Fact-finding study on cold chain agrologistics in Peru

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Summary

The establishment of the Peru-European Union Free Trade Agreement (FTA) in 2013, combined with an increased agricultural production capacity on the Peruvian side, resulted in improved market access and encouraged the export of Peruvian agricultural goods and services to Europe tremendously. Peru has now become the second-largest exporter of fresh fruits to the Netherlands. To further expand the Dutch position as Western Europe's biggest transit port for agricultural products and fulfill the food demand in the Netherlands and the rest of Europe, the Netherlands promotes the improvement and growth of the Peruvian agro-export sector. Agrologistics and cold chain infrastructure are of great importance for the agro-export industry because the export of fresh produce is often combined with long transportation distances and short shelf life of the perishable produce. However, Peru occupies one of the last places in refrigerated warehouse capacity worldwide with only 0.100 million m3 of refrigerated warehouse capacity (0.004 m3 per urban resident). Consequences of this are quality issues and food losses of perishable fruits and vegetables produced by local farmers and downstream actors. Fruits and vegetables contribute to almost half of the total food loss and waste (FLW) in Peru and were estimated at 5.5 million tons in 2019. To create a more efficient and sustainable agrologistics and cold chain infrastructure, it is necessary to gather information on the current situation, weaknesses and opportunities of the agrologistics and cold chain infrastructure in Peru. Therefore this study, commissioned and subsidized by the Embassy of the Kingdom of the Netherlands in Lima, aims to provide a comprehensive analysis of the agrologistics and cold chain infrastructure sectors in Peru that will enable the identification of concrete opportunities for collaboration between the Netherlands and Peru in those fields.

This study focuses on agrologistics and cold chain infrastructure of the major fresh fruit and vegetable value chains oriented towards export markets, transported by road, air, or sea. The 9 selected products included asparagus, avocado, banana, blueberry, ginger, mandarin, mango, pomegranate and table grapes. Information on the agricultural and logistics sector was collected by National Agrarian University - La Molina (Universidad Nacional Agraria La Molina (UNALM)) between March and June 2022. Data were collected by conducting online interviews, field visits to agro-export companies (packing houses) located in the coastal regions of Peru, and gathering information from bibliographic sources and governmental and private entities.

The agrologistics and cold chain infrastructure sector in Peru includes high-tech facilities and a good road connection in the coastal areas. The main agro-export companies have their own production fields and control the supply chain from production to shipment. Agro-export companies that source from independent agricultural producers or producer groups do this based on who offers the best price, as the loyalty between these actors is absent and long-term contracts do not exist. Transport from the production field to the packing houses is arranged by the agricultural producers by using unrefrigerated transport modalities as the distances are often short or the products do not require a very cold environment. For sensitive produce, such as blueberry and asparagus, collection centres are built near the production fields to packing the produce, keep it cool and transport it to the main packing house in refrigerated vehicles. For most products, the cold chain starts at arrival in the packinghouse or after the packed produce are stored. These packing houses are high-tech facilities, with technology for cooling, sorting, packing and storage. For the different activities, the agro-export companies rely (partly) on hand labour. For the products that are cooled in the packing houses, the cold chain is maintained from the moment of arrival in the packing house till and including international shipment.

Opportunities for collaboration between the Netherlands and Peru in the field of agrologistics and cold chain infrastructure can be found in further improving the internal logistics network. This includes improving the capacity of the ports, starting and maintaining the cold chain network when sourcing from external sources and preserving the post-harvest quality. Pre-cooling installations near external production fields or -regions are absent in some areas. Furthermore, the transport between production fields and packing houses does not take place in refrigerated vehicles for all products. These challenges can be found in specific production regions of Peru, often far from the packing houses. Actors mention that they do not consider it a huge problem at this moment, but admit they see it as an opportunity in the near future. Peru has a good business environment to further improve its competitiveness. Private investments in technology and knowledge can

stimulate production quality and maintain the quality of the product in the post-harvest stage. External opportunities are related to monitoring product quality during shipment and setting the right conditions during international transport.

To seize these opportunities, governmental and non-governmental organizations can support private actors by establishing new partnerships and collaboration between agricultural producers and actors further downstream in the supply chain. Governmental and non-governmental support can be in the form of providing financial support for companies that collaborate with smallholder producers or by providing training to help the establishment of producer associations. Even more so when previous programs demonstrated that high impacts can be achieved when farm-level investments are linked with downstream investments in value chain development. Furthermore, research institutes and universities play a vital role in gathering and sharing knowledge insights on post-harvest quality preservation research, such as developing the knowledge for the optimal storage conditions settings for each product.

