the EU–Viet Nam FTA, Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), Viet Nam–Japan FTA, and Korea–Viet Nam

FTA, are highly expected to attract more FDI and imported product flows, thereby promoting significantly the development of the cold chain in the mid-term. Decree 163/2017/ND-CP on the provision of logistics services to create a more friendly investment environment for FDI investments into logistics services generally, and cold chains services in particular, is on time to exploit the advantages.

In the mid-term, seafood, food, and drink export-oriented manufacturers likely continue to dominate in Viet Nam's cold chain. Therefore, their inbound logistics and integrated production systems possibly remain as a main driver in Viet Nam's cold chain development. In particular, the recent launches of highly integrated logistics complexes of Transimex–Saigon Hi-Tech Park (SHTP) in Ho Chi Minh City and Mekong Logistics of Minh Phu–Gemadept in Hau Giang Province in Mekong Delta region would mark a new chapter for cold chain development in Viet Nam.

Increasing consumption of high-value imported food in the domestic market and demand for 'clean', eco-friendly, chilled, packed foods would likely provide some momentum. For example, in February 2018, Masan Nutri-Science (MNS) opened its largest pork processing complex in the north of Viet Nam, to target supplying 140,000 tons of pork, accounting for 5% total domestic supply. Its main product is chilled meat kept in cold storages set at temperatures from 0 – 4°C and optimally used in five days. MNS is cooperating with VinGroup to offer its Meat Deli brand in separated zones inside Vinmart supermarkets. Both enterprises are among the pioneers in developing food processing complex and modern retail chains in Viet Nam, driving new demand for cold storage and transportation. The FTAs would lower tariff rates and, given the low non-tariff trade barriers in Viet Nam, in the mid-term, Viet Nam would likely have an influx of imported foods, especially meat, dairy products, fruit, and packed foods. Meanwhile, the rapid growth of modern retail channels, e-commerce, and food service sectors would definitely help to create more demand for cold chain services, especially for third-party cold chain logistics service.

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Table 2. Information and Glossaries of Major Foreign Stakeholders in the Commercial Cold Storage Market by Region

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FM Logistics: http://www.fmlogistic.com/eng-gb/Media/News/FM-LOGISTIC-SETS-UP-BASE-IN-VIETNAM-TO-REINFORCE-ITS-POSITION-IN-ASIA

Konoike Vina: http://www.konoikevina.com/vi

CLK Cold Storage Company Limited: https://www.kline.co.jp/en/news/other/other-9079631322222887844.html

Sojitz and Kokubu or New Land Co. Ltd. (Vietnam): https://www.newlandvj.com/

Kuehne Nagel: https://vn.kuehne-nagel.com/vi_vn/dich-vu-kho-bai-va-phan-phoi/trung-tam-logistics-kuehne-nagel-vietnam/tour-ao-tham-quan-nha-kho/

Preferred Freezer Services: https://www.preferredfreezer.com/us-locations.php?Ho-Chi-Minh-City-40?expanddiv=interior-nav-region-vietnam

Sagawa Express: http://sagawa-vtm.com.vn/?lang=en

Meito Vietnam: http://www.meitovietnam.com.v

Anpha-AG: http://anpha-ag.com/gioi_thieu

Panasato: www.panasato.com.vn

Lotte Logistics Vietnam Co. Ltd.:

http://www.lottelogistics.com.vn/system/application/views/default/images/LOTTE-SEA%20CATALOGUE.pdf

Table 3: Information and Glossaries of Major Domestic Stakeholders in Commercial Cold Storage Market by Region

ABA Cooltrans: https://aba.com.vn/

Quang Minh: http://quangminhcorp.com.vn/detail/vi-Vn/201/lich-di-hang-2018

Đức Tấn – Sài Gòn: http://www.kholanhductan.com.vn/default.aspx?webid=2

Thăng Long Logistics: http://www.tll.com.vn/

Transimex: www.transimex.com.vn

CTCP Giao nhận Xếp dỡ Tân Cảng: http://s.cafef.vn/hose/TCL-cong-ty-co-phan-dai-ly-giao-nhan-van-tai-xep-do-tan-cang.chn

Hoàng Lai Group: http://www.hoanglaico.com/Default.aspx

Satra: http://satra.com.vn/linh-vuc-hoat-dong/kho-lanh-satra-31076

Phan Duy Corp: www.phanduycorp.vn

An Phú: www.apic.com.vn

Table 4: Information and Glossaries of Major Domestic Stakeholders in the Self-operating Segment of Seafood Cold Storage by Product

Vinh Hoan Corporation: http://vinhhoan.com/

Hung Vuong Corporation: https://www.hungvuongpanga.com/

International Development &Investment Corporation (IDI): http://www.idiseafood.com/en

Nam Viet Corporation: http://navicorp.com.vn/?lang=en

Cadovimex II : http://www.cadovimex2.com.vn/

Mekong Fishery JSC: http://www.mekongfish.vn/en/AboutUs.asp

Godaco Seafood JSC: https://godaco-seafood.com.vn/vi/

Hung Ca Co., Ltd: https://www.hungca.com/

Minh Phu Seafood Corporation: http://minhphu.com/en/home/

Sao Ta Foods JSC: https://www.fimexvn.com/index.php/en/

Camimex Group: https://www.camimex.com.vn/

Seaprodex Minh Hai: https://www.seaminhhai.com/

CTCP Chế biến Thủy sản XNK Âu Vững I: http://www.auvungseafood.com/

Table 5. Information and Glossaries of Major Stakeholders in Commercial Cold Transportation Services

Panalpina World Transport (Vietnam):

http://www.panalpina.com/www/global/en/home/industry_verticals/IVChem.html

Agility Logistics: https://www.agility.com/en/emerging-markets-logistics-index/rankings-2018/

Tân Bảo An: www.xelanhtba.com

Tân Nam Chinh Logistics: https://tannamchinh.com/gioi-thieu/gioi-thieu.html

Bình Minh Tải: www.binhminhtai.com.vn

Chapter 4

A Cold Chain Study of Indonesia

PT Capricorn Indonesia Consult

4.1. Introduction

Background

The cold chain system is a type of supply chain wherein the process aims to maintain temperature so that the product is maintained during the distribution process. An important factor in maintaining cold chain products is the correct treatment in each of the main distribution points in the cold chain so that the right distribution channels will provide good quality of cold chain products.

The application of cold chains requires the provision of several facilities, both in the storage and distribution process. In the storage process, it is needed to have, among others, cold storage and freezing machines, while in the distribution process, it is necessary to have refrigerated transportation fleets (carriers, aircraft and vehicles).

Cold chain business is a major supporter of various industrial sectors such as the food processing industry, fishing industry, retail network, pharmaceutical industry and so on.

Indonesia is considered to have a potential market for cold chain business. This is supported by the user industrial sector, which shows fairly good development. The user industrial sectors such as livestock, fisheries, processed food and chemical, pharmaceutical and drug industries are still an important key for national development, and this can be seen from its contribution to Indonesia's gross domestic product (GDP) during 2018.

Based on the information from the Central Bureau of Statistics (BPS), in that period, GDP of the livestock sector had a contribution of 1.5% or Rp231.7 trillion of the total Indonesian GDP of Rp4,837.3 trillion, the fisheries sector contributed 2.6% of the total GDP, the food and beverage industry accounted for 6.2% and the chemical, pharmaceutical and drug sector amounted to 1.6% of Indonesia's total GDP.

Scope of study

This study aims to discuss more clearly the prospects for cold chain business and the obstacles faced by this industry. It also discusses the user industry such as the processed food industry, fisheries industry, agricultural industry, trade industry and pharmaceutical industry.

In addition, this study features information on companies involved in the processed food industry, fishing industry and pharmaceutical industry. Besides that, it also discusses government policies that support the cold chain industry and the cold chain market share in Indonesia.

Methodology and source of information

This study was conducted in two ways, namely, desk research and field research. Field research is performed by conducting interviews with business players or several stakeholders in related industries in Indonesia that produce primary data. While desk research is obtained based on the information in the form of studies or data from related institutions such as the Ministry of Maritime Affairs and Fisheries (KKP), Fishery Products Processing and Marketing (P2HP), Animal Husbandry and Animal Health, BPS, and Indonesian Cold Chain Associations (ARPI), which produce secondary data.

In addition, to complete the information, this study also relies on several studies and analyses originating from the data bank of PT Capricorn Indonesia Consult, Inc. (PT CIC).

4.2. General review on cold storage in Indonesia

National economic development

The prospect of Indonesia's economy is expected to improve further next year with higher growth and maintained stability. This growth is triggered by stronger domestic demand by both consumption and investment, improved export performance and declining imports. Bank Indonesia (BI) estimates that domestic economic growth will be in the range of 5.5%–6.1% until 2024.

The improving economic condition in Indonesia will certainly lift the growth of various industrial sectors, including the processed food industry, fishing industry, agricultural industry and pharmaceutical industry.

Based on BPS information, the growth rate of the processed food sector during 2014–2018 averaged 5.8% per year. The contribution of the livestock sector averaged 1.5%, the fisheries sector attained 2.5% per year and the processing pharmaceutical industry reached 1.7% per year.

In 2018, the processed food industry was the largest in contribution, namely, 6.2% of the total GDP nationally or reaching Rp927.4 trillion and increased compared with the previous year (2017), which reached Rp834.4 trillion.

The fisheries sector contributed 2.6% or reached Rp385.9 trillion in 2018. Meanwhile, the chemical industry and drug sector contributed Rp239.6 trillion, while the livestock industry contributed 1.5% with a value of Rp231.7 trillion in 2018.

Table 4.1: Gross Domestic Products Based on Current Prices, 2014–2018 (Billion Rupiah)

BUSINESS FIELD / BASED ON CURRENT PRICES	Year					Annual Average (%)
	2014	2015	2016	2017	2018	
AGRICULTURAL SECTOR						
a. Livestock	167,008	184,152	201,124	213,306	231,711	–
Contribution to GDP (%)	1.58	1.60	1.62	1.57	1.56	1.59
b. Fishery	245,488	288,917	317,190	348,854	385,936	–
Contribution to GDP (%)	2.32	2.51	2.56	2.57	2.60	2.51
PROCESSING SECTOR						
a. Food and Beverage Industry	562,017	647,072	740,810	834,425	927,444	–
Contribution to GDP (%)	5.32	5.61	5.97	6.14	6.25	5.86
b. Chemical, Pharmaceutical and Drug	180,037	209,788	223,405	236,193	239,678	–
Contribution to GDP (%)	1.70	1.82	1.80	1.74	1.62	1.74
GROSS DOMESTIC PRODUCTS (GDP)	10,569,705	11,526,333	12,401,729	13,587,213	14,837,358	–

Source: Central Bureau of Statistics (2019).

Contribution of national economic development to cold storage in cold chain business

The development of the livestock, fisheries, processed food, chemical and pharmaceutical and drug industry has a major influence on the development of the cold chain industry in Indonesia. The development of these industrial sectors will automatically affect the increase in cold chain demand.

Several policies are issued by the government to support the development of the cold chain industry by the user industry, such as the fisheries sector. The potential of Indonesian marine products is known to be very abundant. However, the abundant potential of fish catches is often constrained by the limited supporting means, of them is cold storage. The presence of cold storage at each distribution point is needed to extend the freshness of the fish for the buyer.

The fisheries sector is one of the government's special concerns to be optimised; thus, it has added value and contributes to state revenues.

In the livestock sector, the role of the cold chain is also very much needed. Animal products are one of the food sources that are rich in protein and needed to build healthy and smart communities. Food products from animals are also one of the products that are categorised as perishable food and potentially hazardous.

Apart from having to think about its availability, it must also be handled properly to be able to be beneficial and guaranteed to be healthy and safe for consumption. The government continues to try to support the implementation of the cold chain to maintain the supply of

meat to remain stable nationally and to meet not only domestic needs but also export market needs.

Likewise, in the pharmaceutical sector and the processed food industry, where cold chains are indeed needed to maintain good product quality. This condition makes it clear that cold chain industries also have significant contributions in national economic development.

Obstacles and challenges of cold storage in cold chain business in Indonesia

The development of cold chain business is not as expected as this business has many challenges and obstacles to face. Among them are obstacles in investment because of infrastructure problems the lack of fiscal facilities offered by the government.

As is known, 100% raw material of the cold chain industry is still imported, and the government has not yet agreed to provide duty exemption facility on the component as well as the provision of tax holiday facilities to build cold storage assembly plants in the country. Another challenge is the lack of availability of electric power in remote areas. This condition results in the use of cold chains by the user industry not being optimal. According to information from ARPI, the installed capacity of the industry is only half of the national demand.

Seeing the economic development of Indonesia, which is increasingly being supported by abundant natural resources, these obstacles and challenges can create opportunities, as well as challenges, for the cold chain industry in the country.

Prospects for cold storage markets in Indonesia

The need for cold storage in cold chain business in Indonesia is still quite high. This is indicated by almost all cold storage warehouses that are always fully occupied for storing meat products, fish, vegetable fruits and so on.

In addition, Indonesia’s cold chain market has fairly good prospects, marked by the increasing Indonesian economic growth, followed by the development of the user industry.

Another indicator is the large population with a consumption pattern that tends to require efficiency and speed and who likes fresh products such as fresh fruits and vegetables and processed meat, milk and other products.

Besides that, the development of network retail sector and restaurant chain stores has also encouraged the development of cold storage business in Indonesia. Most retail networks have many outlets spread across several locations. This requires handling the availability of goods professionally and on time, similarly, the export and import business of fishery products, meat, fruit and vegetables and the ice cream industry.

4.3. Development of cold chain products in Indonesia

Cold storage production in cold chain business in Indonesia

To maintain cold storage facilities require a substantial investment. It is not surprising that many companies do not have their own cold storage facilities for their needs. For this reason, many of them rent or cooperate with cold storage owners.

It is very difficult to know the amount of cold storage production in Indonesia and can only be known from the production capacity of cold storage.

Several players involved in this business consist of various business sectors, namely, cold storage companies, food processing industries, meat importers including slaughterhouses, fishing industries, ice cream industries, fruit importers, retail networks and pharmaceutical industries.

Based on a survey conducted by CIC, until the end of 2018, there were around 69 major cold storage companies throughout Indonesia with a total capacity of 370,000 tons per year. Of this amount, the largest capacity is owned by PT Enseval Medika Prima Tbk., which has a cold storage production capacity of 59,000 tons. It is followed by PT Unilever Indonesia (Wall's ice cream) with a production capacity of 50,000 tons.

PT Sukanda Djaya ranked third with a total cold storage capacity of 45,000 tons and followed by other companies such as PT Kiat Ananda Cold Storage, PT Mega Internasional, PT Indomaguro Tunas Unggul and others as shown in the following table:

Table 4.2: Cold Storage Company and Capacity in Indonesia, 2018

No.	Name of Company	Capacity (Ton)	Share (%)
1	Enseval Putra Megatrading Tbk, PT	59,000	15.9
2	Unilever Indonesia, PT (Wall's ice cream)	50,000	13.5
3	Sukanda Djaya, PT	45,000	12.2
4	Kiat Ananda Cold Storage, PT	30,000	8.1
5	Mega Internasional Sejahtera, PT	21,000	5.7
6	Indomaguro Tunas Unggul, PT	15,000	4.1
7	Dharma Samudera Fishing Industries, PT	14,000	3.8
8	Savina Cold Storage	9,000	2.4
9	Wahana Cold Storage, PT	7,000	1.9
10	Lion Super Indo, PT/Super Indo	6,600	1.8
11	Bonicom Servistama Compindo, PT	6,000	1.6
12	Central Windu Sejati, PT	6,000	1.6
13	Adib Food Supplies, PT	6,000	1.6
14	Mgm Bosco Logistics, PT	5,500	1.5
15	Perum Perikanan Indonesia	5,100	1.4
16	Bumi MenaraInternusa, PT	5,000	1.4
17	Surya Alam Tunggal, PT	5,000	1.4

No.	Name of Company	Capacity (Ton)	Share (%)
18	Jalur Sejuk, PT	5,000	1.4
19	Hero Supermarket Tbk, PT/Giant	4,400	1.2
20	Trans Retail Indonesia, PT/Carrefour	4,100	1.1
21	Wirontono Cold Storage & Industry, PT	4,000	1.1
22	Supra Boga Lestari/Ranch Market, PT	3,000	0.8
23	Istana CiptaSembada (Ics), PT	3,000	0.8
24	ExpravertNasuba, PT	3,000	0.8
25	Mega Marine Pride, PT	2,000	0.5
26	Scrum Indonesia, PT	2,000	0.5
27	Wira Logitama Saksama	2,000	0.5
28	Fast Food Indonesia, PT Tbk (KFC)	1,800	0.5
29	Perikanan Nusantara, PT	1,550	0.4
30	AGB Tuna, PT	1,500	0.4
31	Alpine Cool Utama	1,500	0.4
32	Central Coldstorage PratamaSakti, PT	1,500	0.4
33	Raficon Sarijaya, PT	1,500	0.4
34	Bintang Citra International, PT	1,500	0.4
35	Guna Pratama, PT	1,500	0.4
36	Lotte Shopping Indonesia, PT/Lotte	1,300	0.4
37	Trade Corp Indonesia, PT	1,200	0.3
38	Starcon Indonesia, PT	1,200	0.3
39	Multi Guna International Persada, PT	1,100	0.3
40	Diamond Cold Storage, PT	1,000	0.3
41	Kini Cold Storage, PT	1,000	0.3
42	Central Food Lestari, PT	1,000	0.3
43	United Refrigeration, PT	1,000	0.3
44	Ercoolcoldstorage, PT	1,000	0.3
45	Rekso Nasional Food, PT/McDonald’s	1,000	0.3
46	Cold Storage Jaya Makmur, PT	1,000	0.3
47	Aneka Boga Nusantara, PT	1,000	0.3
48	IluvaIntiluhur Fuji Abadi, PT	1,000	0.3
49	Cooltech Surabaya, PT	1,000	0.3
50	Widjaya Dwi Kalmindo, PT	1,000	0.3
51	Aneka Cool Citratama, PT	1,000	0.3
52	Indopanel Sukses Makmur, PT	1,000	0.3
53	Sarana Refrigeratama, PT	1,000	0.3
54	Celcius Jaya, PT	1,000	0.3
55	Sarana Dunia Pendingin, PT	1,000	0.3
56	Wahana Boga Nusantara, PT	1,000	0.3
57	Indoguna Utama, PT	1,000	0.3
58	Belfoods Indonesia, PT	1,000	0.3
59	Armada Container Indonesia, PT	1,000	0.3
60	Inter Mitra Transindo, PT	1,000	0.3
61	Tri Putra Perkasa, PT	1,000	0.3

No.	Name of Company	Capacity (Ton)	Share (%)
62	Pluit Cold Storage, PT	500	0.1
63	Tiara Dewata Group	500	0.1
64	San Miguel Pure Foods Indonesia, PT	500	0.1
65	Japfa Santori Indonesia, PT	500	0.1
66	Hwasung Thermo Indonesia, PT	500	0.1
67	Bali Mina Utama, PT	400	0.1
68	Darta Logistic, PT	250	0.1
69	Abbatoir Surya Jaya, PT	200	0.1
TOTAL CAPACITY		**370,200**	**100.0**

Source: Survey by author.

Development of cold chain demand in cold chain business in Indonesia

In the next five years, the demand for cold storage is expected to continue to increase, which will automatically increase the current installed capacity. Based on the trends experienced by major cold storage being surveyed, on average in the next few years, the need for cold storage will increase between 10% and 20% per year.

With this estimate, it is projected that in 2019, the demand for cold storage capacity will reach 462,700 tons, or an additional capacity of 92,500 tons is needed from the current production capacity of 370,200 tons. Until 2024, the capacity will reach 824,700 tons, or an additional capacity of 59,600 tons is needed as shown in the following table:

Table 4.3: Projection of Potential Demand for Cold Storage in Indonesia, 2019–2024

Year	Projection of Production Capacity (tons)	Additional Production Capacity (thousand tons)
2019	462,750	92,550
2020	548,359	85,609
2021	631,161	82,802
2022	692,384	61,223
2023	765,084	72,700
2024	824,760	59,677

Notes: Estimated based on the trends experienced by major cold storages being surveyed. Additional Production Capacity denotes gap between the projected capacity and the previous year's capacity.
Source: Authors.

4.4. Demand for frozen food in Indonesia

Transitions of Indonesia frozen food consumption

Indonesia is considered to have good prospects in the food and beverage industry, which is mainly driven by the frozen food industry, especially those from marine products.

The demand for frozen food in recent years is estimated to have been increasing, along with changes in the pattern of consumption of people, which tend to be fast, practical and economical but meet nutritional and health needs. With a population of around 260 million, it is a considerable market potential for the frozen food industry in Indonesia, especially supported by the increasing public purchasing power.

According to CIC's observations, in the last five years, the consumption of frozen food has increased by an average of 6.9% per year. While in 2014, the consumption of frozen food only reached 5.0 million tons, and in 2015, it increased to 5.5 million tons, up 8.6%. This condition also occurred in 2016, where frozen food consumption again increased to 5.9 million tons, up 7.4%. Until the end of 2018, frozen food consumption has reached 6.6 million tons. More information on the development of frozen food consumption during the 2014–2018 period is presented in the following table:

Table 4.4: Development of Frozen Food Consumption in Indonesia, 2014–2018 (Ton)

Year	Production	Import	Export	Consumption	Growth (%)
2014	5,629,902	280,360	828,130	5,082,132	–
2015	5,920,708	229,551	631,013	5,519,246	8.6
2016	6,211,514	314,470	600,794	5,925,191	7.4
2017	6,502,321	389,626	621,604	6,270,342	5.8
2018	6,793,127	406,179	568,774	6,630,531	5.7
Annual Average (%)					**6.9**

Notes: See footnote for frozen foods referred in this discussion.[18] Domestic consumption was estimated from production + import – export.
Source: Central Bureau of Statistics (2019).

Export of frozen food in Indonesia

Although the frozen food industry has developed in Indonesia, its marketing to the export market has not been optimal, which has good prospects. Admittedly, there are some obstacles to export frozen food overseas that must be faced and certainly difficult. For

[18] Frozen foods in this discussion consist of HS 02023000, 02032200, 02032900, 02044100, 02069000, 02043000, 02071200, 03031900, 03032300, 03032400, 03032600,03032900, 03033100, 03033300, 03033900, 03034100, 03034200, 03034300, 03034400, 03034600, 03034900, 03035300, 03035410, 03035420, 03035500 up to 03035700, 03035910, 03035920, 03035990, 03036800, 03036900, 03038100, 03038200, 03038400, 03038911, 03038913, 03038914, 03038916 up to 03038919, 03038926 up to 03038929, 03039100, 03039200, 03046100, 03046200, 03046900, 03047900, 03048100 up to 03048400, 03048700 up to 03048900, 03049100, 03049300, 03049600, 03049700, 03049900, 03061110, 03061190, 03061210, 03061290, 03061410, 03061490, 03061500, 03061600, 03061711, 03061719, 03061721, 03061722, 03061729, 03061730, 03061790, 03061900, 03071200, 03072200, 03073200, 03074310, 03074390, 03075200, 03077200, 03078400, 03079200, 03081200, 03083030, 04014020, 04014090, 07101000, 07102100, 07102200, 07102900, 07103000, 07104000, 07108000, 07109000, 07141091, 07142010, 07143010, 07144010, 07149011, 08112000, 08119000, 12122930, 20041000, 20049010, 20049090.

example, the tariff of import duty applied by various export destination countries is quite high.

Information obtained by CIC from the Indonesian Food and Beverage Association (GAPMI) stated that the export of food and beverages is targeted at 10% annually, but the import duty factor is an obstacle for food products to compete in the global market.

As an example, African countries provide better import tariffs to some countries such as China because of the cooperation of CEPT (Common Effective Preferential Tariffs). As a result of such constraint, it is not impossible, if seen from its development, for frozen food exports to decline every year.

Some frozen food products that are quite a mainstay of exports are cuttlefish and frozen squid, skipjack, frozen shrimp and other types of frozen fish.

Based on the information from the Central Bureau of Statistics (BPS) during the 2014–2018 period, frozen food exports declined every year with an average of 8.4 % per year. While in 2014, frozen food exports only reached a volume of 828,100 tons worth US$2.8 billion, in 2015, the volume dropped to 631,000 tons or decreased by -23.8% worth US$2.2 billion.

In 2017, frozen food exports increased again with a volume of 621,600 tons (3.5%) worth US$2.7 billion compared with the previous year's export volume of 2016, which reached 600,700 tons worth US$2.5 billion. And until the end of 2018, exports fell to 568,700 tons worth US$2.4 billion as shown in the following table:

Table 4.5: Development of Indonesia Frozen Food Export, 2014–2018

Year	Volume (Ton)	Growth (%)	Value (US$'000)	Growth (%)
2014	828,130	–	2,845,684	–
2015	631,013	- 23.8	2,263,607	- 20.5
2016	600,794	- 4.8	2,525,598	11.6
2017	621,604	3.5	2,715,074	7.5
2018	568,774	- 8.5	2,419,199	-10.9
Annual Average (%)		**-8.4**		**-3.1**

Source: Central Bureau of Statistics (2019).

Frozen food exports from Indonesia are aimed at various countries such as the United States, China, Japan, Vietnam, Thailand, Taiwan and Malaysia. Frozen food exports to the United States are the largest among other export destination countries.

In 2017, exports to the United States reached a volume of 129,200 tons with a value reaching US$1.2 billion or controlling 20.8% of the total export volume that year, which amounted to 621,600 tons. The second position is occupied by China (18.4%) with a volume of 114,400 tons worth US$232.7 million, followed by Japan (14.7%) with a volume of 91,300 tons worth US$452.0 million, and Vietnam with a volume of 71,200 tons (11.4%) worth US$160.8 million.

Table 4.6: Export of Frozen Food by Destination Country, 2017

Country	Volume (Ton)	Value (US$ '000)	Share (%)
United States	129,252	1,224,390	20.8
China	114,481	232,705	18.4
Japan	91,336	452,081	14.7
Vietnam	71,200	160,869	11.5
Thailand	67,606	131,502	10.9
Taiwan	33,591	81,479	5.4
Malaysia	18,496	43,678	3.0
Korea, Republic of	12,901	31,668	2.1
Italy	11,509	56,440	1.9
Philippines	11,211	18,292	1.8
Singapore	9,775	33,371	1.6
Other Countries	50,245	248,599	8.1
TOTAL	**621,604**	**2,715,074**	**100.0**

Source: Central Bureau of Statistics (2019).

Import of frozen food by Indonesia

Even though Indonesia has been able to produce frozen food, the dependence on imported products is still ongoing, even though the volume is not large. Frozen foods that enter Indonesia include frozen beef, mackerel fish, frozen potatoes, sardines, frozen beef innards and so on.

Imports of frozen food in the last five years increased by an average of 11.8% per year. In 2016, imports increased to 37.0% with a volume of 314,400 tons worth US$801.6 million. Whereas in 2017, imports increased with a volume of 389,600 tons with a value reaching US$855.4 million, up 23.9%. In 2018, imports increased again with a volume of 406,100 tons valued US$991.5 million. Details can be seen in the following table:

Table 4.7: Development of Frozen Food Import by Indonesia, 2014–2018

Year	Volume (Ton)	Growth (%)	Value (US$'000)	Growth (%)
2014	280,360	–	669,351	–
2015	229,551	-18.1	482,010	-28.0
2016	314,470	37.0	801,698	66.3
2017	389,626	23.9	855,472	6.7
2018	406,179	4.2	991,566	15.9
Annual Average (%)		**11.8**	–	**15.2**

Source: Central Bureau of Statistics (2019).

Three major countries are recorded as the major suppliers of frozen food products to Indonesia, namely, China, Australia and India. As an illustration, in 2017, frozen food products originating from China reached a volume of 102,300 tons valued at US$88.6 million or

controlled 26.3% of the total volume of frozen food imports that year, which reached 389,600 tons.

Frozen food products from Australia were ranked second after China, reaching a volume of 84,500 tons with a value of US$275.0 million or controlling 21.7%, while frozen food products from India controlled 12.3% with a volume reaching 48,000 tons valued at US$169.5 million. Then it is followed by other countries such as the United States, Oman, the Netherlands and so on as shown in the following table:

Table 4.8: Import of Frozen Food by Origin Country, 2017

Country	Volume (Ton)	Value (US$ '000)	Share (%)
China	102,347	88,674	26.3
Australia	84,555	275,025	21.7
India	48,014	169,508	12.3
United States	37,104	97,370	9.5
Oman	17,298	10,636	4.4
Netherlands	15,792	15,544	4.1
Pakistan	14,854	10,954	3.8
New Zealand	14,700	48,931	3.8
Japan	9,753	12,099	2.5
Belgium	8,296	7,970	2.1
Canada	7,591	39,238	1.9
Norway	5,785	15,822	1.5
Malaysia	4,157	5,317	1.1
Other Countries	19,378	58,384	5.0
Total	**389,626**	**855,472**	**100.0**

Source: Central Bureau of Statistics (2019).

4.5. Demand for cold storage in Indonesia

Cold storage is needed to maintain the temperature so that the product is maintained and not damaged during the distribution process. To get the right cold chain system, there are several steps that need to be observed, especially for frozen products, namely, handling during the initial process, storage and processing upon arrival, handling during transportation to the destination country and handling on loading and distribution systems to consumers.

Cold storage in Indonesia is applied to several industries, namely, the food, agricultural, fishery and pharmaceutical industries, such as medicines. Of the several industries, certainly, the handling is different. CIC reviewed cold storage needs on each user industry.

Development of Demand for Cold Storage Cargo for Foodstuff in Indonesia

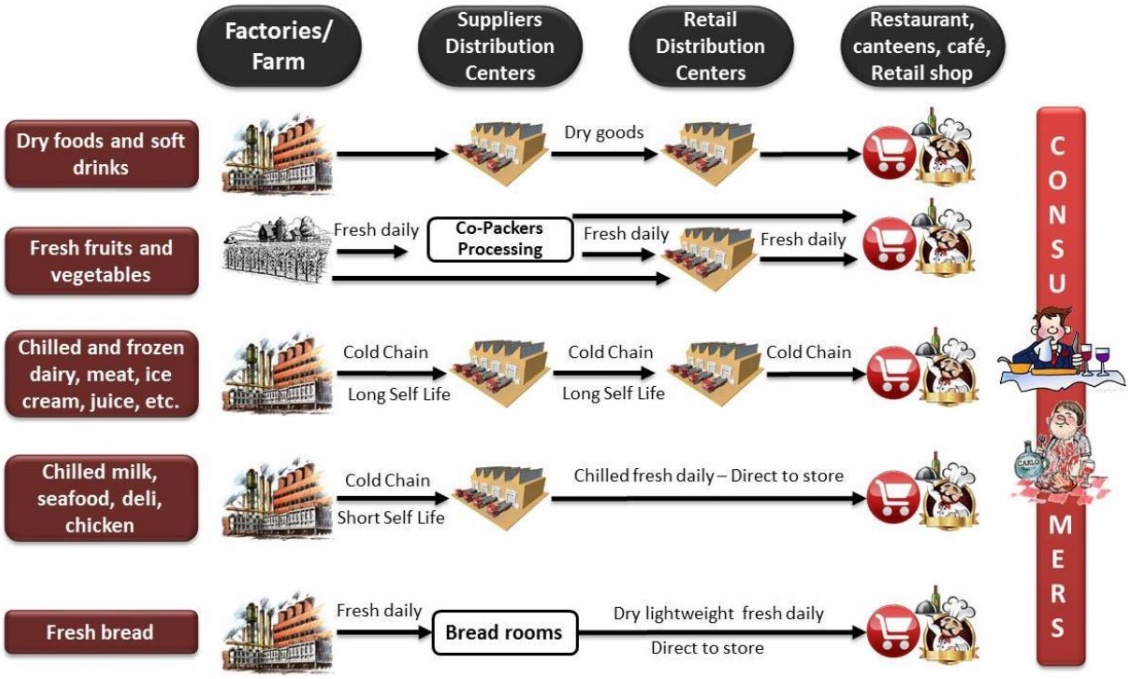
Cold storage for foodstuffs consists of freezing, storing in cold storage, transporting in refrigerated trucks, displaying in cold cabinets at food stores and, ultimately, storing in freezers at home.

Food products (snacks, dish foods and canned food products) that have gone through the stages of processing plants with good packaging usually have a long useful life and can be stored at normal temperatures.

The food processing industry manages the product supply cycle to all consumers in various places with special treatment for each product category and marketing channel and uses different distribution systems for small outlets and large outlets.

For food products that require cold storage such as milk and seafood before being marketed usually enter the cooling room and are distributed using a refrigerated truck before entering the store. The following shows the distribution system of food products based on handling characteristics:

Figure 4.1: Distribution System of Food Products Based on Handling Characteristics



Source: Cited from Tobing (2015).

Each food product has its own specifications in storage depending on the size and amount of food and the size of the storage. The storing temperature of each food product is different, such as for meat, fish, shrimp and its processed food with a temperature of -5°C to 0°C can

store up to three days, with a temperature of -19°C to -5°C can store up to one week and storage with a temperature below -10°C can store more than one week.

Eggs, milk and processed foods with a temperature of -5°C to 7°C can store up to three days, while temperature below -5°C can store food for up to one week.

Development of cargo equipment for cold storage for agricultural products

The agricultural sector is also the user of cold storage to store various kinds of agricultural products ranging from vegetables, meat, fish, chicken, fruits and so forth. However, there are still some limitations in terms of developing cargo equipment for agricultural products.

Limited cooling facilities range from reefer containers, regular packing process up to the use of refrigerated trucking. The potential of food products in Indonesia seems not to be maximally supported by good cold logistics, even though the distribution process and cold storage are very much needed in Indonesia.

The storage of agricultural products has different characteristics such as for vegetables that require a temperature of 6°C to 8°C with 80% to90% humidity. Fruits require a temperature of 4°C to 6°C with 80% to 90% humidity.

According to the type, cold storage is divided into four groups, namely chilled rooms, freezer rooms, blast freezers, and blast chillers. Chilled rooms and freezer rooms are used to store products according to received temperature conditioning, while blasts freezer and blast chillers are used to condition a product at a certain temperature.

A chilled room is a low-temperature cooling room between 1°C and 7°C. This room is used to store fresh food products such as vegetables and fruits and other products with a durability of up to two months. While for fresh meat, it is stored in a freezer room with a temperature of -2°C to 0°C with 80% to 90% humidity as shown in the following table:

Table 4.9: Products That Require Cold Storage, Abbreviated

Product	Temperature (°C)	Humidity (%)
Chocolate	15–18	50–60
Flower	8–16	70–75
Vegetables	6–8	80–90
Fruits	4–6	80–90
Mushrooms	0	90–95
Fresh meat	-2–0	80–90
Frozen fruits and vegetables	-10–0	–
Frozen meat	-20	–
Frozen tuna	-40–-60	–

Source: Survey by author.

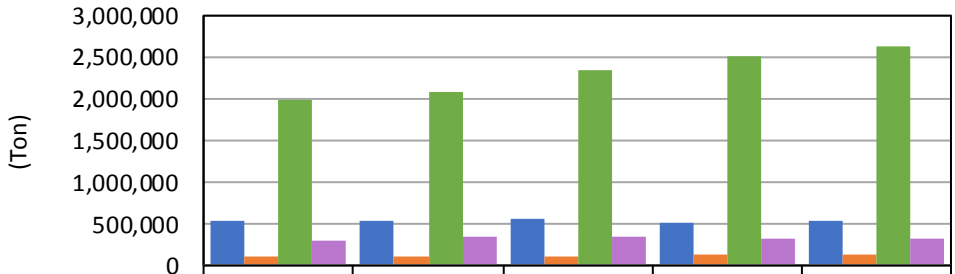
Based on the information from ARPI, Indonesia currently lacks a cold chain for agricultural commodities. Indonesia needs facilities and cold chains to support national cargo so that the transportation of agricultural products can be optimised.

According to ARPI, currently, the capacity of refrigerated trucks is only around 3,000 units with a capacity of 15,000 tons per day or only 10% of the needs, which reach an average of 150,000 tons per day.

This condition is certainly very unfortunate considering the agricultural sector, especially livestock, is a potential market for cold chain sector. As an illustration, meat production, especially chicken, on average, increased to 7.3% annually; pork increased to 2.1% per year and lamb and goat meat averaged to 1.7% per year.

The production of beef and buffalo fell -0.1%. Chicken production in 2018 reached 2.6 million tons, beef and buffalo production reached 527,000 tons, lamb and goat meat production reached 115,000 tons and pork production reached 327,000 tons.

Figure 4.2: Development of Meat Production, 2014–2018



	2014	2015	2016	2017	2018
Cow & Buffalo	532,900	542,100	550,400	515,700	527,900
Sheep & Goat	108,700	109,400	113,700	125,500	115,600
Chicken	1,978,600	2,071,500	2,349,700	2,505,700	2,620,000
Pig	302,300	330,200	339,600	317,400	327,200

Source: Director General of Animal Husbandry, Ministry of Agriculture (2019).

Chicken production increased over a period of five years (2014–2018) during which period, the production increased by an average of 8.4% per year. While in 2014, the production of chicken meat reached 1.6 million tons with a population reaching 1.5 billion, in 2015, it increased to 1.7 million tons with a population of layers and broilers of 1.6 billion tails.

In 2018, the production of chicken meat has reached 2.6 million tons, up 4.6%, compared with the production in 2017, which was only 2.1 million tons, similar with the population as seen in the table of population and production development of layers and broilers below:

Table 4.10: Development of Population and Production of Broilers and Layers, 2014–2018

Year	Layer		Broiler		Total			
	Population ('000 pcs)	Production (tons)	Population ('000 pcs)	Production (tons)	Population ('000 pcs)	Growth (%)	Production (tons)	Growth (%)
2014	146,660	97,200	1,443,349	1,544,400	1,590,009	–	1,641,600	–
2015	155,007	102,800	1,528,329	1,628,300	1,683,336	5.9	1,731,100	5.5
2016	161,364	110,300	1,632,801	1,905,500	1,794,165	6.6	2,015,800	16.4
2017	176,937	114,900	1,848,731	2,046,800	2,025,668	12.9	2,161,700	7.2
2018	181,752	116,300	1,891,435	2,144,000	2,073,187	2.3	2,260,300	4.6
Average Growth (%)						**6.9**	–	**8.4**

Source: Director General of Animal Husbandry, Ministry of Agriculture (2019).

Development of cargo equipment for cold storage for fishery products

Based on the potential value of the logistic market, the potential for cold chain utilisation in Indonesia is very large, especially for perishable commodities (agriculture, livestock and fisheries), while products are very vulnerable to damage. According to the analysis of Supply Chain Indonesia (SCI), an independent institution engaged in education, training, consultation, research and development in the field of logistics and supply chain in Indonesia, the potential value of fishery logistics market reaches Rp43.1 trillion.

