Taiwan Market Study On Opportunities For Cold Chain In Taiwan

Final Report

Asian Pacific Research Ltd.

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Glossary

CPTTP:	Comprehensive and Progressive Agreement for Trans-Pacific Partnership
COA:	Council of Agriculture (Taiwan)
EGAC:	Evergreen Air Cargo Services Corp
Han Kuan:	Han Kuan Fruit & Vegetables Production Cooperative
MFVC:	Mailiao Fruits & Vegetable Cooperative
MT:	Metric ton
NLOT:	Netherlands Office Taipei
TACT:	Taiwan Air Cargo Terminal Limited
TAL:	Tsaitung Agriculture Limited
TALP:	Taoyuan Agricultural Logistics Park
TAPM:	Taipei Agricultural Products Marketing Corporation
TIPC:	Taiwan International Ports Corporation, Ltd.
TOP:	Taiwan Orchid Plantation

Table 1. Annual Average Exchange Rates

Currency	2016	2017	2018	2019	2020
EUR to USD	1.11	1.13	1.18	1.12	1.14
TWD to EUR	35.70	34.37	35.56	34.59	33.59

Source: Exchange Rate European statistics, Bank of Taiwan

1. Objectives and Methodology

Netherlands Office Taipei (NLOT) engaged Asian Pacific Research (APR) to conduct a study of the cold chain in Taiwan which would describe its current status, the responsibilities of its stakeholders, existing shortfalls, the need for upgrading and business opportunities for Dutch companies/institutes in its future development.

The research methodology consisted of primary in-depth interviews with stakeholders in the cold chain in Taiwan and with Dutch companies interested in business participation. Already available data was also collected from stakeholders and other reliable sources.

These inputs were analyzed by APR and reported on herein.

2. Abstract

The main conclusion of this study is that Taiwan's current system of agricultural production and wholesale marketing will need to invest substantially in the provision of additional cold chain facilities to meet the quality demands of Taiwan's highly competitive and rapidly evolving retail sector, which is itself investing in 'last mile' facilities. This process will over time create substantial opportunities for Dutch cold chain technology and equipment to play an important role.

Taiwan's ambitions to develop export growth will also require investment in cold chain systems. Taiwan consumers admire the quality of imported Japanese fruits which is due in large part to its cold chain capabilities. Taiwan will need the same to become a competitive fruit and vegetable exporter.

Arising out of the Presentation discussions on December 9, 2021, we would also

suggest that NLOT/Dutch stakeholders propose to COA that it would be prudent to establish a 'strategic reserve' of vegetables and fruits to be held in cold storage as a buffer against extreme weather events, which will only get worse as climate changes progresses, and as a protection against possible aggression from China. We believe food security could become a major issue as climate change impacts all global economies.

In the past 40 years, Taiwan's retail sector has evolved from 'Mom & Pop' shops to a modern retail sector of supermarket chains, hypermarket chains, convenience store chains, e-commerce, central kitchens and food delivery, During the same period Taiwan's agricultural production and wholesale marketing has remained dependent on 'Mom & Pop' tenant farmers and a fragmented system of Agricultural Co-operatives and Product Marketing Associations established by law in 1981.

As a result, there is an uneasy juxtaposition between the comprehensive cold chain facilities developed by the major retail chains for the 'last mile' delivery and the very patchy provision of cold chain facilities of the Agricultural Co-operatives, Product Marketing Associations and neighborhood wet markets.

The retail chains' demand for high standards of fresh produce is driven by strong competition in the retail sector, the need to sustain their brand image and the incentive of higher prices and income from high quality produce. Preventing loss of product by expiry is also a concern.

Some inroads into the established system of Agricultural Co-operatives and Product Marketing Associations have already been made. The Taipei Agricultural Products Marketing Corporation (TAPM) has adopted some limited cold storage to enable it to supply PX Mart in northern Taiwan, as a second business outside its original remit. In addition PX Mart is using its own logistics company to buy product directly from Agricultural Co-operatives and from some farmers who have specialty fruits and

vegetables. Uni-President, Costco and other major retail chains have followed suit.

Nonetheless, the process of improving cold chains systems throughout the whole supply chain to obtain quality and reduce post-harvest loss is likely to be a slow-moving process. The main barrier to development in the production and wholesale phase is that tenant farmers are too small to develop their own cold chain facilities and many of the multiple small Co-operatives who collect and transport produce are also under-capitalized. They and the wholesale Product Marketing Associations and the neighborhood 'wet markets' rely very much on the speed of same day turn-around.

The consequence of this in the traditional markets is both post-harvest loss, which we estimate at 8-12% as produce passes though many disconnected links, and the delivery of products of variable quality and price. In the wet markets, for example, early customers get the pick of the produce at a reasonable price but the price of left-overs declines sharply as produce moves into the evening 'twilight market' of street vendors and finally the night-markets. It is difficult to measure this loss of value but at a rough estimate it accounts for about 20% of daily sales in the wet markets.

The solution would be a process of consolidation and specialization in the production and wholesale marketing phase to match that in the major retail chains. Some of this is slowly taking place. Some farmers are beginning to accumulate multiple holdings and some of the Agricultural Co-operatives, such as Han Kuan Fruit & Vegetables Production Cooperative and Mailiao Fruits & Vegetable Cooperative, have made substantial improvements in their cold chain facilities to meet the quality demands of retail chains and exports to Japan. It will take time for their peers to follow suit.

Rapid change, however, is hampered by Taiwan's land ownership system and the system of multiple small Co-operatives and Product Marketing Associations enshrined in the Agricultural Products Market Transaction Act of 1981. The present system is also

protected by high tariffs on imported fruits, vegetables and flowers which are mainly about 20-24%, rising to 60% in the case of mangos.

Since it would be difficult for government to accomplish changes in legislation, the government's focus is on improving the existing system with new incremental projects, such as the Taoyuan Agricultural Logistics Park, and with subsidies and technical support offered to farmers and Co-operatives.

Although it will be slow-moving, we believe there will be an on-going process of cold chain upgrading that will offer a strategic opportunity for Dutch interests to apply their cold chain knowledge, expertise, and regional experience.

In the public sector, it will need a policy of collaboration with the Taiwan authorities in the development of logistics parks. In the private sector, the supply of vacuum pre-coolers, packaging machines and more advanced cold storage controls to the Co-operatives and third party logistics companies would offer substantial sales. If each Co-operative were to buy one or one more vacuum pre-cooler, that would be a total market of over 1,000 vacuum pre-coolers.

Dutch companies are already active with direct arm's length sales of equipment and services. Our major recommendation for the medium term is that Dutch companies acquire a controlling interest in an existing agricultural machinery company in Taiwan that has a good domestic sales team and machinery capability and beef it up with Dutch resources, expertise and equipment inventory. This strategy has been successful in Taiwan for Bechtel, a major U.S. engineering company and Colgate Palmolive, a U.S. consumer goods company.

