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NGHIÊN CỨU THỰC TRẠNG THIẾU KHO LẠNH CHO XUẤT KHẨU NÔNG SẢN Ở VIỆT NAM VÀ MỘT SỐ GIẢI PHÁP

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Tóm tắt

Bài nghiên cứu tập trung vào thực trạng thiếu kho lạnh cho xuất khẩu nông sản ở Việt Nam. Nông sản đang là mặt hàng xuất khẩu nội trội, đóng góp lớn vào tổng kim ngạch xuất khẩu của Việt Nam trong thời gian qua. Do tính chất đặc thù của nông sản, xuất khẩu mặt hàng này yêu cầu sử dụng kho lạnh để bảo quản. Tuy nhiên, hiện tại thực trạng thiếu kho lạnh cho xuất khẩu nông sản vẫn đang tồn tại. Dựa trên việc nghiên cứu hoạt động xuất khẩu nông sản và tình hình kho lạnh ở Việt Nam, nhóm tác giả đã đánh giá tình trạng thiếu hụt kho lạnh cho xuất khẩu mặt hàng chủ lực này. Đồng thời nguyên nhân của thực trạng này cũng được làm sáng tỏ. Từ đó nhóm tác giả đưa ra một số giải pháp nhằm giải quyết thực trạng này.

Từ khóa: kho lạnh, nông sản, xuất khẩu

RESEARCH ON THE SITUATION OF LACK OF COLD STORAGE FOR AGRICULTURAL EXPORTS IN VIETNAM AND SOME SOLUTIONS

Abstract

This paper focuses on the shortage of cold storage for agricultural product exports in Vietnam. Agricultural products are a prominent domestic export product, contributing greatly to Vietnam's total export turnover in recent years. Due to the specific characteristics of agricultural products,

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exporting this item requires the use of cold storage for preservation. However, the current situation of lack of cold storage for agricultural exports still exists. Based on the study of agricultural exports and the situation of cold storage in Vietnam, the authors assessed the shortage of cold storage for the export of this staple product. Moreover, the cause of this situation is also elucidated. Since then, the authors have come up with some solutions to solve this situation.

Keywords: cold storage, agricultural products, export

1. Literature review

1.1. An introduction to the cold storage warehouse

1.1.1. Definition

According to Aviation Logistics (2023), Cold storage, also known as cool storage, is a type of warehouse capable of adjusting storage conditions such as humidity, temperature, and so on to match the physical or chemical characteristics of the stored goods.

According to Cambridge Dictionary (2023): "Cold storage warehouse means a storage warehouse used to store fresh and/or frozen perishable fruits or vegetables, meat, seafood, dairy products, or fowl, or any combination thereof, at a desired temperature to maintain the quality of the product for orderly marketing."

Therefore, we can conclude that cold storage is a type of warehouse with special equipment to maintain an ideal condition (temperature, humidity and so on) for preserving different types of goods such as fruits, meat, or dairy products.

1.1.2. Component

The structure of cold storage is divided into two parts: the outer structure and the inner cooling system (Aviation Logistics, 2023).

The outside structure (also known as the insulation system) ensures that heat is not lost, preventing outside air from entering the warehouse. The system includes a warehouse shell and warehouse door.

- Cold storage shells are usually made from large, smooth panels with good vibration and corrosion resistance; The panel layers have a special design, which is quite light but has good thermal insulation.

- Cold storage doors are usually thick doors made of stainless steel with many layers, solid, with drying resistance to ensure the door is always dry and clean.

The internal refrigeration system determines the quality and temperature control of the warehouse and includes the following components:

- Indoor unit: large capacity, designed with a sturdy shell to ensure storage temperature requirements

- Compressor: has a quality lip compression effect. The compressors will be designed and installed according to the indoor unit capacity and usage area.

- System of dehumidifiers, dehumidifiers, ventilation: creating ideal storage conditions for goods

- Control cabinet: to be able to adjust and operate temperature, humidity, ... in accordance with the characteristics of each type of stored goods.

1.1.3. Classification

According to Coldmax (2020), cold storage is classified according to different criteria.

By temperature:

- Cool storage: The storage temperature in cool storage is in the range of 0˚C to 5˚C. The warehouse mainly preserves agricultural products, fruits, and vegetables.

- Cold storage: The storage temperature in cold storage is in the range - 5˚C to 5˚C depending on the requirements of the refrigeration process. This warehouse is used to cool the products from ambient temperature down to cold storage temperature before being put into the freezer.

- Frozen storage: The storage temperature in cold storage is in the range from -18˚C to -25˚C. The warehouse mainly preserves products of animal origin. These products have all been frozen.

By functions:

- Processing cold storage: is a type of cold storage installed in processing plants to preserve raw materials and finished products. For example, export food processing factories, seafood processing factories, meat export factories, and canned meat, etc. These types of cold storage usually have a large capacity and are divided into many warehouses according to raw materials, finished products, and semi-finished products.

- Domestic cold storage: is a type of cold storage used in households, small businesses, hotels, or restaurants to preserve small quantities of goods.

- Transport cold storage: is a type of warehouse for the purpose of transporting and distributing goods on trucks, containers, ships, or trains.

By capacity:

The size of the cold storage depends mainly on its storage capacity. Due to the characteristics of the loading capacity of each food, the capacity is converted into tons of meat (MT-Meet Tons). For example, 50MT warehouse, 100MT warehouse, 150MT warehouse, etc. are warehouses capable of holding 50, 100, and 150 tons of meat.

1.2. Benefits of cold storage

With the ability to adjust storage conditions in accordance with the characteristics of stored goods, cold storage has been applied to economic sectors, especially some industries such as food processing, manufacturing, and chemicals. Especially for the food processing and preservation industry, cold storage plays a very important role, which will be further explained in the following part.

1.3. Importance of cold storage to agricultural products

1.3.1. Characteristics of agricultural goods

Several sectors, including chemistry, medicine, and notably agriculture, forestry, and fishing, benefit greatly from cold storage. Using cold storage is a crucial step in the trend of expanding agricultural exports in Vietnam, particularly when exporters and importers are aware of the flaws in the process of importing and exporting agricultural products and recognize the significance of cold storage.