Cold storage for fishery products is needed to optimise the temperature and quality of freshness of the fish. The optimisation is done by tracking the real-time temperature of the frozen fish. The real-time temperature of fish is used as input information on the energy needed for temperature and environmental conditioning that fish need to maintain quality and freshness.

The frozen fish industry uses fish processing with a system of storing in low temperatures (cold storage). Basically, freezing is the same as cooling, which is intended to preserve the natural properties of frozen products. Freezing results almost all water content in the product being frozen into ice. Frozen conditions cause microbiological activity and enzymes to be inhibited so that the product's shelf life is longer compared with products that are only refrigerated.

Based on a technical paper released by Johnston et al. (1994), fish begins to spoil immediately after death. This is reflected in gradual developments of undesirable flavours, softening of the flesh and eventually substantial losses of fluid containing protein and fat. By lowering the temperature of the dead fish, spoilage can be retarded and, if the temperature is kept low enough, spoilage can be almost stopped.

Rigor mortis, over a period of hours or days soon after death, can have a bearing on handling and processing. In some species the reaction can be strong, especially if the fish has not been chilled. The muscles under strain tend to contract, therefore, some of the tissue may break, especially if the fish is roughly handled, leaving the flesh broken and falling apart. If the muscles are cut before or during rigor, they will contract and in this way fillets from fish can shrink and acquire a somewhat rubbery texture. In many species, however, rigor mortis is not strong enough to be of much significance.

The freezing process alone is not a method of preservation. It is merely the means of preparing the fish for storage at a suitably low temperature. In order to produce a good product, freezing must be accomplished quickly. A freezer requires to be specially designed for this purpose and thus freezing is a separate process from low temperature storage. Fish that are being frozen slowly cannot be used as ingredients for certain processing such as canning, fumigation and so on. Based on the above considerations, besides to shorten the time and produce high output, fish must be frozen quickly.

Frozen fish need to be stored in suitable conditions to maintain its quality. Usually, frozen fish are stored in cold storage. This storage is the main stage of preservation and freezing method. The temperature normally recommended for cold storage is generally -30°C to -60°C, depending on needs.

To get an appropriate cold chain system, there are four critical stages that must be observed, namely, handling on the initial process, storing and processing when arriving on land, handling when transporting to the destination place and handling on loading and distribution systems to consumers.

In developing fish handling devices with cold chains, there are various system elements that must be met. First, the sensor is used to measure the temperature of the product and the environment. This temperature measurement is the key to preventing damage to fish. In further development, sensors are also used to measure humidity, moisture content and freshness of fish products. Second, the transmitter system is used to transmit/send data information to communications networks. Transmitter usually has become one package in the sensor and battery. Last, communication networks are used to build connections among supply chains.

The technology that is developing in the digital era and is compatible with cold chain communication networks, among others, is the Internet of Things (IoT). Development Internet networks now allow users to perform monitoring and handling of aquaculture wherever and whenever. IoT is also a device that can be used long term because future Internet networks will be increasingly widespread and evenly distributed.

As with the agricultural sector, the cold chain needs for the fisheries sector are also still minimal. Even though cold chain system is one of the most important components in the supply chain of fishery products in Indonesia so that it is not quickly damaged, special handling is needed to keep the fish fresh and have high quality.

To overcome this problem, the government, in this case, the Ministry of Maritime Affairs and Fisheries (KKP), allocated funds of Rp1.32 trillion for the fulfilment of the cold chain in 2017.

The total funds will be used to help 270 units of ice flake machines or ice-making machines with a capacity of Rp168 billion, 55 units of four-wheeled refrigerated vehicles at Rp21.6 billion, 75 units of six-wheeled refrigerated vehicles at Rp36.9 billion, three fish processing units with integrated cold storage 1,000 tons capacity of Rp168.6 billion and seven fish processing units with integrated cold storage of 500 tons capacity of Rp120.4 billion.

In addition, KKP will also build 2 modern fish market units at a cost of Rp190.7 billion, 10 clean fish market units with Rp30.4 billion costs, 6 traditional fish market revitalisation units of Rp8.5 billion, 10 culinary centre units of Rp13.05 billion, 15 cold storage units with a capacity of 200 tons at Rp121.4 billion, 100 freezer units of 300 litres at a cost of Rp1 billion and financing of 2 locations of Integrated Marine and Fisheries Centres in Biak and Mimika of Rp78.95 billion.

Furthermore, KKP conducted a groundbreaking for the construction of 1,000 tons of cold storage in Muara Baru, North Jakarta, in 2018. The cold storage built has two floors. The first floor consists of the receiving room, anteroom and loading room, packing room, dry storage, ABF, panel room and engine room and freezer room with a capacity of 300 tons. The second floor consists of an anteroom and freezer room with a capacity of 700 tons.

The fisheries sector is now one of the special concerns of the Indonesian government to optimise the return of its wealth so that it has added value and contributes to state revenues and especially people's welfare. Judging from its development in general, the fishing industry in Indonesia is quite promising.

This can be seen from the development of its production, which, on average, increased to 5.4% per year. While in 2014, the fisheries production only reached 19.2 million tons, in 2015, it increased to 20.4 million tons, up 6.4%. The same conditions also occurred in 2017 and 2018, where the production increased by 23.8 million tons and 25.0 million tons, respectively.

Table 4.11: Production of Fishery Products of Indonesia Based on Its Source, 2014–2018

Type	Volume (tons)					Annual Average (%)
	2014	2015	2016	2017	2018*	
Capture Fisheries	**6,436,000**	**6,678,000**	**6,580,000**	**6,600,000**	**6,930,000**	–
Growth, %	–	3.76	-1.47	0.30	5.00	1.52
Marine Fisheries	6,038,000	6,205,000	6,115,000	6,133,587	6,440,266	–
Inland Fisheries	398,000	473,000	465,000	466,413	489,734	–
Aquaculture	**12,795,000**	**13,792,000**	**15,456,000**	**17,220,000**	**18,081,000**	–
Growth, %	–	7.79	12.06	11.41	5.00	7.25

Type	Volume (tons)					Annual Average (%)
	2014	2015	2016	2017	2018*	
Marine Culture	8,379,000	9,035,000	9,773,000	10,888,397	11,432,817	–
Pond, Brackish Water	2,345,000	2,428,000	3,012,000	3,355,761	3,523,549	–
Pond, Fresh Water	1,774,000	1,964,000	2,289,000	2,550,245	2,677,757	–
Cage Cultivation	200,000	221,000	204,000	227,283	238,647	–
Paddy Field	97,000	144,000	178,000	198,315	208,231	–
TOTAL	**19,231,000**	**20,470,000**	**22,036,000**	**23,820,000**	**25,011,000**	–
Growth, %	–	**6.44**	**7.65**	**8.10**	**5.00**	5.44

* Preliminary value

Source: Ministry of Maritime Affairs and Fisheries (2018).

Meanwhile, if viewed from the company side the frozen industry of fishery products has developed quite a long time. Based on CIC's records, there are currently around 59 companies involved in this business and spread throughout Indonesia with a total capacity of 816,800 tons.

Based on the region, East Java province is the largest with 21 companies engaged in the frozen fish sector. It is followed by Central Java and Jakarta as many as six companies, South Sulawesi and Bali as many as four companies and other regions such as Bali, Lampung, South Kalimantan, West Java and West Sumatra to the Papua region.

Of the 59 companies, PT Bone Commercial Company (Bonecom) is the oldest. PT Bonecom is located in Makassar, South Sulawesi, and founded in 1960. PT Bonecom has a frozen goods production capacity of 12,300 tons per year consisting of frozen shrimp of 4,000 tons, frozen tuna/skipjack of 5,000 tons, frozen bony fillets of 2,500 tons and frozen sunfish fillets of 800 tons. In addition, PT Bonecom also has a cold storage capacity of 14,700 tons per year.

In addition to Bonecom, another company that is long in the frozen fish business is PT Diamond Cold Storage, located in Ancol, North Jakarta. The company was founded in 1970. In addition to being known as a company that deals with ice cream and soft drink industry, it is also involved in the frozen fish business with a capacity of 2,000 tons per year. Besides in Jakarta, this company has branches in Cimahi, West Java, Yogyakarta and Surabaya.

When viewed from its production capacity, the company that has the largest frozen fish capacity is PT Central Proteina PrimaTbk with a production capacity of 400,000 tons per year. The company that has existed in the field of animal feed business, in 2007, also expanded into the frozen shrimp industry in the Tulang Bawang region, Lampung, with a capacity of 1.6 million tons per year. See the following table for more information:

Table 4.12: Frozen Fish and Shrimp Company in Indonesia, 2018

No	Name of Company	Year Established	Location	Production Capacity (tons)
1	Bali Mina Utama, PT	1987	Bali	4,670
2	Canning Indonesian Products, PT	1948	Bali	2
3	Industri PerikananTerpadu Chiu Shih, PT	1996	Bali	160
4	Sari Segar Laut Indonesia, PT	2002	Bali	3,000
5	Aorta, PT	1979	Central Java	1,000
6	Aquafarm Nusantara, PT	1998	Central Java	1,200
7	Karya Mina Putra, CV	1996	Central Java	6,500
8	Maya Food Industries, PT	1995	Central Java	5,000
9	Seafer General Food, PT	1991	Central Java	10,000
10	Toxindo Prima, PT	1997	Central Java	540
11	Aneka Boga Nusantara, PT	1998	East Java	1,000
12	Aneka Tuna Indonesia, PT	1991	East Java	650
13	Bumi Menara Internusa, PT	1985	East Java	5,000
14	Bumi Pangan Utama, PT	1996	East Java	7,000
15	Central Proteina PrimaTbk, PT	1996	East Java	400,000
16	Charoen Pokphand Indonesia Tbk, PT	1996	East Java	36,000
17	Ciomas Adisatwa, PT	1987	East Java	6,000
18	IluvaIntiluhur Fuji Abadi, PT	1997	East Java	700
19	Istana Cipta Sembada, PT	1987	East Java	1,500
20	Kelola Mina Laut Gresik, PT	1994	East Java	7,000
21	Marine Cipta Agung, PT	1994	East Java	1,800
22	Megamarine Pride, PT	1992	East Java	2,000
23	Rex Canning, PT	1990	East Java	5,000
24	Scrum Marine, PT	1997	East Java	2,100

No	Name of Company	Year Established	Location	Production Capacity (tons)
25	Sekar BumiTbk, PT	1997	East Java	24,000
26	Sekar Mulia, PT	1984	East Java	1,500
27	SK Foods Indonesia, PT	1990	East Java	800
28	Suri Tani Pemuka, PT	1987	East Java	7,200
29	Surya Alam Tunggal, PT	1984	East Java	5,000
30	Tani Abadi Sulawesi, PT	1985	East Java	900
31	Wonokoyo Jaya Corporation, PT	1994	East Java	10,600
32	Sumber Kalimantan Abadi, PT	1986	East Kalimantan	4,800
33	Lola Mina, PT	1983	Central Jakarta	1,800
34	Central Pertiwi Bahari, PT	1998	Lampung	77,700
35	Dipasena Citra Darmaja Tbk, PT	1987	Lampung	72,900
36	Sumber Haslindo, PT	1977	North Jakarta	6,000
37	Diamond Cold Storage, PT	1970	North Jakarta	2,000
38	Lousiana Far East, PT	1995	North Jakarta	1,350
39	Lucky Samudra Pratama, PT	1983	North Jakarta	3,000
40	Ocean Mitramas, PT	1989	North Jakarta	6,000
41	Shing Sheng Fa Ocean, PT	2000	North Sulawesi	2,600
42	Sinar Pure Foods International, PT	1991	North Sulawesi	1,000
43	Central Windu Sejati	1994	North Sumatera	5,400
44	Medan Tropical Canning and Frozen, PT	1999	North Sumatera	1,000
45	Timur Jaya Cold Storage, PT	1970	North Sumatera	3,000
46	Alfa Kurnia, PT	2009	Papua	300
47	Dwi Bina Utama, PT	1975	Papua	1,459
48	SahabatInko, PT	1989	South Kalimantan	425

No	Name of Company	Year Established	Location	Production Capacity (tons)
49	Samarinda Cendana Cold Storage& Industry, PT	1975	South Kalimantan	1,800
50	Bone Commercial Company, PT	1960	South Sulawesi	12,300
51	Dharma Samudera Fishing Industries, PT	1999	South Sulawesi	25,200
52	South Suco, PT	1989	South Sulawesi	5,200
53	WahyuPradanaBinamulia, PT	1996	South Sulawesi	3,700
54	Lauraindo, PT	1990	South Sumatera	720
55	Fega Aquafarmindo, PT	1983	Tangerang	4,900
56	Grobest Indomakmur, PT	1989	Tangerang	180
57	Adijaya Guna Satwatama, PT	1998	West Java	3,400
58	Frozen Foods Pahala, PT	1998	West Java	900
59	Danitama Mina, PT	1989	West Sumatera	10,000
TOTAL				**816,856**

Source: Survey by author.

Development of cargo equipment for cold storage for processed foods

The growth of the processed food industry sector in Indonesia has not yet been matched by the presence of the food cold chain industry, which has an installed capacity of only 50% of national needs. For this reason, in food industry policy in the context of implementing the industry 4.0 roadmap, the government will make improvements by building a better cold chain network.

The processed food industries that are highly depending on cold chain systems include the sausage and nugget industry. In addition, there are also burgers, meatballs, corned beef, smoked meat and roulades, all of which must pass the sterilisation process to increase the durability of the product. Cold chains are needed starting from raw materials, processing, up to the product ready to consume by consumers because it must be stored in the refrigerator to extend its durability.

Nowadays, there are lots of frozen food items such as sausages and nuggets. In recent years, the sausage and nugget industry is quite developed in Indonesia.

Based on CIC's records, up to 2018, the number of companies engaged in the sausage business reached around 112, and the nugget business reached 117 with a capacity of 90,200 tons and 67,100 tons, respectively.

Meanwhile, when viewed from its production over the past five years, sausage production increased by an average of 3.4% per year from 17,800 tons in 2014 to 20,300 tons in 2018. Likewise, the production of nuggets over the past five years increased by 6.8% per year from 51,400 tons in 2014 to 66,900 tons in 2018.

Table 4.13: Development of Sausage and Nugget Production, 2014–2018

Year	Production of Sausages (tons)	Growth (%)	Production of Nuggets (tons)	Growth (%)
2014	17,839	–	51,443	–
2015	18,478	3.59	55,317	7.53
2016	19,118	3.46	59,191	7.00
2017	19,757	3.35	63,064	6.54
2018	20,397	3.24	66,938	6.14
Annual Average Growth (%)		**3.41**	–	**6.81**

Source: Survey by author.

In Indonesia, sausages have been known since the Dutch colonial era. Only the first known sausage product is sausages which are packaged in cans and are fully imported. The first sausage industry in Indonesia was pioneered by PT Badranaya, which was founded in 1918. The forerunner of PT Badranaya was inseparable from the effort pioneered by Lambert Scroeder, a Dutch national who made sausages by utilising leftover meat that was not sold.

After the establishment of PT Badranaya, it is then followed by the Mantrust Group with the prime mover of the late Tegoeh Soetantyo AKA Tan KienLiep, formerly known as the champion of canned food products, especially canned fish (tuna, sardines and mackerel) and corned beef, through PT Canning Indonesia Products and PT Pengambengan Raya.

However, the sausage business which was pioneered in the decade of the 1940s was less successful; thus, it was more focused on developing canned fish and corned beef. After that, it was followed by Perusahaan Titiles in Denpasar, which was founded in 1950, UD. Ananda in Denpasar (1974), PT Kemang Food Industries in Jakarta (1975), UD. Dilamo in Bandung (1980) and PT Suba Indah in Jakarta (1980). In its development, PT Suba Indah was subsequently taken over by San Miguel; thus, the name was changed to PT San MiguelPure Foods Indonesia.

In line with the current development, based on the information obtained by CIC, there are 64 companies engaged in the sausage industry. PT So Good Food Manufacturing as a producer of sausage brands SG SOZZIS, SO NICE and SO GOOD is listed as the owner of the

largest production capacity in Indonesia, namely, 45,000 tons per year, or its role constitutes 49.9% of the total sausage production capacity nationally, which is 90,200 tons per year.

The second place is occupied by PT Charoen Pokphand Indonesia Tbk., with a sausage production capacity of 12,000 tons per year (13.3%). It is then followed by PT MadusariNusaperdana with 5,000 tons per year (5.5%), PT San MiguelPure Foods Indonesia with 4,500 tons per year (5.0%), PT Kemang Food Industries with 3,000 tons per year(3.3%), PT Belfoods Indonesia and PT ElodaMitra are each 2,000 tons per year (2.2%), PT Wonokoyo Jaya Corporindo with 1,500 tons per year (1.7%), PT Soejasch Bali and PT DagsapEnduraEatore with 1,000 tons (1.1%) and so on.

As for the nugget industry, the largest production capacity of nugget in Indonesia in 2018 was held by PT Charoen Pokphand Indonesia Tbk., which produces the brand of FIESTA, GOLDEN FIESTA, CHAMP and OKEY with a capacity of 17,500 tons per year, or 26.1% of the total national nugget production capacity, which in 2018 reaches 67,100 tons per year.

It is then followed by PT MadusariNusaperdana with 12,000 tons per year (17.9%), PT Belfoods Indonesia with 8,000 tons (11.9%), PT So Good Food Manufacturing with 6,5000 tons per year (9.7%), PT Kemang Food Industries with 5,000 tons (7.5%) and PT Frozen Food Pahala with 4,600 tons per year (6.9%) as shown in the following table:

Table 4.14: Producers of Sausage and Nugget in Indonesia and Its Capacity, 2018

No.	Name of Company	Production Capacity (tons)	Share (%)
Producer of Sausage			
1	So Good Food Manufacturing, PT	45,000	49.9
2	Charoen Pokphand Indonesia Tbk., PT	12,000	13.3
3	Madusari Nusaperdana, PT	5,000	5.5
4	San Miguel Pure Foods Indonesia, PT	4,500	5.0
5	Kemang Food Industries, PT	3,000	3.3
6	Belfoods Indonesia, PT	2,000	2.2
7	Eloda Mitra, PT	2,000	2.2
8	Wonokoyo Jaya Corporindo, PT	1,500	1.7
9	Soejasch Bali, PT	1,000	1.1
10	Dagsap Endura Eatore, PT	1,000	1.1
11	Makanan Sehat Nusantara, PT	800	0.9
12	Macroprima Pangan Utama, PT	750	0.8
13	Suryajaya Abadi Perkasa, PT	650	0.7
14	Diamond Cold Storage, PT	600	0.7
15	SicmaInti Utama, PT	500	0.6
16	Titiles, Perusahaan	400	0.4
17	Dunia Daging Food Industries, PT	360	0.4
18	Sorin Maharasa, PT	350	0.4
19	Petra Sejahtera Abadi, PT	350	0.4
20	Sumber Prima Anugrah Abadi, PT	300	0.3

No.	Name of Company	Production Capacity (tons)	Share (%)
21	Aroma Duta Rasaprima, PT	300	0.3
22	Sumber Pangan Jaya, PT	300	0.3
23	Elson Bernardi, PT	250	0.3
24	Winner Food Industry, PT	250	0.3
25	Pasir Kaliki, PD	200	0.2
26	Miko PanganUtama, PT	200	0.2
27	Perikanan Nusantara, PT	150	0.2
28	Satria Pangan Sejati, PT	150	0.2
29	Bumifood Agro Industri, PT	150	0.2
30	Other Producers	6,190	6.9
TOTAL CAPACITY		**90,200**	100.0
Producers of Nugget			
1	Charoen Pokphand Indonesia Tbk., PT	17,500	26.1
2	Madusari Nusaperdana, PT	12,000	17.9
3	Belfoods Indonesia, PT	8,000	11.9
4	So Good Food Manufacturing, PT	6,500	9.7
5	Kemang Food Industries, PT	5,000	7.5
6	Frozen Food Pahala, PT	4,600	6.9
7	Wonokoyo Jaya Corporindo, PT	1,500	2.2
8	Suryajaya Abadi Perkasa, PT	1,500	2.2
9	Soejasch Bali, PT	1,250	1.9
10	Macroprima Pangan Utama, PT	1,200	1.8
11	Makanan Sehat Nusantara, PT	1,000	1.5
12	Sorin Maharasa, PT	600	0.9
13	San Miguel Pure Foods Indonesia, PT	500	0.7
14	Dagsap Endura Eatore, PT	500	0.7
15	Diamond Cold Storage, PT	250	0.4
16	Pasir Kaliki, PD	250	0.4
17	Petra Sejahtera Abadi, PT	200	0.3
18	Sumber Prima Anugrah Abadi, PT	200	0.3
19	Sakana Indo Prima, PT	200	0.3
20	Aroma Duta Rasaprima, PT	150	0.2
21	Elson Bernardi, PT	150	0.2
22	Perikanan Nusantara, PT	150	0.2
23	Central Pertiwi Bahari, PT	150	0.2
24	Satria Pangan Sejati, PT	100	0.1
25	Other Producers	3,650	5.4
TOTAL CAPACITY		**67,100**	100.0

Source: Survey by author.

Development of cargo equipment for cold storage for chemical products, pharmaceuticals, and drugs

Cold chain processes in chemical, pharmaceutical and drug industries are also needed to prevent damage to their chemical structure. Changes and damage to chemical structures can cause potential loss, and drugs becomes useless as vaccines for immunisation. Failure to provide good cold chains causes damage to almost 50% of vaccines worldwide every year.

Since the discovery of vaccines and vaccine manufacturing techniques that are growing rapidly to date, there is one thing that absolutely must exist if we talk about vaccine storage, namely, cold chain, which is a vaccine storage system with a temperature of between 2°C and 8°C, so that the components in a bioactive vaccine do not get damaged because of high temperatures or too low temperatures. With the right storage temperature, the potential for vaccine protection will be maintained except for certain types of vaccines such as oral OPV polio vaccine, which must be stored below -20°C.

As for the consideration in choosing the cold chain, it includes the number of targets; the volume of vaccines to be loaded; the available energy sources; the nature, function and temperature stability of storage facilities; the parts and recommendations of WHO or the results of research or trials that have been conducted.

Table 4.15: Storing Temperature and Age of Vaccine Based on Type of Vaccine

Type of Vaccine	Storing Temperature	Age of Vaccine
BCG	+2°C up to +8°C or -15°C up to -25°C	1 year
Polio	+2°C up to +8°C	6 months
	-15°C up to -25°C	2 years
Measles	+2°C up to +8 °C or -15°C up to -25°C	2 years
DPT	+2°C up to +8°C	2 years
Hepatitis B	+2°C up to +8°C	26 months
TT	+2°C up to +8°C	2 years
DT	+2°C up to +8°C	2 years
DPT – HB	+2°C up to +8°C	2 years

Source: Galazka, Milstien, and Zaffran (1998).

The use of cold chains in the chemical, pharmaceutical and drug industry is like the horns of a dilemma. On the one hand, the cold chain is necessary, while on the other hand, the use of cold chain is quite expensive. Based on the information obtained, cold chain costs for vaccines from the beginning of production until they are used in hospitals or clinics can reach around 80% of the selling price of the vaccine itself.

Seeing this condition, the use of cold chains becomes a problem, especially for health service providers and pharmaceutical companies and especially with conditions in some areas, where the availability of electricity is still a problem.

The pharmaceutical industry has been developing in Indonesia for a long time. Various kinds of drugs have been able to be produced in increasing numbers with an increasingly extensive distribution network; thus, they can reach almost all levels of society. Even the pharmaceutical industry is one of the business sectors that still survive.

Based on data collected by CIC, the total number of pharmaceutical companies in Indonesia (both companies that have factories and importing companies that hold imported product licenses) that registered at the relevant agencies up to the end of 2018 reached 259 companies, consisting of 217 companies that already have its own pharmaceutical factories and the remaining 42 companies that are only listed as companies holding licenses for imported pharmaceutical products.

4.6. Cold chain business model in Indonesia

In Indonesia, there are two models of cold chain business player, namely, those that are used alone (integrated) and those that are fully leased. The main function of that is used alone is to store its own products, either temporarily or for long periods, as stock.

Companies with business models like this are usually integrated with the company's main activities and become supporting of its operational activities. Therefore, the activity of storing, shipping goods or distributing is performed by the company itself in accordance with its business activities. Examples of integrated business models are the ice cream industry; importers of meat, fruit, vegetables and food; and exporters of fish or seafood.

Occasionally, it is also leased to other parties, but the space offered is limited. An example of an integrated company is PT Dharma Samudera Fishing Industries, which engaged in the fisheries sector, and PT Unilever Indonesia Tbk., which produces the Wall's ice cream brand.

For the leased one, there are two types of companies, namely, logistics and forwarders, transportation companies, and companies that specifically engaged in the rental of cold storage, among others are PT Wahana Cold Storage and PT Pluit Cold Storage.

Cold storage operated in Indonesia

Cold storage is a room designed with certain temperature conditions and is used to store various products with the aim of maintaining freshness and material content. There are several types of cold storage that are operated, namely, chilled room, freezer room, blast freezer and blast chiller.

Chilled rooms and freezer rooms are used to store products according to received temperature conditioning, while freezer blasts and blast chillers are used to condition a product at a certain temperature. Chilled room is a low-temperature cooling room between 1°C and 7°C. This room is used to store fresh foodstuffs, such as vegetables, fruits and other ingredients with a durability of up to two months.

For freezer rooms, generally, the room temperature is between -15°C and -20°C for storing fish, meat, chicken, sausages, milk, cheese, potatoes and all types of foodstuffs and other ingredients that require freezing temperatures.

Blast chillers are used for rapid cooling after the cooking process is complete with a target temperature of 1°C to 4°C. Blast freezers are used for fast frozen refrigeration for processed foods as well as for meat, fish and shrimp. The purpose of using blast chillers and blast freezers is to avoid bacterial contamination, maintain the taste of food, avoid reducing water content and maintain the nutrient levels.

Meanwhile, according to its capacity and function, cold storage in Indonesia is grouped into two groups, namely, commercial and industrial. Commercial cold storage is generally used for the needs of its owners and is leased and does not become an integrated and special part of an industrial activity, for example, storing meat, fish, fruit and vegetable products owned by supermarkets and hypermarkets. Commercial cold storage capacity in Indonesia is generally under 1,000 tons.

Cold storage industries generally function as part of the production chain or become special business activities, such as cold storage rental and logistics businesses. The capacity of industrial cold storage in Indonesia is generally more than 1,000 tons.

Cold storage operated in Jabodetabek [19] is divided into two categories, namely, for commercial and industrial purposes. Commercial cold storage is generally used for the purposes of the owner and leased out. Examples are the storage of meat, chicken, fish, fruit and vegetable products owned by supermarkets and hypermarkets. Commercial cold storage capacity is generally below 1,000 tons.

Cold storage is used to store various kinds of products ranging from vegetables, meat, fish, chicken, fruits and so on. These products have different characteristics, both temperature and humidity, such as 4°C to 6°C with 80% to 90% humidity. Fresh meat requires a temperature of -2°C to 0°C with 80% to 90% humidity as shown in the following table:

Table 4.16: Products That Require Cold Storage, Detailed

Product	Temperature (°C)	Humidity (%)
Chocolate	15–18	50–60
Flower	8–16	70–75
Banana, one-half matured durian	4–16	80–90
Vegetable	6–8	80–90
Cake	4–8	60–70
Fruits	4–6	80–90
Matured durian	4–6	80–90
Mushroom	0	90–95

[19]Jabodetabek denotes Jakarta, Bogor, Depok, Tangerang and Bekasi or usually states as Greater Jakarta Area.

Product	Temperature (°C)	Humidity (%)
Grapes and fresh dates	0	80–90
Dairy product (cheese, milk, yoghurt)	0	–
Fresh meat	-2–0	80–90
Fruit juice	-2–0	–
Frozen french fries	-10–0	–
Fruits and frozen vegetable	-10–0	–
Seafood (fish, shrimp, shellfish)	-2	95–100
Frozen meat	-20	–
Ice cream	-20	–
Frozen fish (seafood)	-20	–
Frozen premium beef	-40–-50	–
Frozen tuna	-40–-60	–

Source: Survey by author.

Cold storage for industrial needs generally functions as production chain or becomes a special business activity such as warehouse rental and logistics. Industrial cold storage capacity is generally more than 1,000 tons.

Business model by cold chain players in Indonesia

As stated previously, there are two models of cold chain business player, namely those that are used alone (integrated), and those that are fully leased. The main function that is used alone is to store its own products, either temporarily or for long periods of time as stock.

Companies with business models like this are usually integrated with the company's main activities and become supporting its operational activities. So that the activities of storing and shipping goods or distribution are carried out by the company itself in accordance with the business activities of the company. Examples of integrated business models are the ice cream industry, importers of meat, fruit, vegetables and food and exporters of fish or seafood.

But sometimes it is also leased to other parties, but the space offered is limited. An example of an integrated company is PT Dharma Samudera Fishing Industries which engaged in the fisheries sector and PT Unilever Indonesia Tbk. which produces the Wall’s ice cream brand.

Whereas for the leased one, there are two types of companies, namely logistics & forwarders, transportation companies, and companies that specifically engaged in the rental of cold storage, among others are PT Wahana Cold Storage and PT Pluit Cold Storage.

Number of cold chain players in Indonesia and storage capacity

Based on a survey conducted by CIC and information from various other sources, the number of major companies engaged in the cold chain business in Indonesia reached 69 with a total capacity of 370,000 tons. The 69 companies consist of various business sectors, namely, the

cold storage companies, food and beverage industry, marine products processing industry, ice cream industry, pharmaceuticals, meat importers, restaurants, retail/supermarket industry, container suppliers, logistics and forwarders and transportation.

Companies that are specifically engaged in the cold storage industry are as many as 20 companies with a total capacity of 131,000 tons. Seafood processing companies that lease out all or part of their cold storages to other companies amount to 17 with capacities reaching 76,000 tons, and companies engaged in importing meat, ice cream, restaurants and others can be seen in the following table:

Table 4.17: Number of Cold Storage Company by Business Field, 2018

Business Field	Number of Company	Capacity (tons)
Cold Storage	20	131,000
Food and Beverage	3	8,000
Seafood Processing	17	76,050
Ice Cream	2	51,000
Pharmaceutical	1	59,000
Meat Importer	5	3,200
Restaurant	2	2,800
Retail/Supermarket	6	15,800
Container Supplier	4	4,900
Logistics and Forwarder	3	7,600
Transportation	6	10,850
TOTAL	**69**	**370,200**

Source: Survey by author.

Major players of cold storage in Jabodetabek

Currently, there are 20 companies that are specifically engaged in the cold storage industry in the Jabodetabek area. Of the 20 companies, there are 5 major players in the cold storage business. The 5 companies are PT Sukanda Djaya (PT SD), PT Kiat Ananda Cold Storage (PT KICS), PT Mega Internasional Sejahtera (PT MIS), PT Wahana Cold Storage (PT WCS) and PT Jalur Sejuk (PT SJ).

PT Sukanda Djaya (PT SD) has a capacity of 45,000 tons or controls 34.3% of the total capacity of the company engaged in the cold storage industry, namely, 131,000 tons. PT SD was founded in 1978 and is one of the largest food distribution companies in Indonesia. Most of the ice cream products owned by PT Diamond Cold Storage (PT DCS) are stored in cold storage owned by PT SD.

At present, PT SD customers consist of several large chain store restaurants. Those chain store restaurants are Pizza Hut, Mc Donald's, Sizzler and A & W, which rent PT SD's cold storage to store frozen products consisting of meat, chicken, potatoes and spices for restaurant needs.

PT SD handles all distribution of goods to all restaurant outlet chain stores of the customers for the Java region.

PT SD's cold storages are located in Cibitung, currently one of the largest cold storage warehouses in Indonesia. PT SD has a warehouse of 14,000 sq.m with a cold storage capacity of 45,000 tons. Currently, the truck fleet is 100 units. Whereas for handling activities in the warehouse, the company operates 10 units of forklifts. In addition, PT SD also has several distribution centre branches spread across Denpasar (Bali), Surabaya (East Java) and Bandung (West Java) and Balikpapan (East Kalimantan).

The second largest in the cold chain industry is PT Kiat Ananda Cold Storage (PT KA) with a capacity of 30,000 tons or controlling 22.9%. PT KA Kiat Ananda is an experienced and trusted cold supply chain management company, which is for frozen food products.

Founded in Jakarta in 1998, Kiat Ananda provides an integrated cold supply chain management solution starting from the process of purchasing goods to suppliers (import and local), shipping goods from suppliers to clients, storing client items to distributing goods from clients to distributors up to retailers.

PT KA has a cold storage located on Jl. Raya Narogong, Bekasi, with an area of 3 ha. The cooling warehouse owned by PT KA has a building area of 1.6 ha and is supported by modern cooling technology with layered doors, which are able to maintain temperature stability at 15°C to -25°C, and have more than 15 doors to speed up the loading and unloading process. PT KA's cold storage is able to accommodate 30, 000 pallets, equivalent to 30,000 tons.

To support the supply chain process in terms of shipping goods from upstream to downstream, from suppliers to retailers, Kiat Ananda has prepared more than 400 fleets of trucks with cooling systems.

The third largest is PT Mega Internasional Sejahtera (PT MIS) with a capacity of 21,000 tons or a portion of 16.3%. PT MIS is a cold storage service company operating at the end of 2013 located in the MM2100 Cibitung Industrial Estate, Bekasi, West Java.

With a capacity of 21,000 tons, this company has four freezer rooms and two chillers. The temperature of the cold storage room/frozen temperature of this company is -20°C to -28°C, cold storage with a temperature of -20°C to -28°C, cold storage/chill with a temperature of 0°C to +10°C and chilled storage with a temperature of 0°C up to +10°C.

Other companies that are specialised in the cold chain industry can be seen in the following table:

Table 4.18: List of Companies Engaged in the Cold Storage Industry in Jabodetabek, 2018

Company	Year Established	Capacity (tons)	Share (%)
Sukanda Djaya, PT	1974	45,000	34.35
Kiat Ananda Cold Storage, PT	1998	30,000	22.90
Mega Internasional Sejahtera, PT	2013	21,000	16.03

Company	Year Established	Capacity (tons)	Share (%)
Savina Cold Storage	–	9,000	6.87
Wahana Cold Storage, PT	1997	7,000	5.34
Jalur Sejuk, PT	1987	5,000	3.82
Alpine Cool Utama	1985	1,500	1.15
Aneka Cool Citratama, PT	1997	1,000	0.76
Celcius Jaya, PT	1992	1,000	0.76
Central Food Lestari, PT	2007	1,000	0.76
Cold Storage Jaya Makmur	2010	1,000	0.76
Cooltech Surabaya, PT	2005	1,000	0.76
Ercoolcoldstorage, PT	2011	1,000	0.76
Indopanel Sukses Makmur, PT	–	1,000	0.76
Kini Cold Storage	–	1,000	0.76
Sarana Dunia Pendingin, PT	2006	1,000	0.76
Sarana Refrigeratama, PT	–	1,000	0.76
United Refrigeration, PT	2004	1,000	0.76
Widjaya Dwi Kalmindo, PT	2008	1,000	0.76
Pluit Cold Storage, PT	2003	500	0.38
TOTAL CAPACITY		131,000	100.00

Source: Survey by author.

- Companies engaged in cold storage rental

The need for renting cold storage arises when large-scale food industry and retail companies only have cold storage facilities with limited capacity. There are even companies that do not have cold storage facilities at all, even though the products they produce or their raw materials must be stored in cold storage before being used or distributed. Thus, the company needs to rent cold storage facilities from other parties.

Most of the cold storage rental companies initially served only the main users and then developed into cold storage rental companies that serve various types of customers. Generally, these kinds of cold storage companies have many cold storages with a relatively small size.

There is also a cold storage company that changes its function, which was originally used alone such as by seafood product processing company that changed its storage function, besides for its own use but also for rent.

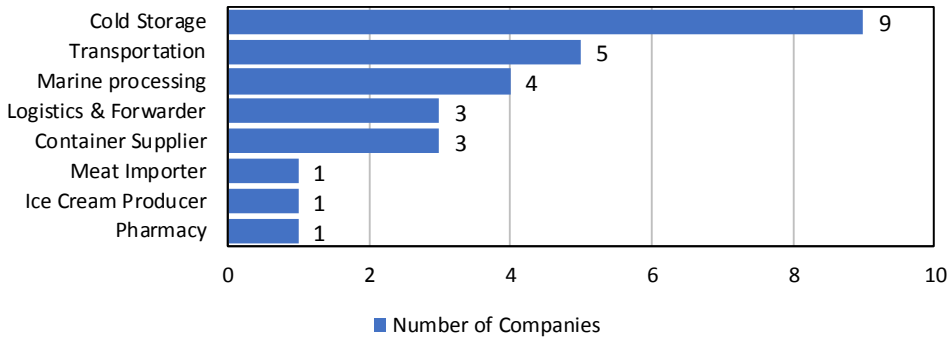
Fees charged to tenants are usually calculated based on rental rates per square meter (M2) per month, while all activities ranging from storing goods to shipping goods are the responsibility of the tenant. Most of the products stored in cold storage facilities are processed food products, frozen food, fruit, vegetable and so on.

The holding capacity of commodities such as fisheries, meat, dairy products, vegetables and fruit is currently still insufficient; thus, it is necessary for cold storage rental business, AKA refrigerated storage space, to be very potential.

During holidays, companies like Diamond need additional cold storage for their dairy products. Unfortunately, additional capacity cannot be gained from cold storage that integrated with processing companies. This is why the company is currently using it for internal storage purposes.

Based on a survey conducted by PT CIC in Jabodetabek (Jakarta, Depok, Bogor, Tangerang and Bekasi), there are 27 major companies that rented their cold storage to other companies. Of the 27 companies, nine of them are companies that are indeed engaged in cold storage business, five companies engaged in transportation, four marine processing companies, three logistics companies and forwarders, three container supplier companies, one pharmaceutical company, one meat importing company and one ice cream company with a total capacity of 2,009,100 tons.

Figure 4.3: Total Cold Storage Rental Company by Business Field, 2018



Source: Survey by author.

The nine companies that rent their cold storages to other companies include PT Wahana Cold Storage. In addition to selling, PT WCS also rents cold storages for food and beverage industry, fisheries, meat exports/imports, fruits and vegetables.

According to information obtained by PT CIC, cold storage rental system applied by PT WCS is per day with a minimum of five days storage costs. For cold storage rental costs, there are six component costs, namely, storage costs, handling in, handling out, handling out loose, plug in, and overtime costs.