This approach would give the Dutch companies a presence on the ground and a basis to build a dominant position in domestic sales. We would also suggest this entity offers

equipment leasing options which would help to overcome the lack of capital of the Co-operatives and others. We think leasing would be a good option for more rapid market penetration in a stable market that is familiar with equipment leasing and for maximizing margins on the lease, maintenance and replacement. As Taiwan develops its export markets, Dutch companies could then leverage their regional and global experience to provide end-to-end cold chain logistics.

To achieve this goal, Dutch companies will need to raise awareness of their capabilities and experience in Taiwan. Dutch cold chain is not completely unknown in Taiwan but Taiwan companies wonder if they have a detailed understanding of the market and a commitment to long term engagement. This would be a potential area for NLOT activity in arranging exhibitions, virtual and physical trade missions and other promotions.

3. Supply Flow of Vegetables, Fruits and Flowers

In 2020, the total market size in Taiwan was about 6 million MT of fruits and vegetables and USD427 million of flowers.

Table 2. Total Market Size of Vegetables, Fruits and Flowers

Product	Unit	Production	Import	Export	Market Size
Vegetables	'000s MT	2,432.8	465.2	76.9	2,822.0
Fruits	'000s MT	2,787.1	550,6	204.5	3,133.2
Total	**'000s MT**	**5.219.9**	**1,015.8**	**281.4**	**5,955.0**
Flowers	USD mill.	600.0	21.7	194.8	426.9

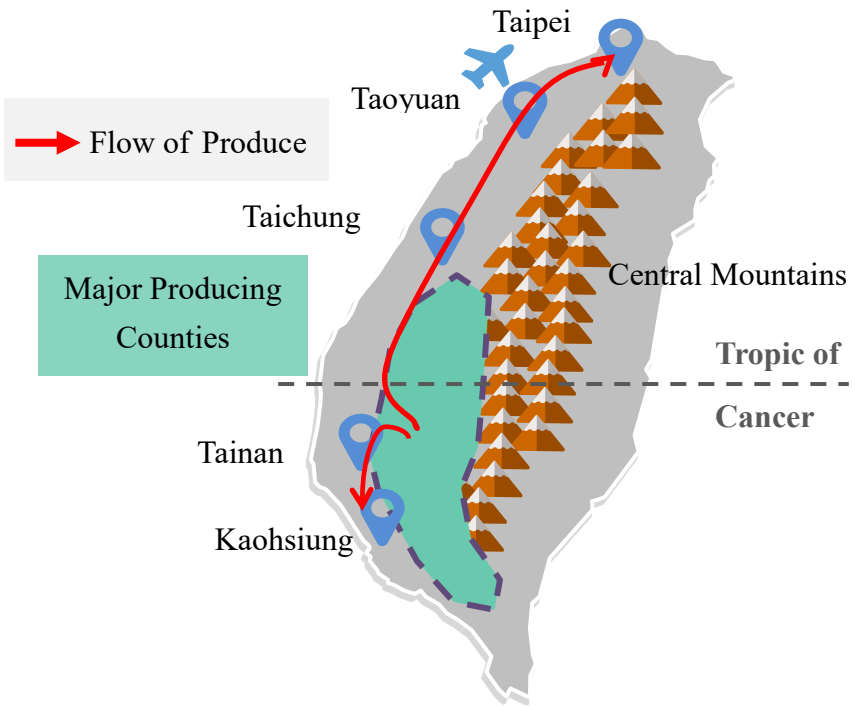
Source COA Statistics/COA Agriculture and Food Agency

3.1 Domestic Supply

In 2020, Taiwan's small, tenant farmers produced 2.4 million MT of vegetables, 2.8 million MT of fruits and US$600 million of flowers, most of which was delivered by

Freeway and highways to the major cities on the west coast of Taiwan.

Table 3. Flow of Produce



The main producing counties are Yunlin, Changhua, Nantou, Pingtung and Chiayi Counties. They are located across the Tropic of Cancer in the foothills and valleys of the central mountain range. Production of orchid seedlings is concentrated in the Tainan Orchid Plantation (TOP).

Vegetables, fruits and flowers are delivered from the major producing counties to the major cities on Taiwan's west coast, mainly along the Freeways. There are also some local deliveries to near-by townships and some small producing areas on the east coast.

3.2 International Trade

In 2020, Taiwan imported about 1 million MT of fruits and vegetables, despite some very high protective import tariffs of 20-25% on many fruits, vegetables and flowers,

rising up to 60% on fresh mangos. This protection against imported produce is one reason why Taiwan's domestic agriculture and its cold chain provisions have not been modernized.

There was a limited amount of predominantly fruit exports of 0.3 million MT, which have encountered some complaints in Singapore, China and Japan and raised questions about consistent quality up to international standards.

The most significant exports were USD194.8 million of orchid seedlings, in which Taiwan is a world leader as a result of investment in high grade, temperature controlled greenhouses and R&D. It is a good example to follow.

3.3 Cold Chain Application in Taiwan

Thus the main application for cold chain logistics in Taiwan is largely for vegetables, fruits and flowers from domestic farmers to domestic markets. Imports/exports are largely by air through Taoyuan International Airport, near Taipei.

For purposes of analysis we have divided the cold chain systems connecting producers with consumers into three parts

- Cold chain stakeholders in production and wholesale
- Cold chain stakeholders in retail
- Cold chain stakeholders in internationally traded product

4. Cold Chain Stakeholders in Production and Wholesale

Taiwan's current agricultural system was established long ago by the Agricultural Products Market Transaction Act of 1981, as amended in administrative details 1983-2006. An English translation of the Act is available at

http://extwprlegs1.fao.org/docs/pdf/chn137871E.pdf. This Act was designed to provide predominantly small tenant farmers with direct access to wholesale and retail markets. It established Agricultural Co-operatives and Agricultural Co-operation Groups to arrange collection, packing, consolidation, transport and overall management services for delivery of produce mainly to government sponsored wholesale Product Marketing Associations spread throughout the country. The Taiwan authorities were concerned that without these government provisions, the farmers would be exploited by middle-men. In 2004, the government also established the Taiwan Orchid Plantation (TOP) near Tainan as a special provision for orchid farmers.

Table 4. Stakeholder Responsibilities in Production and Wholesale Phase

Stakeholder	Cold Chain Stake	Technologies & Operating Systems	Challenges
Fruit, vegetable and flower farmers, except orchids	Grow & harvest produce and arrange for packing & collection by Agricultural Co-operatives.	No cold chain facilities. Rely on quick packing and collection by Agricultural Co-operatives	Small harvest lots, limited resources, labor shortage, remote locations
Agricultural Co-operatives and Groups	Collection from farmers, packing, transport and overall management	Varied capabilities in pre-coolers, reefers and temperature controlled packaging centers.	Just-in-time collection, packing and transport.
Product Marketing Associations	Hubs for distribution of produce by authorized dealers to wet markets and retailers	Limited cold storage. Rely on speed of turn-around	Traffic congestion

Source: APR interviews

4.1 Farmers

Taiwan's farmers are mostly small tenant farmers with average small-holdings of about 0.5 hectare. They are rented from state-enterprises, large corporations and wealthy individuals.