It is important to comprehend the nature of agricultural goods as a result of the growth and development of plants and animals in order to better understand the function of cold storage with agricultural products. According to Account Learning (n.d.), the following traits describe an agricultural product:

Seasonality: The most prevalent characteristic of Vietnamese agricultural goods is seasonality. It stands for the interconnected and continuous processes of germination, growth, and harvesting. There are frequently several seasons in the production process since seasonality in agriculture is permanent and cannot be eradicated because it is the growing rule of nature. This acts as the reason why delivering the right products at the right time is crucial for sellers in Vietnam in particular, and for any traders in general.

Dependence on environmental factors: Each sort of agricultural produce has a different degree of adaptation to changes in the climate and other environmental factors, thus, whether or not the quality of agricultural goods is maintained at a high level is significantly influenced by the storage environment.

Quality has a direct impact on consumer health: As agricultural products fall under the category of key consumer commodities, which have a considerable impact on people's lives and health, they must undergo several stages of testing on food hygiene and safety before they can be sold on the market. Because of this, the quality of imported agricultural goods is always tightly regulated in every market in the globe, safeguarding the consumers' health and lives.

For the uniqueness and need for perfection in this sector, sellers of agricultural goods are compelled to keep up with several sanitary-phytosanitary requirements. By using cold storage, the work of maintenance would be immensely easier as cold storage poses a big part in the preservation process.

1.3.2. The need of using cold storage in preserving agricultural products

As mentioned previously, cold storage is crucial for the sector of food processing and preservation, acting as a protection against weathering or heat influx during the storage process or transportation, only cold storage can help preserve food for the longest period of time while maintaining its nutritional value and quality. Bacteria will not be able to exist in low temperatures in stable environments, which will hinder all of their activities and stop them from affecting food and spoiling it. As a result, food will be fresher and better preserved before it reaches customers. Additionally, not limited to the role of keeping the products cool, cold storage is capable of providing several other benefits, such as: quick freezing, keeping fresh, and protection against wilting and fire hazards.

Food stored in an unstable natural environment, at high temperatures, during hot weather, and with high humidity will be more likely to degrade quickly if no cold storage exists. From that point on, the food will spoil more quickly, and the firm won't be able to do anything when it sees the amount of food, which may occasionally be several tons worth, that has gone bad.

It is recorded that plants could last up to 3 to 5 times longer if kept in cold storage when compared to normal storage which is usually only suitable for processed products that do not need special treatment, as demonstrated in the table below:

Table 1. Standard conditions for preserving agricultural products

Product	**Storage temperatures (ºC)**	**Humidity (%)**	**Ventilation**	**Storage time**
Orange	0.5 – 2	85	Open	1 - 2 months
Grapefruit	0 – 5	85	Open	1 – 2 months
Apple	0 – 3	90 – 95	Open	3 – 10 months
Ripe Tomato	2 – 2.5	75 – 80	Open	1 month
Kohlrabi	0 – 0.5	90	Open	2 – 6 weeks
Cauliflower	0 – 1	90	Open	4 weeks
Avocado	4 – 11	85	Open	10 days
Papaya	8 – 10	80 – 85	Open	2 weeks
Dragon fruit	12	90	Open	4 weeks
Mangosteen	12	85	Open	3 – 4 weeks

Source: Bien Bac group (n.d.)

On the other hand, if raw meats and fish are kept in frozen condition, it can last up to 12 months. Using cold storage/freezer storage, which could go as low as -25 degree celsius, these products and the derivatives could be kept in ideal condition to survive long travel routes, or sea transport (which is a typical mode of transportation for food & beverage) that can last anywhere from 20-45 days if not longer.

2. Lack of cold storage for agricultural exports in Vietnam

As mentioned, cold storages play an essential role in protecting agricultural products from spoiling. For Vietnam, this fact is even more important due to the country's strength in its agriculture export sector. With a large enough supplies of cold storages, firms can rapidly increase their production. However, in reality, the Vietnamese cold chains and cold storage sector are currently unable to keep up with the rapidly growing demand of the export sector.

2.1. Vietnam's agricultural export

2.1.1. Overall

According to the Ministry of Industry and Trade (2023), the agricultural sector in Vietnam experienced a significant breakthrough in 2022 in terms of agricultural product exports. This achievement reflects the efforts of the entire industry to overcome challenges and adapt to changing circumstances. The sector's total export turnover of agricultural, forestry, and fishery products in 2022 was estimated at $53.2 billion, representing a 9.5% increase from the previous year. This marks the highest export value recorded thus far, surpassing the previous record of $48.6 billion in 2021.

The sector's main agricultural products, including coffee, cashews, rice, and vegetables, contributed significantly to this growth. The total value of these products reached $22.59 billion, up 4.8% from the previous year. The forestry sector also made significant contributions, with its main products (wood, wooden products, and bamboo) reaching a total value of $16.93 billion, up 6.1% from the previous year. Meanwhile, the fishery sector saw a remarkable growth rate of 22.9%, with its main products (shrimp, fish, and other aquatic products) reaching a total value of $10.92 billion. However, the livestock sector experienced a slight decline of 7.1%, with an export value of $400 million (Ministry of Industry and Trade, 2023).

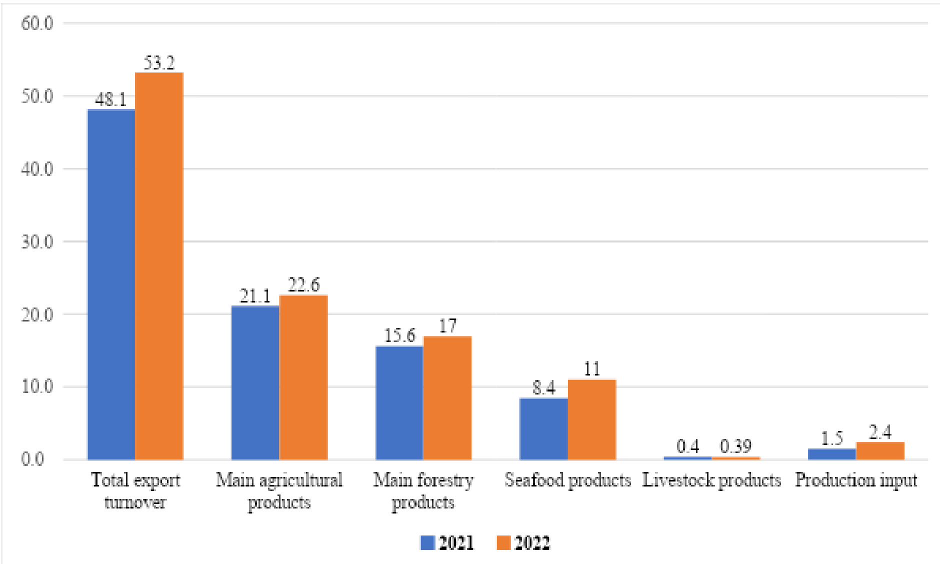

Figure 1. Export turnover of agriculture, forestry, and fishery products in 2022 (billions of USD)

Source: Ministry of Agriculture and Rural Development (2023)

In terms of market share, the United States and China were the two main destinations for Vietnam's agricultural exports in 2022, accounting for 25% and 19% of the total export value, respectively. Japan and South Korea were also significant markets, with a combined market share of 12.6%.