The storage cost is Rp13,000/pallet/day with a minimum storage cost of five days. The storage costs do not include handling costs of Rp40,000/pallet, handling out loose costs of Rp60,000/pallet, plug in cost of Rp50,000/hour and overtime cost of Rp200,000 per hour as shown in the following table:

Table 4.19: Cold Storage Rental Cost of PT WCS, 2018

No.	Cost Component	Cost	Description
1	Storage	Rp13,000/pallet/day	Standard pallet size 1m x 1.2m x 1m
2	Handling In	Rp40,000/pallet	
3	Handling Out	Free	Goods out, full (one pallet)
4	Handling Out Loose	Rp60,000/pallet	Goods out, less than one pallet
5	Plug In	Rp50,000/hour	
6	Overtime	Rp200,000/hour	

Note: Price excludes VAT.
Source: Survey by author.

PT Bintang Citra Internasional (PT BCI) is one of the players in the cold storage business. The company was founded in 1998 and began operating since 1999. The core business of this company is container suppliers that sell, modify/repair and rent out containers both with refrigerators as well as without refrigerators, measuring 20 feet to 40 feet in size.

Among large companies which recorded having used PT BCI's services are PT Unilever, Jababeka, PT Astra Truck Indonesia, PT Halliburton Oil and Gas, PT Wijaya Karya, PT Tyco Europipe Indonesia, PT Sharp Indonesia and so on.

According to information obtained by PT CIC, the cost of a reefer container sized 20 feet at 80% condition is offered at a price of Rp6,000,000/unit/month, while a reefer container sized 40 feet at 80% condition is offered at a price of Rp8,000,000/unit/month. In addition to renting out refrigerated containers, PT BCI also sells containers at a price of Rp90 million for the size of 20 feet and Rp107 million for the size of 40 feet, all of which are in 80% condition.

Table 4.20: Cost of Rental and Sales of Reefer Container by PT BCI, 2018

No.	Description	Size	Cost/Unit/Month (Rp)
	RENTAL SYSTEM		
1	Reefer Container	20 feet, condition 80%	6,000,000
2	Reefer Container	40 feet condition 80%	8,000,000
3	Lolo (liftoff/lifton)		1,000,000
4	Maintenance Technician Visit		500,000
5	Reefer Container Deposit	20 feet, condition 80%	90,000,000
6	Reefer Container Deposit	40 feet, condition 80%	107,000,000
	SALES SYSTEM		
1	Reefer Container	20 feet, condition 80%	90,000,000
2	Reefer Container	40 feet, condition 80%	107,000,000
3	Lolo		500,000

Notes: Excludes VAT, delivery, and handling at location. Terms of payment: cash before delivery or DP 50% and full payment 50% after delivery. Ranger temperature: 30°C up to -18°C. Power supply: 380/460 VAC, three phase, 32 Amp.
Source: Survey by author.

Similarly, PT Raficon Sari Jaya (PT RSJ) is engaged in container suppliers that sell and rent reefer containers (containers equipped with refrigerators). The container is prepared for shipping goods that require special care such as frozen fish, fresh vegetables and fruit.

Reefer containers made by PT RSJ are equipped with a dehumidification system that guarantees the temperature and humidity of the container and the super freezer that can maintain temperatures at -60°C/-76°F. As for the rental of containers owned by this company, according to information, for one month with the size of 20 feet, it is rented at a price of Rp7 million, while the size of 40 feet is Rp9 million.

- Capacity of cold storage rental company

As mentioned above, based on the CIC survey, there are 27 cold chain rental companies with a production capacity of 209,000 tons. Of the 27 companies, the largest capacity is owned by PT Enseval Medika Prima Tbk.

It is followed by PT SukandaDjaya with a capacity of 45,000 tons, PT KiatAnanda Cold Storage with a capacity of 30,000 tons, PT Mega Internasional Sejahtera with a capacity of 21,000 tons, PT Wahana Cold Storage with a capacity of 7,000 tons and so on.

Table 4.21: Cold Storage Rental Company and Its Capacity in Jabodetabek, 2018

Company	Year Established	Capacity (tons)
Enseval Medika Prima, TbkPT	1974	59,000
Sukanda Djaya, PT	1974	45,000
Kiat Ananda Cold Storage, PT	1998	30,000
Mega Internasional Sejahtera, PT	2013	21,000
Savina Cold Storage	–	9,000
Wahana Cold Storage, PT	1997	7,000
Bonicom Servistama Compindo, PT	1960	6,000
Mgm Bosco Logistics, PT	1995	5,500
Perum Perikanan Indonesia	1990	5,100
Expravert Nasuba, PT	2009	3,000
Wira Logitama Saksama	1996	2,000
Perikanan Nusantara, PT	1998	1,550
Alpine Cool Utama	1985	1,500
Bintang Citra International, PT	1998	1,500
Guna Pratama, PT	2002	1,500
Raficon Sarijaya, PT	2005	1,500
Starcon Indonesia, PT	2009	1,200
Trade Corp Indonesia, PT	1990	1,200
Multi Guna International Persada, PT	2014	1,100
Central Food Lestari, PT	2007	1,000
Diamond Cold Storage	1974	1,000

Company	Year Established	Capacity (tons)
Inter Mitra Transindo, PT	2011	1,000
Kini Cold Storage	–	1,000
Hwasung Thermo Indonesia, PT	2014	500
Pluit Cold Storage, PT	2003	500
Darta Logistic, PT	2014	250
Abbatoir Surya Jaya, PT	–	200
TOTAL CAPACITY		209,100

Source: Survey by author.

Major players of cold chain transportation rental company

There are eight main players in cold chain transportation rentals in Jabodetabek. PT Armada Container Indonesia (PT ACI) was established in 2007 and is located in Cakung, East Jakarta. PT ACI is a company that has long been involved in container transportation services. In addition to renting out its containers, this company also sells and modifies containers from standard containers to base office containers, storage and so on. Based on the information obtained by CIC, the reefer containers of PT ACI consist of various types from 10 feet, 20 feet to 40 feet.

Another company that quite exists in cold chain transportation is PT Hwasung Thermo Indonesia (PT HTI). In Indonesia, the presence of PT HTI is represented by PT Hwasung Thermoindo, which is the sole distributor of Hwa Sung cooling machines for the Indonesian market, which has been operating since 2014. PT Hwasung Thermoindo provides cooling solutions for the transportation of products that require refrigeration for either freezer or chiller applications for vegetables, fruits, frozen foods, milk, cheese, ice cream, nuggets, chicken, sausages and others. The type of cooling unit owned by PT Hwasung Termindo according to information is four-wheeled, six-wheeled, and 10-wheeled Mercedes-Benz and Fuso trucks. In addition, there are also car-type refrigerated transportation, namely, Suzuki Carry, Daihatsu Granmax and L300.

PT Wira Logitama Saksama or Wira Logistic is also a company that rents refrigerated transportation throughout Indonesia. This company which was founded in 1996 and has many branches in Indonesia also has several kinds of warehouses with dry, cold storage, frozen and chiller rooms.

PT ASSA Transport is a company that also serves refrigerated transportation rentals. The company, which was founded in 1985, serves the shipping of various kinds of products such as fish, chicken, meat and processed products such as fillets, nuggets, meatballs and sausages that serve almost all islands in Indonesia.

Table 4.22: Refrigerated Transportation Rental Company in Jabodetabek, 2018

No.	Name of Company	Established	Location
1	Armada Container Indonesia, PT	2007	Jakarta
2	ASSA Transport, PT	1985	Tangerang
3	Hwasung Thermo Indonesia, PT	2014	East Java
4	Manggala Kiat Ananda, PT	1996	Tangerang
5	MgmBosco Logistic, PT	1995	Bekasi
6	Raficon Sarijaya, PT	2005	Jakarta
7	Selaras Mandiri Raya Trans, PT	2010	Tangerang
8	Wira Logitama Saksama, PT	1996	Bekasi

Source: Survey by author.

- Major transportation rental players for low-temperature goods

Based on the information obtained from PT Hwasung Thermindo, on average, the company rents out refrigerated fleets capable of cooling cargo space temperatures between 0°C and -20°C. The Hwasung thermo machine can cool cargo temperature starting from 0°C to -20°C with cooling capacities ranging from 2.5 x 1.6 x 1.7 meters to cargo space measuring 9.2 x 2.4 x 2.25 meters.

- Number of fleet/trucks of rental company to load low-temperature goods

Refrigerated truck fleets are needed to distribute goods from factory to warehouse and from warehouse to final customer. The function of the refrigeration truck is that the goods carried, especially food that is easily damaged, are still in good condition.

In its operation, most companies that rent refrigerated fleets use trucks of varying sizes. The number of truck fleets owned depends on the extent of distribution reach and the number of customers owned by the company.

PT MGM Logistics is a company that has experience in the refrigeration transport business. Currently, it has a large enough fleet of trucks reaching 720 trucks spread across several branches such as Surabaya, Banjarmasin and Makassar. Based on the information obtained, the distribution of PT MGM Logistic cooling products reached almost 100 cities in Indonesia with 200 customers.

Likewise, with PT WiraLogitamaSaksama or Wira Logistic, it has around 300 vehicle fleets serving the market in Java region. This company has several well-known customers such as Sari Roti, Petronas, Coca-Cola, Givaudan, Adidas, Solaria, Danone, Unilever, Carrefour, Philip Morris and so on.

- Price of new refrigerated fleet/trucks

Based on the survey at a dealership of Mitsubishi conducted by CIC, the price of new refrigerated truck varies greatly depending on the carrying capacity of each truck and the type of cooler used, such as for four-wheeled trucks with FE 71 110 type with Thermoking SV 400, it is sold atRp400 million per unit. While trucks of the same type with different cooling brands (Starkool SK 350) is sold for Rp370 million per unit.

Trucks with type FE 74 HDF 125 PS 6 BAN with SV 600 Thermoking cooling machines are sold at Rp510 million. The Hwasung HT-250 cooling machine is sold at a price below of Rp495 million. The same type of car with Denso FS-32 cooler is sold for Rp485 million per unit. The following is an overview of the prices of new refrigerated trucks of several types:

Table 4.23: Price of New Refrigerated Truck, 2018

Truck Brand	Type	Cooler	Price (Rp'000)
MITSUBISHI	FE 71 110 PS 4 BAN	THERMOKING SV 400	400,000
	PS 110 PS 4 BAN	THERMOKING SV 400	405,000
	FE 71 L 110 PS 4 BAN	THERMOKING SV 400	425,000
	FE 71 110 PS 4 BAN	STARKOOL SK-350	370,000
	PS 110 PS 4 BAN	STARKOOL SK-350	375,000
	FE 71 L 110 PS 4 BAN	STARKOOL SK-350	395,000
	FE 73 110 PS 6 BAN	THERMOKING SV 600	480,000
	FE 73 HD 110 PS 6 BAN	THERMOKING SV 600	490,000
	FE 73 110 PS 6 BAN	STARKOOL SK-550	460,000
	FE 73 HD 110 PS 6 BAN	STARKOOL SK-550	470,000
	FE 74-S 125 PS 6 BAN	THERMOKING SV 600	505,000
	FE 74-S 125 PS 6 BAN	STARKOOL SK-550	480,000
	FE 74 HDF 125 PS 6 BAN	THERMOKING SV 600	510,000
	FE 74 HDF 125 PS 6 BAN	HWASUNG HT - 250	495,000
	FE 74 HDF 125 PS 6 BAN	DENSO FS - 32	485,000
	FE 74 HDF 125 PS 6 BAN	THERMO FROZEN RG	475,000
	FE 74 HDF 125 PS 6 BAN	STARKOOL SK-350	470,000
	FE 74 S LONG 125 PS 6 BAN	THERMOKING SV 600	525,000
	FE 74 S LONG 125 PS 6 BAN	HWASUNG HT - 500	505,000
	FE 74 S LONG 125 PS 6 BAN	DENSO FS - 42	495,000
	FE 74 S LONG 125 PS 6 BAN	THERMO FROZEN RG	485,000
	FE 74 S LONG 125 PS 6 BAN	STARKOOL SK-550	480,000
	FE 84 HDL 136 PS 6 BAN	THERMOKING SV 600	550,000
	FE 84 HDL 136 PS 6 BAN	HWASUNG HT - 500	530,000
	FE 84 HDL 136 PS 6 BAN	DENSO FS - 42	525,000
	FE 84 HDL 136 PS 6 BAN	THERMO FROZEN RG	515,000
	FE 84 HDL 136 PS 6 BAN	STARKOOL SK-550	510,000
	COLT L 300	BOX FREEZER	255,000
	COLT L 300	THERMO FROZEN	260,000
	COLT L 300	THERMOKING	285,000

Source: Survey by author.

Main users of cold chain service

- Food processing company

As mentioned before, the cold chain is also very much needed in various industries, including food processing industries. The processed food industry is very dependent on the cold chain system. Two companies are noted as main users of cold chain service for food processing companies, namely, PT So Good Food Manufacturing (PT SGM) and PT Charoen Pokphand Indonesia Tbk.

PT So Good Food Manufacturing, initially named PT Japfa Osi Food Industries, was established in Jakarta on May 25, 1994. The scope of products produced by PT SGFM is processed chicken and beef, including sausages, nuggets, meatballs, whole muscle products (karaage, katsu, chicken steak, spicy wings and spicy chicken) and other processed meat and seafood such as corned beef and chicken, shumai, spring rolls, brainbox, dumplings, postage stamps and so on.

For sausage products, PT SGFM classifies sausages based on how they are served, that is, sausages that are ready to eat and are not ready to eat, meaning they need to be cooked first. For sausages that are ready to eat, the company markets its products with two brands, namely, SG SOZZIS and SO NICE. SG SOZZIS was launched in 2002.

The distribution of all products produced by the company is directly handled by the parent company, PT So Good Food, previously named PT Supra Sumber Cipta. Until now, sausage and nugget products are still oriented to the domestic market.

PT Charoen Pokphand Indonesia Tbk., initially named PT Charoen Pokphand Indonesia Animal Feed, was founded in 1967. On December 6, 1990, the company was renamed to PT Charoen Pokphan Indonesia Tbk. In 1995, PT Charoen Pokphan Indonesia established a company named PT Charoen Pokphan Indonesian Chicken Processing Plant (PT CPIT–CPP) as a slaughterhouse and chicken meat processing industry.

PT CPIT–CPP currently produces various processed meat products, including sausages, processed chicken (nugget, spicy wing, karaage, meatballs, dumplings, fried potatoes, etc.), cut chicken and others (fish, fried rice and snacks). Initially, the nugget and sausage products being the mainstay of this company was the FIVE STAR brand. However, the brand's existence only lasted until 2006 and was replaced by various brands that are quite successful in gaining market share, including FIESTA, GOLDEN FIESTA, CHAMP and OKEY. For snack products, the company uses the ASIMO and DUGEM brands.

- Trading company

PT Sumber Alfaria Trijaya Tbk., known as Alfamart, is one of the trading companies that need cold chains to store chicken products, meat, beverages and other processed foods. Alfamart is a supermarket chain that has many branches in Indonesia.

The company was originally named PT Alfa Mitramart Utama and founded by PT Alfa Retailindo Tbk. and PT Lancar Distrindo in 1999. On August 1, 2002, the ownership of PT Alfa

Mitramart Utama was transferred to PT Sumber Alfaria Trijaya, which shares are owned by HM Sampoerna (70%) and PT Sigmantara Alfindo (30%).

Until now, Alfamart already has more than 1,000 outlets in Indonesia. More than 200 food products and other living goods are available at competitive prices.

- Distribution company

PT Unilever Indonesia Tbk. is the largest distribution company that also requires cold chains for the produced products. Unilever produces food, drinks, cleansers and body treatments. Unilever has more than 400 trademarks, and its products are well-known in Indonesia such as Lux, Magnum, Dove, Margarine, Rexona, Sunsilk, Lifebuoy, Clear, Rinso, Molto, Wall's ice cream, Blue Band, Surf and so on.

PT Unilever Indonesia Tbk. is divided into four main divisions, namely food, beverages and ice cream, household care and body care. In distributing its products, PT Unilever involves around 500 Unilever distributors spread throughout Indonesia.

PT Unilever Indonesia Tbk. has six factories in Jababeka Industrial Estate, Cikarang and Bekasi and two factories in the Surabaya Rungkut Industrial Estate in East Java with its head office in Jakarta.

- Retail company

In line with the rapid growth of retail business networks in major cities in Indonesia in recent years, encouraging goods storage services in cold storage has increased. Most retail networks in Indonesia have a number of outlets spread in several locations; thus, there must be standardisation of goods in all outlets. This requires handling the availability of goods in a professional and timely manner.

However, some retail networks only have limited cold storage space to accommodate their trading commodities, including frozen food products, drinks, ice cream, fruit, meat, fish and so on. With the limited capacity of its own cold storage, several large-scale network retailers then rent logistics facilities for cold storage space.

Retail network business is divided into two groups, namely, hypermarkets and supermarkets. Based on the classification from the Ministry of Trade, the minimum area of supermarkets is around 600 m^2 and minimarkets or convenience stores at least 140 m^2, while hypermarkets have bigger floor space than supermarkets.

Included in hypermarket group is Carrefour, which has a network in Jabodetabek (41 outlets); Giant (44 outlets); Hypermart (100 outlets) and Lotte (13 outlets). Meanwhile, the supermarket group includes Hero with 132 outlets, Alfa with 587 outlets and Starmart with 145 outlets in 2018.

Based on a survey conducted by CIC, each of these outlets, such as Carrefour, Giant, and Lotte, has its own cold storage with a capacity of between 10 and 100 tons.

The big potential market of Indonesia has pushed the courage of retail entrepreneurs to add outlets in Indonesia. Retail entrepreneurs are optimistic that retail businesses in Indonesia, especially supermarkets, hypermarkets and shipping companies, have bright prospects in the future.

Type of products that require and use cold chain service

- Food company

Cold chains in the food industry are needed so that food is not quickly damaged. Food products that require cold chains are sausages and nuggets as well as chocolate, sardines, coconut juice and so on.

Table 4.24: Food Products of Some Food Companies That Require Cold Chain Service

Name of Company	Brand	Product
Carrefour Indonesia, PT	CARREFOUR	Sausage and Nugget
Diamond Cold Storage, PT	DIAMOND	Ice Cream
Garuda Food, PT	CLEVO, OKKY JELLY	Milk, Coconut Jelly
Hero Supermarket, PT	GIANT	Nugget
Kelola Mina Laut, PT	MINAKU	Sausage and Nugget
Lion Superindo, PT	365	Sausage Beef
Lotte Shopping Indonesia, PT	LOTTEMART SAVE	Sausage
Matahari Putra Prima Tbk, PT	VALUE PLUS	Sausage and Nugget
Olagafood, PT	OLAGA	Beverage
Petra Food, PT	SILVER QUEEN	Chocolate
Prima Food International, PT	FIESTA DAN GOLDEN FIESTA	Nugget
Rekso Nasional Food, PT	MCDONALD'S	Sausage and Nugget
Sekar Bumi Tbk., PT	BUMIFOOD	Nugget
Sekar Laut, PT	FINNA	Sardines
Sierad Produce, PT	DELFARM	Nugget
So Good Food Manufacturing, PT	SO GOOD	Sausage

Source: Survey by author.

- Trading company

In developing its business, PT Sumber Alfaria Trijaya Tbk. also collaborates with large companies and small producers with small and medium enterprises (SMEs) scale in marketing their products. For this reason, Alfamart created a house brand private label (HBPL) which is specially packaged in a package that has the identity of the place that sells it, and the product can only be obtained at that place.

The purpose of creating HBPL products is to provide a choice of good quality products at affordable prices to consumers. Therefore, the products issued by Alfamart are products made by large and trusted factories in their fields.

Various products found in Alfamart require cold chains such as beverage products (Sprite, Fanta, Coca-Cola, bottled tea, ice cream, Aqua, Le-Minerale, yoghurt and so on), food products (fresh meat, sausages, fruits, sardines, nata de coco, pudding, dates).

- Distribution company

As explained above, the products produced by PT Unilever are more than 400 brands that are well-known to the public. Of the 400 brands, there are several products that are produced requiring cold chains so that the quality of these products is maintained and guaranteed. These products are food products and beverages such as Blue Band Margarine, Wall's ice cream, Lipton and Buavita.

Table 4.25: Products of PT Unilever That Require Cold Chain

Name of Product	Weight	
Blue Band Serbaguna*	1 kilogram, 17 grams, 55	grams
Blue Band Master Original Margarine	5	kilogram
Blue Band Serbaguna Sachet	200	grams
Blue Band Cake and Cookie	1 kilogram, 200	grams
Blue Band Serbaguna Tube	250	grams
Blue Band Master Original Margarine Tin	2	kilograms
Lipton Tea		
Lipton Peppermint Jewel 15 Sachets	1.5	grams
Lipton Strawberry 15 sachets	1.5	grams
Lipton Yellow Label Black Tea 25 Teabags	2	grams
Buavita Juice Royale Sunshine Carrot	250	ml
Buavita Juice Slim Orange	250	ml
Buavita Juice Slim Jambu	250	ml
Buavita Juice Royale Chloro Broccoli	250	ml
Buavita Juice New Mango	1000	ml
Buavita Juice Slim Lychee	250	ml
Buavita Juice New Guava	1000	ml
Buavita Juice Slim Apple	250	ml
Buavita Juice Slim Mangga	250	ml
Walls Ice Cream	38	ml
Walls Ice Cream Magnum Almond	90	ml
Walls Ice Cream Feast Vanilla	65	ml
Walls Ice Cream Feast Chocolate	65	ml

*Name of variant from Blue Band.

Source: Survey by author.

4.7. Utilisation of storage

Utilisation of storage and trucks for ordinary temperatures

Storages are needed as a means to store goods and must be arranged properly so they can be used optimally. Also, they can facilitate the storing, searching, and retrieval of goods.

Goods stored in the storage can be in the form of raw materials, semi-finished goods, spare parts or finished products. A good storage system is a storing system that can utilise its storage space effectively.

Storage utilisation for ordinary temperatures must be designed in a good condition with sufficient radiation, must be easy to clean, and have a temperature range from 19°C to 21°C, especially for food storage, which should be close to the production unit.

Ordinary temperature storage is usually used to store food products, tubers, potatoes, garlic, shallots or tuber vegetables and shoots.

Utilisation of storage and truck for cold temperature

Storage utilisation for cold temperatures is usually performed in coolers that are stored at a temperature of 5°C to 8°C. Besides, the cleanliness of the refrigerator must also be maintained, not close to the source of heat and not directly exposed to the sun.

Products that are usually stored in cold temperature storage are food products in cans, plastic, bottles or other dry food products. This type of food will be easily damaged if it is deviated to a storage that is unclean, irregular and improperly maintained.

There are several factors that are considered in storing food products for cold temperatures, namely, temperature controlling and humidity, arranging and placing food products, food labelling, food ingredients recording and security as well as storage locations.

Utilisation of storage and truck for freezing temperature

Storage for freezing temperatures usually used to store perishable foodstuffs and dairy products, such as eggs, butter, meat, and milk. Food will be saved if stored at temperatures between -1°C and -7°C.

The foodstuff must be placed separately because if put together, it will cause contamination, resulting in damage to the food.

Other foods stored in freezing temperature are various types of meat and ice cream, which are consumed for a long time. Storage of this type of food is stored at a temperature of -18°C or lower.

Utilisation of storage being rented by each company

Storage is a facility that functions as a location for distributing goods from suppliers to end users. In practice, each company tends to have uncertainty in demand.

This encourages the emergence of policies from the company to conduct an inventory system. This policy encourages companies to provide storage facilities as a place to store goods.

In general, warehouse utilisation rented by each company has four objectives, namely, reduction in transportation and production costs, coordination between supply and demand, production needs and warehouse needs.

The benefits of the storage are as a means to support the production process, as a place to sort goods to be sent to customers and as a place to protect goods to be safe from the dangers of theft, fire, floods and other security problems.

Potential demand for cold storage in Indonesia

To calculate the share of cold storage demand in Indonesia, the approach is based on the amount of production (meat, fish, fruit, vegetables, ice cream, etc.) which usually requires storage in cold storage.

The calculation of cold storage demand is based on the assumption of storage time on average per type of foodstuffs such as meat requirements of 80% cold storage with an average storage time of 30 days, fish 50% with a storage time of 30 days, fruit and vegetable products 10% with storage time of 15 and seven days, respectively. Ice cream products need 100% cold storage with a storage time of 15 days.

Based on these assumptions, the potential for cold storage needs can be known. In 2018, the potential need for cold storage is estimated at 17.6 million tons per year. The amount consists of cold storage needs for each product, namely, 397.0,000 tons of beef, 12.5 million tons of frozen fish/frozen shrimp, 1.7 million tons of chicken, 2.8 million tons of fruits, 72.0,000 tons of vegetables, 42.0,000 tons of ice cream and for other needs (nugget, sausage, pharmaceutical and other products) amounting to 24.7,000 tons.

Compared with the cold storage capacity 370,000 tons of surveyed 69 major companies (Tables 2 and 17), the estimated needs 17.6 million tons suggest an overwhelming lack in the supply. There would be a quite large potential to develop cold storage particularly for the fishery sector in Indonesia.

Table 4.26: Demand for cold storage in Indonesia, 2018

Product	Production (tons/year)	Cold Storage Needs (tons/year)	Percentage of Cold Storage Needs (%)
Beef	496,300	397,040	80
Fishery	25,011,000	12,505,500	50
Chicken	2,144,000	1,715,200	80
Fruits	19,021,099	2,853,165	15
Vegetable	480,483	48,048	10
Ice Cream	42,000	42,000	100
Others	95,000	24,700	26
TOTAL	**47,289,882**	**17,585,653**	**37**

Note: Cold storage needs were estimated from production × percentage of cold storage needs.
Source: Author.

4.8. Government policy

Policy on investment

Investment in the cold chain industry in Indonesia still seems to be open both in the context of domestic investment and foreign investment. Based on Presidential Regulation No. 44 of 2016 concerning Negative Investment List, the cold chain is not included and is open to investment.

With the enactment of this Presidential Regulation, Presidential Regulation Number 39 of 2014 concerning list of closed business fields and business fields open with requirements in the investment sector is declared revoked and not valid.

Policy on trade and production

Policy on cold chain trade and production in Indonesia refer to the action plan for the acceleration of the development of national fisheries industry as stipulated in the Regulation of the President of the Republic of Indonesia No. 3 of 2017. The purpose of the issuance of the regulation is to improve the welfare of the community for fishermen, cultivators, processors and marketers of fishery products as well as to increase employment and foreign exchange.

One of the mentioned programs for fisheries processing industry by the government in the period of 2016–2019 is government must provide access to electricity and cold chains for raw materials. The output to be achieved from this activity is the fulfilment of electrical energy for cold chain systems in 31 fishing industry priority locations.

Policy on export and import

Meanwhile, in export and import policy, the government continues to make efforts to balance the food supply and demand by applying cold chains to post-harvest meat, both

broiler and beef. In addition, the regulation also stipulates how to use cold storage. These policies are issued by Minister of Agriculture Regulation No. 32 of 2017 concerning the supply, distribution and supervision of broiler and eggs and Minister of Trade Regulation No. 20 of 2018, which is the Second Amendment of Regulation No. 59/M-Dag/Per/8/2016 concerning provisions on exports and imports of animals and animal products.

In article 11 of the Regulation of the Minister of Trade No. 20 of 2018, it is stated that to obtain approval for importation of animals and animal products, companies must submit applications to the director general of import of the Ministry of Trade by attaching requirements, including proof of ownership of cold storage and proof of ownership of refrigerated transportation means.

Government policy on storage and transportation that uses temperature control or cooling system

The key government policy regarding storage and transportation that uses temperature control or cooling system is Presidential Regulation No. 71 of 2015 stating determination and storage of basic commodity and important goods. This policy indirectly supports the role of warehousing to ensure the smooth management of basic commodity and important goods.

The meaning of basic commodities is goods that concern the lives of many people with a high scale of fulfilment of needs that can become a supporting factor for people's welfare, while important goods are strategic goods that play an important role in determining the smoothness of national development.

The determination of basic commodities is based on the allocation of national household expenditure for these goods, while the determination of important goods is carried out based on the strategic nature of national development.

Types of basic commodities and/or important goods as intended include livestock and fisheries products: beef, broiler, chicken eggs and fresh fish (milkfish, bloated and cod/tuna/skipjack).

The regulation also states how to manage stocks and logistics by optimising inter-island trade, monitoring stock availability in the warehouse and port, providing and optimising distribution facilities, coordinating with relevant ministries and heads of non-ministerial agencies in the provision of transportation modes and coordinating with ministers and heads of non-ministerial government institutions related to the provision of stocks and reserves of certain basic commodities controlled by the government.

Government policy supports the development of cold chain business in Indonesia

The government continues to encourage the development of cold chain business in Indonesia, especially in the fisheries sector. The Ministry of Maritime Affairs and Fisheries has encouraged the development of marketing facilities with cold chain systems to a number of

retail areas and property. This step is expected to support the distribution of capture fisheries products to consumer centres.

The government continues to encourage the entry of investments in the cold chain industry in Indonesia, one of which is by cooperating with several investors, including 13 Japanese companies that participated in a business forum[20] that was organised by KKP and Japan External Trade Organization (JETRO). In this forum, the participants discussed opportunities for investment in fisheries, especially in the construction of cold chain facilities from upstream to downstream fisheries.

The 13 companies are FTI Japan Co., Ltd., PT Daisei Retail Indonesia, Nichirei Logistics Group Inc., Hanwa Co., Ltd., Harada Corporation, Dah Chong Hong (Japan) Ltd., PT Seino Indomobil Logistics, PT Sumitomo Indonesia, Taiho Shoji Co., Ltd., Zensho Holdings Co., Ltd., PT Sinfonia Technology Indonesia, Okamoto Seihyo and Musashi Industry.

KKP hopes to attract investment from companies of Japan in the amount of Rp1 trillion this year. With this investment, KKP wants to build direct logistics from Eastern Indonesia such as in Makassar or Bitung. As is known so far, the map of Indonesian fisheries exports is still centralised in the Jakarta, Surabaya and Denpasar regions.

KKP revealed that in 2018, Japan's investment in the fisheries sector reached Rp500 billion to Rp600 billion, and this year, it is expected to double. In addition to the cold chain sector, other sectors that can be entered by business players are the logistics, trade and processing sectors.

4.9. Conclusion

In general, the cold chain industry in Indonesia continues to experience growth, given the rapid development of its industrial user such as livestock, fisheries, processed food, pharmaceuticals and so on.

In addition, another factor that supports the development of cold chain business is the development of network retail business and restaurants chain store in big cities and also food and beverage processing industry as the users of cold storage. These big network retailers are Carrefour, Giant, Hypermart and Lotte Mart, and large restaurants chain store include Kentucky Fried Chicken, McDonald's, Pizza Hut, Hoka-Hoka Bento and others. The ice cream industry includes Diamond Cold Storage, Unilever and others.

These sectors are the largest users of cold storage facilities, to store their products such as frozen food, drinks, ice cream, fruit, meat, fish and so on, which require certain cold temperatures.

Cold chain implementation requires the provision of several facilities, both in the process of storage and distribution. In the storage process, it needs, among others, cold storage. In

[20] Indonesia–Japan business and investment forum: shaping partnership for sustainable marine and fisheries development, Jakarta, 29 January 2019.

Indonesia, the existence of major cold storage companies is estimated to reach 69 with a total capacity of 370,000 tons per year.

In the next five years, cold storage needs are expected to continue to increase, which will automatically increase the available current installed capacity. CIC estimates that by the end of 2019, it is projected that the demand for cold storage will reach 462,700 tons, or an additional capacity of 92,500 tons is needed from the current production capacity of 370,200 tons. And until 2024, the demand for the capacity is projected to reach 824,700 tons.

The development of cold chain business has challenges and obstacles in investment, which are caused by infrastructure problems and the lack of fiscal facilities offered by the government. The government has not yet provided component import duty exemption of cold storage equipment, similarly, the provision of tax holiday facilities to build cold storage assembly plants in the country. In addition, the lack of availability of electricity in remote areas is also a challenge.

Cold chain needs in cold storage business in Indonesia are still quite high. Based on Presidential Regulation Number 44 of 2016 concerning negative investment list, cold chains are not included and are open to investment. For this reason, the government opens as wide as possible for investors, both domestic and foreign.

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Chapter 5

Inter-State and Transit Trade by Using the Cold Chain in the Lao People's Democratic Republic

Phanhpakit Onphanhdala[21]

5.1. Background of the study

The Lao People's Democratic Republic (Lao PDR) is an agriculture-based economy in terms of labour participation, and 60% of its labour force participates in agricultural activities (World Bank, 2018). However, the contribution of the agricultural sector to gross domestic product (GDP) was only 18% in 2017 (ADB, 2018). The country's major agricultural products are rice, starchy roots, sugarcane, and other crops, which are primarily products supplying the domestic market with some exports to its immediate neighbours (LSB, 2018). It is obvious that the small scale of agricultural production has experienced product loss in the supply chain. Thongsavath et al. (2012), for example, reveals that agricultural product loss was due to poor postharvest and transport in the case of cabbage for Champasak province in both domestic and export supply chains. The small scale and primary production of added value agricultural products in the Lao PDR are also due to technology and capital limitations. A survey conducted in the Lao PDR by the Japan International Cooperation Agency (JICA) in 2012 categorised added value food products, such as processed food, into three groups as *primarily processed foods* (milled rice), *traditionally processed foods* (fermented fish seasoning) and *processed foods by modern technology* (seasonings and foods packed in bottles and cans for long storage and long-distance transportation (JICA, 2012).

At present, the demand for food is increasing because of population growth and consumption diversification. Four surveys of the Lao Expenditure Consumption Survey (LECS) over the past decades have provided data on expenditure and consumption covering all seasons and relating to aspects of every area and region in the Lao PDR. Monthly household consumption is on a rising trend. When it comes to food consumption, surveys showed that carbohydrate consumption has decreased, but protein and mineral consumption, such as meat, fish, fruits, and vegetables, has increased. In other words, a variety of food consumption is playing its role. The slow growth of higher added value agricultural products in the Lao PDR cannot meet the higher demand in the domestic market. Therefore, demand for imported food from its immediate neighbours has increased, such as from Thailand, Viet Nam, and China.

Higher value-added agricultural products have been developed in many countries of ASEAN through a set of activities from production, processing, and distribution until the products are delivered to consumers' hands, which is called the food value chain (Deloitte, 2015; MAFF, 2015). Nowadays, there is considerable diversity in food consumption. The cold chain

[21] National Institute for Economic Research, Lao PDR / National University of Laos.

has been added into part of the food value chain and aims to minimise food loss and preserve food quality. The cold chain is the process of controlling products at proper temperatures, especially perishable goods that have a short shelf life. This process mainly includes precooling/freezing packaging, packing, storage, transporting (Kitinoja, 2013; GIZ, 2016). The cold chain is widely used not only in the food industry but also the cosmetic and pharmaceutical industries as well. It is useful to prevent food losses in many developing countries, where rising urbanisation causes longer distances between productions areas and consumers. Importantly, an agrarian economy, like the Lao PDR, where the expansion of labour-intensive high-added-value sectors, such as non-timber agricultural production, helps improve employment in rural areas, cold chain management is required to preserve product quality.

In the Lao PDR, cold chain operations are almost entirely at the beginning stages. For example, when producers, distributors, or traders want to transport fresh fruits, fish, and/or vegetables from one province to another province, plastic containers and ice are needed to preserve food quality instead of a proper cold chain system. Then a pickup truck will transport these products to wet markets or small supermarkets. The longer distance means more ice. As a result, when a temperature is not controlled, the colour, smell, and taste of these fresh foods will change. This implies that the quality of the products will be affected by heat and other conditions before reaching customers' hands. In addition to food loss, this also means higher food costs. High demand for the cold chain in the Lao PDR, however, does not lead to a rising number of cold chain entrepreneurs entering the market, only some large domestic logistics companies and foreign logistics companies that are involved in the cold chain business.

This raises the questions: Why don't other entrepreneurs in the Lao PDR operate a cold chain business? What are the challenges of initiating or improving cold chain management in the country? Moreover, how can the cold chain improve the higher value added of the Lao PDR's agricultural products?

In this regard, this research study aims to answer these questions by investigating the current situation of frozen foods imported from major trade partners, the situation of the logistics business, and cold chain management in Lao PDR. Moreover, it attempts to determine the advantages and disadvantages of the cold chain business and how to utilise it to develop high-value-added agricultural products for the Lao PDR.

This research will integrate quantitative analysis and qualitative analysis, with additional results provided by direct observations. For the quantitative analysis, secondary data on merchandised trade, especially in high value added of agricultural products, from various domestic and international sources will be synthesised such as the ASEAN Statistics database, the UN Comtrade database, and unpublished documents. For the qualitative analysis, the Key Informant Interview (KII) and the Group Discussion (GD) will be employed to seek a deeper understanding of the supply chain and cold chain management.

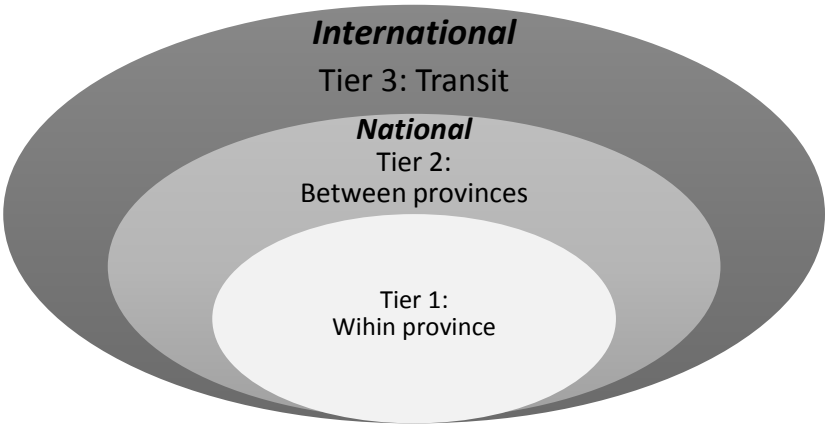
The background of the study is described in Section 5.1. Section 5.2 will mention about the scope of the study based on tiers of cold chain management in the Lao PDR. Trade

information focusing on food imports to the Lao PDR and regulations will be shown in Section 5.3 and Section 5.4, respectively. In Section 5.5, original findings from the KII and GD will be examined. Finally, a discussion and policy recommendations will conclude in Section 5.6.

5.2. Three tiers of cold chain management in the Lao PDR

According to the direct observations of the author, the author proposed tiers of cold chain management in the Lao PDR as shown in Figure 5.1. The classification of these three tiers is based on the level and volume of transport and the government authority level in the country.

Figure 5.1: Tiers of Cold Chain Management in the Lao PDR



Source: Author's compilation.