For farmers, growing their produce is challenge enough. They face a hot and humid subtropical climate, arid soil, extreme weather events, such as typhoons, draughts and flooding, and the occasional earthquake to keep them on their toes. Most of all, their scale is too small and they have no money to invest in cold chain facilities.

In recent years, COA has provided a cold chain subsidy programs for the farmers, but the budget is only NT$10 million at the most and a pre-cooling facility for NT$10 million would use it up and the rest still requires the farmer to have his own capital investment. In any case, individual farmers are too small scale to warrant such a purchase and the only uptake has been by a few Co-operatives.

Some of the farmers are also in remote locations where it is difficult to get labor for picking and packing. Thus the farmers rely heavily on the various Co-operatives to help with harvesting and quick collection to take the produce to their warehousing and packaging centers for delivery to the major city markets and direct to local customers.

We have included the orchid farmers in internationally traded product because their orchid seedlings are mainly exported.

4.2 Agricultural Co-operatives & Groups

Agricultural Cooperatives, registered in the Ministry of Interior, and Agricultural Groups, registered in the Council of Agriculture, are primarily responsible for collecting

produce from the farmers and delivering to the wholesale markets. In 2019, there were 1,161 Co-operatives of various kinds including 768 engaged in production, 373 in marketing and 15 in labor supply.

As a benchmark we have looked in detail at Han Kuan Fruit & Vegetables Production Cooperative, one of the largest Agricultural Cooperatives for fruit and vegetables and located in Yunlin County, which supplies over 30% of Taiwan's vegetables.

There are currently around 1,000 farmers working with Han Kuan, on about 190 hectares of arable land. Han Kuan's farmers produce a wide variety of vegetables, including shallots, potatoes, pakchoi, mustard greens, cabbage, rapeseed, kale, qingjiang cabbage, head lettuce, water spinach, spinach, leaf sweet potato, and also chrysanthemums. Its average annual turnover is more than NT$ 1.1 billion, and when the price of vegetables is good, it can go up to NT$ 1.5 billion.

Han Kuan has adopted a comprehensive ERP operating model including planning, planting and production control, including disease and pest control and the use of fertilizers and pesticides, post-harvest processing, grading, packaging, cutting, ready-to-eat processing, marketing, warehousing, distribution, and online marketing.

Its model also predicts future market demand and plans seasonal production in advance. For example, Han Kuan predicts the demand for carrots in 2022 will be between 80 and 100 hectares. In May, farmers will be asked to keep the land available. After the contract is made, the price is also negotiated. The price of most leafy vegetables is determined according to the price at the time of harvest. The price of root vegetables is set in advance.

Hua Kuan has one vacuum vegetable and fruit pre-cooler with a capacity of 8-10 pallets and purchased at a cost of NT$7-8 million, three temperature-controlled packaging

processing plants and a total 22 packaging lines. In the pre-cooler, the temperature of leafy vegetables can be reduced to 8-10°C. The maximum pre-cooling capacity each time is about 5 tons of vegetables. The daily average output is about 100 tons, and the maximum amount can reach 150 tons. The temperature in the packaging centers is below 20°C.

Depending on season and location, Han Kuan will plan the harvest and drive its vacuum vegetable and fruit pre-cooler to the farms whose produce need it most. For other farms it will send reefers or ordinary trucks. The produce is then delivered to their packaging centers for packaging and grading.

After packaging, produce is mainly delivered to the Product Marketing Associations. More recently, Han Kuan has started to deliver produce to PX Mart, the largest chain of supermarkets. Han Kuan supplies vegetables directly to PX Mart's branches in central and southern Taiwan and to PX Mart's own logistics centers in New Taipei City, Taichung, and Kaohsiung. PX Mart will then distribute them to various stores by its own logistics company.

4.3 Product Marketing Associations

A total of 54 Government-provided Product Marketing Associations are spread through every city and county in Taiwan, 48 of which are for fruits and vegetables and 6 are for flowers.

As a benchmark, we have looked in detail at Taipei Agricultural Products Marketing Corporation (TAPM), which is the largest. The Co-operatives and third party logistics companies deliver produce to TAPM in the early hours of morning where it is sold by auction and/or by negotiation to authorized dealers. The dealers then arrange distribution to the wet markets and to hotels, restaurants and other institutions. Auction

prices are posted by TAPM.

With the development of supermarket chains, TAPM has also diversified into a second business to supply vegetables and fruits for super market chains. TAPM supplies to over 180 PX Mart stores in Greater Taipei, TAPM has limited cold storage and is applying to government for budget to build more, especially for its new PX Mart business

5. Cold Chain and Major Stakeholders in Retail

In Taiwan, the government provided neighborhood wet markets are still popular with the older generation, but the younger generation has turned to large supermarket and hypermarket chains, convenience store chains and more recently e-commerce for fresh produce and food delivery from central kitchens.

Table 5. Stakeholders in Retail Phase

Stakeholder	Cold Chain Responsibilities	Technologies & Operating Systems	Challenges
Neighborhood Wet Markets	Sell produce to households, restaurants and small shops	No cold storage. Rely on speed of turn-around	Traffic congestion
Major Retail Chains	Buy from Co-operatives and wholesalers and directly from farmers	Have their own or hired temperature controlled logistics centers, reefer trucks and quality control	Heavy traffic and narrow roads in the last mile
Third Party Logistics Companies	Support major retail chains	Have their own cold storage and reefer trucks	Heavy traffic and narrow roads in the last mile

Source: APR interviews

5.1 Neighborhood Wet Markets

The major sales channel for domestic fruits, vegetables and flowers from the Product Marketing Associations are the wet markets which are provided and supervised by the government. The wet markets leases stalls to small dealers and are open to the public. Customers include households, hotels and restaurants and small retail shops.

There are many wet markets in neighborhoods throughout Taiwan's major cities, selling fresh meat and fish as well as fruits, vegetables and flowers. The produce is sold 'loose' so that customers can pick and choose their items before wrapping in plastic sheets. The wet markets are kept at about 20°C but have no cold chain facilities. The aim is to clear produce in the same day. The better quality items are sold in the morning and afternoon and the left-overs are then sold at a discount to the 'twilight market' of street vendors and the food stalls of the 'night markets'.

5.2 Major Retailer Chains

PX Mart now has nearly 80 vegetable suppliers, including Han Kuan Co-operative, the Taipei Agricultural Products Marketing Corporation (TAPM), and regional Co-operatives of small farmers that grow some special types of vegetables that only small farmers grow.

PX Mart screens its suppliers to confirm whether the origin, equipment and process meet their standards. After that, suppliers are also required to set up a 'traceable agricultural products center'. All fruits and vegetables are screened for field management and pesticide residue inspection, and then the quality and appearance of the fruits and vegetables are inspected in accordance with the specifications required by PX Mart, and the dimensions and weight are measured. Next, the suppliers would do re-classification, with packaging according to different items, and delivered to PX Mart's 6 fresh

processing centers across Taiwan.