Resumen

El establecimiento del Tratado de Libre Comercio (TLC) entre Perú y la Unión Europea en el 2013, combinado con una mayor capacidad de producción agrícola en el lado peruano, ha dado como resultado un mejor acceso al mercado y un aumento de la exportación de bienes y servicios agrícolas del Perú hacia Europa. Actualmente, Perú se ha convertido en el segundo mayor exportador de frutas frescas a los Países Bajos. Para expandir aún más la posición holandesa como el puerto de tránsito más grande de productos agrícolas en Europa Occidental y para satisfacer la demanda de alimentos en los Países Bajos y el resto de Europa, Países Bajos promueve activamente la mejora y el crecimiento del sector agroexportador peruano. La agrologística y la infraestructura de la cadena de frío son de gran importancia para la industria agroexportadora debido a que la exportación de productos frescos se combina con las largas distancias de transporte y la corta vida útil de los productos perecederos. Sin embargo, Perú ocupa uno de los últimos lugares en capacidad de almacenamiento refrigerado a nivel mundial con solo 0.1 millones de m3 de capacidad de conservación de productos en cámaras frías (0.004 m3 por habitante urbano). Esto trae como consecuencias problemas de calidad y pérdidas de frutas y verduras perecederas producidas por agricultores locales y actores intermedios. Las frutas y verduras contribuyen a casi la mitad de la pérdida y el desperdicio de alimentos (FLW, por sus siglas en inglés) que en Perú, en el 2019, se estimó en 5.5 millones de toneladas. Para crear una agrologística y una infraestructura de cadena de frío más eficientes y sostenibles, es necesario recopilar información sobre la situación actual, las debilidades y las oportunidades relacionadas con la agrologística y la infraestructura de la cadena de frío en el Perú. Es por esto que este estudio, encargado y subvencionado por la Embajada del Reino de los Países Bajos en Lima, tiene como objetivo proporcionar un análisis integral de los sectores de agrologística y de infraestructura de la cadena de frío en Perú que permitirá identificar oportunidades concretas de colaboración entre los Países Bajos y Perú en esos temas.

Este estudio se centra en los factores agrologísticos y de la infraestructura de la cadena de frío de las principales cadenas de abastecimiento de frutas frescas y hortalizas orientadas a los mercados de exportación que están siendo transportadas por carretera, aire o mar. Los 9 productos seleccionados incluyeron espárragos, aguacates, bananos, arándanos, jengibre, mandarinas, mangos, granadas y uvas de mesa. La información del sector agropecuario y logístico fue recolectada por la Universidad Nacional Agraria La Molina (UNALM) entre marzo y junio de 2022. Los datos fueron recolectados mediante la realización de entrevistas en línea, visitas de campo a empresas agroexportadoras (empacadoras) ubicadas en las regiones costeras del Perú, y recopilando información de fuentes bibliográficas y de entidades privadas y gubernamentales.

El sector de agrologística y de cadena de frío en Perú incluye instalaciones de alta tecnología y una buena conexión vial en las zonas costeras. Las principales empresas agroexportadoras tienen sus propios campos de producción y controlan la cadena de suministro desde la producción hasta el envío. Las empresas agroexportadoras que se abastecen de productores agrícolas independientes o grupos de productores lo hacen en función de quién ofrece el mejor precio, ya que hay lealtad entre estos actores y no existen contratos a largo plazo. Los productores agrícolas organizan el transporte desde el campo de producción hasta las plantas de empaque utilizando modalidades de transporte no refrigeradas, ya que las distancias suelen ser cortas o porque los productos no requieren bajas temperaturas. Para productos sensibles, como arándanos y espárragos, se construyen centros de acopio cerca de los campos de producción para empacar los productos, mantenerlos frescos y transportarlos a la planta empacadora principal en vehículos refrigerados. Para la mayoría de los productos, la cadena de frío comienza al llegar a la planta empacadora o hasta después de que los productos empacados son almacenados. Estas empacadoras son instalaciones de alta tecnología, con tecnología para enfriamiento, clasificación, empaque y almacenamiento. Para las diferentes actividades, las empresas agroexportadoras se basan (parcialmente) en mano de obra. Para los productos que se mantienen a bajas temperaturas en las empacadoras, la cadena de frío inicia desde el momento de su llegada a la empacadora hasta inclusive su embarque internacional.