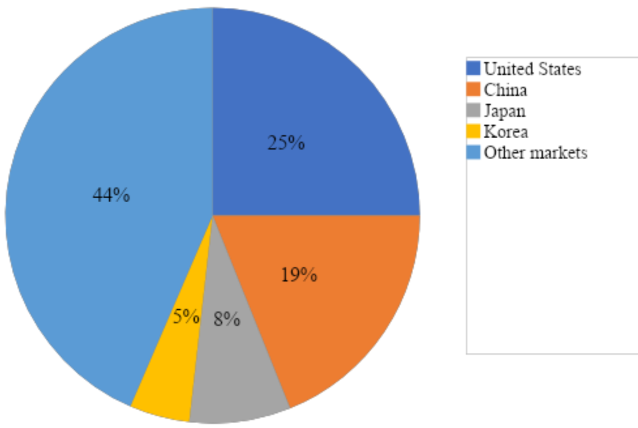

Figure 2. Key agricultural export markets in 2022

Source: Ministry of Industry and Trade (2023)

The demanding consumption markets of the United States, China, Japan, and South Korea require high-quality products, making product freshness a crucial factor in meeting market demands. This creates both an opportunity and a challenge for Vietnamese agricultural exporters, as it is important to maintain product quality throughout the supply chain, especially for products that require cold-chain transportation.

It is noteworthy that Vietnam has 11 product groups with export values exceeding $1 billion, seven of which exceed $3 billion. These groups include wood and wooden products ($10.92 billion), shrimp ($4.33 billion), coffee ($3.94 billion), rice ($3.49 billion), rubber ($3.31 billion), fruits and vegetables ($3.34 billion), and cashews ($3.07 billion) (Ministry of Industry and Trade, 2023).

Overall, the agricultural sector's trade surplus in 2022 is expected to reach $8.5 billion, representing a significant increase of 30% compared to the previous year. This reflects the sector's efforts to improve product quality, expand markets, and promote exports.

2.1.2. Vegetable market

According to the Ministry of Industry and Trade, the export value of fruits and vegetables in Vietnam in 2022 reached USD 3.34 billion, a 5.9% decrease compared to 2021. Fresh and frozen fruits and vegetables accounted for USD 2.32 billion, while processed fruits and vegetables accounted for USD 1.014 billion. The proportion of processed fruit and vegetable exports in the total fruit and vegetable export revenue increased from 26% in 2021 (USD 923 million out of USD 3.52 billion) to 30.4% in 2022 (USD 1.014 billion out of USD 3.34 billion).

In 2022, Vietnam's fruit and vegetable export structure showed positive changes as the proportion of processed products increased. According to data from the General Department of Customs (2022), the proportion of processed products in the export structure of fruits and vegetables in 2022 was 29.47%, up 3.8 percentage points compared to 2021. Among the processed products, those made from cucumber and coconut led in terms of value and showed strong growth in 2022, followed by processed products made from various fruits, cashews, and pineapple. Currently, Vietnam mainly exports fresh fruits, which are difficult to transport long distances due to their short shelf life. Therefore, fruit and vegetable businesses should focus on the processed product segment as it is a trend in the market in the future.

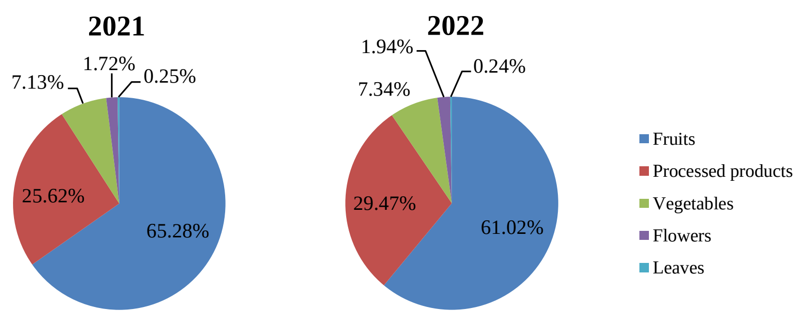

Figure 3. The structure of Vietnam's fruit and vegetable export items in 2021 and 2022

Source: General Department of Customs (2022)

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Fresh fruits still accounted for the majority of Vietnam's fruit and vegetable export structure in 2022, with a 61.02% share of the total export value, down 4.3 percentage points compared to 2021. According to the Vietnam Fruit and Vegetable Association, China is the largest export market for Vietnamese fruits and vegetables. However, due to the country's "Zero Covid-19" policy, fruit and vegetable exports to China in 2022 only reached USD 1.53 billion, a 22% decrease compared to 2021. Nevertheless, at the beginning of January 2023, there were positive signs for fruit and vegetable exports to China, as the country had reopened its borders. The reopening of China's borders would facilitate the export of Vietnamese fruits and vegetables to this market in the future.

While most of Vietnam's fresh fruits and vegetables are destined for the Chinese market, the processed fruits and vegetables segment is growing rapidly in distant markets, especially the EU and the United States (VnEconomy, 2022b). This can be explained by the fact that fruits and vegetables are perishable goods, and their shelf life is short, making them suitable only for nearby markets. For the European and US markets, fresh fruits and vegetables are difficult to transport by sea, which can take up to a month. If transported by air, the shipping cost is too high. In contrast, processed fruits and vegetables in cans or bottled juice have a longer shelf life and can be transported to these markets. This trend presents opportunities for Vietnamese fruit and vegetable businesses to expand their exports to these markets.