Sunmake Enterprise Co. is responsible for supplying all the fresh products sold to PX Mart. PX Mart has 6 processing centers in Taiwan, 3 for fresh produce and 3 for fruit and vegetable products. They are located in New Taipei City (Wugu and Xindian), Taichung City (Dadu and Tanzi), and Kaohsiung City.

After arriving at the processing centers, there are three checkpoints including reefer temperature test, pesticide test and quality test. After confirming that the goods are in good condition, they will be sent to all PX Mart stores in Taiwan for sale. In addition, food safety inspections will also be conducted from time to time.

5.3 E-Commerce and Central Kitchens

MOMO, a major e-commerce platform, started selling fresh vegetables and fruits in Taipei and New Taipei from May 2021 because of the surge in consumer demand for online purchase of fresh products after the outbreak of the Covid epidemic.

MOMO does not yet have any cold chain storage or delivery and cooperates with 9 logistics companies, 3 for vegetables and 6 for fruits, to ship produce to the consumers' side.

One of their suppliers has 3 warehouses in Northern Taiwan where they grade and package the produce and use their own 60 small reefer trucks, which can be allocated every other day in Taipei/ New Taipei city from their logistics center in Taipei. MOMO is concerned that they do not have pre-cooling or cold storage, because they often receive complaints from consumers, such as vegetables getting old and not being fresh.

Another supplier is Tsaitung Agriculture Limited (TAL) which established the brand

'Next Door Fresh', originally as a platform for restaurants to directly purchase vegetable from producers. TAL would collect vegetables in the production area and transport them to their logistic center in Taipei to distribute to their restaurants. However, the outbreak of Covid-19 in May 2021 greatly reduced the demand from restaurants and so they began co-operation with MOMO. TAL has its own cold chain facilities to distribute products to the consumers' side

MOMO's fresh food sales account for about 15% of the total. While the shelf life of fresh vegetables and fruits is short, the investment of cold chain warehousing logistics is about 3 to 5 times that of room temperature, so MOMO will continue to monitor its fruit and vegetable sales post-Covid before making any investment decision.

Other e-commerce platforms following MOMO are Foodpanda, a food delivery company, Just Kitchen, a rapidly growing central kitchen chain that supplies food to restaurants, hotels and household and Family Mart, a major convenience store. Like MOMO they rely on third party logistics companies

5.4 Third Party Logistics Companies

Some of the major retail chains, such as Costco, a hypermarket chain, and emerging e-commerce platforms, have outsourced their logistics to third party logistics companies. Costco imports fruit and vegetable both by sea and by air. If they are by sea, they will be sent to Costco's distribution center in Taoyuan after arriving at the port, and then distributed to 14 branches across Taiwan. Costco's logistics center is called a cross dock depot, different from other manufacturers.

The Depot itself basically does not store any goods, but collects all the ordered goods and then distributes them to the refer trucks for transport to the required shopping malls. After the goods arrive at the depot, they can be distributed directly to the store without entering

the warehouse, which can greatly reduce logistics costs. In the cross-transport mode, it only takes 8 hours from receiving the goods to being fully loaded to the store. The above distribution process is handled by a third-party logistics company.

About products transported by air, after arriving at the airport, they are directly delivered to Costco's stores by a third-party logistics company. As an example, during the summer fruit season, the fruit "Washington cherries" imported from the U.S. was picked up from the production area and delivered to the store in Neihu, Taipei. It took only three days.

Costco also sells fruits and vegetables produced in Taiwan, but the quantity is small, and the conditions of each branch are different. For this part of the fruits and vegetables, they cooperate with farmer Cooperatives or logistics companies in the producing area. Costco requires products to go through a complete cold chain supplied by its third party logistics companies.

We have found that Rd&D Cold Logistics Co. is one of those that works with Costco. Rd&D provides total solutions for cold chain logistics services and have 8 cool temperature warehouses and 150 reefer trucks.

One of the largest logistics companies is Yuguo Refrigeration. Yuguo's business includes refrigerated storage, low-temperature warehousing and reefer transportation for meat and vegetable imports, food processing & manufacturing. It is a listed company with a total of seven factories in Taiwan

Another logistics company is Flow Tide Enterprises whose logistics park covers an area of 66,000 m^2 and it has 9 warehouses, 7 in the north, 1 in the middle, and 1 in the south. It also has 300 workers, 150 three-temperature vehicles, and over 18,000 pallets.

These third party logistics companies are becoming increasingly important in getting

round the limitations of the Agricultural Co-operatives and Product Marketing Associations.

6. Cold Chain and Major Stakeholders for Internationally Traded Product

Most fruits and vegetables and orchids that are gown for export, as well as most imports for the domestic market, are transported by air, mainly through Taoyuan International Airport. Only a few fruits and vegetables are exported by sea from the Port of Kaohsiung to China or from Kaohsiung Airport, due to limited flights.

Table 6. Major Stakeholders For International Traded Produce

Stakeholder	Cold Chain Stake	Technologies & Operating Systems	Challenges
Orchid farmers	Lease greenhouses from TOP	TOP provides bacteria free, humidity, light and temperature controlled greenhouses	Small lots but benefit from the TOP cluster. Maintain high quality for exports, mainly to U.S. and Japan
Niche Co-operatives	Produce specialty fruits and vegetables for export	Pre-cooler, temperature controlled warehouses, reefer trucks	Maintaining top quality for export markets, especially Japan
Airports and sea ports	Lease land to Cargo Terminal Operators	None. Allow transfer from planeside or shipside to cargo terminal operators	Flight delays
Airport Cargo Terminal Operators	Store produce for collection	Pre-coolers, freezers, low temperature warehousing	Limited capacity and many varieties of product

Source: APR interviews

6.1 Tainan Orchid Plantation (TOP)

Tainan Orchid Plantation was established in 2004 by the government which leased land and state-of-the-art greenhouses to orchid seedling growers. The greenhouses were built with the help of the Netherlands and the USA and are bacteria free, humidity, light and temperature controlled.

TOP also provides R &D facilities which enable the growers to produce many new varieties each year for sales to the EU, U.S. Japan and other countries with whom it has mutual IP recognition agreements. It is also a global sales platform with international exhibitions. TOP is thus very much an outlier and an example of the consolidation, specialization and quality which is needed to develop international markets.

6.2 Niche Cooperatives

Mailiao Fruits & Vegetable Cooperative (MFVC) is an example of a new breed of niche co-operatives. MFVC is located in Yunlin which supplies 90% of Taiwan's lettuce. MFVC has co-operated with a small group of 200 farmers who specialize in lettuce. The planting area of lettuce is 350 hectares, with an annual output of 12,000 tons and annual turnover is more than NT$200 million.