- Tier 1 has the smallest volume of freight transport among the three tiers. It is for internal transport within a province, which is freight transport between one district to another district in the same province. The distribution of chilled and/or frozen product(s) is carried out by pickup trucks or small trucks to local wet markets and small supermarkets in town. One reason is because these trucks are suitable for a small volume of transport and they use ice, cooling containers, and/or cooled insulated transport boxes (not a refrigerator container), which is cheaper than a proper temperature controlling system. Another reason is because of limitations on truck weights in urban areas and limitations on road accessibility in rural areas, where only smaller trucks can access.
- Tier 2 is the medium volume of freight transport of the three tiers. This freight transport is for internal transport within the country, for freight transport between one province and another province. It is counted as the informal national level of freight transport in cold chain logistics. Consolidated trucks will load chilled and/or frozen products together with various kinds of other products, then distribute them

to another province. It can be seen that sometimes consolidated trucks also play a similar role in transport as Tier 1. For example, the transport of vegetables or fishes from the Pakse district of Champasak province in the south to Vientiane, the capital. Producers or traders had packed fresh vegetables or fish into ice boxes/containers and then transported them by commercial long-distance private transport companies, such as buses. The buses would take around 12–14 hours to travel 750 km from Champasak to Vientiane, the capital. In some cases, a consolidated truck picked up these perishable products in Champasak and delivered to the central wet markets in Vientiane, then its role would stop there. In addition, the truck could play a role as a distributor to deliver these products to small wet markets.

- Tier 3 is the highest level of cold chain logistics, and massive amounts of chilled and/or frozen products are stored in proper temperature containers to preserve their original quality. This inter-state and transit freight transport operated by both domestic and foreign logistics companies. It is counted as a formal international level of freight transport in cold chain logistics. In the past, Tier 3 was only inter-state freight transport, which could be seen from the importation of frozen food products, including fruits, meat, and vegetables by the mega project in the Lao PDR, such as the Nam Theun 2 hydropower project. Furthermore, there were also imports of dairy products and ice cream for supplying to supermarkets in urban areas. At present, agricultural and food products are in high demand, both in the Lao PDR and in nearby countries. The Lao PDR not only import chilled and/or frozen foods for domestic consumption, but it is also a beneficiary in utilising its geographical advantage for transit freight transport between its immediate neighbours.

The proposed three tiers of cold chain logistics are to draw a clear visual of freight transport in the Lao PDR. Tier 1 and Tier 2 are an informal form of the cold chain, while Tier 3 is the best starter for this research study for digging for recommendations on the high-value-added agricultural sector development, as it is core for the fundamental improvement of people's livelihoods.

5.3. Overview of the situation of food imports

Currently, the Lao PDR's major trade partners are Thailand, China and Viet Nam. In 2017, Thailand accounted for almost 50% of trade[22] in goods, while China and Viet Nam accounted for around 26% and 14%, respectively (ASEAN Stats, 2018). In the past, trade with Thailand and Viet Nam comprised a small volume of consumer goods along borders. In today's world, the international trade of the Lao PDR has expanded.

Merchandised trade transactions can be seen as a mixture between two forms, such as inter-state and the transit of goods. The inter-state transport of goods is international freight transport between one country to another country. The transit transport of goods is a transit

[22] Both export and import.

of goods from one country to a third country by transiting another country. However, due to the limitation of data collection, we show the total value of goods import as a sum of inter-state and transit import value in this report.

Table 5.1: Top Three Imported Food Products from Thailand

Year	1	2	3
2017*	Pastrycooks' products[23]	Sugars and sugar confectionery	Meat and edible meat
2012	Meat and edible meat	Beverage, spirits and vinegar	Pastrycooks' products
2007	Pastrycooks' products	Miscellaneous edible products	Beverage, spirits and vinegar
2002	Beverage, spirits and vinegar	Sugars and sugar confectionery	Pastrycooks' products
1997	Cereal	Sugars and sugar confectionery	Flour and milk preparations and products
1992	Cereal	Dairy products	Miscellaneous edible products

Source: *ASEAN Stats (2018), UN (2018), HS 2-digits at current prices.

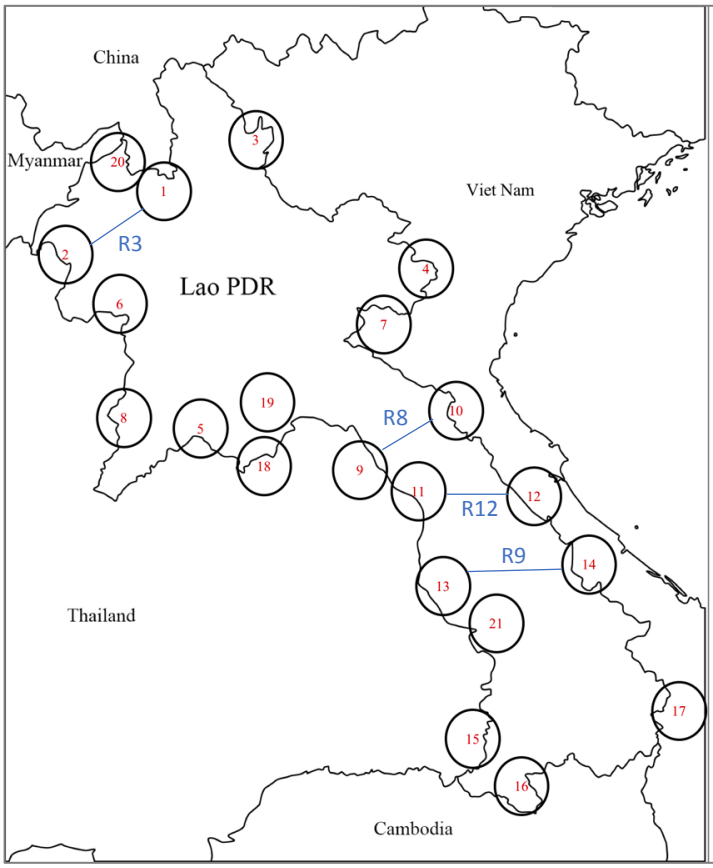
The Lao PDR does not only heavily import machinery and petroleum oil from Thailand but also high added value food products. Table 5.1 shows the top three imported food products from Thailand that derived data from the Thailand side (data reported by Thailand). This is because of the limitation of trade data reported by the Lao PDR. In the 1990s, the main food products that imported from Thailand were cereal and sugar. These raw food products mainly supplied household consumption and micro local food sellers, especially in border provinces. A decade later, there was a variety of food consumption, such as beverages, vinegar, and pastrycook products. Pastrycook products are flour, pasta, cooked grain, pastry, rice paper, and others for food preparation. In the 2010s, meat and edible meat were in high demand, including both chilled/fresh and frozen meat. These were supplied to individual consumers and led to the growth of the services sector, such as hotels and restaurants.

Data shown in Table 5.2, Table 5.3 (A), Table 5.3 (B), Table 5.4 (A), Table 5.4 (B), Table 5.5 (A), Table 5.5 (B), Table 5.6 (A), and Table 5.6 (B) were obtained from unpublished documents of Ministry of Finance. Data have been collected for FY 2015–FY 2016, the final quarter of 2016, and 2017.[24] This is because a transition of statistical record regime from the Fiscal Year in 2015/16 to the Calendar Year in 2017.

[23] HS code 19 'Preparations of cereals, flour, starch or milk; pastrycooks' products'

[24] FY: Fiscal Year from October to September.

Figure 5.2: Maps of international borders



	Border	Between
1	Boten	Luang Namtha-Yunnan
2	4th Friendship Bridge	Bokeo-Chaing Rai
3	Pang Hok	Phongsaly-Tai Chang
4	Nam Soiy	Houaphanh-Nameo
5	Nam Heang	Xayyabouly-Nakaseng
6	Nam Ngene	Xayyabouly-Hua Kon
7	Nam Kan (Ninghaed)	Xiengkhouang-Nghe An
8	Phou Dou	Xayyabouly-Utaradith
9	Pak Xan	Bolikhamxay-Buengkan
10	Nam Phao (Km 20)	Bolikhamxay-Cau treo
11	3rd Friendship Bridge	Khammouan-Nakhon Panom
12	Na Phao	Khammouan-Cha lo
13	2nd Friendship Bridge	Savannakhet-Mukdahan
14	Dansavanh	Savannakhet-Lao Bao
15	Vang Tao	Champasak-Ubon
16	Nong Nokkhien (Veunkham)	Champasak-Nong Nokkhien
17	Phou Keua	Attapeu-Kontoum
18	1st Friendship Bridge	Vientiane C-Nongkahi
19	Wattay International Airport	Vientiane C.
20	Ban Mom	Luang Namtha-Pangha
21	SEZ Savan Logistics	Savannakhet

Notes: There are 27 international immigration checkpoints in total. This map does not include all international immigration checkpoints but only major ones that recorded a frozen food product movement. R3, R8, R9, and R12 denote National Roads No. 3, 8, 9, and 12, respectively.
Source: Author's compilation.

Table 5.2 shows inter-state and transit import value by the international borders of Lao PDR between the period of FY 2013–2017. Based on secondary data from unpublished documents[25], it can be seen that a massive number of frozen/chilled/fresh food products[26] requiring temperature control have been formally imported since 2015. Before this, frozen products were probably imported individually by informal traders. For example, frozen/chilled/fresh food products had been imported, then distributed to wet markets or sold them at their own minimarkets. Since 2015, a proportion of frozen/chilled/fresh food products import was more than 80% of total inter-state and transit import. The top five major borders crossed by frozen food products trade values are 1. The 3rd Lao–Thai Friendship Bridge (11), 2. The 2nd Lao–Thai Friendship Bridge (13), 3. Na Phao (12), 4. Dansavan (14), and 5. The 4th Lao–Thai Friendship Bridge (2), see the map in Figure 5.2. This implies that Thailand is a major exporter of the Lao PDR, followed by Viet Nam.

[25] Documents obtained from the Ministry of Finance.
[26] Frozen/chilled/fresh food products include mainly livestock and aquatic products, and others such as fruit and vegetable products. While this value consists of frozen, chilled, and fresh products, most of that is frozen products.

Table 5.2: Inter-state and Transit Import Values by International Border, FY 2013–2017 (US$'000)

No.	International Borders	FY 2013/2014			FY 2014/2015			FY 2015/2016			10-11–12 / 2016***			2017		
		Total values of food products	Frozen / chilled / fresh products*	Share (%)**	Total values of food products	Frozen / chilled / fresh products	Share (%)	Total values of food products	Frozen / chilled / fresh products	Share (%)	Total values of food products	Frozen / chilled / fresh products	Share (%)	Total values of food products	Frozen / chilled / fresh products	Share (%)
1	Boten	603,358.81	–	–	49.81	–	–	118,911.77	118,654.50	99.78	30,737.97	30,637.97	99.67	105,214.93	104,796.68	99.60
2	4th Friendship Bridge	12,911.15	–	–	45,222.82	–	–	320,386.52	214,182.76	66.85	104,621.09	78,704.73	75.23	423,496.43	347,333.12	82.02
3	Pang Hok	–	–	–	314.10	–	–	1,798.95	1,366.29	75.95	1,753.94	1,364.71	77.81	4,482.22	1,671.89	37.30
4	Nam Soiy	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
5	Nam Heang	–	–	–	–	–	–	52.00	–	0.00	–	–	–	–	–	–
6	Nam Ngene	–	–	–	–	–	–	457.66	–	0.00	270.54	–	0.00	5,002.71	–	0.00
7	Nam Kan	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
8	Phou Dou	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9	Pak Xan	–	–	–	7,335.95	–	–	18,702.46	422.40	2.26	4,676.30	224.92	4.81	23,435.34	2,354.71	10.05
10	Nam Phao (Km20)	431.25	–	–	1,021.61	–	–	652.93	51.58	7.90	277.81	–	0.00	765.04	50.76	6.63
11	3rd Friendship Bridge	122,625.65	–	–	219,585.01	–	–	1,374,354.85	1,191,849.89	86.72	176,557.91	123,108.27	69.73	1,650,120.58	1,393,682.97	84.46
12	Na Phao	3,631.81	–	–	5,257.42	–	–	795,985.92	790,870.27	99.36	127,929.86	126,072.16	98.55	349,785.32	342,179.66	97.83
13	2nd Friendship Bridge	47,691.81	–	–	58,399.23	–	–	638,571.51	577,603.64	90.45	127,795.96	113,901.16	89.13	919,570.87	840,543.60	91.41
14	Dansavanh	9,552.13	–	–	29,031.60	–	–	271,823.41	243,692.46	89.65	117,124.34	109,678.36	93.64	834,549.59	803,607.31	96.29
15	Vang Tao	9,483.06	–	–	15,676.52	–	–	19,662.52	–	0.00	10,242.66	–	0.00	26,318.21	–	0.00
16	Nong Nokkhien	–	–	–	5.05	–	–	341.86	341.86	100.00	–	–	–	–	–	–
17	Phou Keua	–	–	–	–	–	–	–	–		–	–	–	–	–	–
18	1e Friendship Bridge	25,726.99	–	–	18,835.10	–	–	37,244.41	22.30	0.06	690.48	–	0.00	15,678.11	185.54	1.18
19	Wattay International Airport	5,432.67	–	–	6,259.38	–	–	7,118.14	–	0.00	1,947.40	–	0.00	–	–	–
20	Ban Mom	–	–	–	–	–	–	–	–		–	–	–	–	–	–
21	SEZ Savan Logistics	–	–	–	–	–	–	–	–		–	–	–	–	–	–
	Total	**840,845.33**	**–**	**–**	**406,993.59**	**–**	**–**	**3,606,064.89**	**3,139,057.95**	**87.05**	**704,626.26**	**583,692.28**	**82.84**	**4,358,419.32**	**3,836,406.23**	**88.02**

Notes: *Products requiring temperature control. While this value consists of frozen, chilled, and fresh products, most of that is frozen products. **'Share' denotes as a proportion of frozen/chilled/fresh products to total values. ***'10–11–12 / 2016' denotes from October to December in 2016.

Source: Unpublished documents.

Table 5.3: Inter-state and Transit Import Values of Chilled and Frozen Products by Border, FY 2015–2017

A. In US$'000

No.	Borders	FY 2015/2016	10–11–12/2016	2017	Sub-total
Border with Thailand					
11	3rd Friendship Bdg.	390,828	153,818	394,204	938,850
2	4th Friendship Bdg.	43,862	–	118,477	162,339
13	2nd Friendship Bdg.	847	28,520	26,004	55,371
9	Pak Xan	–	–	83	83
Border with China					
1	Boten	–	–	–	–
Border with Viet Nam					
3	Pang Hok	9,320	–	3,278	12,598
Total		**444,857**	**182,339**	**542,046**	**1,169,242**

B. In '000 kg

No.	Borders	FY 2015/2016	10–11–12/2016	2017	Sub-total
Border with Thailand					
11	3rd Friendship Bdg.	8,840	7,556	14,112	30,509
2	4th Friendship Bdg.	1,376	–	8,558	9,933
13	2nd Friendship Bdg.	109	3,672	3,348	7,129
9	Pak Xan	–	–	2	2
Border with China					
1	Boten	–	–	–	–
Border with Viet Nam					
3	Pang Hok	992	–	225	1,217
Total		**11,317**	**11,228**	**26,245**	**48,790**

Source: Unpublished documents.

Frozen food products have been transported from mostly Thailand through the 3rd Lao–Thai Friendship Bridge crossing border between Khammouan and Nakhon Pranom (11). Another important border is the 2nd Lao–Thai Friendship Bridge between Savannakhet and Mukdahan (13) as shown in Table 5.3 (A) and (B). This is because Route No. 12, which goes through Khammouan province of the Lao PDR and connects Thailand and Viet Nam's borders, is shorter than Route No. 9 of Savannakhet province. Moreover, there is a significant change in transit products, such as fresh fruits from Thailand to China through the 4th Lao–Thai Friendship Bridge (2) to Boten border (1). Trade between China and Viet Nam can be seen through the route in the Lao PDR through Boten border (1) to the Pang Hok border (3). It is worth noting that the top-three trade partners of the Lao PDR are Thailand, China, and Viet Nam (Table 5.4 (A) and (B), Table 5.5 (A) and (B).

Table 5.4: Inter-state and Transit Import Values of Chilled and Frozen Products by Exporter,
FY 2015–2017

A. In US$'000

No.	Export Partners	FY 2015/2016	10–11–12/2016	2017	Sub-total
1	China	–	–	338	338
2	Thailand	44,860	1,879	55,493	102,232
3	Viet Nam	960	–	–	960
	Total	**45,820**	**1,879**	**55,831**	**103,530**

B. In percentages

No.	Export Partners	FY 2015/2016	10–11–12/2016	2017	Sub-total
1	China	0%	0%	1%	0%
2	Thailand	98%	100%	99%	99%
3	Viet Nam	2%	0%	0%	1%
	Total	**100%**	**100%**	**100%**	**100%**

Source: Unpublished documents.

Table 5.5: Inter-state and Transit Import Volumes of Chilled and Frozen Products by Exporter,
FY 2015–2017

A. In '000 kg

No.	Export Partners	FY 2015/2016	10–11–12/2016	2017	Sub-total
1	China	–	–	225	225
2	Thailand	10,325	1,228	26,020	37,573
3	Viet Nam	992	–	–	992
	Total	**11,317**	**1,228**	**26,245**	**38,790**

B. In percentages

No.	Export Partners	FY 2015/2016	10–11–12/2016	2017	Sub-total
1	China	0%	0%	1%	1%
2	Thailand	91%	100%	99%	97%
3	Viet Nam	9%	0%	0%	3%
	Total	**100%**	**100%**	**100%**	**100%**

Source: Unpublished documents.

Tables 5.6 (A) and (B) show the types of frozen food products. Due to the diversification of food consumption and temperature controls, it can be seen that during FY 2015/2016, the volume of frozen products was larger than for chilled products. For example, the transport of *durian fruit* from Thailand to China takes only four days by land transport thanks to the cold chain system of preserving the quality of fruits until they meet their final customers.

Table 5.6: Inter-state and Transit Import Values of Chilled and Frozen Products by Product,
FY 2015–2017

A. In US$'000

No.	Products	FY 2015/2016	10–11–12/2016	2017	Sub-total
1	Frozen meat	9,222	8,496	10,727	28,444
2	Frozen salmon/fish	34,713	9,337	30,664	74,714
3	Chilled meat	1,886	879	2,801	5,565
4	Chilled salmon	–	22	35	56
5	Dried meat and fish	–	48	11,604	11,652
6	Fruit	–	–	–	–
	Total	**45,820**	**18,781**	**55,831**	**120,432**

B. In '000 kg

No.	Products	FY 2015/2016	10–11–12/2016	2017	Sub-total
1	Frozen meat	5,972	9,290	11,541	26,804
2	Frozen salmon/fish	2,893	778	3,100	6,770
3	Chilled meat	2,452	1,122	3,252	6,826
4	Chilled salmon	–	18	38	56
5	Dried meat and fish	–	20	8,314	8,335
6	Fruit	–	–	–	–
	Total	**11,317**	**11,228**	**26,245**	**48,790**

Source: Unpublished documents.

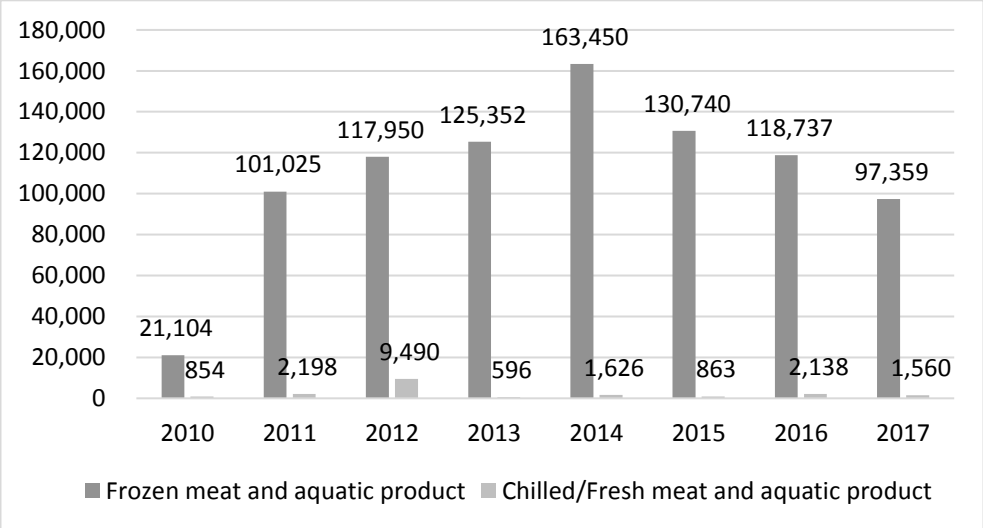
The import value of selected frozen and chilled/fresh meat and aquatic products that comprise the majority of traded items using the cold chain are displayed in Figure 3. The data were obtained from the ASEAN Stats database and reported by Thailand. They include data on the meat of bovine animals, swine, sheep or goats, fowl, turkeys, ducks, geese, fish, shrimps, and crabs.[27] It can be seen that the import value of frozen products was larger than

[27] HS codes for frozen meat are 020210, 020220, 020230, 020321, 020322, 020329, 020430, 020441, 020442, 020443, 020450, 020500, 020621, 020622, 020629, 020641, 020649, 020690, 020712, 020714, 020725, 020727, 020742, 020745, 020752, 020755, 020760, 020810, and 020830. HS codes for frozen aquatic products are 030311, 030312, 030313, 030314, 030319, 030323, 030324, 030325, 030326, 030329, 030331, 030332, 030333, 030334, 030339, 030341, 030342, 030343, 030344, 030345, 030346, 030349, 030351, 030353, 030354, 030355, 030356, 030357, 030359, 030363, 030364, 030365, 030366, 030367, 030368, 030369, 030379, 030381, 030382, 030383, 030384, 030389, 030390, 030391, 030392, 030399, 030461, 030462, 030463, 030469, 030471, 030472, 030474, 030475, 030479, 030481, 030482, 030483, 030484, 030485, 030486, 030487, 030488, 030489, 030491, 030492, 030493, 030494, 030495, 030496, 030497, 030499, 030611, 030612, 030613, 030614, 030619, 030752, and 030772. HS codes for chilled/fresh meat are 020110, 020120, 020130, 020311, 020312, 020319, 020410, 020421, 020422, 020423, 020610, 020630, 020680, 020711, 020713, 020724, 020726, 020732, 020734, 020735, 020741, 020743, 020744, 020744, 020751, 020753, 020754, and 020760. HS codes for chilled/fresh aquatic products 030211, 030212, 030213, 030214, 030219, 030221, 030222, 030223, 030224, 030229, 030231, 030232, 030233, 030234, 030235, 030236, 030239, 030240, 030241, 030242, 030243, 030244, 030245, 030246,

for chilled/fresh products. This is because they all are perishable products that have a short shelf life. There is a requirement of the cold chain to precool or freeze products in order to extend their shelf life until delivery to customers. On the contrary, the frozen vegetables and fruits import value was relatively smaller than for chilled/fresh vegetables and fruits as shown in Figure 4.[28] This included potatoes, peas, beans, legumes, spinach, sweet corn, mixed vegetables, and fruits. This is because the freezing process changes the taste of vegetables and fruits.

It is often said that cold chain management is playing an important role in high-value-added agricultural production. This system and less transport time can guarantee quality and the taste of food products that have a short shelf life. But how can the Lao PDR gain such an advantage from its geography to enhance trade integration in the course of cold chain logistics and more importantly to enhance local agricultural production in order to supply the domestic and regional markets, when the Lao PDR is an importer not an exporter?

Figure 5.3: Selected Meat and Aquatic Products, Import Value from Thailand (in US$'000)

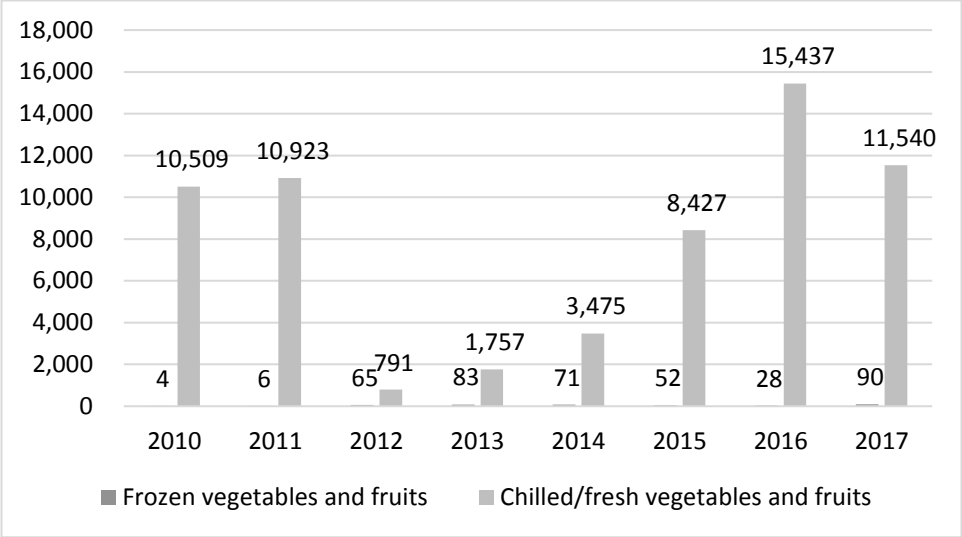


030247, 030249, 030250, 030251, 040252, 030253, 030254, 030255, 030256, 030259, 030261, 030262, 030263, 030264, 030265, 030266, 030267, 030268, 030269, 030271, 030272, 030273, 030274, 030279, 030281, 030282, 030283, 030284, 030285, 030289, 030290, 030291, 030292, 030299, 030410, 030411, 030412, 030419, 030431, 030432, 030433, 030439, 0304391, 030441, 030442, 030443, 030444, 030445, 030446, 030447, 030448, 030449, 030451, 030452, 030453, 030454, 030454, 030455, 030456, 030457, and 030459.

[28] HS code for frozen vegetables is 0710. HS code for frozen fruits is 0811. HS code for chilled/fresh vegetables are 070110, 070190, 070200, 070310, 070320, 070390, 070410, 070420, 070490, 070511, 070519, 070521, 070529, 070600, 070610, 00690, 070700, 070810, 070820, 070890, 070910, 070920, 070930, 070940, 070951, 070952, 070959, 070960, 070970, 070990, 070991, 070992, 070993, and 070999. HS code for chilled/fresh fruits are 080100, 080111, 080112, 080119, 080220, 080121, 080122, 080130, 080131, 080132, 080200, 080211, 080212, 080221, 080222, 080231, 080232, 080240, 080241, 080242, 080250, 080251, 080260, 080261, 080262, 080270, 080280, 080290, 080300, 080310, 080390, 080410, 080420, 080430, 080440, 080450, 080500, 080510, 080520, 080520, 080521, 080522, 080529, 080530, 080540, 080550, 080590, 080610, 080700, 080710, 080711, 080719, 080800, 080810, 080820, 080830, 080840, 080910, 080920, 080921, 080929, 080930, 080940, 081000, 081010, 081020, 081030, 081040, 081050, 081060, 081070, and 081090.

Source: ASEAN Stats (2018), at current prices.

Figure 5.4: Vegetable and Fruit Import Value from Thailand (in US$'000)



Source: ASEAN Stats (2018), at current prices.

5.4. Trade and freight transport regulations in the Lao PDR

International trade is relevant to inter-state and transit freight transport. Regulations related to inter-state and transit transport and regular transport were proposed for trade facilitation. It is easier to access these regulations nowadays compared to over the past decade, when most regulations were in the Lao language with difficulties in translating them into English. As we can see, there are more customs formalities that have been promulgated than transport regulations. First, this is because the Customs Department plays a major role in customs clearance. Second, there are requirements from international agencies that enforce the Lao PDR to improve soft infrastructure in order to enhance international trade integration.

Table 5.7 shows the laws, regulations, and customs formalities related to inter-state and transit transport. They have been classified by level of authority, such as law, decree, decision, instruction, notification, and official letter. Sometimes, an instruction and a notification can be promulgated at the ministry or provincial level based on the current situation. Customs formalities have general principles on export–import and the transit and movement of goods within the Lao PDR. The movement of goods also covers transit goods, temporary importation, and import for re-export vehicle and fuel. In addition, customs formalities include the *National Single Window* implementation, customs declaration, electronic customs clearance system (ASYCUDA), and fee and services charges. It can be seen that these regulations provide general principles for general goods movements but miss regulating principles related to perishable goods that require the fastest customs clearance.

In the course of transport regulations, this study categorised them by transport component, such as law enforcement, driving licence, truck standard, truck weight limitation, driving speed limitation, and measure against violators and punishment (Table 5.8). Regulations on

transport are mainly authorised by the Ministry of Public Works and Transport, which include land transport and land traffic. However, these regulations provide general statements on truck limitations, but lack of regulations related to truck bans and unqualified technical trucks, etc. Measures against violators only refer to fee and fine charges and have weak statements about enforcement. On the other hand, regulations for special goods transport are limited. There are only a few types of dangerous goods, such as cooking gas, fuel, ozone depleting substances (ODS), and explosive substances. For prohibition goods that are relevant to national security, regulations are authorised by the Ministry of National Defense and the Ministry of Public Security. Furthermore, the management of consolidated trucks and cold chain logistics is limited in terms of regulations.

To sum up, regulations on inter-state and transit transport are limited and provide only general content in terms of principles, roles, responsibilities, and measures. The management of goods movement is stated in general, but it is rare when it comes to perishable goods that have a short shelf life. The statement in many regulations is rather ambiguous and unclear. In addition, regulation enforcement is weak and not integrated. Therefore, it makes implementation complicated for both relevant agencies and the importers and exporters. Some of them probably abuse the regulations gap to avoid some procedures, while some of them might struggle with the numbers of procedures, which require more cost and time.

Table 5.7: Laws, Regulations, Customs, and Formalities Related to Inter-state and Transit Transport

Laws, regulations, customs, and formalities related to inter-state and transit transport		Official No.	Issued Date	Authorised by
Laws				
Customs				
a.	Law on Customs (Revised version)	04/NA	20-Dec-2011	NA
b.	Law on Customs (Revised version of certain articles)	57/NA	24-Dec-2014	NA
Transport				
a.	Law on Multi Transport	28/NA	18-Dec-2012	NA
Decrees				
a.	Executive Decree of the President of the Lao PDR on Fees and Services Charges (Amended 2012)	003/PS	26-Dec-2012	OP
Decisions				
a.	Decision on Implementation and Operation for the Development, Implementation and Operation of National Single Window on Customs Procedures	2109/MOF	26-Jun-2015	MOF
b.	Decision of the Minister of Finance: Declaration Form on the Use of Customs Declaration Form for Imported Goods Subjected to Duties and Taxes	2095/MOF	26-Sep-2011	MOF
c.	Decision of Acting Minister on Facility Provision for Cross-Border Goods Transportation	2184/CTPC	3-Jul-2006	CTPC
d.	Ministerial Decision on Collection of Fixed Fee for Importation of Some Goods for Exportation	0462/MOF	14-Mar-2003	MOF
Instruction/Guidance				
a.	Instruction of Governor on the Management of Transfer of Goods at International Border Checkpoint in Khammouane Province	07/G/KM	17-Dec-2015	Provincial Governor
b.	Administrative Guidance: To Issuance of Guarantee for Release of Goods by Using IM8 Regime	06893/CD	29-May-2013	MOF
c.	Instruction on Completing the Customs Valuation Form	00266/CD	4-Nov-2011	MOF
d.	Instruction: Application of ASEAN Harmonized Customs Declaration Document (ACDD)	1696/CD	17-Jun-2010	MOF
e.	Instruction on Management of Security for Temporary Importation	1456/CD	26-May-2009	MOF
f.	Finance Ministerial Instruction on Management of Refund for Security of Duty and Taxes for Temporary Importation	0153/MOF	29-Jan-2009	MOF
Notifications				

a.	Notification on the Implementation of Fee Collection of Transit Vehicles and Access of Vehicles through Lao PDR	05666/CD	27-Sep-2018	MOF
b.	Notification on the Suspension of the Permit for Import for Re-export of Vehicle and Fuel as Being Stipulated in the Minister's decision No.0462/MOF dated 14 March 2003	3431/MOF	10-Oct-2016	MOF
c.	Notification on the Management of Goods Transport through the Friendship Bridge Border Checkpoint I into Container Yard at Thanaleng Train Station	07972/CD	25-Jul-2016	MOF
d.	Notification on the Management of Export-Import of Goods through local, and traditional border checkpoint	1587/MOF	26-May-2016	MOF
e.	Notification on Administrative and Service Fee Collection for Trucks Entering the Parking Lot at International Lao-Thai Friendship Bridge I	006/LTFB.1	20-Oct-2014	MOF
f.	Notification on Attention to Manage Importation, Transit through Borders and Relocating Fuel in the Lao PDR	06304/CD	8-Sep-2014	MOF
g.	Notification on the Management of Foreign Transport Vehicles Temporary Entry in the Lao PDR	09539/PWT.C	14-Jun-2012	PWT
h.	Notification on the Implementation of Electronic Customs Clearance (ASYCUDA) at the Pilot Site at Lao-Thai Friendship Bridge I, Customs Regional Office V	1408/MOF	13-Jun-2011	MOF
i.	Notification on Regulations on Transportation of Transit Goods	0749/CTD	24-Feb-2007	MOF
Official Letters				
a.	International Transit of Goods	1242/CD	6-Apr-2010	MOF

Notes :
CD = Customs Department
CTPC = Ministry of Communications, Transport, Post and Construction (Old name of Ministry of Public Works and Transport)
DOT = Department of Transport
GOL = Government of the Lao PDR
ILTFB.1 = International Lao–Thai Friendship Bridge I
KM = Khammouan Province (Provincial government authority)
MOF = Ministry of Finance
NA = National Assembly
OP = Office of President
PS = President of the Lao PDR
PWT = Ministry of Public Works and Transport
PWT.C = Cabinet of Ministry of Public Works and Transport

Sources: Policy documents listed in this table.

Table 5.8: Laws and Regulations on Transport

Laws and regulations on transport		Official No.	Issued Date	Authorised by
Laws				
a.	Law on Land Transport	24/NA	12-Dec-2012	PWT
b.	Law on Land Traffic	23/NA	12-Dec-2012	PWT
Driving license				
a.	Regulation on Management and Driving License Examination of Land Transport Vehicles	3416/MCTPC	4-Sep-2002	PWT
b.	Guideline on Request for Changing a Driving License, Using Different Types of Driving Licenses, Conditions for Using and Requesting a New Driving License to Replace a Lost License	9051/DoT	8-Oct-2002	PWT
c.	Guideline on Criteria for Applicants for Lao Citizen Driving License Examination	906/DoT	8-Oct-2002	PWT
d.	Guideline on Driving Examination Regulation	907/DoT	8-Oct-2002	PWT
Trucking standard				
a.	Provisions on the Technical Standards and Accessories of Vehicles that are Authorized for Import for Registering and Assembling for Using in Lao PDR	4312/MCTPC	11-Nov-2002	PWT
Truck weight				
a.	Regulation on Approval of Total Maximum Weight of Trucks	13848/MPWT	26-Sep-2013	PWT
b.	Decision of the Minister of Public Works and Transport on Management of Truck Weight Measurement Countrywide	20480/MPWT	29-Dec-2011	PWT
c.	Decision on the Approval of Total Maximum Weight if 22-Wheel/6-Axle Trucks (Semi-trailer trucks)	5064/MPWT	21-Apr-2009	PWT
e.	Instruction to Inspect and Manage Heavy Trucks (Weight Measurement) for 24 hours	736/MCTPC	21-Feb-2001	CTPC
Speed limitation				
a.	Links to the Law on Land Traffic, No.23/NA, dated 12/12/2012, Article 19			
Punishments				
a.	Decree on Fines and Measures against Violators of Laws and Regulations on Road Traffic, Land Transportation and Protection of National Roads	188/PM	3-Jul-2007	PWT
Transport business				
a.	Decision of Minister on Regulation Management Operate Business on Public Works and Transport	17582/MPWT	8-Aug-2010	PWT

Sources: Policy documents listed in this table.

5.5. Findings from key interviewees and group discussion

Key informant interviewees

The results of the Key Informant Interviews (KII) are employed in this research study. The interviews were conducted in October 2018. There were four respondents available for the KII. Three of them were from the Lao PDR and Thai logistics companies. One of them was a government officer in charge of the Automated System for Customs Data (ASYCDA) system, Department of Customs, Ministry of Finance, as shown in Table 5.9. Semi-structured questionnaires were prepared for obtaining information from the KIIs by focusing on the challenges of freight transport, the current situation of logistics, and the opportunity of business expansion. Direct observations focused on formal and informal forms of cold chain freight transport, soft and hard basic infrastructure along the economic corridors, market orientation, Special Economic Zones (SEZs), and two international borders with Thailand at the 2nd Lao–Thai Friendship Bridge (Savannakhet-Mukdahan) (13) and the 3rd Lao–Thai Friendship Bridge (Khammouan-Nakhon Panom) (11).

Table 5.9: List of Key Informant Interviewees (KIIs)

No.	Respondents	Person(s)
1	Department of Customs, Ministry of Finance	1
2	Lao logistics company	2
3	Thai logistics company	1
	Total	**4**

Source: Author.

There are two points to discuss about cold chain logistics based on the results from the KIIs as follows:

- Trend of transit goods

In recent years, the demand for Thai fruits and vegetables in China is on a rising trend, especially in the east and the south of China. The volume of trade has increased seven times compared to the past few years, which implies that there is a massive volume of merchandised trade flow movements between these two countries. In order to export fruits, vegetables, and related food products to China, there are two common ways for Thailand. First, via shipments from Laem Chabang seaport to a seaport in China. Second, transit transport via the Lao PDR to Viet Nam[29], and through the Lao PDR to China[30].

[29] National Road No. 8 (R8) through Bueng Kann (Thailand) – Bolikhamxay (9) to Nam Phao (10). National Road No. 9 (R9) through Mukdahan (Thailand) – Savannakhet (13) to Dansavan (14). National Road No.12 (R12) through Nakhon Panom (Thailand) – Khammouan (11) to Na Phao (12).

[30] National Road No. 3 (R3) through the 4th Laos–Thai Friendship Bridge (2) to the international border at Boten – Mohan (China) (1).

Transporting perishable products, such as fruits and vegetables, requires short distances and durations to preserve quality because the transport time directly affects the quality and taste of fruits and vegetables. The duration of goods transport from Laem Chabang, Thailand to China's seaport takes around 10 to 12 days, with almost 50% cheaper costs than land freight transport, even though the distance is longer than through the land mode. For example, 70% of *durian* exports from Thailand to China via land transport takes around 4 days in total (e.g. transport and customs clearance), by going through the 4th Lao–Thai Friendship Bridge (2). In the past, there was smuggling at a route between Houaysay, Bokeo province to China border. The KII informed that, however, goods transport inspection is strict now's a day. So, a legal trade volume between Thailand and China via this route is around 30% of total volume.