According to Dan Tri Newspaper (2022), the main vegetable and flower growing areas in Vietnam include Tay Nguyen (cashew nuts, coffee), Da Lat (tomatoes, orchids), Hai Duong (carrots, onions), and Hai Phong (beets, potatoes). These regions all have favorable natural conditions for vegetable and flower production, and have also been invested in and developed by the Vietnamese government. The main markets for Vietnam's vegetable and flower exports include China, Japan, the EU, and the US. These countries are currently showing a growing trend in demand for Vietnam's vegetable and flower exports. According to VnEconomy (2022), China is one of the largest and most potential markets for Vietnam's vegetable and flower exports. Vietnam has successfully exported various types of vegetables and flowers to this market, including tomatoes, carrots, turnips, potatoes, onions, garlic, chili peppers, green beans, snow peas, broccoli, beets, pumpkins, and water spinach. This can be explained by the fact that fruits and vegetables are perishable goods, and their shelf life is short, making them suitable only for nearby markets. For the European and US markets, fresh fruits and vegetables are difficult to transport by sea, which can take up to a month. If transported by air, the shipping cost is too high. In contrast, processed fruits and vegetables in cans or bottled juice have a longer shelf life and can be transported to these markets. This trend presents opportunities for Vietnamese fruit and vegetable businesses to expand their exports to these markets.

2.1.3. Meat market

According to data from the General Department of Vietnam Customs (2022), in 2022, Vietnam exported 18.87 thousand tons of meat and meat products worth 84.6 million USD, a decrease of 3.3% in quantity but an increase of 3.6% in value compared to 2021. The majority of Vietnamese meat and meat products were exported to markets such as Hong Kong, Thailand, Belgium, France, and Laos. Specifically, exports to Hong Kong accounted for 40.72% of the total meat export volume of the country, with 7.68 thousand tons worth 42.61 million USD, a decrease of 21.5% in quantity and 16.3% in value compared to 2021. Vietnamese meat and meat products exported to Hong Kong mainly consist of fresh or frozen pork.

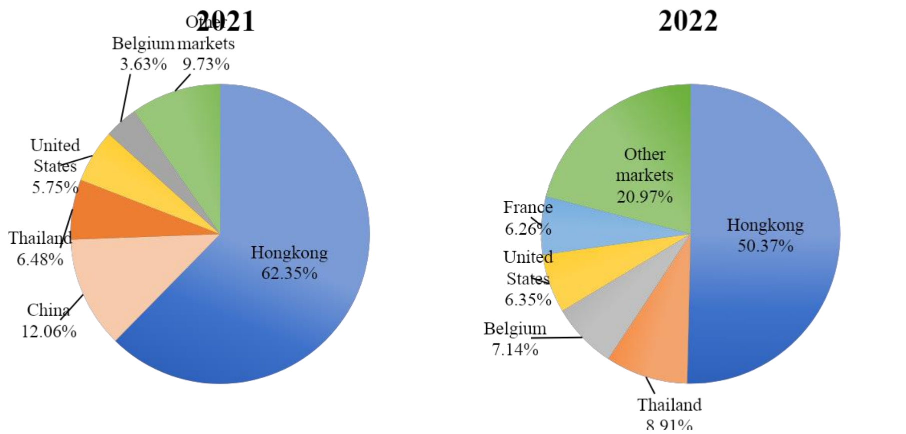

Figure 4. The structure of Vietnam's meat and meat product export market in 2021 and 2022

Source: General Department of Customs (2023)

In 2022, Vietnamese exports of meat and meat products mainly consisted of various types, including fresh, chilled or frozen pork (primarily fresh pork, frozen whole piglets, and frozen whole pigs), other fresh, chilled or frozen meat from other animals, and edible meat by-products (mainly frozen frog legs). Among them, fresh, chilled or frozen pork was the most exported with 10.49 thousand tons worth 50.78 million USD, an increase of 75.9% in quantity and 16.5% in value compared to 2021. Fresh, chilled or frozen pork was exported to six markets, of which exports to Hong Kong accounted for 67.46% of the total volume of fresh, chilled or frozen pork in the country in 2022.

In second place were other fresh, chilled or frozen meat from other animals, and edible meat by-products. In 2022, the export of other fresh, chilled or frozen meat from other animals, and edible meat by-products reached 5.16 thousand tons worth 23.94 million USD, an increase of 130% in quantity and 88.6% in value compared to 2021, and were exported to 24 markets, with exports to Belgium accounting for 30.22% of the total volume of these products in the country in 2022.

The Northern and Central regions are considered the main areas for livestock production in Vietnam. Among them, the Northern provinces such as Hanoi, Hai Duong, and Hung Yen specialize in producing pork; the Central provinces such as Nghe An, Thanh Hoa, and Ha Tinh specialize in producing beef and buffalo meat. These are considered high-potential meat production areas thanks to the natural conditions, geography, and production experience of the local people. Furthermore, according to the report by the Ministry of Agriculture and Rural Development, the main markets for Vietnam's meat exports are countries such as Japan, South Korea, China, the EU, and the US. Specifically, Vietnam's pork exports to China are currently trending upward due to the increasing demand of the Chinese market.

2.1.4. Seafood market

In 2022, there were changes in the structure of Vietnam's seafood exports as the proportion of shrimp in the total value of seafood exports decreased, while the proportion of catfish, frozen fish, and tuna increased. The changes in the structure of seafood exports were due to slow growth in shrimp exports, while catfish, frozen fish, and tuna exports saw strong growth.

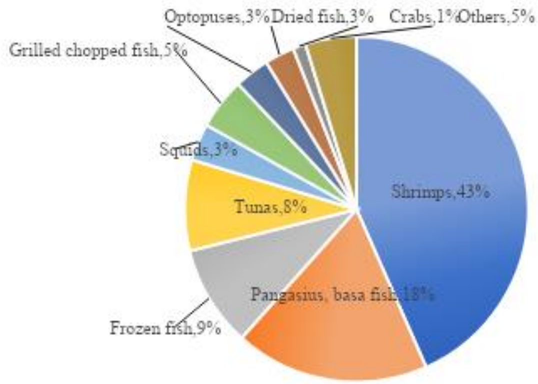

Figure 5. The structure of Vietnam's exported seafood products in 2021

Source: General Department of Customs (2022)