Over 50% of the lettuce is exported, and 90% of it is sold to Japan where its main customers are McDonalds and MOS burger. In the domestic market they mainly supply to the processing plants of Family Mart for sale in salads. Its Japanese customers especially not only require good appearance and quality of their vegetables, but also the supply and quality must be stable, so that customers can have a sense of trust in its supplier. Hence MFVC puts a strong emphasis on quality control

At about the end of July each year, the MFVC negotiates orders with clients and

proposes the land area and production plan of the season with farmers based on the number of orders and personally visits the fields to survey farmers. In this way, each farmer can stagger the planting time and MFVC can also have stable supply.

MFVC then provides seed to every farmer uniformly. Farmers are responsible for planting, fertilizing, irrigating, and occasionally pulling and weeding at the specified time. Other tasks such as pesticide application and harvesting are left to MFVC. The contract price is about NT$250,000 per hectare.

To meet its customers' quality requirements, MFVC has purchased one vacuum pre-cooler, one low temperature warehouse, three packaging machines and ethylene gas control equipment and packaging materials. The vacuum pre-cooler was purchased at price of about NT$10 million from a Taiwan manufacturer (who probably imported the compressor from Japan) in preference to a Dutch offer which was cheaper, but MFVC was worried about import tariffs and maintenance costs. The three packaging machines were specially imported from the Netherlands and cost more than NT$10 million.

MFVC recently bought an ethylene gas controller because vegetables (and fruits) generate ethylene gas by themselves which affects the ripening effect. They hope to slow down the content of ethylene gas and further extend the shelf life.

After harvesting, the lettuce is placed in the vacuum pre-cooler, in which the temperature can be reduced to 4°C in 30 minutes, and then moved to the low-temperature temporary storage area for grading, packaging, and shipping. They can control the entire process to be completed within 4-6 hours. The storage and transportation preservation period for export has been extended from 20 days to 28 days. After deducting the voyage, the time to market can be maintained at no more than one week, and the product yield rate can be maintained at 98%.

MFVC have almost no problems with post-harvest loss, and the proportion is very low, only about 1-2%. MFVC mentioned that each Co-operative and its farmers have their own different operating processes and customize the equipment they want with equipment manufacturers. MFVC also mentioned the shortage of labor, especially for packers. Few people can work with them for half a year and take a half-year off. Even if they buy a machine and want to reduce manpower, it's still hard to find a person who can operate the machine.

MFVC recommend that Dutch manufacturers get to know the general situation and then contact various agricultural organizations one by one to understand the needs and pain points of each customer.

6.3 Air Cargo Terminal Operators

Most internationally traded fruits and vegetables are transported by air, mainly through Taoyuan International Airport and a little through the Port of Kaohsiung to Fujian, China. The role of Taoyuan Airport and the seaports, owned and operated by Taiwan International Ports Corp. (TIPC), is to lease land to their clients to build their own logistics processing centers, because the knowledge/ know-how of cold chain logistics is best known to their clients.

Taoyuan airport currently leases out four cargo terminals to Taiwan Air Cargo Terminal Limited (TACT), Evergreen Air Cargo Services Corp. (EGAC), Farglory Free Trade Zone, and Everterminal Co. However, only Evergreen and Farglory have Planeside Release warehouses for handling fruits, vegetables, live orchid seedlings and other perishable items. Since the Evergreen Air Cargo warehouse is closest to the apron, 70% of the Planeside Release Warehouse operations are undertaken by them. The rest 30% are undertaken by Farglory Free Trade Zone

Evergreen Air Cargo's warehouse is divided into four areas: Express, Planeside Release cargo, Export / Import cargo, and Transit cargo. The designed annual handling capacity of Evergreen Air Cargo is 720,000 tons, but only 80,000-90,000 tons are for Planeside Release cargo, which includes fresh food, perishable products, live animals/plants and special items.

When perishable products, like vegetables, fruit and flowers, arrive at the airport, the ground company will drag the goods to the Planeside Release Warehouse where the authority would check import declarations, packing lists, invoices, airway bills, letters of appointment, and import permits (in required cases) for clearance applications. Once the clearance procedures are completed, the applicants could take away their goods. In general, the timeframe from the plane's arrival at the airport to the applicant picking up the goods is about 3-4 hours. Even if there are delays due to safety inspections or document changes, it will not take more than 6 hours as a whole. The whole purpose of Planeside Release cargo is to ensure products are picked up as soon as possible.

Exports need to arrive at the airport about 2 hours before the flight to deal with inspections and documents. Evergreen Air Cargo would the pack these goods in a form that can be shipped. The whole process from the arrival of the goods at the airport to the flight takes about 2-3 hours. An online cargo tracking and tracing system enables customers to check their cargo in real time through.

Because of the short stay in their warehouse, Evergreen has 20 coolers (0 to 15°C), 25 freezers (- 18 to 0°C) and 1 temperature controlled warehouse (20 to 25°C). The current cooler/freezer was built more than 10 years ago by a Taiwanese manufacture. It is a very simple one only to control the temperature, there is no special technology. Evergreen also expects its customer to pack their goods in a special packaging material if needed before boarding the plane

It's being discussed that around 2032, Taoyuan Airport will develop a new Air Cargo Park adjacent to the airport. At that time, Evergreen Air Cargo will also move over, so they will not be able to invest in new equipment with only 10 years left, unless it is moveable.

7. Shortfalls in Taiwan's Cold Chains and the Need for Upgrading

Even though Taiwan is a relatively small market, its supply chain is highly fragmented and disconnected with too many small farmers, too many small Co-operatives, too many Product Marketing Associations and not enough mouths.

7.1 Fragmented and Disconnected Cold Chain System

At the start of the process, Taiwan's small tenant farmers do not have the money or the business justification to invest in cold chain storage. They are reliant on working with a large number of Co-operatives and other logistics companies to collect their produce and deliver it to packing centers provided by the Co-operatives or to logistics centers set up by major retail chains.

In the production and wholesale system, the cold chain capabilities of the Agricultural Co-operatives are very varied. Han Kuan, which serves over 1,000 farmers has one vacuum pre-cooler, three temperature-controlled packaging and processing plants and a total 22 packaging lines and 200 reefer trucks. By comparison, MFVC has one vacuum pre-cooler, one low temperature warehouse, three packaging machines and ethylene gas control equipment and packaging materials for 200 farmers. Both of these are probably best-in-class and the cold chain capabilities of other co-operatives are much less.

At the next stage, wholesale Product Marketing Associations have even less cold chain capability with only a limited amount of cool storage and the wet markets none at all.

Major retail chains, on the other hand, such as PX Mart, Uni-President and Costco have

set up their own logistics centers to receive product from the Co-operatives, Product Marketing Associations and direct from farmers as well as fleets of reefers to preserve quality in the last mile delivery to their branches, either in their own facilities or those of third party logistics companies.