- Key factors of logistics and the cold chain and business competitors

National Road No. 12 (R12) of the Lao PDR, connecting Nakhon Panom, Thailand, to Viet Nam (11 to 12) is the main mode of transport, while the National Road No. 9 (EWEC[31], 13 to 14) and National Road No. 3 (R3) (2 to 1) are the supplementary routes informed by the KIIs. Firstly, this was because the R12 is shorter than R9 in terms of distance and time. Secondly, this was because of the bad road condition of R9 that was damaged by overweight trucks loading minerals. Thirdly, it connects Thailand, the Lao PDR, and Viet Nam, then Vung Ang seaport, for transport through the maritime mode to China and Japan. This route is also a gateway to the New East–West Corridor for North-Eastern Thailand, the Lao PDR, and Viet Nam.

The KIIs informed that the Lao PDR–China Railway Project is also a key factor that might change this business game. This railway will connect Thailand, the Lao PDR, China, Russia, and Europe by different modes of transport as a part of the One Belt One Road strategy of China. Goods transport will be changed from different modes to another. For example, transport from truck to railway to waterway and airway.

Normally, business rivals are those that come from the same field. In the course of the logistics business, land freight transport businesses are competing with each other rather than with different modes of transport. In the case of the Lao PDR, we are not competing with logistics businesses that operate transport in the land mode, but other transport modes, such as air and maritime as confirmed by the KIIs. For example, international trade between Thailand and Viet Nam is via the air and maritime modes and is rapidly growing, while the Lao PDR's land transport business growth very slow. There are two obstacles that weaken freight transport as well as trade competitiveness. The first obstacle is transit time, and the second obstacle is the high logistics costs of the relevant fees and service charges. In other words, Lao PDR companies have no choice but to compete with different modes of transport in terms of price.

[31] East–West Economic Corridor.

Cold chain group discussion

The result of the Group Discussion (GD) was also employed in this research study. The GD was conducted in February 2019. There were eight respondents from logistics companies in Vientiane, that participated in the GD. Three of them operated cold chain businesses and the rest were running general logistics businesses as shown in Table 5.10. A semi-structured questionnaire was prepared for obtaining information during the group discussion by focusing on the challenges of cold chain business and the reason why they do not operate in the cold chain.

Table 5.10: List of Cold Chain Group Discussion

No.	Participants	Person(s)
1	Operate cold chain business	3
2	Non-operate cold chain business (general logistics)	5
	Total	**8**

Source: Author.

Results from the GD revealed that both cold chain and non-cold chain business are mainly Lao PDR companies, except for one foreign company in the cold chain group. This is because cooled and frozen food products are mostly imported from the country's immediate neighbours, such as Thailand. The GD also revealed that both are running freight transport in the land mode, covering inter-state/transit and domestic transport. Their businesses focus on freight logistics, storage, and documents declaration, such as export–import declarations and customs clearance declarations as sub-contractors for other companies. Specifically, among the cold chain companies, they operate only *cold storage/warehouses.* Information and challenges of the cold chain business are displayed in Table 11.

Table 5.11: Challenges of the Cold chain and Logistics Operations

Cold Chain Business	Non-Cold Chain Business
General information about the cold chain business	*Why don't these companies operate in the cold chain?*
● Operating cold storage/warehouses, repackaging and being a forwarder. ● Fresh/chilled and frozen meat, frozen aquatic products, and frozen ready meals are the main products.	
Cold chain equipment and facilities	● Cold chain equipment and facilities are expensive. ● Costs of operating are high. ● The market for frozen products is limited. ● Cannot compete in the market in terms of price and transport time. ● Insufficient truck drivers who have experience in the cold chain.
● Basic equipment: forklifts, pallets, containers, four-wheel trucks, six-wheel trucks, and 12-wheel trucks. ● Cold chain: Cold storage, cooled boxes, refrigerators, thermometers, voltage stabilisers, trucks with cooling systems.	
Cold chain equipment maintenance	
● Sufficient truck parking lots and some expansion of processes. ● Trucks are above five years. ● Trucks repaired less than six times per year.	
Challenges of cold chain business	
● Price of fuel (expensive).	

• Truck condition and high repairing charge. • Bad road conditions. • Insufficient truck drivers.	

Source:_Author.

5.6. Discussion

It is important for the Lao PDR, home to 7 million residents, to gain benefits from its geographical advantage. The Lao PDR is surrounded by five AMS and one of the biggest economy nations, China. Imagine the massive volume of products and transactions between these countries if the Lao PDR can utilise its advantage for trade integration in the region.

However, instead of being an exporter of high-added-value of agricultural products, the Lao PDR is an importer of its immediate neighbours, such as Thailand. This is because the scale of agricultural production is growing slower than domestic demand. Furthermore, processed food products of the Lao PDR are currently at the primary level. Food imports are being used to fulfil this demand. Frozen meat and aquatic products are the major imported food products, together with fresh/chilled fruits and vegetables, over the last five years.

This import transaction covers both imports for domestic consumption and transit transport to third countries (e.g. China). This is an opportunity for the Lao PDR to be a beneficiary from transit transport if the country has a comparative advantage from its geographical logistics and freight transport. Unfortunately, despite a number of regulations aiming to facilitate trade in terms of customs clearance, implementation is still complicated and enforcement is weak. These weaken the capacity of freight transport in the country. In this regard, there are a couple of points for discussion as follows:

- Enhance higher added value agricultural production, such as organic fruits and vegetables, that relatively high in nutrition and price (e.g. premium and/or super food). This aims to alleviate a trade deficit with the Lao PDR's trade partners. To do this, it is important to start with land distribution, provide technical training, production technique, market access, credit access, and guarantee irrigation access to farmers.

  On the other hand, food loss means more food costs. An improvement in cold chain management within provinces instead of using primary cold transport decreases the chance of food loss. First, we can utilise the advantage of being an electricity supplier for cold storage businesses in terms of cheaper prices and electricity stability. Then, basic infrastructure, such as roads, must be improved in order to prevent damage to refrigerator containers when transporting. In this way, the Lao PDR can supply more agricultural products from provinces to provinces in the domestic market instead of more food imports.

- Another point is that regulations relating to customs and transport should be reconsidered and made a clear statement, especially to decrease customs clearance procedures for perishable goods and avoid an overnight stay because it will affect the

quality of these products and lead to food loss. In addition, a deduction of customs clearance procedures of transit products is important. These regulations will be a guide for custom officers and the relevant agencies to work on determining time and collecting the exact amount of fees based on the reference rate without any negotiation.

- As well as soft infrastructure, hard infrastructure also plays an important role in logistics as well as the food value chain. Full utilisation of the upcoming Vientiane–Kunming high-speed railway project by 2021 is the most desirable, and the construction of the Vientiane–Hanoi expressway would contribute to the improvement of the cold chain.

These are to enhance the Lao PDR's capacity to compete and utilise its geographical advantage for the integration of its economy, trade, and transport in the region.

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Chapter 6

The Cold Chain in Myanmar

Aung Min[32] and Theint Sandy Htut[33]

6.1. Introduction and Background

Study background

The agri-food market in Southeast Asia has been activated by the steady population and economic growth and the deepening regional and international economic integration. However, the agri-food sector in this region still has unresolved issues, such as the low-income of small-scale farmers. There is plenty of scope for improvement in the food value chain (FVC) containing the whole process of production, processing, circulation, and trade of agri-food products, from institutional and technical aspects.

This study focuses on demand for refrigerated and frozen cargo by-products; selected agricultural products, such as fruits and vegetables, livestock products, fishery products, processed food, and chemical products to understand the cold chain logistics sector of Myanmar. Agricultural, livestock, and fishery are included under the agri-food industry. Foreign trade is the one sector that is vastly driving cold chain demand. Myanmar's agricultural foreign trade amounted to US$2,928 million in fiscal year (FY)2017/2018, from April to March, of which US$1,519 million was from border trade and US$1,409 million from normal trade. However, the foreign trade of agriculture-related cold chain products was not even 1%. It contributed only US$20 million in the same FY which was conducted via sea. Cold chain usage for agricultural products is not found at border trade. Most traded items are fruits, vegetables, vegetable seeds, and a few amounts of flowers.

The use of the cold chain for agriculture is still in its earliest stage and it has the most potential for growth in the future with the support from both the private and public sectors, such as businesses, NGOs, internal organisations, and the government. As for livestock and fishery, in the same FY, they contributed US$91 million and US$609 million, respectively. In the livestock sector, the trade of dairy products is also contained. In terms of cold chain logistics, more reefer containers and generator-equipped tractor trailers and third-party logistics (3PL) cold chain warehousing providers are needed. This particular study will analyse the whole cold chain landscape of Myanmar in relation to its market size for each product category while portraying the supply chains, cold chain assets, and human resources. Then, it will identify the current issues and challenges faced by the sector and recommend the related governments to take the necessary measures accordingly.

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Study objectives

The project aims to study cold chain logistics in Myanmar in the following scopes:

1. Current situation of the cold chain in Myanmar
2. Issues and challenges of the cold chain
3. Government policy to support its development
4. The mid-term prospects of the cold chain

Research methodology

The study of the cold chain in Myanmar was carried out by the Research Division of Myanmar Marketing Research and Development Company (MMRD) in November and December 2018. In order to portray the whole cold chain landscape, desk research and interviews with various stakeholders, including associations, logistics service providers, and users were conducted (Table 6.1). Desk research is done by collecting secondary data from various sources and previous reports as per the requirements. Expert interviews are conducted with pivotal associations that have direct contact with the cold chain. The study takes place in Yangon, Mandalay/Pyin Oo Lwin, Muse, and Ayeyarwady. The main routes covered are AyeyarwadyYangon and Yangon – Mandalay/ Pyin Oo Lwin – Muse.

Table 6.1: Sample Allocation

Description	Sample Size
Expert Interviews	
Myanmar International Freight Forwarders Association (MIFFA)	1
Myanmar Food Processors & Exporters Association	1
Myanmar Retailors Association	1
Cargo Truck Association	1
Myanmar Fisheries Federation (MFF)	1
Myanmar Fruits & Vegetables Association	1
Service Provider Interviews	
Transportation service (trucking gate)	3
Cold storages/ processing plants	6
3PL logistics companies	11
Customers Interviews	
Food processors	3
Poultry & meat processing plants/ slaughters	2
Importers/exporters	7
Retail – supermarkets	2
Pharmaceutical companies	2
Farmers	6
Total	46

Source: Authors.

6.2. Current Situation of the Cold Chain

Demand for refrigerated and frozen foods

The cold chain, as a subsector under the logistics industry, has every possibility of growth as long as there is demand in the country to transport its perishable produce. A country's potential for the cold chain can be estimated just by looking at its available volume of products that might need cold storage or transport. Fishery, livestock, agricultural, pharmaceuticals, and processed foods are the most visible product categories that use the cold chain.

Fishery products and processed foods; excluding dairy products, such as cheese, are the only categories that are transported frozen. They are mainly export or import items with less than 20% of total production. With that, more than 80% is going in the chilled stage mixed with crushed ice and is dedicated to domestic consumption. This traditional cold chain is still dominating the modern cold chain. Refrigeration is being utilised for storage and transport of perishables: livestock products such as meat and dairy; selected agricultural products such as flowers, fruit and vegetables; and pharmaceutical products such as vaccines. Here again, export/import items are the ones that commonly use refrigeration to meet international standards. Pharmaceuticals are an exception; it is the only category that has to use refrigeration even locally. Otherwise, for domestic consumption, the vast majority of the three categories mentioned are all distributed in chilled conditions using crushed ice.

In terms of trucking, the use of refrigerated trucks or reefer containers; twenty-foot equivalent unit (TEU) and forty-foot equivalent unit (FEU) are in demand mainly from export/import businesses while the rest depends on ice supply, insulated box trucks and general freight trucks. A few exceptions are top businesses in retail, hospitality, and other high-end markets. They are demanded to use modern cold chain facilities to sustain product quality. That being said, the volume of cold chain demand is described as the sum of domestic distribution, export and import as in Table 6.2.

Table 6.2: Current Cold Chain Demand in Myanmar (FY 2017/2018 based)

Category	Ordinary		Refrigerated		Chilled/cold		Frozen		Total	
	Ton	%	Ton	%	Ton	%	Ton	%	Ton	%
Fishery domestic distribution	–	–	–	–	5,309,233	34.90	–	–	5,309,233	34.90
Fishery export	–	–	–	–	–	–	568,227	3.73	568,227	3.73
Fishery import	–	–	–	–	–	–	15,616	0.10	15,616	0.10
Meat domestic distribution	2,829,910	18.60	–	–	–	–	–	–	2,829,910	18.60
Meat export	–	–	804	0.01	–	–	–	–	804	0.01
Meat import	–	–	789	0.01	–	–	–	–	789	0.01
Dairy domestic distribution	2,278,430	14.98	–	–	–	–	–	–	2,278,430	14.98
Dairy import	–	–	23,342	0.15	–	–	–	–	23,342	0.15
Selected agricultural products domestic distribution	4,145,245	27.25	–	–	–	–	–	–	4,145,245	27.25
Selected agricultural products export	–	–	14,118	0.09	–	–	–	–	14,118	0.09
Selected agricultural products import	–	–	25,444	0.17	–	–	–	–	25,444	0.17
Pharmaceuticals (vaccines) import	–	–	2,618	0.02	–	–	–	–	2,618	0.02
Total cold chain potential (B = C + D)	9,253,586	60.82	67,115	0.44	5,309,233	34.90	583,843	3.84	15,213,777	100.00
Current cold chain demand (C)	–	–	67,115	10.31	–	–	583,843	89.69	650,958	100.00
Cold chain potential (D)	9,253,586	63.54	–	–	5,309,233	36.46	–	–	14,562,818	100.00
Cold chain demand for local consumption (A)	–	–	52,194	0.97	5,309,233	98.74	15,616	0.29	5,377,042	100.00

Sources: Central Statistical Organisation (CSO, 2018), Department of Fisheries (DOF, 2018), and Myanmar Customs Department (2010).[34]

[34] For detail data on trade, authors requested Myanmar Customs Department directly as ad hoc basis. The same applies to the following tables and figures.

- The transition of consumption in refrigerated and frozen foods

In FY 2017/2018, the total domestic consumption of fishery, livestock, and agricultural product categories combined was about 12 million tons, of which fishery contributed the most at 43.16% followed by agricultural at 33.71% and livestock at 23.13%. However, only 5.4 million tons was demanding the cold chain. Fishery is the main sector making use of the cold chain; 5.3 million tons for domestic distribution and 15,616 tons for imports. The rest, 52,194 tons, makes up the import of meat, dairy, and selected agricultural and pharmaceutical products, such as vaccines. In addition, fishery domestic distribution is vastly through the traditional cold chain, which is the use of ample ice supply instead of running the chilling system of a truck or a warehouse.

Table 6.3: Current Cold Chain Demand for Domestic Consumption in Myanmar (FY 2017/2018) (A)

Sr.	Category	Tonnage	% Contribution
1	Cold/chilled	5,309,233	98.74
2	Refrigerated	52,194	0.97
3	Frozen	15,616	0.29
	Total	5,377,042	100.00

Sources: CSO (2018), DOF (2018), and Myanmar Customs Department (2010).

With the abundance of natural resources, keeping products in the frozen stage is not common or necessary for Myanmar for local consumption, except for ready-to-eat processed food items, for example, dumpling and ice-creams. In many countries with a developed cold chain sector, the storage of fruit and vegetables and other commodities in the freezing stage for sale at a future date is already widespread. But in Myanmar, it is still in the early developing stage and therefore Myanmar is still relying on imports in times of supply shortage. Freezing for future sale is mentioned in a later section[35] and in the strawberry distribution case study[36]. If this were to become mainstream, cold chain demand for local consumption would go up.

[35] The subsection titled ‘Selected agricultural products’ under 'Demand for Refrigerated and Frozen Cargo by Product' in this section.

[36] The subsection titled ‘Cold chain logistics for strawberry’ under ‘6.4. Case Study’.

- The transition of import of refrigerated and frozen foods

The use of modern cold chain facilities has been increasing along with increasing foreign trade. Specifically, the import of fresh seafood and these facilities simultaneously gained momentum after 2015. Fishery imports increased fivefold from 3,014 tons in 2015 to 15,616 tons in 2018. Meat imports are also rising in response to the growth of the hotel and tourism industry and the entrance of well-known international fast food chains, such as KFC and Lotteria. The dairy sector saw a gradual decline of trade, yet it seems reasonable when checking with the steady increase of domestic production. Of the imported dairy items, high-quality processed products, such as whole and skimmed milk powder and cream milk are standing at the top, as the local dairy sector still needs a lot of improvement, especially regarding technical know-how and raw supplies.

In FY 2017/2018, the top seafood exporters into Myanmar were Thailand, Switzerland, and Indonesia while meat was sourced mainly from Thailand, Brazil, and the Netherlands. Dairy products are mainly imported from New Zealand, Australia, and Germany. Seafood comes in the frozen stage, while meat and dairy come with refrigeration. Once arrived at Yangon Ports, reefer containers carrying these products are plugged in at dedicated charging facilities powered by the port. After customs procedures, containers are unplugged from charging and sent to the respective processing plants or factories. Continuous chilling/cooling may not be guaranteed at all times as the vehicles used are usually not equipped with generators. However, this is not that of a big issue as it seems given the distance and time; some factories are located at the industrial zones which are of a short distance from the port and thus take less time, an hour or so. In this case, reefers are only driven vehicle-powered. Some products are not even powered throughout the short intercity trip. The vast majority of imports are to fulfil local demand whereas very few of them, especially seafood, are imported for local processing and then export back to the countries of origin on Cut-Make-Pack (CMP) basis.

Table 6.4: Transition of Import of Refrigerated and Frozen Foods

FY	Fishery		Meat		Dairy		Total	
	Tonnage	US$ Million	Tonnage	US$ Million	Tonnage	US$ Million	Tonnage	US$ Million
2014/2015	3,014	2.25	153	0.57	62,460	97.02	65,627	99.84
2015/2016	2,736	3.57	150	0.64	61,408	98.29	64,293	102.5
2016/2017	12,777	2.86	276	1.38	56,527	87.90	69,579	92.14
2017/2018	15,616	5.40	789	2.49	23,342	60.31	39,747	68.2

Source: Myanmar Customs Department (2010).

Demand for refrigerated and frozen cargo

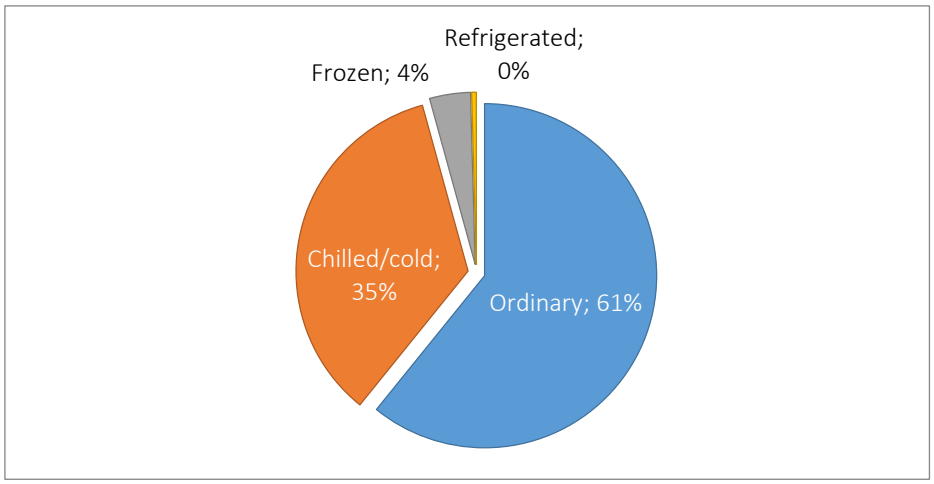
Logistics services in the country are demanded in four distinct ways depending on the temperature control requirements by different product category, such as livestock, fishery, agricultural and chemicals or pharmaceuticals. In this subsection, logistics will be defined as a combination of transport and storage. Controlled temperatures differ based on each product or its shelf life. Common temperature adjustments found are frozen: -25°C to -18°C, chilled or cold: -5°C to +15°C, air-conditioned or refrigeration: +15°C to +25°C, and ambient: +25°C and above. Ambient is a logistics terms used for dry goods that can be kept at room temperature with no further temperature adjustments. For example, fishery products need to be kept at frozen temperatures to maintain their quality while ambient is in use for most consumer goods.

Technically, in countries with developed logistics sectors, cold chain utilisation is common sense for the distribution and storage of all possible perishable products. On the other hand, non-perishables or dry goods use traditional logistics with ordinary temperature. But this is not entirely the case for Myanmar. As analysed in Table 6.2, the product categories named under “Ordinary” which make up the vast majority of the country’s total cold chain potential, are only utilising traditional logistics for the whole supply chain. This is more than half, at 60.82% or 9.3 million tons in volume. It is possible that it would demand cold chain in the future in line with the growth of the economy and thus the logistics industry.

It also needs to be noted that the base statistics for agriculture-related product categories, such as “Selected agricultural products domestic distribution”, “Selected agricultural products export” and “Selected agricultural products import”, are all filtered to get a more realistic look at the industry’s actual potential. Therefore, these statistics only represent cold chain needs rather than the whole agricultural industry. Other product categories that need

do not appear in Table 6.2 are “Dairy export”, “Domestic distribution of pharmaceuticals” and “Pharmaceuticals export”. This is due to the fact that their volume is insignificant to be shown. Specifically, for pharmaceuticals; it is a given that local supply should be enough to consider export. Yet, Myanmar has a supply shortage to even fulfil the local demand. With that, the cold chain is potentially in demand from the remaining 39.18%, of which the chilled category contributes the most, with 34.90%: 5.3 million tons, accompanied by frozen 3.84%: 0.6 million tons and refrigerated 0.44%: 0.07 million ton, respectively.

Figure 6.1: Percentage Contribution of Total Cold Chain Potential in Myanmar (B)



Sources: CSO (2018), DOF (2018), and Myanmar Customs Department (2010).

To be more specific, it is only the ordinary category that is not utilising the cold chain, i.e. of the total volume of 15 million tons. Therefore, it can be concluded that the country’s cold chain sector represents the remaining 6 million tons, combining the refrigerated, chilled or cold, and frozen categories. The sector can be presented with each category divided as followed in Table 6.5. This conclusion is under the assumption that the industrial-wide value or size of the sector, i.e. 6 million tons, represents the absolute value of product tonnage with no further specification; whether they are for storage, transport only, or both, and the fact that they are using the traditional or modern cold chain.

Table 6.5: Current Cold Chain Sector of Myanmar in FY 2017/2018 (C and D) (Ton)

Sr.	Category	Modern Cold Chain (C)	Traditional Cold Chain (D)
1	Chilled/cold	–	5,309,233
2	Refrigerated	67,115	–
3	Frozen	583,843	–
	Total	**650,958**	5,309,233

Sources: CSO (2018), DOF (2018), and Myanmar Customs Department (2010).

Myanmar's current cold chain demand can be described in two ways; traditional and modern. The former would be the 5.3 million tons, which consists of bucket and crushed ice transport or storage dedicating for domestic distribution of fishery products. This is a bit different from its counterpart of foreign trade and from other product categories. It is stored in frozen temperatures and transported in chilled conditions. If it was stored before distribution, utilisation of the frozen category would go up. The percentage increase is not yet known and needs to be verified with thorough ground checks. It can also be concluded that 5.3 million tons or 89% of total demand for cold chain is a huge potential if it were to be transformed into the modern chain. Anyhow, both of these can be reasonably referred to as Myanmar's cold chain demand in that they both utilise means to sustain product quality with temperature control.

Demand for refrigerated and frozen cargo by product

Myanmar's total cold chain demand of 650,958 tons can also be presented by product categories, including but not limited to fishery, meat, dairy, agricultural, and pharmaceuticals. In general, all product categories named here have already been arranged with the cold chain throughout the supply chain in most developed economies. If Myanmar's logistics industry were to be developed together with its economy, the potential of the cold chain, a sub-sector under the logistics industry would leap to 15 million tons, which is threefold the sector's current size.

Table 6.6: Cold Chain Demand by Product Category in FY 2017/2018 (Ton)

No.	Category	Current Demand		Potential Demand		Total Demand	
		Tonnage	%	Tonnage	%	Tonnage	%
1	Fishery	583,843	89.69	5,309,233	36.46	5,893,076	38.74
2	Meat	1,593	0.24	2,829,910	19.43	2,831,503	18.61
3	Dairy	23,342	3.59	2,278,430	15.65	2,301,772	15.13
4	Selected agricultural	39,562	6.08	4,145,245	28.46	4,184,807	27.51
5	Pharmaceutical	2,618	0.40	0	0.00	2,618	0.02
	Total	**650,958**	**100.00**	**14,562,818**	**100.00**	**15,213,777**	**100.00**

Sources: CSO (2018), DOF (2018), and Myanmar Customs Department (2010).

- Fishery products

Myanmar's fishery sector has long been accustomed to cold transport, although its way of the cold chain may not necessarily mean our modern cold chain facilities, such as reefers and cold storages. The total production of fishery products was 5.9 million tons in FY 2017/2018. In the same FY, fishery trade worth US$717 million has been conducted, which accounted for 583,843 tons. Of this, 97% was exports and 3% was imports, with each contributing to US$712 million and US$ 5 million, respectively.

Table 6.7: Annual Statistics of Fishery Products from FY 2015/2016 to FY 2017/2018 (Ton)

FY	Production	Export	Import	Consumption
2015/2016	5,591,830	368,971	3,014	5,225,595
2016/2017	5,675,470	438,707	2,736	5,249,540
2017/2018	5,877,460	568,227	12,777	5,324,849

Sources: DOF (2018) and Myanmar Customs Department (2010).

The coastal regions, such as Ayeyarwady, Tanintharyi, Rakhine, Mon, and Yangon, are the primary sources of various fishery products. Aquaculture farms are also in place and they are mostly targeted towards locals, unlike sea fisheries which are highly demanded from foreign importers. Yangon is the main fishery distribution centre in the country distributing fresh seafood; both wild and farmed from its two main fish markets, namely Central San Pya Fish Market and Shwe Padauk Fish Market in Yangon, to all parts of Myanmar. The cold chain brings the finest quality to its users along with its convenient cooling/chilling systems.

However, for traditional transport, the manual workforce has to be extensively used for loading and unloading while the freshness of goods is compensated with ample ice supply and cold boxes. There are 301 ice plants in Myanmar, all owned and operated by the private sector, with a daily output of 6,786 tons. As described below in Table 8, one-third of them are accumulated in the Yangon area or the central distribution centre.

Table 6.8: Ice Plants by State and Region

Sr.	State/Region	Unit	Capacity (Tonnage/Day)
1	Yangon	106	2,364
2	Tanintharyi	48	2,536
3	Rakhine	39	456
4	Ayeyarwaddy	70	869
5	Mon	29	528
6	Mandalay	7	30
7	Shan	2	3
	Total	**301**	**6,786**

Source: DOF (2018).

Aquaculture

Of the total fishery production, 19% was from aquaculture, which is about 1 million tons. There are 491,345 ponds in Myanmar, and Yangon is the main destination for their outputs. The mode of transport depends on the location of the farm. For inland water transport, primarily picked freshwater farm fish have to be loaded into a boat together with crushed ice in the ratio of 1:1 to maintain the temperature below 4°C. The boat has to be filled with poly vinyl chloride mesh beforehand to keep the melting of ice at minimum. They are all designated to Yangon landing sites or auction area at jetties, from then to winning processing plants/cold storages or the two fish markets.

As for land transport, general boxed trucks are mostly used, and they have to be loaded with crushed ice first at the nearest ice plant; many of them can be found in major regions. After that, fish is picked and loaded at the farm using manual labour. When loading, it is a

requirement to keep fishery products in ice in 1:1 ratio[37]. However, some fish farms and trucks apply the ratio 1:2 to gather more fish in one go; with that combination, a 19ft truck can carry up to three tons of fish with 1.5 tons of ice. Most of the time, they are directly sent to the central fish market, San Pya. Here, the direct linkage or negotiation between fish wholesalers in the market and the farm may apply instead of auctioning.

Fisheries

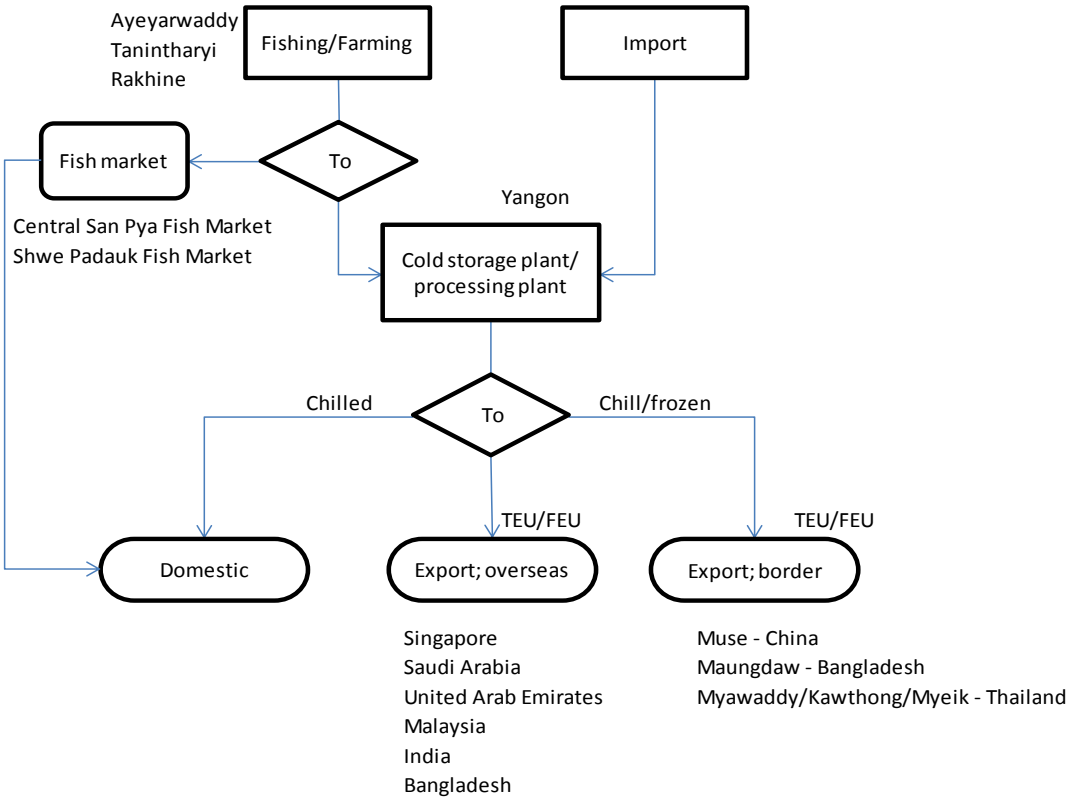
The rest, 81%, makes up natural catching or fishing. Of this, marine fishery makes up 3.2 million tons or 54%, followed by open fisheries: 1.3 million tons at 21% and leasable fisheries: 0.3 million tons at 6%. After catching, fish are kept in plastic barrels; which are placed in the fish hold, with crushed ice at 1:1 ratio to maintain the temperature below 4°C. They are transported from fishing grounds to Yangon jetties for auction, and fishery processors and exporters are usually the main participants. Fish caught at sea are landed at jetties within 1–5 days depending on the location of the fishing ground. At the auction area, all kinds of seafood are washed with clean water and sorted for sale. Each type is displayed in steel trays mixed with crushed ice and is set for different prices. After auction, they are transported from the jetty to processing plants or cold storages, and the two fish markets with insulated box trucks or with general trucks; in which are iced boxes filled with ice and fish. The fish auction is held once a month while shrimp and prawn auctions are there every day.

Domestic distribution flow of fishery products

As the distribution hub of all fishery products, Yangon is made up of two central fishery wholesale markets; San Pya and Shwe Padauk, and a few others including Pazuntaung Naungdan and Annawa markets. All fishery products that end up in the two markets are directed towards the rest of Myanmar, including the top cities, namely Kalay, Tamu, Myitkyeena, Muse, Chauk, Taunggyi, Aung Ban, Loikaw and Myawaddy. They go until Bangladesh, India, China, and Thailand through border towns.

[37] Myanmar Fishery Federation (MFF) adopted the guidelines for cold chain management of fish and fishery products in ASEAN region.

Figure 6.2: The Flow of Fishery Products in Myanmar



Source: Authors.

As stated above, the traditional cold chain is still heavily used for domestic distribution. Seafood mixed with ice is loaded into box trucks and directly transported, or it is put into ice boxes and transported with general trucks; usually six wheelers. The former is common for Yangon intercity while the latter is typical for long haul. Maintaining product quality sounds difficult and inconvenient considering the conventional way of the cold chain. Uninterrupted free flow of products is hard to achieve as transits or stops at second cities, for example, Mandalay, are necessary to further reach the remote areas while sustaining product quality. Fish farms get rid of this hassle; but at a cost of bargaining power and consumers do not have many choices of fishery varieties.

Figure 6.3: Activities at Central San Pya Fish Market, Yangon

Source: Authors.

Figure 6.4: Refrigerated Trucks Lined at San Pya Fish Market, Yangon

Source: Authors.

Yangon had a fishery supply of 267,890 tons in FY 2017/2018; which would equate 734 tons of movement a day. The local production for the whole country was 5.9 million tons. Although fishery production is increasing, widespread use of modern cold chain facilities for domestic distribution has not been found, except for some imported premium seafood volume for retail, as they are all transported chilled with normal trucks. Modern cold chain demand is mainly driven by high-end markets, such as supermarkets, hotels, and fine dining restaurants for quality and safety control. In FY 2017/2018, there were imports of 15,616 tons of fishery products into Myanmar.

Table 6.9: Annual Imports of Fishery Products

FY	Volume in Tons	Value in US$ Million
2015/2016	2,736	3.57
2016/2017	12,777	2.86
2017/2018	15,616	5.40

Source: Myanmar Customs Department (2010).

With Yangon being the centre of all high-end communities, it is safe to assume that these imports are designated to cold storages and processing plants in Yangon. They are then distributed within Yangon and to other big cities where a high-end consumer base is present, generally Nay Pyi Taw and Mandalay. If this was the case, then the percentage of modern cold chain usage for domestic distribution of imported fishery would be only 0.26% of the total cold chain potential of 15 million tons compared to fishery exports that contributed 9.64%. The rest of the local distribution of 90% is through the traditional cold chain.

Export flow of fishery products

In Myanmar's fishery export sector, sea fishery has better prices rather aquaculture farming. In FY 2017/2018, fishery exports reached 568,227 tons, which was an increase of 129,520 tons from the previous year. In terms of value, it was US$712 million in FY 2017/2018, an 18% increase from the previous year. The top seafood buyers are Singapore, Saudi Arabia, China, the United Arab Emirates, and Malaysia. Border exports are conducted with neighbouring countries, such as Thailand and China, while the rest are through normal

exports. Exported fishery products are mostly acquired from auction and are first processed; with minimal processing, freezing, and packing at processing plants in Yangon. Minimal processing includes washing, weighing, belly-gutting, and peeling.

Table 6.10: Annual Export of Fishery Products

FY	Volume in Tons	Value in US$ Million
2015/2016	368,971	502.63
2016/2017	438,707	605.82
2017/2018	568,227	711.72

Source: DOF (2018).

Only after that are they ready for export standards and are transported to either Yangon Port or the respective border towns, namely Maungdaw (Bangladesh), Muse (China), and Myawaddy, Kawthaung, or Myeik (Thailand). As for the neighbours of India and Bangladesh, normal trade is more utilised due to infrastructure limitations, for instance, severe road conditions en route to destination cities or border towns. TEU and specially FEU reefer containers are used for export. The export quality for normal trade is unquestionable and meets international cold chain standards. However, for border trade, some reefer containers are equipped with generator sets, while the others are only powered by vehicles. There are even cases of frozen transport without continuous chilling. This seems feasible given the time, distance, and the duration of products staying in the frozen stage with no refrigeration until they reach the destination.

To summarise, fishery is the most significant of all categories of cold chain demand and holds the largest share of cold chain demand at 98.87%. This is out of 6 million tons inclusive of bucket and ice transport. Regardless of the actual practices on the ground, it remains the largest with 89.69% for the authentic total cold chain demand of 650,958 tons (Table 6.5), even when the massive local distribution volume of 5.3 million tons that utilises the traditional cold chain is excluded. Given that trade volume is the only factor driving the authentic cold chain demand, especially export, exports are increasing at a steady rate of avg. 9% every passing year, which can be seen in Table 6.11. Thus, it can be concluded that cold chain demand is likely to increase in the future.

Table 6.11: Annual Foreign Trade of Fishery Products

FY	Export		Import		Total Trade	
	Tons	US$ Million	Tons	US$ Million	Tons	US$ Million
2015/2016	368,971	502.63	3,014	2.25	371,985	504.88
2016/2017	438,707	605.82	2,736	3.57	441,443	609.39
2017/2018	568,227	711.72	12,777	2.86	581,004	714.58

Sources: DOF (2018) and Myanmar Customs Department (2010)

- Livestock products

Livestock products include meat: pork; beef; mutton, poultry: chicken; duck, and dairy products. In this subsection, meat refers to both meat products and poultry unless specified, whereas dairy means dairy products, such as milk, milk powder, cheese, etc. Meat production is more accessible to the masses, even to far-off regions. Consequently, the extensive use of storage and transportation facilities for local consumption is with general trucks only. In FY 2017/2018, domestic meat production was 2.8 million tons; this was a decline of 120,302 tons from previous the year. In the same FY, 804 tons worth US$3 million were exported overseas, largely to Singapore, Malaysia, New Zealand, and the United States.

Table 6.12: Annual Statistics of Meat Products from FY 2015/2016 to FY 2017/2018 (tons)

FY	Production	Export	Import	Consumption
2015/2016	2,889,610	197	149	2,889,562
2016/2017	2,951,016	355	276	2,950,937
2017/2018	2,830,714	804	789	2,830,699

Sources: CSO (2018) and Myanmar Customs Department (2010).

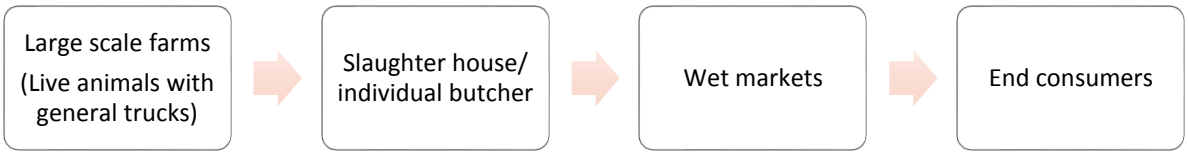
Livestock farming

Of the total production, meat contributes 44% and poultry 56%. Large-scale livestock farming is a major supplier of meat production in Myanmar, while a few small-scale farms are operated by rural households. They are found in every big city supplying enough for regional consumption. Live animals are sent with general trucks from the farm to wholesalers for butchering then to wet markets, or directly to wet markets. The domestication of poultry is common for rural households and therefore is readily available at all times. Some of those

households are sole proprietors in poultry production and distribute the output to nearby areas or towns on a regular basis or when demanded. For them, transportation is not limited to trucks, could sometimes be a motorcycle.