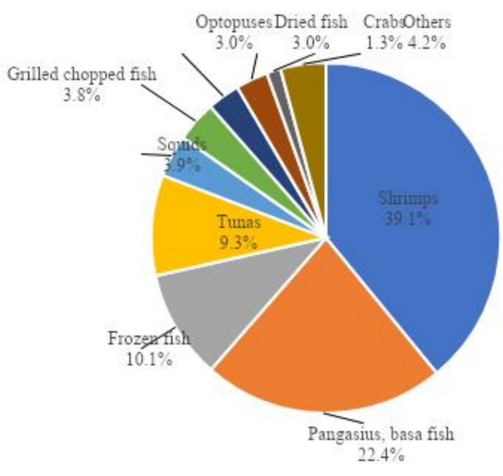

Figure 6. The structure of Vietnam's exported seafood products in 2022

Source: General Department of Customs (2022)

In 2022, shrimp remained Vietnam's main seafood export product, accounting for 19.34% of the total volume and 39.06% of the total value of seafood exports, reaching 443.4 thousand tons with a value of 4.27 billion USD, an increase of 6.7% in volume and 10.7% in value compared to 2021. Catfish and basa fish exports increased by 18% in volume and 50.9% in value compared to 2021, reaching 873.7 thousand tons with a value of 2.45 billion USD. Overall, in 2022, in the context of high inflation, seafood products that are easy to process at home, convenient, easy to store, and have affordable prices are the consumption and import trend in most markets.

In addition to shrimp, catfish, and basa fish, Vietnam also exports other seafood products such as fresh seafood (squid, tuna, octopus), canned seafood (canned fish), and some dried products (dried fish, fish floss, etc.). The common feature of these products, whether fresh or processed, is that they need to be stored at a suitable low temperature to avoid spoilage. Therefore, for seafood products, the requirement for refrigerated storage is extremely high.

The main areas for seafood production in Vietnam include: the Mekong Delta region with catfish and basa fish; Khanh Hoa, Binh Dinh, and Phu Yen with shrimp; Vung Tau, Ca Mau, and Kien Giang with tuna, swordfish, sharks, and other seafood. The main markets for Vietnam's seafood exports include Japan, the EU, the US, and China. China is currently the largest market for Vietnam's seafood exports. (Vietnam Investment Review, 2022)

In conclusion, with the total export turnover of agricultural, forestry, and fishery products in 2022 of $53.2 billion, the agriculture export sector is putting heavy pressure on Vietnamese cold chains and cold storage services. The demand may continue to rise in the near future due to the export sector growing rapidly. However, the cold storage sector is showing signs of not being able to keep up with the pace.

2.2. Status of lack of cold storage for agricultural exports in Vietnam

2.2.1. Cold storage status of Viet Nam

Vietnam's cold storage industry is experiencing rapid growth due to increased demand for services in agriculture, fisheries, pharmaceuticals, food processing, and fresh-cut flowers. According to Cushman & Wakefield, the industry is expected to reach $295 million by 2025 with a 12% annual growth rate. However, despite this growth, the industry has not yet reached its full potential. As of May 2021, there are 48 cold storage locations in the country, with a capacity of approximately 700,000 pallets, and thousands of smaller cold storage facilities with a total capacity of 2 million tons of products. Only 8.2% of domestic food manufacturers use cold chain systems, while 66.7% of export manufacturers do. Many new cold storage facilities are under construction, such as Hung Vuong Warehouse (Thaco) with 60,000 pallets, AJ Total Long Hau with 32,000 pallets, and AJ Total Hung Yen with 25,000 pallets. Emergent Cold Vietnam and Preferred Freezer have merged with Lineage Logistics, which now has three warehouses located in Binh Duong, District 7, and VSIP Bac Ninh. The southern region, particularly the province of Long An, has a more developed cold storage market due to its proximity to the Mekong Delta and Ho Chi Minh City. In contrast, the northern market has a surplus of cold storage facilities, with a design capacity increase from 26,750 pallets in 2015 to 71,750 pallets in 2018. In 2019, the leading cold storage suppliers were 16 Mekong Logistics of Minh Phu – Gemadept, ABA Cooltrans, Emergent Cold, and Hoang Lai Group, with a capacity of 45,000-50,000 shelves per warehouse.

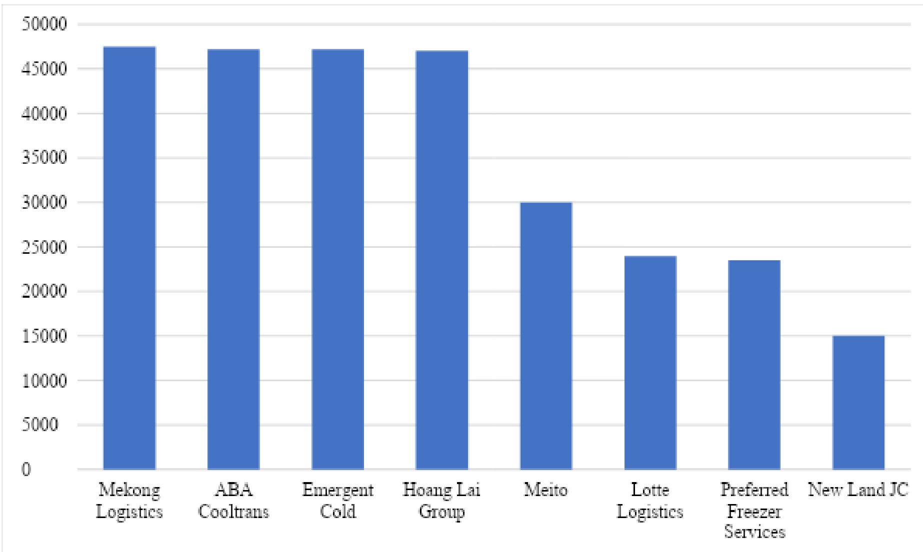

Figure 7. Typical cold storage developers by pallets in 2019

Source: Savills (2019)

In the cold storage industry of Vietnam, commercial cold storage and self-managed facilities are the primary players, with the seafood processing sector dominating the self-managed market. Between 2009 and 2019, the total import value of frozen fish rose from approximately $195 million to $828 million, while the import value of frozen shrimp and prawns increased from about $72 million to $705 million. These figures suggest that Vietnam has the potential to become a seafood processing hub in the region - indicating an ever increasing importance of cold warehouses in Vietnam