7.2 Post-Harvest Loss and Value Loss

In this mix of systems, it is difficult to estimate post-harvest loss. Fruits, vegetables and flowers naturally start to deteriorate as soon as they are cut and in Taiwan they have to pass through many hands, from farmers to Agricultural Co-operatives to Product Marketing Associations and to wet markets and retailers. Even though some of the better Co-operatives claim a product loss of only 1-2%, the accumulation of losses through the supply chain probably adds up 8-12%. In some cases, it may well be more.

A more important issue, however, is the deterioration in product quality in terms of appearance, taste and texture because of the lack of cold chain facilities. These would not only extend shelf-life but improve the quality and thereby command a higher price. By comparison, Japanese fruit is well-known for its superior quality and high price. Much of this is due to Japan's much better cold chain systems. Taiwan's agriculture will need to reach similar standards both for its domestic market and to achieve export growth.

7.3 Need for Capital Investment

Upgrading of the cold chain system will require substantial capital investment. Cold storage warehouses are 3 to 6 times more expensive than standard warehousing and reefers much more expensive than standard trucks. This will require capital and to obtain capital the various players will need to grow in scale in a process of consolidation and specialization.

Upgrading is already well advanced in the retail sector. Most foreign retailers have already been bought out and when PX Mart concludes its purchase of RT Mart, it will be the dominant player in supermarkets. Uni-President is dominant in hypermarkets, convenience stores, organic stores and others. Costco, a wholesale hypermarket chain, is dominant in imported fruits. They will thus continue to invest in cold chain logistics and third party logistics companies to remain competitive, especially as e-commerce, central kitchens and food delivery firms open up new challenges and opportunities.

A similar consolidation process is now needed in the production phase among farmers, Co-operatives and Product Marketing Associations. Unfortunately, the structure of this system was established by government legislation in 1981 and supported by government investment in facilities leased out to the Co-operatives and Product Marketing Associations. There seems little likelihood of the government formally repealing this structure to allow rapid consolidation and the raising of capital.

The probability, therefore, is of incremental improvements in the current operating environment such as the COA's plan to set up the Taoyuan Agricultural Logistics Park in Dayuan District, close to Taoyuan International Airport, covering an area of about 13.12 hectares. The park plans to introduce cold chain warehousing and logistics for, ornamental aquariums, flowers, fruits and vegetables, plant factories, seed and seedlings, frozen fish, meat and agricultural value-added industries such as temporary storage and cold chain distribution functions. The land has been obtained and the Park is being mainly organized by Pingtung Agricultural Biotechnology Park. The Taoyuan Agricultural Logistics Park is aimed at improving distribution in northern Taiwan and facilitating export growth, which is one of the government's goals.

Among the Co-operatives, competitive pressure is slowly forcing them to grow bigger and better resourced for acquiring cold chain facilities. If each Co-operative bought one, or one more, vacuum pre-cooler, there would be a market of over 1,000 units. The

Product Marketing Associations are also beginning to adapt to the needs of retail chains. Farms are also getting a little bigger, but it is a long process.

8. Strategic View of Market Development

The development of cold chain facilities is likely to be a continuing but slow moving 'race to quality' to meet the demands of modern retailing and to have any hope of export growth.

8.1 Drivers of Growth for Cold Chain

Overall volumes of vegetables, fruits and flowers sold in Taiwan are unlikely to change since the population has long been stable and is, indeed, beginning to decline. Changes in cold chain will therefore be driven by internal changes in the distribution and sale of produce and possible the growth of exports.

The main drivers of growth for cold chain development are coming from consolidation and competition in the retail store chains which have the scale, buying power and incentive to improve the quality and pricing of product through improved cold chain facilities The entry into the retail market of major e-commerce platforms and central kitchens for delivery to chain restaurants, hotels and households will also expand the demand for third party logistics companies.

The Taiwan authorities also have a goal of promoting Taiwan's exports of fruits and vegetables. This has been hampered in the short term by Covid-19, but there have also been issues of quality in China, Singapore and Japan which suggest it will need to upgrade the quality of its produce to achieve success.

On the supply side, Taiwan manufacturers have little knowledge and experience beyond basic facilities and are particularly weak on compressors, a critical component. So far

Japan and the Netherlands have been the major source of more advanced equipment with some interest from the U.S. The major barriers to imported equipment are import tariffs, maintenance and repair and the high capital cost.

8.2 CPTPP

There is a strong diplomatic push for Taiwan to join CPTPP and it may obtain favorable terms as it did when it joined the WTO in 2001. However, its high protective tariffs on agricultural produce may well have to be reduced in return for assess to new export markets.

More fundamentally, however, it will need to improve its end-to-end cold chain facilities to international standards.

8.3 Impact of Covid

Covid 19 has accelerated the switch to e-commerce and ford deliveries, but the overall impact on domestic supply has been limited by the government's successful control of the virus. The main impact so far has been on fruits imported by air because of disruption in producing countries and air cargo schedules. Assuming Taiwan re-opens to international travel in the spring of 2022 operations are expected to return to normal.

There is a risk, however, that when Taiwan opens up, even with a high level of vaccinations, the virus may spread into Taiwan. Its impact may not be so great but in a country that has got used to 'zero Covid' it could still be disruptive.

8.4 Issues Raised at December 9, 2021 Presentation

A number of challenges facing the vegetable, fruit and flower industry were raised by

Taiwanese stakeholders at the Presentation on December 9, 2021.

Differing country quarantine regulations, including for example inspections for insects or pests, are a major hindrance. Bi-lateral agreements may help to improve this.

There was concern at how small farmers and co-operatives could achieve the standard operating procedures required by large super-markets and mass merchandisers. APR responded that consolidation of small farms and a transition from a government controlled system to more of a free market system would assist development.

COA mentioned there will be new regulations in the EU in 2026 to levy taxes on carbon emissions and asked how to balance between developing the cold chain and being environmentally friendly.

In response to these concerns, Dutch stakeholders acknowledged the impact of climate change and new carbon emission restrictions on the way that agriculture is operated. The two issues of small farms and the increasing burden from climate change restrictions needed to be met by the sharing of knowledge and experience to find cost-effective solutions. The Dutch stakeholders have experience not only from the Netherlands but also, for example, from Saudi Arabia where they co-operated in providing a food city business model and auctioning system. The Dutch stakeholders are always ready to further co-operate with Taiwanese industry players and carry out different projects for different needs. They also put great emphasis on demonstration projects and the sharing of knowledge. In this context, the Dutch stakeholders very much hope to co-operate on the establishment of an agricultural logistics park.

9. Opportunities For Applying Dutch Innovation And Technology In Taiwan

There are a number of opportunities in public sector facilities, private sector players and

the development of exports.

9.1 Public Sector Facilities

The most immediate project is the COA's plan to set up the Taoyuan Agricultural Logistics Park (TALP) in Dayuan District, close to Taoyuan International Airport and covering an area of about 13.12 hectares as described above. The land has already been obtained and the Park is being mainly organized by Pingtung Agricultural Biotechnology Park. Construction has not yet started but is planned to be completed by 2024

TALP will introduce cold chain warehousing and logistics capabilities for a range of , ornamental aquariums, flowers, fruits and vegetables, plant factories, seed and seedlings, frozen fish, meat and agricultural value-added industries. It is aimed primarily at facilitating export growth as well as relieving pressure on Taoyuan Airport from imports of fresh and frozen product.