Las oportunidades de colaboración entre los Países Bajos y Perú en el área agrologística y de la infraestructura de la cadena de frío se pueden encontrar en la mejora adicional de la red de logística interna.

Esto incluye el mejorar la capacidad de los puertos, el iniciar y mantener la cadena de frío al abastecerse de fuentes externas y el resguardar la calidad postcosecha. Instalaciones de preenfriamiento cerca de los campos o regiones de producción externos están ausentes en algunas áreas. Además, el transporte entre los campos de producción y las plantas empacadoras no se realiza en vehículos refrigerados para todos los productos. Estos desafíos se encuentran en regiones de producción específicas de Perú, a menudo en regiones lejos de las empacadoras. Los actores mencionan que en este momento no consideran esto un gran problema, pero admiten que estas mejoras se ven como oportunidades en un futuro cercano. Perú tiene un buen ambiente de negocios para mejorar aún más su competitividad. Las inversiones privadas en tecnología y conocimiento pueden estimular la calidad de la producción y mantener la calidad del producto en la etapa de postcosecha. Las oportunidades externas están relacionadas con el control de la calidad del producto durante el envío y el establecimiento de las condiciones apropiadas durante el transporte internacional.

Para aprovechar estas oportunidades, las organizaciones gubernamentales y no gubernamentales pueden apoyar a los actores privados mediante el establecimiento de nuevas asociaciones y por medio de colaboraciones entre los productores agrícolas y los actores que se encuentran más abajo en la cadena de suministro. El apoyo gubernamental y no gubernamental puede darse por medio de apoyo financiero a las empresas que colaboran con los pequeños productores o por medio de capacitación para facilitar el establecimiento de asociaciones de productores. Aún más cuando programas anteriores han demostrado que se pueden lograr grandes impactos cuando las inversiones a nivel de finca están vinculadas con otras inversiones en puntos más avanzados de las cadenas de suministros. Además, los institutos de investigación y las universidades desempeñan un papel vital en la recopilación y el intercambio de conocimientos sobre la investigación de la preservación de la calidad postcosecha, como por ejemplo, en el desarrollo de conocimientos para la configuración de las condiciones óptimas de almacenamiento de cada producto.

1 Introduction

Since the establishment of the Peru-European Union Free Trade Agreement (FTA) in 2013, bilateral trade between Peru and the Netherlands has increased by more than 40% (UNComtrade, 2020). The FTA has resulted in reduced trade tariffs and was important for the commercial relationship between both countries. This FTA, combined with an increased agricultural production capacity on the Peruvian side, resulted in improved EU market access and encouraged the international trade of agricultural goods and services tremendously (Van der Werf, 2021). 86% of the total export from Peru to the Netherlands consists of agricultural products, which has reached 1.1 billion euros in 2019. Of this group, fruits are mainly exported to the Netherlands with a total value of 753 million euros. With this amount Peru became the second largest exporter of fresh fruits to the Netherlands (LNV, 2020; Jukema et al., 2022).

The Netherlands is known for its expertise with efficient agricultural production and logistics of fresh produce and is one of the major agricultural import and export countries in the world. Nowadays, the Netherlands is the second-largest exporter of agricultural and agriculture-related products worldwide. A large part of this consists of agricultural and food products but also includes a growing share of enabling technology, products and services. This illustrates not only the significance of the Dutch agricultural sector but also the significance of the Netherlands as a hub for trade in agricultural and agriculture-related products (Castelein et al., 2022). The Port of Rotterdam, with its 18.500 reefer connections, is even expanding its position as Western Europe's biggest transit port for agricultural, horticultural and fishery products with the establishment of the Rotterdam Food Hub offering optimal facilities for agrofood sector companies (Port of Rotterdam, 2019). To further expand its position, the Netherlands is promoting the growth of the Peruvian agro-export sector. Therefore the objective of the Dutch government regarding Peru is to position Peru as an agricultural powerhouse and to promote sustainable value chains with Peru as a supplier of agricultural products to the Netherlands (Personal communication Embassy of the Kingdom of the Netherlands in Lima). Improving agricultural export value chains has also proven to be an effective way to promote the upgrading of agriculture in developing countries (OECD/WTO, 2013). The development of Peruvian-Dutch agricultural trade will benefit the income growth in the Peruvian countryside, will bring high standards for sustainable agricultural development to the country, and benefit the Netherlands.