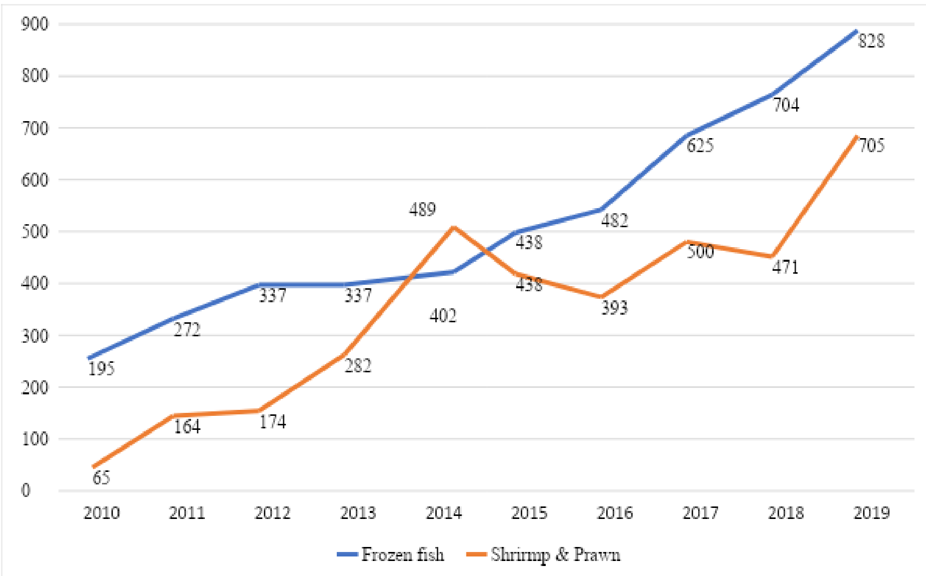

Figure 8. Import value of seafood in the period 2009-2019

Source: Trade map (2020)

2.2.2. Distribution of cold storage in Vietnam

The current utilization rate of the service cold storage system stands at a remarkably high 90%, indicating a rising demand for cold storage facilities. The market leaders in cold storage services include Swire Cold Storage Vietnam, Lotte Logistics Vietnam, Konoike Vina, CLK Cold Storage, Hung Vuong, Sojitz and Kokubu, Mekong Logistics, Kuehne Nagel, Preferred Freezer Services, Panalpina, Triton Container International, DB Schenker, Agility Logistics Vietnam, APL Vietnam, Maersk Line, Transimex, MP Logistics, Vinafco Vietnam, HPD, Emergent Cold, ABA Cooltrans, Panasato, Phan Duy, Alpha, Satra, and Lotte-Sea (VietNamNet News, 2021). In addition, there are manufacturing enterprises with self-owned warehouses that have a capacity of approximately 50-150 tons for domestic consumption, and medium to large self-owned warehouses with storage capacities ranging from 3,000 to 10,000 pallets that cater to export goods.

In recent years, a number of logistics companies have made significant investments in cold storage infrastructure on a large scale, in response to the growing demand in the market. Capacity, in this regard, is primarily based on pallets, since the evolution of technology has allowed for warehouses to be constructed with multiple floors and shelves.

- **Regarding function:** Different types of cold storage will meet the storage and transportation needs of different items based on their characteristics and properties. Items that need to be used to the deep freezer such as medicines and medical materials are used to the maximum during the outbreak of the COVID-19 epidemic. But at the present time, pre-cold storage and processing warehouses will probably be the two main objects that are invested and built the most because the items they store are meat, fish, vegetables, and sugar. .., which are the main products used in cold storage in Vietnam today. The processing industry in Vietnam is also growing, which is why these cold storages are getting more and more attention. In addition, there are distribution warehouses, stockpile and commercial warehouses, two types of warehouses that are also expected to thrive based on the trading activities of vegetables, processed meat and fish on supermarket or market applications of households in big cities such as Hanoi and Ho Chi Minh City. To meet the need of goods that are always ready to be delivered to consumers, business owners have also invested in household warehouses for food and beverage items with small businesses.

- **Regarding capacity:** capacity, occupancy rate, and distribution by region:

- Capacity: According to a market survey by Savills published at the end of 2021, Vietnam's current cold storage capacity is 0.116 m3 per capita, ranking third in Asia- Pacific after China (0.132 m3). per capita) and Japan (0.315 m3), but outperformed Australia and the Philippines by 1.4-3.1 times. The ability to provide domestic services of cold stores in Vietnam is gradually improving to facilitate exports, especially Vietnamese seafood with high-quality refrigeration.

- **The number of pallets**: Vietnam's cold storage system can currently provide nearly 900,000 pallets (much higher than the estimated 700,000 pallets by the end of 2020). The largest concentration is in the southern region, accounting for 2/3 of the total number of pallets. Particularly, Satra's cold storage (Ho Chi Minh City) currently has a capacity of 22,000 pallets, including 5 cold rooms with temperature settings, suitable for storage and preservation of a variety of agricultural and aquatic products, food, vegetables, and fruits. The second place in terms of capacity is the warehouse system in the North region (focusing on the satellite markets of Hanoi and Hai Phong) and finally the Central region and the Central Highlands.

- **Fill rate**: For cold storage: About 90%-95% depending on the season. Particularly in some areas where export orders are spread evenly throughout the year, some cold storage temperatures can be stable at nearly 100%. The rate of use of cool storage has increased compared to 2020 but in general, is still lower than that of cold storage.

- **Distribution by region**: The cold storage market is more developed in the South, especially in the Southeast provinces/cities where food processing factories (aquarius) are concentrated in meat of all kinds. The Southeast region has a lot of cold storage in Vietnam because it is closely connected with large agricultural production bases in the Mekong Delta, in addition, it is also close to Ho Chi Minh City, where there is a large population of the South and Convenient for exporting both by sea and by air.

- **Regarding demand:** The cold storage market is in a situation where demand exceeds supply due to strong demand while the addition of new cold storage supply cannot happen quickly because cold stores take longer to build other properties and cost more than standard warehouses. The demand is and will increase to serve agricultural and aquatic products in distribution channels in big cities: Modern distribution channels (supermarkets, hypermarkets, convenience stores...) will be the main driving force for Vietnam's cold storage market in the near future as about 80% of demand will come from the food sector. Products. In addition, the demand for cold storage for pharmaceuticals and cosmetics is also forecasted to increase in 2022 and the following years, when income and living standards increase.