We believe Dutch cold chain logistics industry could have opportunities for overall design of the Park, consulting advice to Pingtung Agricultural Biotechnology Park as the operator of the Park and the provision of technologies and equipment.

There is also a long term plan to expand the land available to Air Cargo Terminal Operators, but this is not expected until 2030.

Among the Product Marketing Associations, TAPM has already applied to government for a budget to expand its cold chain facilities to support its new business of supplying PX Mart. Over time, other PMAs are likely to follow suit to protect their business volumes.

9.2 Private Sector Sales

We can include the various Agricultural Co-operatives as private sector sales as COA as indicated they are left to make their own decisions as well as the retail chains and the third party logistics companies.

It is difficult to estimate the total market among Co-operatives for vacuum pre-coolers, cool and cold storage and reefers. So far market penetration seems to have been limited to only a few larger Co-operatives such as Han Kuan. If we assume that each Co-operative either buys or adds one pre-cooler there could be a market of over 1,000 pre-coolers with, say, 5–year replacement and warranty service. Similarly there is a clear need for additional warehousing in the logistics centers of up to 15 C instead of the current 20 C, which is hardly 'cool', as well as cold storage for selected items. The Co-operatives will also need more reefer trucks.

In the retail sector, we have already seen major retail chains developing their own low temperature logistics centers and fleet of reefers, sometimes supported by third party logistics companies. These would be prime sales targets as they have the scale, the produce quality requirements and the brand image to justify cold chain upgrading.

Longer term there could also be demand from farmers who have consolidated their small-holdings into a viable size. At this stage, farmers may be able to afford vacuum pre-coolers and temperature controlled storage to reduce their dependence on the Agricultural Associations. COA has already introduced a subsidy of NT$10 million to buy equipment such as pre-coolers, but as yet the farmers still cannot afford this.

As farmers and Co-operatives gain scale, they will also need ERP management systems. Taiwan is very strong in this part and foreign supplies may find it difficult.

9.3 International Trade

The Taiwan government's ambition to develop Taiwan's exports of fruits and vegetables will depend on improvement in quality and reliability that will need more than the improved facilities at Taoyuan Agricultural Logistics Park and should give further impetus to both the farmers and the Co-operatives.

Mailiao Fruits & Vegetable Cooperation (MFVC) which specializes in the production of lettuce for export to Japan is a good example of what it is needed. To serve 200 farmers, it has one vacuum pre-cooler, three packaging machines, which were specially imported from the Netherlands and cost more than NT$10 million, a complete quality control system and ethylene control equipment and packaging materials. Not all Co-operatives will want to go down this route, but we would expect to see an increase in specialization to meet the quality standards for export.

The development of exports will also encourage farmers and Co-operatives to develop end-to-end systems to their export destinations in Japan, China, S.E. Asia and possibly further afield. This will offer opportunities for Dutch companies to leverage their regional and global capabilities.

Overall, trade development will be encouraged by Taiwan's likely accession to the CPTPP, although this may also mean a reduction in Taiwan's import tariffs.

9.4 Competition

The market is in an early stage of development and the two main international suppliers mentioned by companies are the Netherlands and Japan.

MFVC mentioned to us that they originally planned to buy their vacuum pre-cooler from

the Netherlands, but after considering import tariffs and the cost of maintenance, they decided to buy from a Taiwanese manufacturer. Although MFVC did not say, we suspect the Taiwan manufacturer imported the compressor and then assembled the machine in Taiwan.

Some respondents expressed a general view that Japan was probably more familiar with Taiwan than the Netherlands so that Dutch companies would need to get to know the situation in Taiwan and then contact various agricultural organizations one by one to understand the needs and pain points of each customer.

10. Recommendations on Market Approach

We believe there is a strategic business opportunity in Taiwan for the provision of cold chain equipment and technologies. There are, however, a number of critical considerations.

Firstly, cold chain improvements are likely to be a slow-moving process as continuing pressures for consistent quality in the retail market and export growth require improvements in the current cold chain system. There is also unlikely to be any change in Taiwan's land owning system or the Agricultural Products Market Transaction Act (1981) which underpins the current production and wholesale marketing system.

Secondly, the Dutch companies will need to co-operate with COA and the Taiwan authorities on public sector projects as well setting up a sales force for the many Co-operatives, wholesale markets, logistics companies and retail chains. Fortunately, COA has indicated that the government sponsored Co-operatives and wholesale markets will be free to make their own competitive choices.

Thirdly, COA and many companies have expressed some doubt that Dutch companies

would understand and adapt to the operating environment in Taiwan and Taiwan organizations are unaware of Dutch capabilities in Middle East and Asia as well as globally.

Lastly, there is an increased political risk factor arising from the deterioration of both Taiwan-China relations and EU-China relations. This includes economic retaliations as well as military intervention.

Some of these barriers can be tackled by raising awareness in Taiwan that the Dutch cold chain companies have experienced similar issues in the Netherlands, where too many small farmers have consolidated into larger units, as well as the Dutch regional experience in the Middle East and Asia which would help export growth

Our major recommendation is that the Dutch companies should acquire a controlling interest in an existing Taiwan agricultural machinery manufacturer and use it as a vehicle to introduce Dutch technology and equipment in both the public and private sectors and to limit Dutch exposure. This domestic entity would be well placed to contact farmers, Co-operatives and other stakeholders. This is a strategy that has been successfully adopted by Bechtel, a U.S. engineering company, and Colgate-Palmolive, a U.S. consumer goods company.

We would also recommend that Dutch companies use this local entity to provide equipment on a lease-hold basis over, say, 5 years. This would enable the purchasers to spread the initial capital cost which is clearly a concern. Leasehold is well-established in Taiwan and, as discussed, the market is very stable.

If Dutch companies are unwilling to make this investment, arm's length sales can be conducted directly, but we suspect this would only lead to a few opportunistic sales to Taiwanese trading companies with little margin.

The Netherlands Office Taipei would be well-placed to assist any dialogue between Dutch interests, the COA and Taiwan companies. This may include arranging for COA officials to visit the Netherlands to see Dutch capabilities. It may also include virtual or physical trade mission for Dutch companies to meet leading players in both the retail phase and the production and marketing phases as well as exhibition and other promotional activity.

Arising from the Presentation discussions on December 9, 2021, we would also recommend that NLOT/Dutch stakeholders propose to COA that it would be prudent to establish a 'strategic reserve' of vegetables and fruits to be held in cold storage as a buffer against extreme weather events, which will only get worse as climate change progresses, and as a protection against possible aggression from China. We believe food security could become a major issue as climate change impacts all global economies.