Contract farming for the livestock sector is also developed, particularly for poultry, although they are designated for Yangon. They are mostly located around the Yangon region, such as Bago, Thikekyi, Inta Gaw, etc. Myanmar C.P. Livestock (MCPL) is one of the market players in contract farming. From the contracted farm, live birds are transported to the firm's butchering factories, and from there to dedicated clients and markets. But, most of the time, for the vast majority of consumption, meat is produced by local butchering businesses each day and is transported to wet markets or delivered door-to-door to restaurants. They are based in every big city and general light trucks are mostly used for commercial distribution to the mass market. Slaughtering licences are also held by individual butchers and are mostly for meat such as beef, pork, and mutton.

Figure 6.5: The Flow of Livestock Products in Myanmar



Source: Authors.

Cold chain distribution flow of meat products in Yangon

Again, for Yangon consumption, meat production can be divided into two categories; meat products, such as beef, pork, and mutton, and poultry, such as chicken and duck. Generally, the purchase of fresh meat products at supermarkets is not mainstreamed in Myanmar. As a result, cold chain demand, which is mainly driven by modern supermarket chains, are only limited to a few percentages compared with the total volume. However, the cold chain is apparently used for all export/import meat products as it is a minimum requirement for quality control.

Meat production is mainly handled by Ywar Thar Gyi Slaughter House in East Dagon Township and two others in Hlaing Thar Yar and Kyeemyindaing. Freshly butchered meat cuts and

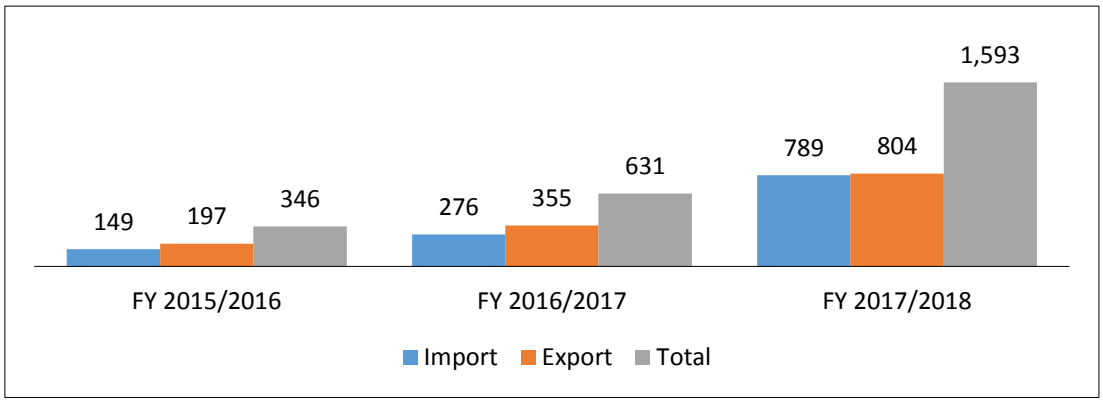
carcasses are delivered to wet markets before daybreak with general trucks. Some of them are sent to City Mart's warehouse, while a few are ordered by restaurants and hotels. As for poultry production, Chicken and Duck Market in Mingala Taung Nyunt Township, Myanmar C.P. Livestock (MCPL) and Japfa Comfeed Myanmar Co., Ltd (Japfa) are the key players. Chicken and Duck Market is the main poultry wholesale centre in Yangon. Japfa is a leading supplier of poultry products and its main business is the manufacturing of animal feeds. Japfa distributes 10,000 whole chicken birds; that is about two tons of meat each day with refrigerated box trucks. There are five trucks in its ownership with a capacity ranging from two to four tons. Temperature setting in the truck is chill or air-conditioned.

MCPL is a major user of the cold chain in the livestock sector. They have under them many lines of business that are closely associated with poultry production, which nearly covers the whole value chain; from breeding, hatchery and farming to finished goods production. MCPL is partnering with KOSPA Limited, the second largest 3PL cold chain service provider in terms of asset, to fulfil its cold chain needs. The cold chain comes into play when the finished goods; meat and processed foods such as sausage need to be delivered to City Mart. They are loaded into the three-ton refrigerated box truck using cold boxes. The controlled temperature in the truck is between 0°C and 10°C. Further information about MCPL can be assessed in detail under Section 6.3.

Trade of meat products

Premium meat consumption has been on the rise since 2016 in response to the growth of the hospitality industry and hotels and fine dining restaurants. These high-end markets demand premium quality at all time, and consequently the cold chain becomes a basic necessity. In FY 2017/2018, the total foreign trade volume of meat products reached 1,593 tons with each accounting for US$2 million in value. Most imported items were chicken: 111 tons and beef: 66 tons. They were mostly imported from Thailand, Brazil, and the Netherlands. They can be found largely at City Mart's Marketplace and fine dining facilities in hotels and restaurants, such as steak houses. As for exports, pork is the most exported item with a volume of 386 tons, followed by chicken and beef at 190 tons and 151 tons, respectively. The top meat importers are Thailand and the Netherlands. The trade is conducted via land for Thailand and sea for the Netherlands.

Figure 6.6: Annual Foreign Trade of Meat Products (tons)

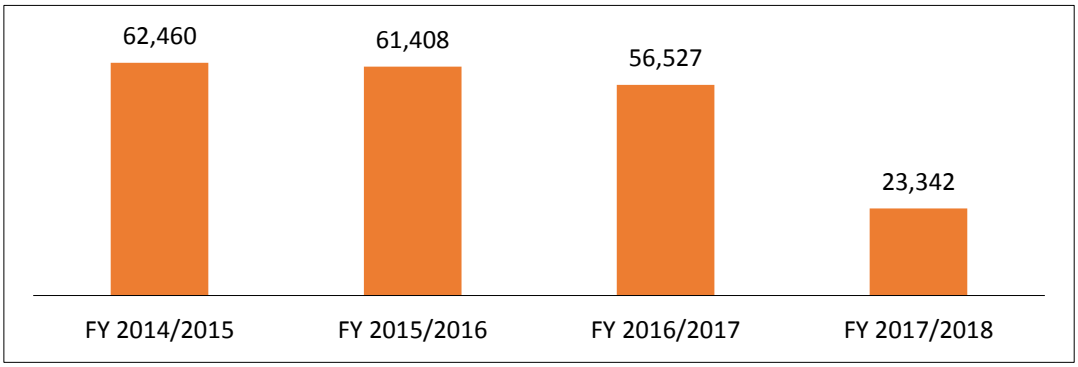


Source: Myanmar Customs Department (2010).

Dairy products

Dairy is another product category that cannot be ignored as the cold chain is essential to keep processed foods such as cheese and butter in good shape. Pure or raw milk is produced largely in the country, which can be verified with government statistics; 2.3 million tons in FY 2017/2018. However, the dairy processing sector has yet to be developed in order to keep pace with the appearance of bakeries and confectionary production, for example, Dutch Mill or other First Moving Consumer Goods (FMCG) products such as coffee mix, tea mix. Therefore, local consumption is still relying on imports. The top imported products are milk powder, cream milk and skim milk. These accounted for US$ 60 million or 23,342 tons for the same FY. The importing amount is shrinking over the years, which can be seen in Figure 6.7.

Figure 6.7: Annual Import of Dairy Products (tons)



Source: Myanmar Customs Department (2010).

This means the local industry is catching up, even though at a slower pace, and the sector's total production output is still hard to grasp. The top imports of dairy products by country are New Zealand, Australia, and Germany, with each contributing 36%, 14%, and 12%, respectively. In the matter of the cold chain, storage appears to be more in demand than transport. Depending on the product, cold boxes are more widely used for local distribution rather than refrigerated trucks.

In brief, the livestock sector, a combination of meat and dairy is not using the cold chain for local distribution, except for foreign trade. On the other hand, on a more positive side, it can be concluded that the sector has potential given its worth of 5.1 million tons. This is 34% of the total volume with cold chain potential. The current demand of the cold chain is only 0.42%, which is 24,935 tons or US$ 65 million in value.

- Selected agricultural products

There appear to be very few amounts of agricultural products that demand the cold chain, largely due to the fact that Myanmar is an agri-based economy with plentiful fresh produce available all year round. Cold chain demand is only driven by export produce items and imports of produce that cannot be fully cultivated locally and is demanded, particularly from the hospitality industry. In FY 2017/2018, the production of agricultural products was 4.16 million tons; of which, fruit comprised 18% and vegetables 82%. In this figure, only the selected items with cold chain potential as well as the items that are of significant yields are included.

Table 6.13: Annual Statistics of Selected Agricultural Products (tons)

FY	Production	Export	Import	Consumption
2014/2015	4,165,384	–	–	4,165,384
2015/2016	4,224,876	–	–	4,224,876
2016/2017	4,362,192	10,881	15,571	4,366,882
2017/2018	4,159,363	14,118	25,444	4,159,363

Sources: CSO (2018), Myanmar Customs Department (2010).

Table 6.14: Production of Major Selected Agricultural Products in FY 2017/2018

Category	Volume in Ton	% Contribution
Major Selected Fruits		
Mango	415,096	9.98
Watermelon	317,018	7.62
Strawberry	1,571	0.04
Total	*733,685*	*17.64*
Major Selected Vegetables		
Tomato	1,173,258	28.21
Potato	499,949	12.02
Cabbage	451,442	10.85
Cauliflower	345,149	8.30
Mustard (leaf)	294,298	7.08
Gourd	272,678	6.56
Radish	263,838	6.34
Lettuce	103,894	2.50
Carrot	17,586	0.42
Asparagus	3,587	0.09
Total	*3,425,679*	*82.36*
Grand Total	**4,159,363**	**100.00**

Source: CSO (2018).

In the same FY, 25,444 tons worth US$33 million agriculture products were imported into Myanmar. Of the 25,444 tons, vegetable products contributed the most at 84.31%. As for exports, fruit contributed 81% and vegetable products 19%, respectively. Flowers were also exported, but only around 5 tons. Therefore, the current cold chain demand for domestic consumption of agriculture products is estimated to be 4.15 million tons, which is 99% of the total volume of selected agricultural products of 4.18 million tons. This is the combined value of production and import in FY 2017/2018. Both exports and imports are done via sea trade.

Table 6.15: Foreign Trade of Agricultural Products in FY 2017/2018

Category	Volume in Tons	US$ Million
Export		
Fruits	11,428	2.25
Vegetable	1,580	0.59
Vegetable Products	1,105	1.28
Flower	5	0.00
Total	*14,118*	*4.13*

Import		
Vegetable	11,731	6.03
Vegetable Products	9,720	20.04
Fruits	3,992	6.48
Flower	0	0.00
Total	*25,444*	*32.56*
Grand Total	**39,562**	**36.69**

Source: Myanmar Customs Department (2010).

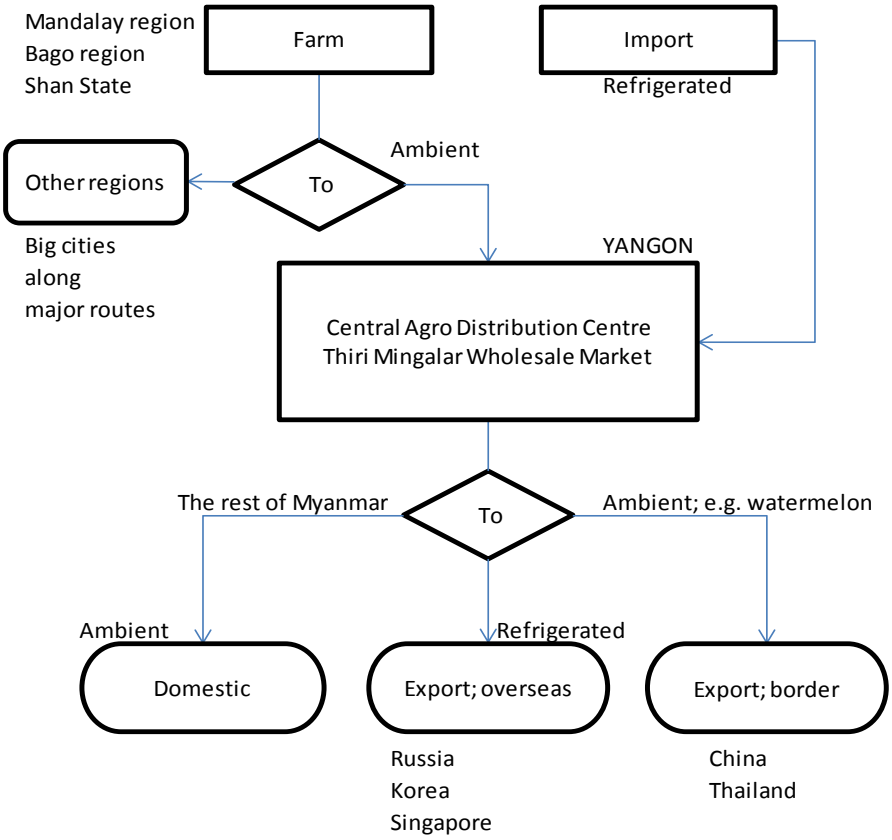
The major cultivation areas of the selected products in Myanmar are Mandalay Region: Pyin Oo Lwin; Mandalay; Nay Pyi Taw; Kume, Shan State: Aung Ban; Heho; Thibaw, and Bago regions. Yangon is apparently the main distribution hub of all agricultural products, while a point-to-point pattern can also apply depending on the route and distance. For example, produce grown in Shan State may directly go to Mandalay, rather than through Yangon; the central distribution hub. Thiri Mingalar Wholesale Market is the main market in Yangon for all agricultural products from across Myanmar. The establishment of the new market, Danyingone Wholesale Market is also in progress. The plan is to settle residents from Thiri Mingalar Market at the new market. More detailed information is described below at the end of this subsection.[38] Fresh produce is largely transported dry with express buses and general trucks (12 wheelers).

Less than 1% of produce that ends up in Thiri Mingalar market comes by the cold chain; demand is driven by traders. Traders that are involved in export/import or that prefer rather high-quality fresh produce usually request refrigerated transport from growers. Delivery is door-to-door; one of the benefits of the cold chain. Otherwise, for other buyers that target local consumption, the transport destination is the market rather than the company. Only from there, produce is delivered to final buyers such as modern retails namely City Mart, hotels and high-end restaurants. City Mart has connections with brokers; liaisons between growers and the mart. Brokers are in charge of procuring or collecting fresh produce. For technical-knowhow, Myanmar cannot produce certain fruit and vegetables all year. In this

[38] See 'Establishment of State of the Art Wholesale Market in Yangon' under 'Potential Agricultural Products' in this subsection.

case, brokers have to import them from overseas. For example, bell peppers are imported from Thailand when in the off-season.

Figure 6.8: The Flow of Selected Agricultural Products in Myanmar



Source: Authors.

Cold chain demand for agricultural products

Agri-cold chain demand is driven by traders in Yangon. Some traders have contract farms in some regions, while the vast majority of sourcing is from individual growers. The top distributed items are flowers, such as chrysanths, fruits, namely strawberries, dragon fruit, and grape, and more than 20 varieties of vegetables. They are mainly cultivated in Pyin Oo Lwin, Mandalay, Nay Pyi Taw, Heho, Loikaw, and Naung Tayar. The cold chain is demanded for long-haul transport from those areas to Yangon Thiri Mingalar market. Drop-off locations can be specified based on the preferences of the buyers. There are only two major processing

factories in Myanmar for fresh produce; dehydration and freezing. Production output is about 150 FEUs which is half its actual capacity. They are exported to Japan. Pickup from the farm is generally done through general light trucks, however refrigerated trucks would be utilised for the varieties mentioned 2019 onwards to keep the exact quality from harvest.

Figure 6.9: Cold Chain Product Flow for Fresh Produce in Pyin Oo Lwin City, Mandalay Region

Collect produce at the farm; e.g. flower

Sent to PSL's truck staion/ packing centre

Initial cleaning & packing for freshly picked produce at the centre; chinese broccoli

Put fruit and vegetables into stackable basket; e.g. tomato

Initially packed produce in the truck; chinese broccoli and mustard greens

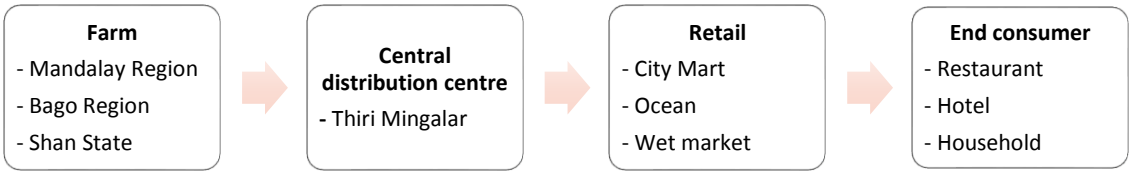
Isuzu Elf 3ton reefer box truck at the centre, waiting to be sent to PSL's main truck staion in Anee Sakhan

Source: Authors.

Go Green is one of the traders in Yangon that has its own fresh produce store. It gathers organic fresh produce, including flowers from growers throughout Myanmar, especially from Pyin Oo Lwin and adds value with proper packaging and labelling to make it ready for sale. The sale is mainly through the store, while the products can also be found on City Mart's shelves. Premium Sojitz Logistics (PSL) is the sole third-party cold chain service provider for the city. PSL deploys two refrigerated trucks to the city unloaded every day which carry back full truck loads of produce to Yangon. The controlled temperature in the truck depends on the type of produce, but is about 8°C. The company purchases about 20–30% of flowers from

the city with the cold chain. Unlike fruit and vegetables that can be carried together, dedicated trucks are required for flowers based on seasonality. Stackable moving baskets are used for loading vegetables, while corrugated cartons are used for flowers and some fruits. A fruit carton box weights about 10 kg and a vegetable basket about 20 to 30 kg. For flowers, about 18 bundles can be filled in carton boxes, and up to 100 carton boxes can be loaded into a refrigerated truck.

Figure 6.10: The Flow of Fresh Produce in Yangon Region



Source: Authors.

Potential agricultural products

Strawberry: Local production of strawberries was 1,571 tons in FY 2017/2018. The strawberry season starts from November and ends in May, before monsoon. There is a steady flow of them, about 10 tons each day from Pyin Oo Lwin to Yangon with the cold chain. About 40 tons of them are being frozen at PSL cold store to make up for the off-season. During those times, they are distributed to cafés and other drink and juice stands in Yangon. Representatives from Germany also studied about strawberries in Pyin Oo Lwin and Taunggyi. With the support of GIZ, about 20 acres are getting required certificates for export to the European Union and other countries. Currently, 20 tons is being grown as an export sample to Russia. If successful, about 40 acres of strawberry plantation would definitely need the cold chain.

Carrot: Carrots are in demand all year round, particularly in Yangon as they cannot be grown in Myanmar for technical reasons. Therefore, carrots have to be imported a lot during monsoon from China. Each week from August to October, a carrot trader has to import two truckloads of them with semi-trailers to fill up the demand shortage. Once they reach Yangon, they are stored in the fish and prawn cold storage. Some traders want to distribute them

directly from Pyin Oo Lwin to Mandalay without going through Yangon, which is now the case. Carrots are largely grown in Pyin Oo Lwin and Taunggyi, and its season falls between December and May, a period of the highest yields bearing the finest quality. But there is not a single facility in the city to store them for later use to meet the demand. In the future, the dehydration of carrot and cabbage, the ingredients for instant noodles, will be possible with the technical support of Korea and factory construction and operation.

Mango: China buys the vast majority of fresh mangoes, but the export is through the border with general trucks. Only a few of them, about 36 tons, are exported via sea freight with reefer containers. The major buyers are Russia, Korea, and Singapore. They are grown in the Nay Pyi Taw and Mandalay region. Dehydration of mangoes is also expected in the near future. A new solar-powered cold storage has been placed in Palate Township in Mandalay region for fresh produce. Up to 5 tons of produce can be stored in it. In addition, they are expected to be exported into Thailand in 2019 with the cold chain.

Dragon fruit: some growers are test-growing the fruit; commercial plantation will be considered according to its fertility and productivity. It is the cheapest fruit during the season; about a hundred Kyat[39] per unit. Therefore, related stakeholders are planning to add value to it with dehydration under the support of Taiwan in terms of technical knowhow.

Though it seems like baby steps, the development work in the sector is taking shape steadily. Some noticeable works are as follows:

Establishment of solar-powered mobile cold rooms at farms for fresh produce: The Myanmar Fruit, Flower and Vegetable Producer and Exporter Association (MEVP) is drawing up many plans for the development of the agricultural cold chain sector. One of the many plans is to construct a cold storage facility for fresh produce in each main city for each region: Monywar in Sagaing Region; Min Dat in Chin State, Myit Kyee Nar in Kachin State, Dawei in Tanintharyi Region, etc. Produce will then be consolidated and sent to the two central cold storage facilities. They will be located in Titar Oo for Upper Myanmar and in Bago or Kyaung Kone in Ayeyarwaddy for Lower Myanmar. Freight transport is planned to be with reefer containers only. However, implementation will depend on the funding availability. Therefore,

[39] 1 Kyat = 1/1500 US$

to fulfil current needs in the short term, the association is planning to place a 5-ton solar-powered reefer container down at the farm with the support of GIZ. When the full consolidation is reached, an unloaded reefer trailer would be sent to the farm for goods transhipment.

There are 32 small associations for produce. Capacity building campaigns, including knowledge sharing of cold chain technologies, are planned to be delivered to those associations. They in turn will reach the farms for re-sharing. Awareness-raising campaigns will also be delivered to traders to encourage them to use cold chain logistics for all their export produce. This will be done by stressing the benefits that cold chain can bring over traditional logistics such as traders' produce meeting the international standard or export quality and therefore, gain the best price.[40] Additionally, it is heard that there is a conceptual plan to build a new agricultural distribution hub in the Nay Pyi Taw and Mandalay region. If it were to be materialised, current agricultural product flow; shown in Figure 6.10, will change accordingly.

The private sector is also contributing partly to the sector's development. In Palate city in the Mandalay region, a test-running 5-ton mobile cold storage has been provided by Natural Farm Fresh Myanmar Co., Ltd in collaboration with the Indian Start-up, EcoZen.[41] Electricity would not be a problem as they are solar-powered. The company is a social enterprise as well as an entrepreneur empowering growers and their direct communities. It is partnering with Convestro and DEG KfW, for technical and funding support.[42] Its main business function is providing solar drying technologies for produce; initiation with spices such as chilli, turmeric, and ginger. This technology reduces 30% wastage to upstream final products while adding value to the low-earning fresh produce for farmers. It is part of a public–private partnership project called Economic Transformation through Food Security. Myanmar is one of the three countries that the project is based on. So far, the company has installed 11 solar dryer domes in Shan State, Yangon, and the Mandalay region, while Thailand has about 600 units. The finished processed products of chilli, turmeric, and ginger are being exported to overseas markets, and the cold chain is being used until they reach export markets.[43] If the test-

[40] Interview to Myanmar Fruit, Flower and Vegetable Producer and Exporter Association.
[41] Convestro (n.d.).
[42] Phuong (2018) .
[43] Natural Farm Fresh Myanmar (2019).

running succeeds, hopefully, the steady installation of cold storage will come along just as solar dryers.

Establishment of a state-of-the-art wholesale market in Yangon: The new Danyingone Wholesale Market has been developed jointly by Myanmar Agro Exchange Public Limited (MAEX) and the Yangon City Development Committee (YCDC). The development has three phases; the opening of the shops in phase 1 and cold storages in phase 2. The final phase is expected to be completed by the end of 2019. The Yangon Government will take charge of the operation once it becomes fully functional. So far, phase 1 has been carried out and space rental started in October 2018. However, it would take some time before residents become entirely resettled from Thiri Mingalar Market as it is still in progress. Currently, two 40-feet reefer containers have been placed on the premise for early use prior to phase 2. They are powered by the facility's electricity supply and storage is free of charge as of now.

Figure 6.11: Two Reefer Containers Placed at the New Danyingone Wholesale Market

Source: Authors.

Unlike the old Thiri Mingalar Wholesale Market, this newly developed establishment aims to go beyond its primary function of a wholesale market and provide unparalleled services, i.e. to promote the entire agricultural supply chain. This includes the enhancement of farm produce quality that is in line with export standards and providing necessary support until they reach foreign markets. It is also planning to connect growers directly with end customers. Given the fact that cold storages are placed at its core phase, the entire agricultural supply

chain landscape might change depending on how well it is implemented and promoted. Businesses also agree that awareness-raising among stakeholders, particularly consumers and growers is a basic necessity for the development of the cold chain sector. Despite its ambition, the completion of phase 2 or cold storage construction appears to be behind schedule; it was initially planned to be accomplished by June 2018.

Figure 6.12: Building 1; the Fruit Wholesale Centre of the Danyingone Wholesale Market

Source: Authors.

The facility is constructed on YCDC's 85-acre land and once completed, it would become a hub for all perishables Myanmar has to offer, including fruit and vegetables, flowers, dried fish, and fresh meat and fish and other agricultural products. It has the capacity to accommodate 5,600 shops and 2,500 vehicles. To go with the modern outlook, facilities such as petrol stations, restrooms, recreation centres, wholesale centres, and vegetable washing areas are included. Other wholesale markets for agricultural products, though they might not be as massive as this, are also being constructed in Nay Pyi Taw, Mandalay, and Muse.[44]

To sum up, 6.08% of agricultural products are demanding modern cold chain services; i.e. to recap, the use of facilities, such as reefers. This equals 39,562 tons in volume. Potential produce for future commercial plantations is strawberries, carrots, dragon fruit, avocados, and flowers, for which the varieties are still to be specified. Flower plantation is said to be designated for export markets only. The cold chain demand of the sector can reach up to 4.2

[44] Tun (2017).

million tons, which is 28% of the cold chain sector. In fruit variety, mango bears the highest possibility with 9.98%, accompanied by carrots at 0.42% and strawberries at 0.04%. That would leave vegetables, which represents 82.36%.

- Chemicals/pharmaceuticals

The cold chain is in demand for health products, such as vaccines and snake antivenom, in order to sustain constant quality from the day of manufacture to the day of expiry. Temperature adjustments have to be carefully set, which usually are between 2°C and 8°C, while ensuring for the temperature does not reach under freezing point. A certain amount of them are being imported into Myanmar as local supply does not meet the demand. In FY 2017/2018, vaccine imports totalled 2,618 tons with a value of US$ 22.78 million. 86% of them worth of US$ 17.58 million are dedicated for human needs and they come via air freight. Between 20 and 30 carton boxes are imported per shipment.

During transit, they have to be lined with frozen ice packs to keep the temperature under 10°C. As for other drugs, such as tablets and pills, they come in general TEU and FEU via sea and land. Large storage space is not necessary for vaccines as the stock is kept low. Only the required amount is imported for its expensive nature. It is plenty if the space is 18.5 sqm (200 square feet) wide; about the size of a garage. They are stored in the cold room with the temperature adjustment between 2°C and 8°C. A general warehouse with below 25°C room temperature is acceptable for other drugs.

Top vaccines distributors in the field are Mega, AA, DKSH and Capital Diamond Star. Distribution is with air-conditioned trucks; though it used to be express buses. When transporting, they have to be put into foam cooler boxes lined with ice packs. These ice packs can last 24 hours, 36 hours, or 48 hours and are used accordingly based on the distance of transport. Other drugs are not that temperature-sensitive compared with vaccines. Therefore, they are mostly distributed with general trucks, except for the top-notch companies, such as above, that use air-conditioned trucks.

- Processed foods

Processed foods are divided into two categories. The first category includes fruit and vegetable-based processed food, such as jam, jelly, pickles, and syrup. The latter includes processed seafood and meat, such as meatballs, fillets, and sausages. There are other categories of processed foods such as dairy, microwave meals, or convenience foods and many more. The main emphasis here would be the only two mentioned.

Fruit and vegetable-based processed foods

There are many local agri-food processors, but they are all spread out producing small scale, mainly for some big markets such as Yangon and Mandalay. There is no evidence of cold chain usage for local consumption or distribution of those products, except for wine with a trivial amount. However, there are about 150 40-ft reefer containers departing for Japan fully loaded with processed vegetables every year.

They are the work of Myanmar Belle and Myanmar Agro Foods Companies, the sole manufacturers of export-quality dehydrated and frozen vegetables in Myanmar. Both companies are owned by a single entity. The company has a joint venture with a Japanese logistics company, Logitem, for its cold chain requirements. With Logitem at its side, the company's business operations cover nearly the whole agricultural supply chain and the inbound supply chain, such as contract farming and processing for outbound until export. The distribution of fresh produce to local supermarkets and restaurants is only through general logistics or express buses. It also engages in seafood exports, but only agricultural products will be emphasised here. The dehydration factory is in Taunggyi and the frozen factory is in Nay Pyi Taw. Raw supplies for dehydration are cabbages, mustard leaves, garlic, and carrots. They are grown in Shan State, namely Heho and processed in Taunggyi, and transported directly to the Yangon International Port in FEU reefer containers, owned by the entity. The products are used as ingredients in instant noodle. Refrigeration temperatures in the reefers are set below 25°C.

As for frozen vegetables, produce such as ladyfingers, spinach, taro, green beans, and green soybeans are the inputs. They are sourced in nearby regions of the factory in Nay Pyi Taw, which is mainly meant for seafood processing. Starting from 2019, leaf-type vegetables, such

as mustard leaves, which are grown in Loikaw, Pyin Oo Lwin and Naung Tayar, are going to use refrigerated trucks for transport from the farm to the factories; transportation of others, such as cabbages and carrots, will remain as they are with general light trucks. Freezing will take place in the cold storage in Nay Pyi Taw, which has a capacity between 600 and 800 tons. After that, products will rest at the temporary 400-ton chilled room before reaching the certain amount to fill up the FEU. Only after that will the entity deploy an empty reefer container from Yangon for product pickup. The trailer will then drive directly down to the port for export. The factory's full production capacity is 300 FEUs, though only 150 FEUs are produced each year depending on trade demand. The company is expecting to export frozen mangoes next year.

Seafood and meat-based processed foods

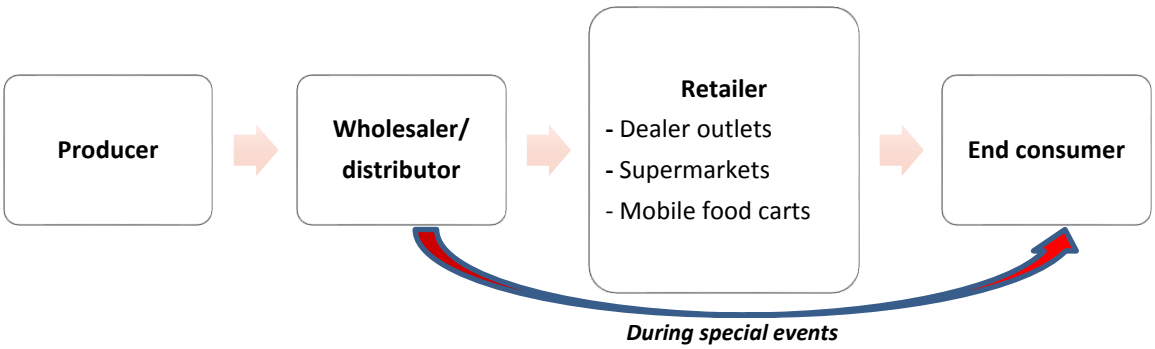
Processed seafood and meat are contained in this category. The available products in the market are processed meat, such as chicken fillets, meatballs, and sausages, and processed seafood, such as fish fillets, fish balls, and artificial crab sticks, etc. They are considered a type of hearty snack that goes along with different beverages and also are convenient to get. Therefore, frequent, but fewer amounts of purchases for consumption are common among the urban population, especially young people. But hotpot restaurants demand a larger quantity of them as the ingredient. There are very few manufacturers or suppliers of the product and all of them reside in the Yangon region. But product reachability is considerably high in comparison to other foodstuffs; they can be found selling as a fast food in a mobile food cart at every possible corner of the street, as in many tea houses in Myanmar.

Figure 6.13: Processed Meat and Seafood Displayed at Hotpot City Yangon

Source: Authors.

Demand is generally the highest during Christmas and New Year. There are two channels that they can reach to final consumers. Under normal growth, sales are through retailers. However, during special events, direct sales from the wholesalers or mainly through producers' outlets are possible. There is no evidence of the cold chain for distribution except for storage at the production plant, which is necessary before the order placement. Most of the time, the distribution of processed foods from producer to wholesaler and then to retailers are with general light trucks. Cold boxes are used to maintain quality. This does not apply to City Mart, which has its own storage facility. The producer transports goods to the storage when an order is placed or at regular intervals.

Figure 6.14: Product Flow of Processed Seafood and Meat in Yangon Region



Source: Authors.

Figure 6.15: Processed Meat and Seafood Found at City Mart Supermarket

Source: Authors.

6.3. Major Players in the Cold Chain

Main players in storage services

Suppliers in cold storage can divided into two; own account operators, and common users of third-party service providers. In the first category are processing plants and cold storages monopolised by the fishery sector. Some of them own insulated box trucks or other freight vehicles, even freezer trucks if it is an exporter. The outsourcing of assets or storage space to a third party is not common for the sector. However, it is possible for them to rent out space for storage or transport to small-scale businesses that do not have owned assets and properties. According to the MFF, Myanmar has 113 cold storage plants with a total capacity of 54,490 tons in 2018 as described in Table 16 below. A typical operator would have its own cold processing plant, standalone cold storage, and even an ice plant or possibly an aquaculture farm, though it is not always the case.

Table 6.16: Registered Cold Storages and Processing Plants in Myanmar (2018)

Sr.	Region	Unit	Capacity in Tons
1	Yangon	69	47,000
2	Tanintharyi	20	2,940
3	Rakhine	9	1,110
4	Ayerwaddy	8	1,100
5	Mon	6	1,340
6	Shan (Muse)	1	1,000
	Total	**113**	**54,490**

Source: DOF (2018).

As for third-party cold warehousing services, there are not many suppliers; no more than 10 of them in Myanmar. To clarify, third party here means common user facility, which could be for any type of goods from any sector. Most of the suppliers are joint ventures with Japanese logistics companies, except Ryobi Myanmar, which is wholly Japanese owned and operated. It is also the largest 3PL cold store facility in Myanmar. 3PL cold storages can only be found in Yangon. The profiles of top 3PL logistic service providers can be seen in the Appendix.

Table 6.17: Top 3PL Cold Chain Warehousing Service Providers in the Yangon Region

Sr.	Operator	Capacity (Sqm)	Capacity (Tons)	Location
1	Ryobi Myanmar Distribution Service Co., Ltd	4,584	11,460	Thilawa SEZ
2	KOSPA Limited	3,960	9,900	Mingalardon
3	Phee Central Logistics	929	4,645	Shwe Pyi Thar
4	Premium Sojitz Logistics (PSL)	1,701	4,253	North Dagon
5	Premium Worldwide	1,360	3,400	Hlaing Thar Yar IZ
	Total	**11,854**	**33,658**	

Source: Authors.

To sum up, Myanmar has a capacity of 88,148 tons of cold storage to fulfil its cold chain needs. Its own account capacity is only from the fishery sector. If businesses from other sectors were included, the storage capacity would vastly increase. For example, Mega, Pahtama Group and DKSH provide services to businesses, yet they operate more as distributors. Besides, the fishery sector is the largest contributor for cold chain demand. Therefore, own accounts in other sectors were not considered in the list shown in Table 16.

Table 6.18: Estimated Cold Storage Capacity of Myanmar in 2018

Sr.	Category	Capacity in Tons
1	Own account cold storage	54,490
2	3PL cold chain warehousing	33,658
	Total	**88,148**

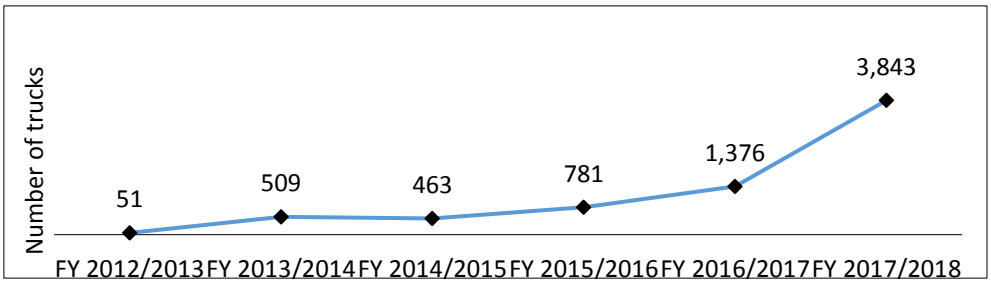
Source: Authors.

Main players in transportation services

In terms of assets, the size of Myanmar's cold chain sector is worth 7,023 trucks; all are refrigerated box trucks. The common user service providers shown in Table 6.17 own just a few of them. The rest are operated by own accounts or businesses, and they provide services to the related sectors. For example, fishery exporters rent out cold chain transport to other fishery businesses. The top suppliers of refrigerated trucks are businesses from the fishery sector and distribution companies, such as Mega and DKSH and other private businesses. These companies operate hundreds of cold chain assets, but it is found that cold boxes are more in use rather than running the truck's refrigeration or chilling system. While most

transported goods are fresh perishables, non-perishables such as consumer goods are also using insulated box trucks substantially though with no refrigeration, just to keep products out of rain and dust. More than 90% of these are used trucks imported from Japan. Top imported brands are Mitsubishi, Daihatsu, Toyota and Nissan. There are also local businesses that do reconditioning works for assets owners, including the service to make in-truck compartments for different temperatures. Figure 6.16 shows the import of cold chain trucks has been on the rise since 2014.

Figure 6.16: Annual Import of Refrigerated Trucks (FY 2012/2013 to FY 2017/2018)



Source: Myanmar Customs Department (2010).

It is said that on average, only 10% of reefer containers are in utilisation for foreign trade. In terms of prime movers, each trucking operator has between 10 and 30 of them. Some big operators have a fleet over 200. But, none of them are equipped with generators except for a few of them, which is said to be about 10, according to a spokesperson from the Myanmar Container Trucks Association (MCTA). Just as 3PL warehousing, there are no more than 10 cold chain transportation service providers, as listed below in Table 6.19. Some logistics companies are export-oriented and, consequently, they deploy their own fleet of semi-trailers which can carry any type of container. Therefore, they are not considered as the key players even though they own hundreds of assets. To clarify again, 3PL refers to service providers that are actually using the authentic cold chain for the distribution of products. They provide services to every business; not limited to a single product category in certain sectors. There are many 3PLs that are not included in this list as they operate less than three refrigerated trucks.

Table 6.19: Top 3PL Cold Chain Transportation Service Providers in the Yangon Region

Sr.	Operator	Box Truck (Qty)	Location
1	Nature Logistics	5*	Pabedan
2	Premium Sojitz Logistics (PSL)	27	North Dagon
3	SENKOSMI	16	Insein
4	Myan Express	12	South Oakkalapa
5	Ryobi Myanmar Distribution	10	Thilawa SEZ
6	KOSPA Limited	10	Hlaing Thar Yar
7	Phee Central Logistics	10	Botahtaung
8	Premium Worldwide	6	Hlaing Thar Yar Industrial Zone
	Total	**96**	

Note: * refers to semi-trailers equipped with a generator set.