- **Regarding price and term of warehouse rental:**

- **Rental price and rental period**: The rental price of cold storage services (including space and associated services) has increased rapidly from $52/ ton of goods to be stored in early 2020 to $87/ ton in 2021. The cold storage market in the southern provinces is considered to be more developed due to the strong increase in demand for storing food, seafood, and retail items. Due to the scarce supply of cold storage and the need to renovate to meet the individual requirements of each item, cold storage tenants often tend to prefer long-term leases. The lease term for cold storage is usually from 10 to 20 years, significantly longer than that of a conventional dry warehouse, which is only 1 year.

- **Cold storage business**: Domestic companies occupy a higher share of the supply space but foreign companies, such as Emergent Cold, PFS, and LOTTE Logistics, lead the way in quality, management and value-added services - including includes multiple temperature zones (frozen, chilled), barcodes and inventory management systems. Leading the market share in the cold storage service market are foreign enterprises such as FM Logistics, CLK Cold Storage, Emergent Cold, Swire Cold Storage Vietnam, and Lotte Logistics Vietnam. Foreign investors mainly develop large-scale cold storage systems such as Emergent Cold Ta Vietnam (formerly Swire Cold Storage Vietnam), CLK Cold Storage, and FM Logistics. Emergent Cold Vietnam and Preferred Freezer (District 7 has just decided to merge with Lineage Logistics, the world's largest corporation in cold supply chain, so in Vietnam, Lineage has 3 warehouses, and 1 warehouse in Song Than Industrial Park. 1, Binh Duong, 1 warehouse in District 7, and 1 warehouse in VSIP Bac Ninh, in addition, cold storages AJ Total Long Hau 32,000 pallets and AJ Total Hung Yen 25,000 pallets.

2.2.3. Critical shortage of Cold Storage

Vietnam is facing a critical shortage of cold storage infrastructure, which poses a significant challenge to its ability to preserve and export agricultural products, especially seafood. The nation's need for preserving fresh food, agricultural products, and seafood is now only, at most, 35% satisfied by Vietnam's cold storage warehouse capacity (Asia Perspective, 2022). The situation has been further exacerbated by the Covid-19 pandemic, leading to canceled orders and restricted movement, which has resulted in congested goods filling up the limited cold storage capacity and a surge in rent prices. This shortage of cold storage capacity also affects the ability of local sellers to distribute fresh food to consumers, especially through e-commerce and online shopping channels.

The southern region of Vietnam has a more developed cold storage market due to the growth of the fisheries and agriculture sectors, with Long An province having the highest number of cold storage facilities. This is largely due to the province's proximity to the agricultural product basket of the Mekong Delta and Ho Chi Minh City, where there is a large population. Long An is also strategically located close to Cat Lai port and directly connected to the airport by Ring Road 2, making it an advantageous location for future development. In contrast, the northern market has experienced a sharp increase in design capacity from 26,750 pallets in 2015 to 71,750 pallets in 2018. However, this has resulted in temporary oversupply and low occupancy rates, especially for new facilities.

The use of cold preservation systems is widespread in the seafood industry, but not commonly used in other agricultural products. According to a CEL Consulting survey conducted in 2020, only 8.2% of producers for the domestic market use proper cold chains, compared to two-thirds of exporters. This highlights a significant gap in the adoption of cold storage systems among domestic producers and suppliers, resulting in a high rate of post-harvest spoilage of fruits and vegetables (25.4% of total output) and an overload of cold chains during peak periods.

Despite the challenges, the cold chain segment is highly attractive in the logistics industry, with the majority of cold storage services operating at over 90% capacity (Emergen, 2021). Emergen predicts that the construction volume of cold storage will increase by 13.8% per year, reaching $18.6 billion by 2027, but shortages are still likely due to high demand for agricultural products. The growth of e-commerce and a shift towards organic consumption are expected to fuel the growth of cold chains in the coming decades, with new trade agreements like EVFTA, CPTPP, and UKVFTA contributing to increased demand for cold storage systems.

2.2.4. Reasons for the lack of cold storage

Despite quite noticeable figures regarding export values as well as positive thriving prospects for refrigerated warehouses in Vietnam, a shortage in the supply of cold storage still exists. This may be attributed to several reasons as follows:

Requirement for huge initial investment

The benefits of investing in the preservation of agricultural products, including the cold storage system, are clear, but not many farmers, cooperatives, and even businesses can do it because the investment costs are very high. For large enterprises with strong potential, investing in building cold storage to preserve agricultural products may not appear as a big challenge, but for small and medium enterprises - the sector accounts for about 97% of the total number of enterprises in Vietnam (General Statistics Office of Vietnam, 2022) - this is quite a difficult problem.

In fact, cold storage is often designed with a high degree of customization and must comply with many different layers of regulations, so construction costs are also 2-3 times higher than conventional warehouses. To illustrate, Vietnam Green Start-up Foundation (VGSF), after receiving funding from FinExpro Committee (Belgium), has started construction of 5 smart cold storages in the Mekong Delta region (Mekong Delta) with the first cold storage invested by this project having a total capital of nearly VND 24.5 billion, built on an area of 10,000 m2. ABA Cooltrans Group also set up their third cold distribution facility with a total expenditure of VND 250 billion, covering 10,000 m2 in the Linh Trung export processing zone (Thu Duc, Ho Chi Minh City). In Tan Tao Industrial Park (Binh Tan District, Ho Chi Minh City), the largest cold storage in Vietnam and Southeast Asia has been put into operation by Hung Vuong Joint Stock Company with an area of nearly 4 hectares, a total investment of VND 1,300 billion (VnEconomy, 2022).

These are just a number of notable projects covering large space storage. Checking the cost for setting up small refrigerated warehouses provided by several construction companies in Vietnam, it can register a figure of around VND 200 million for only a cubic capacity of 100m3, which is equal to a $40m^2$ area with a height of 2.5m. The number indicates the initial investment alone, the cost for land purchase or renting as well as monthly operating costs are not included.

Poor infrastructure and facilities

In order to efficiently operate a refrigerated warehouse, the vital element is a stable power source. The terrain of Vietnam is long and narrow, energy resources are unevenly distributed with coal mines with large reserves mostly concentrated in Quang Ninh region, the main gas reserves are mainly located on the continental shelf of the East and Southwest, hydropower reserves are mainly distributed in the region North and Central. While the demand for electricity is concentrated about 50% in the South, about 40% in the North and just over 10% in the Central region. These are just regional diversities, not to mention huge differences in the electricity network between urban areas and rural areas. Consequently, the chances of newly constructed cold warehouses are lower.