The details of the facility would need to be discussed. We would imagine an initial facility of 500,000 MT of fruits and vegetables, equivalent to about one month's supply. It could possibly be located on the new Taoyuan Agricultural Logistics Park. As a project in its own right and as a means to engage with Taiwan stakeholders, we believe such a proposal would provide a good forum for exchange of Dutch capabilities and the needs of Taiwanese stakeholders.

Annex: Statistics

Table 7. Domestic Production of Vegetables and Fruits

Units: 000'MT

	2016	2017	2018	2019	2020
Vegetables	**2,443.1**	**2,572.6**	**2,623.0**	**2,482.2**	**2,432.8**
1. Green leafy	962.8	1,028.2	1,051.9	1,013.6	1,005.2
2. Roots	202.0	223.7	220.1	207.1	165.3
3. Bulbs & tubers	621.0	659.9	685.6	624.2	617.7
4. Flowers & fruits	616.4	619.7	623.6	596.9	601.2
5. Mushrooms	40.9	41.1	41.7	40.4	43.5
Fruits	**2,552.9**	**2,940.6**	**2,895.6**	**2,636.6**	**2,787.1**
1. Bananas	257.5	356.0	356.2	342.6	359.6
2. Pineapples	527.2	553.5	432.1	431.1	419.0
3. Citrus	462.6	533.8	524.1	523.1	507.4
4. Melons	267.0	276.8	278.5	226.0	217.6
5. Others	1,038.5	1,220.5	1,304.6	1,113.8	1,283.4

Source: Statistics Office, COA, Executive Yuan

Table 8. Grand Total of Planted Area of Flowers

Units: ha

	2016	2017	2018	2019	2020
Grand Total of Planted Area	**14,409**	**14,355**	**14,374**	**14,455**	**14,520**
1. Cut Flowers	3,358	3,017	3,054	3,038	3,003
2. Magnolia	60	50	49	52	50
3. Orchid	745	751	750	761	741
4. Bulbs	7	4	2	0	2
5. Herbaceous Flower Seeds	1	7	10	2	18
6. Nurseries	9,220	9,469	9,474	9,546	9,631
7. Potted Flowers	1,019	1,057	1,036	1,056	1,074

Source：Statistics Office, COA, Executive Yuan.

Table 9. Production of Flowers

	2016	2017	2018	2019	2020
Cut Flowers (000' dozen)	72,460	67,662	66,957	66,803	65,680
Magnolia (MT)	130	124	115	134	124
Orchid (000' bowls)	74,903	76,880	80,242	80,650	79,043
Bulbs (MT)	34	14	12	1	12
Herbaceous Flower Seeds (MT)	0	4	6	1	11
Nurseries (000'NTD)	3,725,519	4,251,602	4,318,749	4,469,921	4,480,948
Potted Flowers (000'NTD)	991,475	1,163,394	1,086,552	1,164,343	1,052,892

Source: Statistics Office, COA, Executive Yuan

Table 10. Export of Vegetables, Fruits and Flowers

Units: 000' MT

	2016	2017	2018	2019	2020
Vegetables	**113.6**	**80.8**	**95.5**	**81.7**	**76.9**
1. Green leafy	13.5	11.2	22.4	11.5	9.9
2. Roots	7.5	10.7	13.3	10.2	8.6
3. Bulbs & tubers	4.5	5.0	7.4	5.7	6.9
4. Flowers & fruits	85.8	51.7	50.5	52.4	49.9
5. Mushrooms	2.3	2.1	1.9	1.8	1.7
Fruits	**173.6**	**181.9**	**203.0**	**243.6**	**204.5**
1. Bananas	1.6	1.1	1.9	2.9	3.7
2. Pineapples	30.6	28.3	33.4	54.7	47.5
3. Citrus	20.9	25.4	32.4	47.2	30.7
4. Melons	0.2	0.2	0.5	0.6	1.1
5. Others	120.4	126.9	134.8	138.3	121.6
Flower & Flower Seeds	**23.9**	**25.4**	**26.2**	**25.8**	**20.7**

Source: Statistics Office, COA, Executive Yuan

Table 11. Import of Vegetables, Fruits, and Flowers

Units: MT

	2016	2017	2018	2019	2020
Vegetables	**551,732**	**473,466**	**424,899**	**518,958**	**465,274**
1. Green leafy	142,913	109,663	98,289	133,736	106,498
2. Roots	65,075	52,147	44,204	46,364	42,527
3. Bulbs & tubers	142,163	137,518	98,907	142,271	124,690
4. Flowers & fruits	177,492	151,542	160,191	173,603	170,224
5. Mushrooms	24,090	22,595	23,308	22,985	21,335
Fruits	**628,993**	**635,503**	**557,638**	**585,670**	**550,605**
1. Bananas	224	32	12	20	12
2. Pineapples	27,850	32,821	25,144	22,823	17,781
3. Citrus	62,879	75,802	52,769	62,713	59,220
4. Melons	7,927	4,414	4,761	4,130	3,111
5. Others	530,113	522,433	474,952	495,985	470,480
Flower & Flower Seeds	**9,354**	**10,535**	**9,581**	**9,778**	**8,910**

Source: Statistics Office, COA, Executive Yuan

Table 12. Taiwan Major Agricultural Exports by Destinations, 2020

Item	Amount (000'US$)	*Rel. Share%	Country	Ratio%
Phalaenopsis, Live	97,500	1.99	U.S.	45.88
Vegetable Soybean, Frozen	78,957	1.61	Japan	85.78
Pineapple, Fresh or chilled	54,704	1.11	China	91.10
Sugar Apples, Fresh or chilled	44,683	0.91	China	94.76
Mongo, Fresh or Chilled	26,070	0.53	China	30.10

Note: Proportion of the value of agricultural exports.

Source: Customs Administration, Ministry of Finance.

Table 13. Vegetable, Fruit, Flower Transaction Volume at Agricultural Products Wholesale Market, 2016-2020

	2016	2017	2018	2019	2020
Vegetables (‘000MT)	1,334	1,470	1,501	1,447	1,463
Fruits (‘000MT)	1,002	1,049	1,106	1,064	1,065
Flowers (‘000 bunch)	65,811	66,084	67,322	66,017	63,362

Source: Taiwan Area Agricultural Product Wholesale Market Yearbook, 2016-2020

Table 14. Vegetable, Fruit, Flower Transaction Volume at Agricultural Products Wholesale Market - by Major Supply County/City, 2020

Vegetables		Fruits		Flowers	
County/City	%	County/City	%	County/City	%
Yunlin County	28%	Tainan City	13%	Changhua County	36%
Changhwa County	19%	Taichung City	10%	Pingtung County	15%
Nantou County	9%	Kaohsiung City	10%	Taichung City	14%
Pingtung County	9%	Pingtung County	9%	Nantou County	14%
Chiayi County	9%	Chaiyi County	9%	Taoyuan City	6%
Taichung City	4%	Changhua County	9%	Kaohsiung City	4%
Others	22%	Others	40%	Others	11%
Total	100%	Total	100%	Total	100%

Source: Taiwan Area Agricultural Product Wholesale Market Yearbook, 2016-2020