Source: Authors.

The most common brands for tractor units are Nissan, Hino, Sino, Mitsubishi, Fuso, Toyota, and MAN, while Daihatsu, Mitsubishi, and Toyota are mostly found for reefer box trucks. There are slight differences, but not significant gaps among the purchase prices based on the brand model and capacity. However, the market price mentioned below can be a good reference as they come from reliable sources; i.e. big operators that are actively involved in the field. For example, Moe Nan Taw is a highway container trucking service provider with its 100 semi-trailers up and running on the major routes such as Yangon – Pathein, Yangon – Mandalay and till Muse. Export/import businesses are its main clients and chicken by-products, chicken feed, fish, and prawns are the top items transported.

Table 6.20: Estimated Purchase Prices of Cold Chain Trucks (2018)

Sr.	Description	Est. Brand New Truck Price (MMK)	Est. Second-hand Truck Price (MMK)
1	10ft box truck	18,000,000	15,000,000
2	14ft box truck	24,000,000	20,000,000
3	16ft box truck	27,000,000	23,000,000
4	19ft/21ft box truck	30,000,000	25,000,000
5	Reefer container	100,000,000	50,000,000

Source: Authors' interview to Moe Nan Taw Transportation, Royal Link Transportation, Myan Express.

Main users of cold chain logistics

The top three businesses will be discussed under this subsection. They include City Mart Holdings Limited to represent the retail sector, Myanmar C.P. Livestock Company for processing, and Premium Distribution Company for trading.

- City Mart Holdings Limited (CMHL); retailer

City Mart Holdings is the largest retail group in Myanmar with a supplier network of about 3,000 companies. Under its umbrella are well-recognised brands, namely City Mart, Ocean, Marketplace, Season's, City Express, Shabushi, and Pizza Hut. To be more specific, it has established 20 supermarkets, 7 hypermarkets, and 45 convenience stores (City Express) throughout Myanmar, mainly in Yangon, Mandalay and Nay Pyi Taw. With its largest network brings the need for cold chain usage to maintain its standing and further grow its business. Premium Distribution Company (PDC) has been its main associate company handling food wholesale until its departure from the group for the joint venture with Japanese Sojitz Logistics Company which is known as PSL.

The procurement of premium quality meat, seafood, dairy products, and other foodstuffs mostly goes into Marketplace, which targets the high-end sector. Direct sales or outsourcing services are also provided to hotels and fine dining facilities. Meanwhile, Ocean and City Mart outlets are inclined towards the mass market and grocery shoppers. Currently, the group has its own storage facility in Tharketa Township. For transportation capacity, it has 60 cold chain trucks, 33 frozen and 25 chilled, at its disposal, which were operated by PDC prior its departure from the group. or the frozen type, 22 of them are 14-ft trucks and 11 are 10-ft trucks. For the chilled type, 16 are 10-ft trucks, nine are 14-ft trucks, and two are 20-ft trucks. In times of inventory excess, the group outsources dedicated storage space to PSL and other 3PL service providers.

- Myanmar C.P. Livestock Company (MCPL); meat processor

Myanmar C.P. Livestock Company or MCPL is one of the major suppliers of poultry products, both fresh and processed. It is operating more than 200 outlets in Myanmar, mostly accumulating in Yangon. The sale of fresh chicken and processed meat, such as meatballs and

sausages, are through its outlets and City Mart. Whole chicken birds are also distributed to wet markets in Yangon. MCPL has its own cold storage facility with a capacity of 7 tons; 5 tons for frozen and 2 tons for chilled. Temperature can vary depending on the duration of storage, from -25°C to 4°C. Storage space and transportation is outsourced during times of excess demand. Transportation is mainly handled by KOSPA for distribution of chicken to its main client KFC, which carries out regular inspection every three months or six months for quality control. Therefore, cold chain usage is necessary. Apart from that, delivery of meat to its clients including hotels and restaurants are mostly done with company own insulated box trucks. Cold boxes are largely used during transport to maintain quality.

- Premium Distribution Company (PDC); meat trader

Premium Distribution Co., Ltd is a trader of premium quality meat, seafood, and other foodstuffs. Its main clients are City Mart, high-end restaurants, and hotels. PDC signed a joint venture and combined with Japanese Sojitz Logistics Company, which called forth the split-up with the City Mart holdings. The joint venture (JV), called PSL, is now fulfilling its cold chain needs for its own joint venture, which is providing third-party cold chain services to businesses in Myanmar, while PDC shifts its emphasis on the import or trade of premium quality seafood, meat and various foodstuffs. PSL handles both urban and long-haul city-to-city cold chain transportation services; it is mentioned under the strawberry case study. PSL's cold chain capacity can be assessed in Table A.3.

Table 6.21: Top five Meat Traders in FY 2016/2017

No	Meat Exporter	Meat Importer
1	Premium Distribution Co., Ltd	Premium Distribution Co., Ltd
2	Agri Trade International Ltd.	Agri Trade International Ltd.
3	Grand Wynn Enterprises Ltd.	Grand Twin Brothers Ltd.
4	Advance Seafood Co., Ltd	Top Home-made Foodstuff Trading Co., Ltd
5	Top Home-made Foodstuff Trading Co., Ltd	Mandalay Bay Company Limited

Source: Myanmar Customs Department (2010).

6.4. Case Study

Cold chain logistics for fish and prawns

Various fishery products are sourced primarily from Ayerwaddy, Rakhine, Tanintharyi, Yangon, and Mon. They are also imported, although domestic production is more than enough for local consumption. Fish and prawn exports into China made up 9% of Myanmar's total fishery export in FY 2017/2018 which was valued at US$ 17.85 million. This was 13,949 tons in volume and simply indicates the demand for the cold chain as they are being transported frozen in refrigerated trucks. As for domestic consumption, the use of cold chain trucks is not that widespread with distribution heavily relying on ice supply to keep goods in chilled condition.

Aung Kyaw Zaw Company is a fishery business in Yangon with own aquaculture farm and ice plant. Output from the farm is mostly transported to San Pya Fish Market, then to the exporter. It is also a supplier of ice for roundabout areas. As can be seen in Figure 18, only ice is used to keep products fresh although the truck has a refrigeration system.

Figure 6.17: Company's Fish Farm in Ayeyarwaddy Region

Source: Authors.

Figure 6.18: Aung Kyaw Zaw Ice Plant in the Ayeyarwaddy Region

Source: Authors.

Figure 6.19: Aung Kyaw Zaw Ice Plant in the Ayeyarwaddy Region

Source: Authors.

Figure 6.20: Aung Kyaw Zaw Ice Plant in the Ayeyarwaddy Region

Source: Authors.

Figure 6.21: Loading Ice into a Refrigerated Truck from Company Owned Ice Plant

Source: Authors.

Figure 6.22: Loading Ice into Cold Boxes from Company Owned Ice Plant

Source: Authors.

Figure 6.23: Loading Fish from an Aquaculture Farm along Yangon Pathein Road

Source: Authors.

Figure 6.24: Loading Fish from an Aquaculture Farm along Yangon Pathein Road

Source: Authors.

Figure 6.25: Loading Fish from an Aquaculture Farm along Yangon Pathein Road

Source: Authors.

Generally, Myanmar's exporters deal directly with Chinese traders and deliver goods from Yangon to Muse, and from then to China via Muse border trading posts. There are about 20 Chinese traders (seafood importers). FEU reefer containers and refrigerated 12-wheeler box trucks are mainly used, carrying 16 tons and 29 tons of truckload, respectively. To name a few, Nan Htike Thazin, Taw Win Thazin, Ngwe Pinlae and Tun Thawtar are major players or fishery exporters in Muse's cold chains sector, but they all reside in Yangon. There is already a steady export of fisheries via Muse; it reached record high in the first half of October 2018 at about 130 trucks. Under normal growth, on average, eight cold chain trucks go to Muse each day.

Table 6.22: No. of Cold Chain Trucks Coming into Muse Each Day (Under Normal Growth)

Exported Products	Type of truck	No. of Trucks	Total Volume in Tons
Frozen fish/prawn	Refrigerated 12-wheeler box truck	3	48
Frozen fish/prawn	FEU reefer container	5	145
	Total	8	193

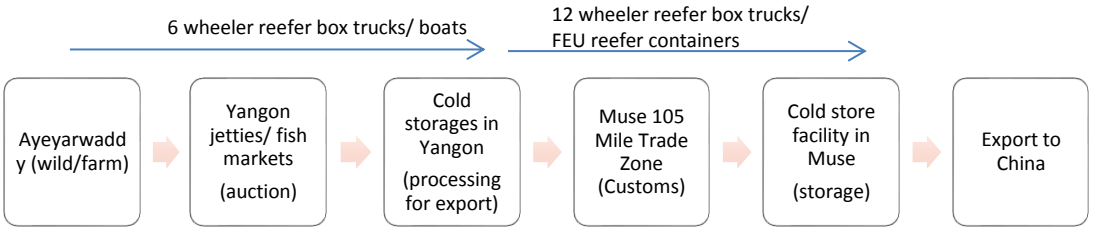
Source: Authors.

- Product flow of exported fish and prawns

The primary source of fish and prawns for China is the Ayeyarwaddy Region. Exported goods are mainly purchased at auction, and procurement from Yangon's Central Fish Market can also happen when the demanded export quantity does not meet or exceed the acquired fishery volume. There are also cases when the processor or exporter operates its own fish farms around Yangon or in Ayeyarwaddy. Regardless of the distance, refrigerated six-wheeler box trucks are generally used for domestic transport. After the initial procurement of goods at the jetties or Central Fish Market in Yangon, the selection of premium quality fish and prawns is carried out at cold storage plants. Once the required quantity is achieved, value-added works, including initial processing, freezing, packing and labelling, are done to meet the export standards. Frozen fish and prawns are usually stored at the plant to wait for the best prices to be offered. This can last up to 45 days, which is quite normal for border exports. On the contrary, for overseas exports, the longest storage duration is three days. Once the

best deal is reached, they are sent to Muse in FEU reefer containers or refrigerated 12-wheeler box trucks. Two drivers are employed for each truck for safety reasons.

Figure 6.26: Product Flow of Exported Fish and Prawns into China



Source: Authors.

These trucks ought to reach Muse in two days. After going through customs procedures in Muse 105 Mile Trade Zone, they are stored in the only cold storage facility in Muse. Storage duration depends on trucking availability; normally a day. They are transported into China the next morning with Chinese refrigerated six-wheeler box trucks. Transportation is charged Kyat (K) 1,900,000 for a 12-wheeler and K 3,400,000 for a FEU for a round trip for Yangon – Muse route.

Figure 6.27: Fish and Prawn Trucks Waiting for Customs Declaration at the Muse 105 Mile Trade Zone

Source: Authors.

Figure 6.28: Reefer Trailers Found on the Mandalay – Muse Route

Source: Authors.

- Cold storage facility in Muse

There is only one cold store facility in Muse, which is operated by National Prosperity Public Company Limited. The facility has six storage chambers; one for beef and the rest for frozen fish and prawn. It has a total capacity of 1,200 tons, and the temperature can be adjusted on demand as low as -27°C. Goods can be stored for three days at K 20 per kg. After three days, additional K 3 is added to the original price of K 20 and becomes K 23/kg for each day onwards.

Figure 6.29: National Prosperity's Cold Store Facility in Muse

Source: Authors.

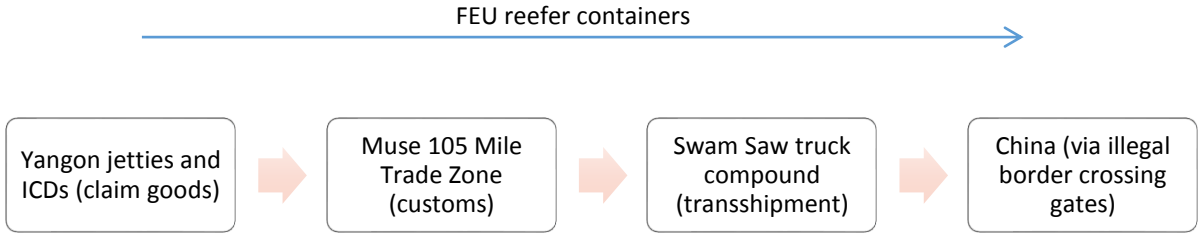
Cold chain logistics of re-exporting meat into China

There is a movement of re-exporting meat products, mainly beef and chicken by-products into China via land trade. Re-exporting is defined according to the Ministry of Commerce (MOC) as the import of goods from a first country to a second country or importing country; i.e. Myanmar for the purpose of exporting to a third country, whereas imported goods may or may not have been processed in the importing country before they are exported. Under this case study, the first countries for those products would be India, Australia, Switzerland, and the United States, especially India and Australia. The mode of transport applied by these particular meat items is a combination of sea; normal trade and land transport; and border trade.

The products come in FEU reefer containers and can be claimed at Bo Aung Kyaw Jetty, Myanmar Industrial Port (MIP), and Botahtaung Inland Container Depot (ICD) two in Yangon. The FEUs are plugged at the charging facilities powered by the port, while they are going through customs clearance. Once trucking is available, they are unplugged from charging and are transported directly to Muse, a border town connecting Yunnan Province of China, which makes storage unnecessary. The tractor trailers that carry the FEU containers are usually not equipped with gensets or portable generators. Therefore, the required electricity is vehicle-powered. It takes three days from Yangon to Muse.

The study shows that meat re-exports into China became the highest in September 2018, which was between 10 and 15 trucks (FEU reefer containers) a day with each truck carrying 29 tons of goods in general. This means the tonnage movement of cold chains for meat on the Mandalay – Muse Road is minimum 290 tons and maximum 435 tons a day in September. But under normal growth, only about two meat trucks can be found in Muse, which is 58 tons per day. There are about 10 Chinese meat importers. Unlike fish and prawns, meat imports into China are considered illegal, which is why border trade is favoured over normal trade. However, it is legal in Myanmar and therefore these trucks go through customs in the Muse 105 Mile Trade Zone and are transported into China via illegal border crossing gates.

Figure 6.30: Product Flow of Re-export Meat Products



Source: Authors.

After the customs clearance as shown in Figure 6.30, meat is transloaded into Chinese refrigerated trucks at Swam Saw (Myay Ni Kwin) Truck Compound, which is just beyond the Man Wein Gate, one of the four main legal border crossing gates in Muse. Transportation charges vary depending on the season and thus tonnage. Generally, the permitted truckload for a semi-trailer is 48 tons in monsoon and 50.5 tons in summer. In the matter of re-export meat transport, FEU reefer containers carry as much as 29 tons. Until September which is the end of the rainy season, transportation cost for a FEU from Yangon jetties and ICDs to 105 Mile Trade Zone was K3,800,000. In this cost, excess tonnage charge of K400,000 is included. This charge is dismissed in October and the total transportation charge becomes K3,400,000 throughout the year.

Figure 6.31: A SINO Reefer Trailer Found in Muse

Source: Authors.

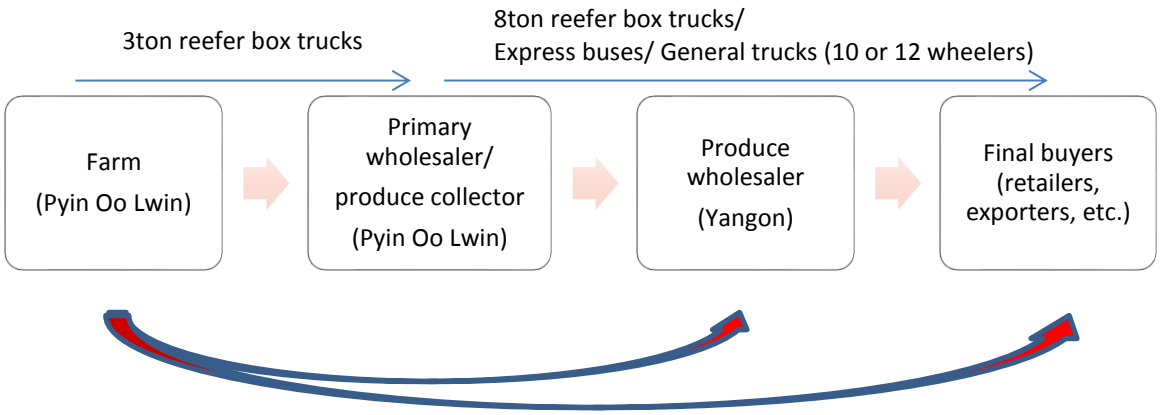
Cold chain logistics for strawberries

Strawberries are one of the fruit varieties that utilises the cold chain and is mainly cultivated in Pyin Oo Lwin, a hilly station in Mandalay Region, for its unique weather. In FY 2017/2018, the total production volume of strawberries reached 982,000 viss[45] countrywide, which is equivalent to 1,571 tons. The city's strawberry production generally starts from November at 20 kg plucked every two days. It increases to 15–20 tons a day during the peak season, which falls between November and May. Strawberries are picked every two days or four days depending on the weather. Setting aside the insignificant local consumption volume, about 90% of them are transported to Yangon, Mandalay, and Nay Pyi Taw, while some end up in other big cities, such as Mawlamyine, Magway, and Myan Aung. Of the total production, 70% goes into fresh sale, the focal point of the case study, 20% for processed such as jam, and 10% for wine making.

Brokers play a crucial role for the promotion and distribution of the city's farm produce. A broker's services resemble that of a produce wholesaler. However, it is not always about purchasing and selling in bulk. It could be an individual acting as a middleman between produce wholesalers in Yangon and farmers as buyers; for example, retailers do not purchase directly from the farm. A broker's main function is to collect the demanded amount of produce from a farmer or multiple farmers and transport them to wholesalers in Yangon. Putting aside a few prominent growers with tens of acres of farmlands, there appear to be very few farmers who sell directly to buyers. Generally, it takes at least two middlemen from the farm to retailers in Yangon. Broker service fee or commission for strawberry is between K 20 and 50 per transparent disposable plastic box. The primary collection of agricultural produce at farms which are located in remote villages is between K 15 and 20 per basket (8 viss or 12.8 kg). Generally speaking, a primary collection fee is included in the broker's commission, and sometimes the service is demanded separately by the agricultural produce wholesaler in the city.

[45] 1 viss = 1.6 kg

Figure 6.32: Product Flow of Strawberries



Source: Authors.

There are about 50 to 70 brokers in the city, while seemingly 10 of them hold the most market share of approximately 70%. Of these 10 brokers, some are a combination of produce grower, collector or broker, and wholesaler. This gives them a competitive advantage over individual brokers and farmers as they get rid of middlemen and gain direct contact or bargaining power with buyers. In-depth interviews were carried out with two out of those ten brokers and a few small farms to cover the city's agricultural supply chain while emphasizing on that of strawberry. One of the respondents was a top primary produce wholesaler while the other was a pioneer in the cold chain, and both operate tens of acres of farms.

One of the pioneers in the city's cold chain sector who we interviewed has 20 acres of farmland, seven for strawberry and the rest for other vegetables such as garlic chives, cilantro, Chinese broccoli, mustard greens, coriander leaves, etc. Though he is a cold chain user with required certificates, he still does not have direct contact with the buyer, in this case City Mart, due to some constraints in the contract, e.g. ongoing supply of produce. Therefore, he has to deliver produce to wholesalers at Thiri Mingalar Market first, from which City Mart's procurement department purchases the finest quality strawberries and produce and display them on its shelves under its brand name. According to him, the city's cold chain usage does not exceed 30% of the total production volume; which has not been published by the government and needs to be verified with ground checks.

Figure 6.33: Organic Strawberry Plantation of Cold Chain Pioneer in Pyin Oo Lwin

Source: Authors.

Express buses and rigid trucks are mainly used for freight transport. Produce wholesalers from Thiri Mingalar Wholesale Market are the main buyers of farm produce, and refrigerated transport is used only when demanded. There are other farms that sell their strawberries directly to City Mart under their own brands; however, it is only a few of them. They do not use the cold chain; instead, they pluck strawberries early in the semi-ripened stage and transport them with passenger buses. Additional packaging and labelling are done on their own in Yangon and sent to City Mart afterwards. Cold chain strawberry movement is limited to its seasonality, but many types of produce are available all year round and therefore are picked each day in the morning at 10:00am with two eight-ton reefer box trucks. The available produce includes flowers, strawberry, dragon fruit, carrot, cabbage, lattice and other vegetables. While fruits and vegetables can be loaded together, flowers demand dedicated trucks for quality control. Each type's tonnage movement depends on order placement.

Figure 6.34: Garlic Chive Plantation of Cold Chain Pioneer in Pyi Oo Lwin City

Source: Authors.

During the peak season, about 10 tons of strawberries are delivered to Yangon every day from his farm with cold chain. The adjusted temperature in the truck is about 8°C. The transportation charge is K220 per kg of strawberries. It normally takes about 12 hours from the city to Yangon. Throughout the off season, which falls between July and October, they are imported from China in order to maintain a continuous supply in the market, which is rather expensive. To take advantage of this opportunity, he tried freezing 40 tons of strawberries as a test at PSL's cold store in Yangon for later use. Freezing costs about K11 million for 10 tons or K2,000 per kg, plus storage charges for six months. They are being distributed to bakeries and fruit stands. Also, 20 tons of Japanese variety strawberries are being cultivated under contract farming as a test to export to Russia as a sample. This is done together with his companions in the city. Cold chain demand would increase if those ventures became a success.

Figure 6.35: PSL's 8-ton Truck in Pyin Oo Lwin for Produce Pickup

Source: Authors.

PSL is the only cold chain service provider for the whole city. It has two packing centres or pick up stations: Yay Ngal and Anee Sakhan in the city and another one in Htone Bo in Mandalay. Goods are collected either at Yay Ngal with a 3-ton reefer or at Anee Sakhan with an 8-ton reefer. The 3-ton trucks are better utilised for initial pickup from farms if demanded. As of now, there are two pioneers who have contracts with PSL for the long-term use of cold chain transportation services. The contract duration is one year and can be renewed as required. Contract terms require the farm to collect enough produce to get full truckloads, which is unreasonable given the product's seasonality. Therefore, other growers and brokers are also using the service without having contracts.

Figure 6.36: Isuzu 3-ton Reefer Box Truck Found at the Yay Ngal Station in Pyin Oo Lwin City

Source: Authors.

Figure 6.37: PSL's Yay Ngal Truck Station in Pyin Oo Lwin City, Mandalay Region

Source: Authors.

Cold chain demand is also driven by bakeries, namely My Apple Cake Café in Yangon, although its demand is quite small. Although the cold chain is not being used, another cafeteria chain, namely Shwe Pazun, is also buying strawberries and, therefore, could become a potential user of the cold chain. Its business nature requires a considerable volume of strawberries as a crucial supply, both raw and processed. Therefore, there is a regular pick up of strawberries at the wholesaler; one of the respondents, in the city. Every other day during the peak season, Shwe Pazun's own light truck loaded with moving baskets would come and get strawberries, whereas each basket can be filled with 8kg strawberries. From this wholesaler, between 2,500 baskets (32 tons) and 3,000 baskets (38.4 tons) of strawberries are delivered to Yangon and other big cities every day. It takes three days for strawberries to reach Yangon: one night at farms; one night at the wholesaler for primary packing; and one night for the trip to Yangon.

Apart from those, more than 70% of strawberry transport is through trucks and mostly express buses: Mandalar Min, Tat Lan, Shwe Sin Sakyar and Elite, just to name a few. They are all located at the bus terminal Myo Thit Padathar. Strawberries are first put into the transparent disposable plastic box and then into the corrugated carton that weighs about 10kg. Forty plastic boxes can be placed into the carton. The transportation charges are mostly paid by buyers and they vary depending on the destination; K2,000 per carton from Myo Thit Padathar to Aung Mingalar Bus Terminal and K2,500 to Aung San Bus Terminal. Unsurprisingly, refrigerated transport is more costly at K5,000, which is one of the major

factors hindering the growth of the cold chain. Initial dry transport from the farm to the city's bus station is K3,000 with mini-truck (Hijet), up to 15 cartons of strawberries can be loaded.

According to a spokesperson from the MOC, there is a plan for the development of value-added processing zone or industrial zone in Pyin Oo Lwin, Mandalay Region for agricultural products. In the new zone, cold storages will be constructed for fresh produce such as fruits, flowers and vegetables for export purpose. Once completed, cold chain demand of the city and its surrounding areas would tremendously go up.[46]

Cold chain logistics for processed food

Myanmar C.P. Livestock Company or MCPL was founded in 1997 by the Charoen Pokphand Group (CP), a conglomerate based in Thailand. It is a pioneer as well as a leader in livestock feed, farm, and food production and distribution in Myanmar. Its breeder farms are located in Bago, Ye' Mon, Thar Yar Gone, Inta Gaw, and Sint Kine, while hatcheries are based in Yangon and Mandalay. It is also a manufacturer of animal health products, such as vitamins, vaccines, antibiotics, disinfectant, injections, and other miscellaneous products. MCPL is marketing all its businesses in two distinct ways; one is the B2B approach, and the other is the B2C approach. Under B2B, it deals directly with restaurants, hotels, bakery food services, and conventional and modern retail markets. As for the B2C approach, it is running owned CP outlets, called CP Freshmart. CP Five Star food stations and uncooked fresh chicken and processed food stores are included in this. At present, it is operating 235 outlets across Myanmar.[47]

MCPL has one main processing plant and four slaughtering factories. Live birds are first transported with 3-ton general trucks from its farms to the four factories in Yangon for slaughtering. They are also sold to wet markets in Yangon. The production capacity of these four factories is 8.8 tons per day. Slaughtered chicken is put into cold boxes and sent to the processing plant with 3-ton box trucks. From the processing plant, meat and processed foods, such as sausages (European and Chinese style), meatballs, and soft bones, are produced. The

[46] Myanmar Alinn (2019).

[47] Wai (2016).

daily production capacity of the plant is 2.5 tons. Therefore, MCPL has a total production output of 11.3 tons per day under normal growth. The sale of chicken meat is a cash cow for MCPL and is growing about 20 tons every passing year. The sale of whole chicken bird is introduced this year and about 3,000 of them are already demanded each day or between 70,000 and 80,000 each month.

The processing plant has a cold storage room with a capacity of 5 tons for frozen and 2 tons for chilled storage. Storage utilisation is low as daily or on-demand production is applied. The adjusted temperatures are 0°C, -4°C and -25°C, respectively. 4°C is typical for daily storage, while -25°C is applied for longer periods, for example, during holiday seasons such as Thingyan and Thadingyut. In times of excess demand, dedicated space is outsourced to other 3PL service providers. As for cold chain transportation, MCPL is partnering with KOSPA Limited. KOSPA mainly handles the cold distribution or storage for KFC; the company's main client and sometimes distribute to City Mart warehouse. KOSPA also transports chicken to KFC's branches in other big cities. CP's factories are inspected by KFC's team once every three months or six months for quality control. Meat is mainly distributed to CP outlets, hotels and restaurants, City Mart, and KFC, while processed foods, such as sausage are marketed only through City Mart and CP's outlets. The cold chain is mainly used for KFC, while the rest use general box trucks loaded with cold boxes full of chicken and processed foods.

6.5. Current issues and challenges of the cold chain

The issues and challenges of the cold chain are collected from various sources, such as trade associations and service providers.

Cold chain warehousing service providers

The main challenge for operating a cold storage facility is that it tends to be less profitable in a country such as Myanmar, whose cold chain sector still needs a lot of improvement. It is a given for a cold store to be utilised between 70% and 80% in order to make profits. However, current the utilisation rate is said to be lower. It is a long way off until reaching this threshold due to insufficient demand and a lack of cold chain awareness among users and other stakeholders. Cash draining operation and maintenance costs are also challenging for operators. With that, the maintenance cost for a cold store is said to fall around the range of

K7,000,000 on average. Additionally, current warehouse designs in Myanmar are based on the design layout of countries with an already developed cold chain sector. Their warehouse capacities are usually massive. But, the fact that Myanmar's cold chain sector is still in its infancy cannot be overlooked. Therefore, in the future, warehouse designs should be developed in line with the local market size and its demand.

Cold chain transportation service providers[48]

With regard to cold chain transportation, electricity or power supply is the major hindrance, particularly for trucks that are not equipped with generators. This is more important for highway trucking as running the chilling system of a reefer container with a vehicle's power supply is not sustainable. Consequently, cold chain trucks have to charge electricity at every possible stop, such as refill or truck station along the highway. However, there is not a single station solely designated for heavy-duty trucks en route to the destination, let alone the proper charging facilities for the cold chain. On the other hand, trucks with generators are efficient and convenient, yet they demand a large sum of money compared with general trucks. There appear to be no more than ten tractor trailers with portable generators in the market.

As of now, most tractor trailers destined for border trade areas are carrying reefer containers with no plug on. To cope with this, they drive straight to the border point while keeping a countdown before goods get damaged. For example, reefer containers loaded with frozen goods are given the required temperature just before the take-off with which the freezing of goods might last possibly another eight hours before it starts wearing off. It takes three days from Yangon to Muse, a border town with China. Therefore, the reefer containers have to be charged at Mandalay and there will be no more charging en route to Muse. Regardless, this seems not a good solution yet. If the establishment of charging facilities is expensive, another way out for this issue is by having a faster route towards the destination so that shipments reach the end point in the designated time, subsequently eliminating all possible cargo damages caused by delays. A faster route means making the Yangon – Mandalay Highway Road accessible for cold chain trucks. This is one of the major factors that need more

[48] Interview to MIFFA and MCTA.

deliberate considerations from the authorities for the development of the cold chain. In addition, for infrastructure, the expansion of highway roads should go together with the expansion of bridges. Truck weight scales in all weight stations should also be uniform, as the current weight scales are found to indicate different outputs.

Cold chain users[49]

Cold chain users include all businesses from cultivators to traders. A lack of user awareness is still the main issue for cold chain development. Myanmar is also still behind its regional peers in terms of technical knowhow. Therefore, awareness raising programmes should be organised for all related users, and it is not just traders who ask the most of cold chain demand but also reach till the most basic level of the supply chain, such as growers. Even the most basic understanding of the cold chain, such as the required temperature adjustments for different products, should be fully aware by truck drivers. There appear to be very few users or more precisely traders that demand the utilisation of the cold chain for the whole supply chain till export. The undeniable fact is that they gain more profit or better prices as their products have longer shelf life, better quality, and become value-added.

Operation cost is the main reason behind its unpopularity among users. The cold chain cost incurred along the supply chain makes the final market price be less attractive for consumers. In the same sense, higher cost brings higher benefits, such as fresher and longer shelf life, and, as a result, healthier product choices. The huge price gap between products that utilise cold chain and traditional logistics can be lower by developing the whole sector. This means being able to use cold chain services more conveniently for products that need the cold chain. For example, in produce, non-hard shell fruits require the cold chain for better quality at the time they reach final consumers. Consumers should be aware of the many benefits of consuming healthier products and place quality above a few more dollars. Another surprising fact only found in Myanmar is that consumers pay the same price for produce regardless of how or what sort of logistics they had to use. This discourages users or sellers to utilise the cold chain. For this, awareness-raising campaigns for end consumers should be arranged.

[49] Interview to Myanmar Fruit, Flower and Vegetables Producer and Exporter Association (MFVP).

To clarify a more convenient use of the cold chain, a better example would be a freight consolidation service. The current cold chain sector is not yet developed, and the result is that users or pioneers have to use it at a high cost. In the agricultural industry, fresh produce has many possibilities to use the cold chain in the future, and it is found that the vast majority of cold chain utilisation for transport is only one way. But, users have to pay double for a round trip. Also, as there are not many choices among service providers, they have to make use of what is available at the doorstep even at a higher cost. Therefore, widespread use of the cold chain would be possible if many 3PL cold chain service providers were to arise and if the supporting basic infrastructure and facilities, such as electricity, were improved. For instance, growers should be able to reach the main cold storage facility more easily; the facility should even be placed at the farm. Yet, farms and the facility are too far from each other. On top of that, connecting road conditions are severe causing unnecessary delays.

Human resources and others[50]

The lack of skilled drivers and proper insurance for highly damageable goods are other challenges that should be addressed. Heavy-duty truck drivers should be properly trained for different types of vehicles. Only after that should they be granted driving certificates for each preferred truck, and with that the issuance of a driving licence. This has already been practised in other developed countries. In Myanmar, drivers holding red licences are all able to operate any type of commercial vehicles available, be they light duty or heavy duty. Therefore, what needs to be done immediately is to first provide intensive training for the operation of heavy-duty trucks. This will allow Myanmar drivers to be certified when operating in international borders. Their working hours should also be standardised to make them get used to international standards. In addition, there should be more skilled professionals for warehouse management and operation to provide services that rival the international standards demanded by the international audience. Doing so will prepare Myanmar for any upcoming cross-border agreements in terms of human resources.

[50] Interview to MIFFA and MCTA.

6.6. Government policy

In the matter of the cold chain, no news about the government policies is heard. Existing rules and regulations relevant to the logistics industry are cargo restrictions, maximum truckload limitations, and container truck curfews. Curfews are not applicable to cold chain trucks as they can operate 24 hours, but they have to propose the operating routes to the department concerned before transport. However, at the operational level for the cold chain, there are certain standards that need to be met by cold storages or processing plants. The standard is based on "the Drafted Regional Guidelines on Cold Chain Management of Fish and Fishery Products in ASEAN Region", developed by the Marine Fisheries Research Department (MFRD) Programmes[51]. The guidelines are for ASEAN and SEAFDEC member countries and are in line with Myanmar Regulation promulgated by the DOF.

According to the guidelines adopted by the MFF, fishery products have to be handled at a temperature below -4°C from post-harvest handling to receiving and processing at processing plants. This temperature is maintained by placing fish and crushed ice at the ratio of 1:1. Besides, clean water has to be used both for cleaning and ice-making. At the plant for packing and labelling, the room temperature is set at about 10°C, and after packing, the cold storage temperature is about -20°C or -2°C. A first-in-first-out system has to be used for product movement. As for transport and distribution, the controlled temperature is -18°C in reefer containers that are destined for the Yangon International Port for normal trade. But for border trade, frozen products are carried by reefer container at -18°C, chilled products by carrier boat with crushed ice, and some products with insulated box trucks. For local consumption, cold boxes and crushed ice are mainly used in a ratio of 1:1. They are transported by truck and passenger buses to other regions from Yangon.[52] Regardless of the guidelines, there is weak compliance from local businesses for many reasons, such as a lack of facilities, electricity and containers with no power supply from factory to port, quality and safety awareness, and training.

[51] SEAFDEC (2018).

[52] Interview to Myanmar Fisheries Federation.

6.7. The mid-term prospect of the cold chain

In the private sector, local logistics-related businesses have voiced themselves regarding the mid-term prospect of Myanmar's cold chain sector. According to them, some positive changes to the cold chain sector will be visible in the next five years if the following factors are improved:

1. If transportation infrastructure is improved and long-haul cold chain transport becomes more in demand compared with urban distribution;
2. If much FDI comes to the sector;
3. If the government lifts some export/import restrictions on products that require cold chain and subsequently increased foreign trade; at present, products such as chicken and other foodstuffs and vegetables are restricted for import;
4. If the demand of refrigerated storage increases in line with trade growth;
5. If the consumption of foodstuffs from supermarkets becomes widespread;
6. If the number of hotels, restaurants, modern supermarkets, and minimarts increases; and last but not least
7. If knowledge-sharing workshops, training, and awareness-raising campaigns about cold chain usage and benefits are delivered to drivers and other stakeholders from the government level.

On closer inspection, the cold chain sector can potentially be developed in three distinct ways: boosting foreign trade, especially exports; re-exporting; and transit trade. These would just be pure optimism unless prerequisite actions are taken. Of the three approaches, re-exporting and transit trade have some contradicting effects on the sector. While re-exporting would potentially demand cold chain warehousing services, transit trade might require more transportation services. Besides, re-exporting shows more promise in the short term than transit and brings along more competition together with the opportunities arising from regional transport agreements.

Foreign trade

Cold chain demand will most likely be driven in the future by the trade of fresh perishables, such as fruit and vegetables, fishery products, pharmaceuticals, and seeds. The government has also taken the necessary steps in terms of rules, regulations, and policies to invite local and foreign investments for trade development, i.e. the National Export Strategy (NES) launched in 2015. With the current implementation of the NES, the development of foreign trade, specifically exports, is reassuring. In the strategy are seven priority sectors and four cross-sector focuses for development. The seven sectors include fisheries, textiles and garments, forestry products, beans and pulses and oilseeds, rice, rubber, and tourism. The four cross-sectors include access to finance, quality management, trade facilitation and logistics, and trade information and promotion.

Five more sectors were proposed in September 2018 and are still in the negotiation stage. Among them are two potential sectors; fruits and vegetables, and value-added agricultural food products that are likely to demand the cold chain.[53] Following the NES, the Myanmar Investment Commission also announced the 10 prioritised areas in June 2017 for investments as an additional enforcement, and in that list are export promotion sector and logistics industries. Furthermore, the import substitution sector; agriculture and its related services, and the value-added production of agricultural products; livestock production, breeding, and production of fishery products; and the healthcare industry are also included.[54] Half of the lists are the sectors that are contributing to the growth of the cold chain.

Re-exporting

To recap, re-exporting is defined according to the MOC as the import of goods from a first country to a second country or importing country, i.e. Myanmar for the purpose of exporting to a third country, whereas imported goods may or may not have been processed in the importing country before they are re-exported. Re-exporting was first initiated in 2015 with the approval from the MOC. There are 17 items to date and they are sugar, betel nuts, and oil, which were permitted in 2015 and the rest such as tyres, sesame (white and black), dried

[53] Global New Light of Myanmar (2018).

[54] Interview to Myanmar Investment Commission.

chilli, groundnut, cotton, soy beans, textiles, fresh fruit, electronic materials, cosmetics, juices and other groceries, clothes, edible oil and garlic, which were later approved in late June 2016. Sugar re-exporting reached a record high in 2016, comprising more than 3 million tons. When China, the major buyer, stopped importing sugar from Myanmar in 2017 in order to protect its local industries, re-exports of sugar and diesel were also suspended temporarily.[55]

According to the specification published by the MOC, there must be a warehouse in place to store re-export products in order to get the re-export license. Re-exporting has been practised substantially with China: sugar buyer, Thailand: sugar exporter, and Indonesia: betel nut exporter, India: betel nut buyer. However, these items only require general warehouses. Meanwhile, in the newly added items are some perishables that will likely demand cold chain warehouses in the future, such as dried chilli and fresh fruit. Products such as dried chilli, fresh fruit, electronics, computer and laptop placed in a dirt-free air-conditioned chamber, and cosmetics have been found to use the cold chain, although not for re-exports. If the demand for these items were to increase, demand for cold chain warehouses would likely increase as well.