Moreover, due to the characteristics of this industry, agricultural products demand the least delivery time possible, which means the road infrastructure is another important factor to be considered. Unfortunately, the highway system in Vietnam is incomplete, especially in the Mekong Delta Region and Southeast Region with total exploited distances being 117 km and 95 km respectively.

The limited number of cold-container-equipped trucks may also be an obstacle. The modest number of about 1600 trucks compared to over 200,000 currently operated trucks in Vietnam indicates inefficiency, leading to less interest in building a cold storage facility.

Other causes

There may exist several other affecting factors such as a lack of promotion policies. Director of the Department of Agricultural Product Processing and Market Development Nguyen Quoc Toan said that currently there is a policy to support interest rates of 0% per annum for the first 2 years and reduce interest rates by 50% in the next 4 years for long-term loans to invest in building cold storage with a capacity of 5,000 pallets or more. “However, the loan process is cumbersome and complicated, so it has not attracted many businesses.” This is just the case for “5,0000 pallets or more” - which are quite large warehouses - meanwhile smaller businesses accounting for the majority of enterprises are benefiting from no other policies, making it even more difficult to set up refrigerated storage.

The construction of cold storage also requires meeting common standards of the whole chain, for example, cold storage for food must ensure food hygiene and safety standards. Enterprises must take quite a long journey just to satisfy this standard, not to mention the complexity of earning the certificate itself.

Another reason can be a prolonged lease time of about 15 to 20 years. This means both shortage in cold storage supply and demotivating enterprises from building their own warehouses, which consequently causes more shortages like a never-ending loop.

3. The solutions

3.1. To the Vietnamese government

3.1.1. Increase investment and support in the cold storage sector

Tax support and loan interest rate reduction: Cold storage businesses require a lot of capital. To complete cold storage, businesses may need to pay up to a hundred million VND, depending on the type of cold storage

Compared to conventional warehouses, cold storage needs more equipment such as insulation compression panels, electrical cabinets, etc. Furthermore, maintaining cold storage needs constant electricity and cold gas, which, in the long run, pushes up costs, especially taxes. "The investment cost of cold storage is two to three times higher than conventional warehouses, and the construction process may take up to six months longer" (Tin, 2021).

In addition, the post-COVID-19 economic recovery has caused the number of agricultural export orders to rise again. However, many exporters, especially seafood exporters, still face difficulties due to low cold storage reserves, causing them to reduce exploitation to avoid excessive inventory or damage to their goods, thereby leading to failure to meet market demand.

Thus, tax support and interest rate reduction, especially credit loan packages, is a good measures to support businesses that invest in cold storage. When supported, these businesses will reduce rents, thereby reducing pressure on exporters' customers.

3.1.2. Invest in researching equipment, educating enterprises, and gradually reducing professional dependence on foreign countries

The investment in cold storage also faces many challenges because some peripheral equipment must be imported and consulted from abroad. The State plays an important role in researching scientific and technical solutions, buying patents, transferring technologies to support enterprises, and creating conditions for enterprises to be proactive in investing and operating cold storage.

3.1.3. Constantly changing or reducing unnecessary administrative procedures

Trade facilitation is also an issue that the Vietnamese government should also consider. The elimination of cumbersome and unnecessary export procedures will speed up the export of agricultural products, and reduce the congestion and damage of goods. Fast export time will reduce inventory status, thus reducing cold storage cost pressure for businesses.

3.1.4. Facilitate the formation of a cold storage supply chain network

Vietnam has many cold storage suppliers, but most of them are small and medium suppliers, operating locally, and the connectivity between regions is not high. The government could invest in more infrastructure such as highway development, as well as other utility networks, such as communications and renewable energy, to attract more domestic and foreign investors to Vietnam's potential cold storage market.

3.2. To cold storage businesses

3.2.1. Focus on improving the cold storage management

Cold storage management requires high professional expertise. Some of the requirements include understanding the activities taking place in and out of the cold storage, and monitoring related factors such as freezing time, cold storage equipment, electrical cabinet maintenance, and disinfection. Cold storage system management also requires knowledge about the risks that may occur in the warehouse and finding the best way to deal with those arising problems.

In general, the current management of cold storage also has some difficulties such as controlling warehouse temperature; preservation of food and goods in warehouses; arranging and system goods in warehouses to optimize the loading and unloading and transportation process (very important because agricultural products have a short lifespan and quickly rot). Businesses can overcome the above problems by using smart warehouse management software, using the shelf system, and continuously training storekeepers and warehouse staff,...

3.2.2. Expand current storage or build new warehouses

The best way to solve the problem of cold storage shortage is to build new ones. Cold storage works best near the source of supply, typically seafood with a convenient warehouse location must be near the port, near convenient traffic locations, which as mentioned, requires significant investment capital. In addition, the current capacity of warehouses is low, and the occupancy rate is still high, in some places over 90% (Phong, 2021). Thus, building new cold storage requires close cooperation of enterprises with authorities at all levels.

Expanding current storage is also viable, should the businesses have enough investments.

3.3. To cold storage users

3.3.1. Reducing cold storage lease time

According to Trang Bui (2021, cited in VietNamNews, 2021), in the Vietnam market, the cold storage lease term usually lasts 15-20 years while the country only has about 50 facilities, along with difficulties in new construction and expansion, making cold storages supply even more scarce. Reducing the allowed lease time may be able to relieve the pressure of shortage.

3.3.2. Diverting exports of agricultural products to official quota exports seaway or railway

Sub-quota exports are familiar in the Vietnamese agricultural market, especially with fruit products like dragon fruits to the Chinese market, making businesses passive should any changes in importing policies be made in the importing countries. Turning to official quotas for export using seaway or railway may be a solution to reduce congestion of goods congestion at the border gate, and improve the import-export cycle rate, which helps reduce pressure on cold storage.

4. Conclusion

Cold storage is an indispensable factor in the export process of agricultural products. However, the shortage of cold-storage vegetables and fruits, fishery, and meat has caused a bottleneck in the export of these products in Vietnam. The reasons for this scarcity come from a lack of resources for investment, poor facilities and infrastructures, and so on. Since, many parties including the government, cold storage businesses as well as cold storage users should take action to solve the problem with a view to ensuring the development of the agricultural export industry.

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