Transit trade

When it comes to transit trade, Singapore has been a very good example, benefiting from its position as a focal point of contact for the East and West. Myanmar also has the potential to be just as beneficial as Singapore, not entirely through the sea but also focusing on land transport. This conclusion is reached due to the fact that Myanmar is a major part of many renowned connectivity projects in Asia, such as the Greater Mekong Sub-region Cross Border Transport Agreement (GMS CBTA), GMS Economic Corridors, the ASEAN Free Trade Area (AFTA), India's Kaladan Multi-Modal Transit Transport Project (KMTT) and India–Myanmar–Thailand Trilateral Highway Project, and China's One Belt One Road Initiative (OBOR). Despite the delays, Myanmar still has a part to play as a transit destination if they are accomplished.

In 2017, the total regional trade value reached US$165,828 million as described in Table 6.23. The contribution of land transport is thought to be about 20% of the total value compared

[55] Wai (2018).

with sea transport. In this, Myanmar currently has some involvement as a land transit point for its neighbours' trade. **Thailand–China** trade is done through the Myanmar Tachilek border point. As for **India–China trade**, there appear to be both land and multimodal transports. Land transport is via the Muse (China border) – Mandalay – Tamu (India border) route, which is part of the GMS Eastern Corridor. A sea route from India to Myanmar i.e. part of KMTT project would add to this land route to make it multimodal. There is also the India – Myanmar – Thailand Trilateral Highway Project, which is expected to be accomplished in the next two years. If this happens, **India–Thailand trade** has the most possibility with Myanmar acting as the main transit point.[56]

Table 6.23: Total Regional Trade in 2017 (Potential of Transit Trade Via Myanmar)

Sr.	Description	Trade Value (US$ Million)
1	Thailand Export to China	21,426.20
2	China Export to Thailand	32,547.08
3	Thailand Export to India	4,700.59
4	India Export to Thailand	3,653.83
5	Thailand Export to Bangladesh	909.48
6	Bangladesh Export to Thailand	44.83
7	India Export to China	13,333.53
8	China Export to India	76,380.70
9	Viet Nam Export to India	5,018.55
10	India Export to Viet Nam	7,813.08
	Total Trade	**165,827.86**

Sources: MOC (2017), Central Board of Indirect Taxes and Customs (2019), and the Customs Department (2015).

Apart from these, the vast majority of regional trade is being conducted via sea. However, when the Trilateral Highway is completed, it would connect with the GMS's East–West Economic Corridor (EWEC) that starts from Da Nang, Viet Nam, passes by the Lao PDR and Thailand, and finally ends in Mawlamyine, Myanmar, in the Myanmar section. However, the new Myanmar section of the EWEC will be from Myawaddy to Yangon and applied under the CBTA Agreement in the Myawaddy border. But if it becomes active just like its counterparts, it would form an easier trade link between **Viet Nam and India**. In the same way, **Bangladesh**

[56] The Hindu Business Line (2018).

– Thailand trade can be conducted through Myanmar via land transit or even port to port. The only issue is whether Myanmar can improve the required infrastructure in time for the activation of those agreements. Depending on that, most of the transit fees and other appealing benefits from the 20% of regional trade will become Myanmar's.

Goods in transit normally do not require the transhipment of goods or containers; this is more so if the agreements such as CBTA and AFTA become up and running. The use of the cold chain is more widespread for regional market leaders, such as Thailand and Viet Nam, and other prominent trade partners, such as India and China. The agreement allows the free flow of goods by removing national borders. This includes all tradable goods, so it will include the items that require the cold chain as well. However, making use of the CBTA pass is likely to leave warehousing along the border vacant, and the use of cold chain trucks that meet regional standards set and adhere by all traded partners will become more in demand.

When the agreement becomes active, Thailand's trucks will pass the borders and come down to Yangon Thilawa, while Myanmar's trucks will be able to go until Bangkok. This brings many benefits, such as trade growth and the resulting cold chain demand. The utilisation of assets, such as trucks and warehouses, will become higher. However, considering the current capacity of Myanmar, it is not nearly enough in terms of both soft assets; skilled drivers and hard assets; and trucks, warehouses, and other tangible assets. According to a spokesperson from MCTA, Thailand has about 15 times the required assets, including reefer containers. There will be a downfall for the logistics industry if the same product quality cannot be guaranteed stemming from insufficient assets and human resources.

If this continues, the potential logistics market share will be seized by a more powerful counterpart. Myanmar also has an issue with trade deficits, and it is nearly certain that more imports and therefore the utilisation of foreign assets is more likely rather that of local assets. This is a loss for the local industry and may cost many potential users. If the local industry cannot bring forth the demanded quality, there will be a demand shortage for local logistics services. If there is a demand shortage, local service providers will not be able to fund themselves in enhancing their capacities to provide better quality. If they cannot provide the same regional quality standard, the market share will slip away to other regional peers. This

forms an endless loop, and to stop it during many uncertainties and possibilities, infrastructure must come first.[57]

But if Myanmar can compete with regard to skills and assets, the table will turn, and Myanmar will benefit the most from transit just as Singapore. The bet is on how fast Myanmar can develop the current logistics capacities. It is the fresh perishables that have the most potential to use the cold chain if they acquire access to the vast regional market or consumer base more easily. To accommodate the demand, more technical training to cold chain suppliers, most needed from drivers, should be provided. There is also another way to solve this issue, i.e. the construction of transhipping, material handling and cross-docking facilities for transit trucks at border points along the corridor. This would reduce the negative impact on the industry given that no changes were made to the current logistics capacities. The former solution seems more viable, and if implemented, the development of Myanmar's cold chain sector would be unquestionable when the time came.

6.8. Conclusion

In conclusion, there are resources in Myanmar to fulfil current cold chain needs with 88,148 tons of storage capacity, which only represents the fishery sector and a couple of top third-party service businesses, and more than 7,000 refrigerated trucks to date. But, they are all underutilised even though the total volume of current demand and potential demand is about 15 million tons a year. So far, we have seen the market situation in the study. An example is the use of refrigerated trucks without running chilling systems, not using generators for continuous chilling, or warehouses with less than 80% of utilisation. When tracing back to the source of this issue, it is found that what is lacking still are intermediaries to make the market realise the true usefulness of the cold chain. Intermediaries mean the emergence of commodity markets in business hubs, such as Yangon, Mandalay, and Nay Pyi Taw. The government should support the development of commodity markets, such as the ongoing Danyingone Wholesale Market, the conceptual plan of Mandalay and Pyin Oo Lwin wholesale market and value-added processing zone. If these facilities enforce the use of the authentic cold chain, then the market would follow its lead. Other necessities, such as the

[57] Interview to Myanmar Food Processors & Exporters Association.

enhancement of human capacities and cargo insurance service businesses would come along as well as the cold chain becomes a norm. However, implementation work is at a slow pace. To reach the point of success of the cold chain industry in Myanmar would require faster development of infrastructure, awareness of users, and supportive and enforced government policies to go along with it.

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Appendix

Cold chain profiles of top service providers

(1) Ryobi Myanmar Distribution

Ryobi Myanmar Distribution is a wholly Japanese-owned logistics company and is operating the largest warehouse in Myanmar.

Table A.1. Cold Chain Profile of Ryobi Myanmar Distribution

Name	Ryobi Myanmar Distribution Service Co., Ltd
Address	Lot No. B-9, Zone A, Thilawa Special Economic Zone, Yangon
Storage Capacity (Bonded warehouse TBC included)	Total floor area is 36,695 sqm (2 storeys): ▪ Frozen : -25°C to -20°C 1,901 sqm (3 rooms) 2,400 pallets ▪ Chilled : +1°C to +10°C 1,523 sqm (3 rooms) 1,400 pallets ▪ Aircon : +25°C to +28°C 1,160 sqm (2 rooms) 850 pallets ▪ Dry : 4,032 sqm 12,100 pallets ▪ Document: 542 sqm 14,500/carton
Transportation Capacity	Operate ten refrigerated box trucks ▪ 2 tons truck: -25°C to +20°C ▪ 3 tons truck: -25°C to +20°C
Product	▪ Frozen: frozen foods (seafood, meat), prepreg, etc. ▪ Chilled: processed foods, health care materials, vegetables, fruits ▪ Aircon: grains (rice/bean), chocolate, chemicals ▪ Dry: general cargo
Additional information	▪ All-weather durability (dustproof, dock shelter etc.) ▪ Full-canopy truck yard ▪ 24-hour security and monitoring system ▪ 48-hour back-up battery for emergency shut down ▪ Risk protection of flooding by 6.5m above sea level location

Source: Interview to Ryobi Myanmar Distribution (https://ryobitransport.com/transport-kokusai-myanmar.html)

(2) KOSPA Limited

KOSPA Limited is one of the leading 3PL cold chain logistics service providers in Myanmar providing end-to-end logistics solutions for agricultural, pharmaceutical, FMCG, and others. It is a joint venture between Yoma Strategic Holdings Limited (Myanmar) and Kokubu & Co. (Japan).

Table A.2. Cold Chain Profile of KOSPA Limited

Name	KOSPA Limited
Address	Mingaladon Township, Yangon
Storage Capacity	Total cold storage capacity is about 4,500 sqm: ▪ Frozen zone: -25°C to -18°C 1,100 sqm (2 units * 550 sqm) ▪ Chilled zone: -5°C to +15°C 2,200 sqm (4 units * 550 sqm) ▪ Aircon zone: +15°C to +25°C 660 sqm ▪ Ambient: +25°C and above 540 sqm
Transportation Capacity	Total cold chain fleet is ten trucks, ▪ 6 x 2 tons frozen/refrigerated trucks ▪ 1 x 28 tons refrigerated truck ▪ 3 prime movers with portable generators ▪ 3 chassis for FEUs
Product	Food and beverages; wine; cheese; ice-cream
Client	Retail, restaurant, hotel, exporter/importers

Source: Interview to KOSPA Limited (https://www.kospalogistics.com/)

(3) Premium Sojitz Logistics (PSL)

PSL, a 3PL cold chain logistics company, is a joint venture between Premium Distribution Company (PDC), a foodstuff and consumer good wholesaler and Japanese Sojitz Corporation. PDC handles food wholesale mainly for City Mart Group, a market leader in the retail sector. It has head offices in Yangon, Mandalay, Pyin Oo Lwin, and Heho.

Table A.3. Cold Chain Profile of PSL

Name	Premium Sojitz Logistics (PSL)
Address	No.39/B, Shu Khin Thar Street, Shwe Pin Lone Housig, 27 Ward, North Dagon Township, Yangon
Storage Capacity	Total cold storage capacity is about 5,733 sqm (in Yangon and Mandalay): ▪ Frozen zone : -20°C 895 sqm ▪ Chilled zone : +5°C 298 sqm ▪ Aircon : +18°C 508 sqm ▪ Ambient : +25°C and above 4,032 sqm
Transportation Capacity	Total 30 trucks ▪ 27 x 6 wheeled refrigerated box trucks ▪ 3 x 12 wheeled insulated box trucks
Product	Various retail products including foodstuffs, flowers, fruits and vegetables
Client	Hotels, restaurants, supermarkets, vegetable markets, flower markets, exporters and distributors

Source: Interview to PSL (https://www.facebook.com/myanmarpsl/)

(4) Premium Worldwide

Premium Worldwide Co., Ltd is majority owned and operated by a Singapore Private Limited Company with Diversified Holdings in Logistics, Information Technology, Trading, Real Estate, Lifestyle and the Food & Beverage Sectors. Sales Direct is its associate company providing foodstuffs and general trading services for businesses in Myanmar.

Table A.4. Cold Chain Profile of Premium Worldwide

Name	Premium Worldwide Co., Ltd
Address	HQ & Central Distribution Hub, 209 & 238 Hlaing Tha Yar Industrial Zone 2, Ka Naung Min Thar Gyi Road, Yangon
Storage Capacity	Total cold storage capacity is 3,400 tons ▪ Cold/Chilled zone : 1,600 tons (8 units x 200 tons) ▪ Ambient : 1,800 tons (2 units x 900 tons)
Transportation Capacity	Has six refrigerated trucks; ▪ 3 x 2 tons trucks ▪ 3 x 3.5 tons trucks
Product	Over 300 items: Mainly store foodstuffs; cheese, butter, juice, various sauce dressings, tomato paste, ketchup, etc.
Client	Hotels, retail, and restaurant chains; KFC, for example.

Source: Interview to Premium Worldwide (http://www.premiumgroup.com.mm/)

(5) Nature Logistics

Nature logistics is a 3PL logistics service provider focusing on cold chain logistics and refrigeration services. It provides a full range of logistics services, refrigerated and dry container sales, and rental and refrigeration engineering services for reefers and cold storage factories.

Table A.5. Cold Chain Profile of Nature Logistics

Name	Nature Cold Chain Logistics and Refrigeration Services Co., Ltd
Address	No. 74, Ground Floor, 30th Street, Lower Block, Yangon
Fleet size	Operating five tractor trailers; prime-movers and chassis equipped with generators
Product	Chemicals, pharmaceuticals, beef, seeds, flowers, fruits, vegetables, ice-cream, cheese, etc.
Client	Mainly exporters/importers

Source: Interview to Nature Logistics Company (https://www.natureclr.com/)

(6) Myan Express

Table A.6. Cold Chain Profile of Myan Express

Name	Myan Express Logistics Co., Ltd
Address	No.7(B), Cherry Condo(2), Cherry Garden City,14/3 Ward, South Oakkalapa Tsp., Yangon
Fleet size	Total fleet of 12 box trucks with temperature range between +15°C and -25°C, ▪ 3 x 2 tons (10ft truck) ▪ 3 x 2.5 tons (12ft truck) ▪ 2 x 3 tons (14ft truck) ▪ 2 x 4 tons (16ft truck) ▪ 1 x 4.5 tons (19ft truck) ▪ 1 x 6 tons (21ft truck)
Brand	Hino, Nissan, Mitsubishi, Toyota, Man
Purchase price	Average purchase prices of box trucks, ▪ 10ft: K18 million (new) K15 million (second-hand) ▪ 14ft: K24 million (new) K20 million (second-hand) ▪ 16ft: K27 million (new) K23 million (second-hand) ▪ 19ft: K30 million (new) K25 million (second-hand) ▪ 21ft: K30 million (new) K25 million (second-hand)
Product	Mainly pharmaceuticals
Client	Ministry of Health, hospitals, pharmacies

Source: Interview to Myan Express (https://www.facebook.com/pages/category/Local-Business/Mayan-Express-Courier)

(7) SENKOSMI

SENKOSMI is a joint venture company between Senko Co., Ltd, one of the leading logistics companies in Japan and Singapore Myanmar Investco, an investment and management company focused on Myanmar, listed on the Singapore Stock Exchange. SENKOSMI provides comprehensive 3PL logistics services. SENKOSMI is registered as US FDA Food Facility and it has a workforce of 30.

Table A.7. Cold Chain Profile of SENKOSMI

Name	SENKOSMI
Address	Insein Township, Yangon
Capacity	Has 16 refrigerated box trucks with capacity ranging from 2 to 4.5 tons
Product	Mainly imports such as seafood and meat
Client	Wholesalers/retailers, restaurants, hotels, importers

Source: Interview to SENKOSMI (http://senkosmi.com/

Chapter 7

Summary and Policy Implications

Eiichi Kusano[58]

This report described the current status of the cold chain. mainly focusing on (i) demand for the cold chain, (ii) the activities of the main players, and (iii) government policies in Thailand, Viet Nam, Indonesia, the Lao PDR, and Myanmar. We investigated the pathways to improve the cold chain by detecting choke points and opportunities in each country and obtained various findings and suggestions. This chapter summarises the abovementioned three key issues as well as policy implications for the development of the cold chain.

7.1. Demand for the cold chain

Total demand and its trend

In this report, the demand for the cold chain was mainly estimated based on the values or quantities of agri-food products that are internationally traded. All chapters focused on the types of products generally needed to be kept under low temperatures, which include fish, fruit and vegetables, and livestock products, regardless of whether those are fresh, chilled, or frozen.

The chapters on Indonesia and Myanmar estimated the cold chain demand by using different methods from other countries. Indonesia focused on the supply-demand balance of frozen products and estimated its quantity of domestic consumption. Indonesia also calculated the demand for cold storage by multiplying the production quantities and specific rates obtained from interviews. Myanmar classified circulated products into those that are internationally and domestically traded and interpreted that the former causes demand for the modern cold chain using refrigerating or freezing systems. The latter is understood as traditional logistics, which use crushed ice, insulated box trucks, and general freight trucks, or denoting the potential demand for the modern cold chain.

[58] Economic Research Institute for ASEAN and East Asia (ERIA)/Japan International Research Center for Agricultural Sciences (JIRCAS).

Table 7.1 shows the estimated demand for the cold chain and its change in recent years. Although the values of different countries are not comparable, we can observe common features: the growing international trade of many agri-food products requiring the cold chain, other than decreasing exports of Indonesia and imports of refrigerated and frozen food by Myanmar. Similarly, domestic consumption also drives demand for the cold chain, which is suggested from the rapidly expanding consumption of frozen products in Thailand, the production of livestock products and the number of large farmers in Viet Nam, and the production of agri-food products in Indonesia. Data on Myanmar imply there is a large potential that the modern cold chain could expand to the traditional chain or circulation under ordinary temperatures.

Table 7.1: Demand for the Cold chain and Values and Changes in Circulated Products

Item		Demand for cold chain		Annual growth rate*		Table
		Year	Value	Year	%	No.
Thailand						
Frozen food	Consumption	2015	US$0.50 billion	2011–2015	10.0	2.10
Cold chain products	Export	2018	US$16.05 billion	2012–2018	3.3	2.11
	Import	2018	US$10.43 billion	2012–2018	5.3	
Viet Nam						
Agricultural products	Export	2017	US$36.37 billion	2001–2017	12.5	Fig. 3.1
	Import	2017	US$27.82 billion	2001–2017	13.6	
Pig, cow, and poultry meat	Production	2016	4.93 million tons	2000–2016	16.7	Fig. 3.6
Milk		2016	0.80 million litres	2000–2016	6.6	
Number of large farms	Number	2017	34,050 farms	2011–2017	9.6	Fig. 3.7
Indonesia						
Frozen food	Production	2018	6.79 million tons	2014–2018	4.8	4.4
	Export	2018	0.57 million tons	2014–2018	-7.4	
	Import	2018	0.41 million tons	2014–2018	13.5	
Production of agri-food products	–	2018	47.3 million tons	–	–	4.26
Estimated demand for cold storage	–	2018	17.6 million tons	–	–	
Lao PDR						
Frozen / chilled / fresh products	Import	2017	US$3.87 billion	FY 2015–2017**	10.6	5.2
Myanmar						
Refrigerated products (modern)	Domestic distribution,	FY 2017	0.07 million tons	–	–	6.2
Frozen products (modern)			0.58 million tons	–	–	

Item		Demand for cold chain		Annual growth rate*		Table
		Year	Value	Year	%	No.
Chilled/cold products (traditional)	export, and import		5.31 million tons	–	–	
Ordinary temperature			9.25 million tons	–	–	
Refrigerated and frozen foods	Import	FY 2017	0.04 million tons	FY 2014–2017	-13.3	6.4
			US$68.2 million	FY 2014–2017	-11.7	

Notes: * Compound average growth rate (CAGR) recalculated from original data. ** Growth rate estimated by data in two years, FY 2015/2016 and 2017. FY: Fiscal year (from October to September in the Lao PDR, and from April to March in Myanmar). Values in Thailand are converted from Thai baht to US dollars by the exchange rate, 31.76 baht/US dollar. See each chapter for the descriptions in more detail.

Source: Tables and Figures in each chapter listed in this table.

Composition of cold chain demand

Table 7.2 indicates the composition of products requiring the cold chain. The remarkable thing is that aquatic products take a large share in the total demand for the cold chain in most countries. The cold chain is deeply related to the circulation of aquatic products in terms of both value and quantity.

The volumes of most products have generally increased. More specifically, there has been notable sharp growth in the export of fruit and chicken in Thailand, the import of frozen shrimps and prawns for intermediate use in Viet Nam, aquaculture production in Indonesia, and the import of frozen meat in the Lao PDR. In Myanmar, the export quantity of fishery products outstripped the international trade of other products and has grown dramatically in recent years.

Table 7.2: Composition of cold chain demand

Country	Item	Aquatic products	Agricultural products	Livestock products	Other products	Table
Thailand (2018)	Export (US$ million)	1,996	2,988	4,198	687	2.13
	Import (US$ million)	3,183	2,089	1,526	3,632	2.12
Viet Nam (2017)	Import (US$ million)	813	173	357	–	Fig. 3.2, 3.3, 3.4
Indonesia (2018)	Estimated demand (million tons)	12.51	2.90	2.11	0.07	4.26
Lao PDR (2017)	Import (US$ million)	31	12	14	–	5.6
	Import (million tons)	0.003	–	0.015	–	
Myanmar (FY 2017/2018)	Current demand (million tons)	0.58	0.03	0.04	0.003	5.6
	Potential demand (million tons)	5.31	5.11	4.14	0	

Notes: Thailand: Aquatic products; agricultural products; livestock products; and the sum of live plants and pharmaceutical products. Exported value of canned and processed foods including fruits, vegetables, and seafood were omitted. Viet Nam: Sum of frozen tuna, salmon, mackerel, cod, shrimps, and prawns for intermediate use; the sum of fresh apples, grapes, pears, cherries, and kiwifruit; and meat. Indonesia: Fishery products; fruits and vegetables; beef and chicken; and other products. Lao PDR: Frozen/chilled salmon/fish; vegetable and fruit; and frozen/chilled meat. Myanmar: Fishery products; selected agricultural products; meat and dairy products; and imported pharmaceutical products. The values for Thailand are converted from Thai baht to US dollars by the exchange rate, 31.76 baht/US dollar. See each chapter for the descriptions in more detail.

Source: Tables and Figures in each chapter listed in this table.

7.2. Activities of the main players

Differences in chains and players

Cold warehouse and transportation companies take their roles in selected parts of the distribution chain split by producer or importer, distribution centre, wholesaler, retailer, and domestic final consumer or exporter, rather than the whole logistics of the chain. The transportation distance of each company may be either short or long. For example, domestically produced products and transit trade may need long-distance transportation runs through the nation, as shown in Lao PDR and Myanmar. The scale of transportation depends on the part of the chain. Refrigerated containers of imported products are directly transported to cold storages as explained in the chapter on Viet Nam. After that, small trucks carry chilled or frozen products to the next nodal point. Viet Nam reported that motorbikes attached with ice boxes deliver products to consumers.

The differences in warehouse and transportation equipment by the purpose of the trade is notable. Modern cold transportation logistics using refrigerated trucks is mainly used for international trade according to the Lao PDR and Myanmar, although trucks do not necessarily equip or use the generating system. Meanwhile, traditional methods by using crushed ice and plastic case are widely used for products targeting the domestic market in those countries. In the case of the circulation of fishery products in Myanmar, products mixed with ice are loaded into box trucks and directly transported are common for Yangon intercity, while they are put into ice boxes and transported with general trucks for the long haul.

Representative companies of cold storage and transportation

Companies using cold storage and transportation can be classified into two types. The first is food processing companies operating own cold warehouses or transportation, particularly in the fishery sector accounting for large parts of the cold storage service in Viet Nam, Indonesia, and Myanmar. Case studies in Myanmar also show that the crushed ice produced by aquaculture farms is necessary for the traditional way of fish transportation. As well as seafood companies, the storage capacity of other food processing companies is remarkably large in Thailand, Viet Nam, and Indonesia.

The other type is that companies rent cold warehouses or transportation services from other companies. There are two types of cold warehouse rental company: third-party cold warehouse or transportation services, and other companies such as food processing companies providing cold warehouses. Information on third-party services is limited in this report. Myanmar showed there were no more than 10 large-scale third-party warehousing and transportation services, respectively. Meanwhile, as shown in the chapter on Indonesia, various types of companies, including transportation, processing, logistics and forwarder, and container supplier, as well as cold storage companies, rent cold storage out to other companies. Companies with cold storage can gradually change their function, such as Hung Vuong Corporation and Minh Phu Seafood Corporation in Viet Nam. Those original seafood processing companies invested in integrated logistics centres to offer cold services for other seafood companies for addressing the degradation of cold storages installed in the 2000s. Similar to cold storage, cold transportation can be provided from various types of companies to the related sector. Myanmar showed an example of fishery exporters renting out cold transport to other fishery businesses.

Tables 3 and 4 list major companies which operate cold warehousing and transportation. We can grasp that the largest cold storage companies in Viet Nam and Indonesia are similar in level, near 60,000 tons, if we can assume the static load capacity of one pallet is a ton. The capacity of the largest third-party company in Myanmar, Ryobi Myanmar Distribution Service, is one rank smaller at 11,460 tons. Furthermore, it there are active operations of foreign capital companies, such as Emergent Cold, Ryobi Myanmar Distribution Service, and Hwasung Thermo Indonesia, and joint ventures with foreign companies including KOSPA, Premium Sojitz Logistics, and SENKOSMI.

Table 7.3: Major Cold Warehousing Services

	1	2	3	Table
Thailand*	Chiangmai Frozen Foods	Bangkok Seafood	Pacific Cold Storage	2.23
Viet Nam	Emergent Cold (56,650 pallets)	Mekong Logistics (Minh Phu Seafood Corporation) (50,000 pallets)	ABA Cooltrans (45,000 pallets)	3.2, 3.3, 3.4
Indonesia	Enseval Putra Megatrading Tbk, PT (59,000 tons)	Unilever Indonesia, PT (50,000 tons)	Sukanda Djaya, PT (45,000 tons)	4.2
Indonesia Jabodetabek**	Enseval Medika Prima, TbkPT (59,000 tons)	Sukanda Djaya, PT (45,000 tons)	Kiat Ananda Cold Storage, PT (30,000 tons)	4.21
Myanmar Yangon***	Ryobi Myanmar Distribution Service Co., Ltd (11,460 tons)	KOSPA Limited (9,900 tons)	Phee Central Logistics (4,645 tons)	6.17

Notes: Top three companies in descending order of capacity. Jabodetabek: Metropolitan area surrounding Jakarta. *Companies carrying out refrigerated storage activities in order of revenue. **Cold Storage Rental Company. ***Information on third-party cold warehousing services.

Source: Tables in each chapter listed in this table.

Table 7.4: Major Cold Chain Transportation Service Providers

	1	2	3	Table
Thailand*	P.M. Distribution	Paramee Logistics	2299 Trading	2.22
Viet Nam	ABA Cooltrans	Tan Nam Chinh Logistics	Tan Bao An	3.5
Indonesia Jabodetabek**	Hwasung Thermo Indonesia, PT	Selaras Mandiri Raya Trans, PT	Armada Container Indonesia, PT	4.22
Myanmar Yangon***	Premium Sojitz Logistics	SENKOSMI	Myan Express	6.19

Notes: Top three companies in descending order of capacity. *The road transport services of freight by refrigerator vehicles' activity in order of revenue. **Information on third-party cold transportation services, in descending order of the established year. ***Information on third-party cold transportation services, in descending order of the number of box trucks.

Source: Tables in each chapter listed in this table.

Supply of cold chain services

Table 7.5 shows the supply of cold storage in each country. The capacity of both the public and private sectors is 940,000 tons in Thailand. The capacity of the private sector in Viet Nam is larger than 500,000 pallets. The capacities in Indonesia and Myanmar are 370,200 tons and 88,148 tons, respectively, although those indicate only the capacities of major companies. Companies operating their own cold storage, such as seafood processing companies, have large capacities for cold storage compared with cold storage companies, including third-party warehouse companies, at least in Viet Nam, Indonesia, and Myanmar.

The supplied capacity of cold storage shown in Table 7.5 is quite limited compared with the cold chain demand in Table 7.1. In Viet Nam, the production volume of pig, cow, and poultry meat account for 4.93 million tons, while cold storage provided from the private sector is 0.5 million tons when we assume one pallet can load a ton. Similarly, the estimated demand for cold storage of 17.6 million tons far exceeds the capacity of major cold storage companies of 0.4 million tons in Indonesia. In Myanmar, the total supplied capacity of major cold storage companies of 0.88 million tons is larger than the demand for modern refrigerated and frozen products of 0.65 million ton, while it is smaller than the demand for the traditional cold chain of 5.31 million tons and circulation under ordinary temperatures of 5.31 million tons.

The shortage of cold storage supply allows us to two interpretations. First, the demanded quantities listed in Table 7.5 only indicate the volumes of products that should be circulated under cold temperatures regardless of the actual storage conditions. Second, the supply of cold storage in Table 7.3, especially in Indonesia and Myanmar, only shows that of large-scale companies that can provide modern cold storage services. The large gap between the demand and supply of cold storage suggest that a substantial part of the cold chain demand is satisfied with supply from small and medium enterprises or is not fulfilled and has significant potential for companies to provide cold chain services.

Table 7.5: Supply of Cold Storage

	Description	Supply	No. of companies	Table
Thailand (2015)	Public and private sectors	940,000 tons	632	2.18, 2.19
	Private sector	180,000 tons	–	2.18
Viet Nam (2015)	Private sector	349,000 pallets	–	Fig. 3.12
Viet Nam (2018)	Private sector	> 500,000 pallets	–	Unoffic
	Major cold storage companies	246,850 pallets + 73,000 tons***	18	3.2, 3.3
	Major seafood companies*	50,000 pallets + 165,500 tons****	17	3.4
Indonesia (2018)	Major cold storage companies	131,000 tons	20	4.17
	Other companies*	239,200 tons	49	
Myanmar (2018)	Major cold storage companies**	33,658 tons	5	6.17
	Major seafood companies*	54,490 tons	113	6.16

Notes: *Major companies operating own account cold storage other than the business field of cold storage. **Cold storage of third-party logistics. ***Capacity of 14 (pallets) and 4 (tons) of 27 major warehouse companies. ****Capacity of 1 (pallet) and 16 (tons) of the total of 17 warehouses of seafood companies. Including warehouses under construction. Unoffic: Unofficial data.

Source: Tables and Figures in each chapter listed in this table.

Information on cold transportation in the whole country was briefly shown in the chapters on Indonesia and Myanmar. According to the Indonesian Cold Chain Association, the capacity of refrigerated trucks in Indonesia is around 3,000 units with a capacity of 15,000 tons per day, which meet 10% of the needs. Myanmar's cold chain sector has 7,023 refrigerated box trucks operated by both own-account and third-party logistics.

7.3. Government policies

Neither country in this study has an integrated policy on the cold chain, although economic and social development plans might be placed as a guide in a broad sense. Various policies affect the development of the cold chain both directly and indirectly.

Policies directly affecting the development of the cold chain

A noteworthy voluntary regulation directly affecting cold storage and transportation is the service quality standard for truck operation, or the Q Mark standard, in Thailand tested in 2019, which set up a common quality standard of temperature-controlled transport. The evaluation approach of the standard focuses on four key factors, such as the operation of transport, hygiene, the standard and maintenance of cold storage, and human resource development. In addition, the Thailand Professional Qualification Institute is developing a professional cold chain course to improve the Thai workforce's competitiveness in terms of skill and knowledge. We can learn from the advanced efforts of the Thai government to standardise cold transportation and develop human resources.

Other regulations related to the cold chain include the Warehouse, Silo and Cold Storage Act in Thailand and Presidential Regulation No. 71 of 2015 in Indonesia for controlling operations in factories, storage, and transportation that use the cooling system. Rather than regulations, a guideline about the temperature control of fishery products is adopted by the Myanmar Fisheries Federation, although there is weak compliance from local businesses.

Temperature control is generally stipulated in food standards in each country. For example, the Food Safety Law in Viet Nam states the technical requirements for frozen and chilled products, such as seafood and meat requiring temperature control.

The government can directly support facilities and markets, which can be nodes of the cold chain. The government in Viet Nam conducted credit support to purchase machinery and equipment, including refrigerated cargo, machines for producing ice, and cold storage facilities under Decision 68/2013/QD-TTg, although the accessibility to the support is low for targeted groups. The Ministry of Maritime Affairs and Fisheries in Indonesia has allocated funds to introduce cold chain facilities, such as ice flake machines, refrigerated vehicles, cold storage, and fish markets in recent years. In Myanmar, the government supports the development of commodity markets, such as the ongoing Danyingone Wholesale Market with modern cold storage.

Policies indirectly affecting the development of the cold chain

Several policies examined in each chapter would indirectly affect the improvement in the cold chain. First is investment promotion for cold chain businesses, such as tax exemptions for investment and permission for ownership to foreign investors in Thailand. Decree 163/2017/ND-CP in Viet Nam would have impacts on shaping the investment environment while creating more room for foreign investors to join logistics services. One of the aims of Directive 21/CT-TTg in Viet Nam is to attract investment in logistics infrastructure aligned with e-commerce development. Similarly, the Indonesian government has opened the cold chain, especially the field of cold storage, to foreign investments, according to Presidential Regulation Number 44 of 2016.

Infrastructure development led by the government would also affect cold logistics. In the Greater Mekong Subregion, the development of roads and seaports crossing the region is focused on as a factor largely affecting international transportation. Those initiatives include the construction of the Eastern Economic Corridor in Thailand, a few projects affecting transportation in Myanmar, such as India – Myanmar – Thailand Trilateral Highway Project, and China's One Belt One Road Initiative, containing the Vientiane – Kunming High-Speed Railway Project that is expected to change the transportation environment in the Lao PDR.

Customs operations have been improved in many countries as well as investment promotion. Thailand introduced modern systems, namely the National Single Window, to facilitate the use of electronic data and information sharing, and the Port Community System to set the electronic platform to improve processes at seaports and airports. Meanwhile, the Lao PDR pointed out problems with the regulations on customs that the number is limited and that they miss regulating principles related to perishable goods. This results in the ambiguity of statements and non-integrated and weak enforcement.

7.4. Policy implications

Governments have already implemented or considered the countermeasures to issues of cold chains as shown in the previous section. However, the arguments in each chapter might provide further insights to improve the cold chain. In this section, we summarise the policy implications from the aspects of the hard and soft assets of companies, public infrastructure, and

connectivity of the chain. These would affect the operation cost of the cold chain, one of the common and essential issues, as well as the transportation times and quality of products requiring cold temperatures.

Stimulating the investment of companies in hard assets

Insufficient hard assets, such as warehouses and trucks in specific regions or parts of the chain in terms of quantity and quality was specifically mentioned in the chapter of Viet Nam. For example, both refrigerated vehicle resources and refrigerated warehouse space are not enough in the producing areas of agricultural products. When focusing on farmers, the enhancement of household-scale cold storage technology and equipment, particularly for perishable products, is needed. Companies need to update degraded cold storages in specific sectors, such as the seafood industry, with expanding capacities and by introducing new technologies. Modified cold vans with attached air-conditioners widely used by small transportation companies have the room to reinforce equipment to ensure the quality of transported products. As well, home delivery using cold insulation boxes attached to motorbikes will be demanded according to the expansion of e-commerce and are thought to be a potential investment area.

Facilities should be designed in line with the local market size and its demand. In the case of Myanmar, warehouses with massive capacities, designed based on countries having developed cold chains, are mismatched with local demand and cause a low utilisation rate. Transportation with modified cold vans and motorbikes reported by Viet Nam, domestic circulation using crushed ice and insulation box in the Lao PDR and Myanmar, and farmers' storage utilising natural cold weather at night in Thailand are economically rational ways with the potential for investment or improvement, rather than low-technology which should be cast off.

Investment in agriculture and fisheries, which are affected by natural conditions, is risky and costly. As mentioned in the chapter on Viet Nam, a clear vision of the government showing the development priorities of the cold chain and the public–private partnership mechanism would ease investors to make decisions about entry into those sectors.

Fulfilment of soft assets or human resources

This report often stressed insufficient soft assets, especially human resources, in the cold chain. The Lao PDR mentioned the shortage of truck drivers who have experience in the cold chain. Myanmar argued the need for training for different types of vehicles before issuing driving licences. More skilled professionals for warehouse management and operation to provide services demanded by the international audience are also needed. Thailand mentioned drivers' insufficient English skills and knowledge for working across borders.

In Viet Nam, there are almost no universities offering courses and or with curriculums related to cold chain logistics and management in agriculture. It is expected for that universities will open new education programs and short-course training for the staff and managers of companies involved in the cold chain.

Investment in public infrastructure

The lack in quantity and quality of infrastructure, including roads, railways, waterways, ports, and electricity supply, cause high logistics costs and damage perishable products. The issue of roads includes the availability of short-distance roads, the quality of the roads, and traffic conditions. Regarding short-distance roads in Myanmar, for example, there is a need for consideration of the opening of the Yangon–Mandalay Highway Road, which is currently restricted for trucks. This argument contains a wide range of issues, such as investment for highway equipment, road maintenance, and traffic safety.

Meanwhile, the chapters on Viet Nam and the Lao PDR pointed out the problem of road quality, as roads are damaged by too many or over-weighted trucks. Thailand mentioned that traffic congestion, which can be caused by road construction, would result in delivery delays. There is room for further discussion about traffic control, substitutional transportation modes, and the method of road construction for routes important for cold chain.

Stable electricity supply in the routes of the cold chain is also needed to reduce the costs of cold storage and transportation. This might reduce the need for backup batteries in cold warehouses for power outages as considered by Viet Nam. In the case of Myanmar, the construction of stations with proper charging facilities designed for long-distance transport vehicles would benefit transportation by trucks, which do not equip portable generators for the chilling systems of the reefer containers.

Improvement of connectivity of the chain

Integrative management of the cold chain would decrease the risks and costs during the preservation and transportation of products. Cold chains in Viet Nam, other than that for the in-house seafood chain, are evaluated as highly fragmented in all stages. Strengthening the vertical relationship between companies, or further vertical integration, could be a measure to realise such integrative management. Another essential factor is individual technologies, such as the sensor and transmitter system that is used to send data, and communication networks between the actors of supply chains, which are mentioned as technologies for the fishery chain in the chapter on Indonesia.

Connectivity in terms of international trade through customs is also a notable issue. In particular, the Lao PDR and Myanmar examined transit trade as a key driver to develop the cold chain since it can expand without being restricted by the scale of domestic production. Although the high connectivity of international trade requires efficient customs operations, there are still several issues in customs in the reported countries. Thailand mentioned the inconvenient and complicated import declaration process and the inconsistent clarification of exported products. Similarly, the Lao PDR argued the need to decrease customs procedures and release clear statements about the times and fees of customs operations. These measures would improve competitiveness in terms of transportation time and the freshness of carried products.

We should note the warning in the chapter on Myanmar about the necessity of countermeasures to prepare for international competition, particularly in the field of transit-trade. There will be a downfall for the logistics industry if the cost, time, and quality of the cold chain cannot be guaranteed as neighbouring countries under the condition of high international or regional connectivity. The cold chain should be promptly improved from various aspects since the progress of international connectivity suggests an intensification of international competition in cold chain industries.