Agrologistics[1] and cold chain infrastructure are of great importance for the agro-export industry since the export of fresh produce is often combined with long transportation distances and short shelf life of the perishable produce. Furthermore, a weak agrologistics network can hamper the quick transportation and optimal climate control of these perishable products. Although agrologistics and cold chain infrastructure are important for the agro-export industry, Peru occupies one of the last places in refrigerated warehouse capacity worldwide (Salin, 2018; Jukema et al., 2022; LNV, 2022). In 2018 it was estimated that Peru has only 0.100 million m^3 of refrigerated warehouse capacity (0.004 m^3 per urban resident). For comparison, Brazil has 19.057 million m^3 of refrigerated warehouse capacity (0.106 m^3 per urban resident) and the Netherlands has 13.700 million m^3 of refrigerated warehouse capacity (0.958 m^3 per urban resident (Salin, 2018). Illustratively, Peruvian enterprises stated that sometimes temporary high-quality refrigerated storage capacity is hard to find (WFLO, 2014; Nowthatslogistics, 2018).

The main problem regarding an analysis of agrologistics and cold chain infrastructure is the lack of comprehensive, systematized and unified information at the country level. This lack of information makes it difficult to make and implement good, appropriate policies by the Peruvian government. Consequences of this limited transparency and absence of policy focus are quality issues and food loss of perishable products produced by local farmers, and the atomization of a market that hinders the entry of new actors with new solutions (LNV, 2022). Fruits and vegetables contribute to almost half of the total food losses and waste (FLW) in Peru (Bedoya-parales & Dal'Magro, 2021). FLW for fruits and vegetables was estimated at 5.5 million tons in 2019 (Wageningen Food & Biobased Research's FLW database). The main part was lost during processing and packaging (30% of the fruit and vegetable FLW) and agricultural production (29%). Post-harvest handling and storage (15%), distribution (14%) and consumption (12%) contributed to a lesser extent to the total FLW (Bedoya-parales & Dal'Magro, 2021).

[1] Agrologistics is the set of functions that ensure that the right product is delivered at the right time and under the right conditions to the customer, while minimizing costs (Van der Vorst & Snels, 2014).

Although the refrigerated warehouse capacity is low and the agrologistics sector faces its challenges, multiple Peruvian enterprises can export fresh fruits and vegetables to the Netherlands and other foreign markets. These enterprises have shown that they can meet all international standards regarding food safety and product quality. Even though manual labor is present, most large companies have largely been automatized. This, in combination with the Peru-European Union FTA, has increased the investment opportunities for Dutch investors in a wide range of sectors, among others agriculture and logistics. As a result, the number of Dutch enterprises with Peruvian operations is significantly increasing and this creates further opportunities for the entry of technologies and new solutions into the country (Van der Werf, 2021). Currently, Dutch enterprises export 0.1 billion euros of agricultural goods to Peru, including agricultural technology, materials, and knowledge (Jukema et al., 2022; Castelein et al., 2022).

1.1 Aim

To support the development and improvement of the local private sector in Peru, and enhance the creation of more efficient supply chains, it is important to cooperate with foreign companies providing enabling technology, products and services regarding agrologistics and cold chain improvement. Traditionally, Dutch companies have proven to be internationally competitive and innovative players in this domain (Castelein et al, 2022) and, as such, there is considerable potential for Dutch technology and knowledge in the Peruvian market – with opportunities for Dutch as well as Peruvian companies. However, lack of information on the Peruvian market, including the current state of agrologistics and cold chain infrastructure and the main needs in this domain, hinders Dutch companies in entering the Peruvian market. Since information is currently lacking, the aim of this study is to provide a comprehensive situation analysis of Peru that will enable the identification of concrete opportunities for collaboration between the Netherlands and Peru in the field of agrologistics and cold chain infrastructure.

1.2 Scope

This study focuses on agrologistics and cold chain infrastructure of the major fresh fruit and vegetable value chains oriented towards export markets, transported by road, air or sea. The interface between the agricultural and logistics sector is called agrologistics (Figure 1). Agrologistics includes all post-harvest logistics functions in the agro chain (of food and related products), including transportation, handling, storage, climate control and management. Besides, it includes the organization of coherent interplay between these activities, from harvest up to the end consumer, as well as the supply of technologies, products, and services that enable these functions and that have direct relevance for the agro chain, agro products, and product quality (Castelein et al., 2022).

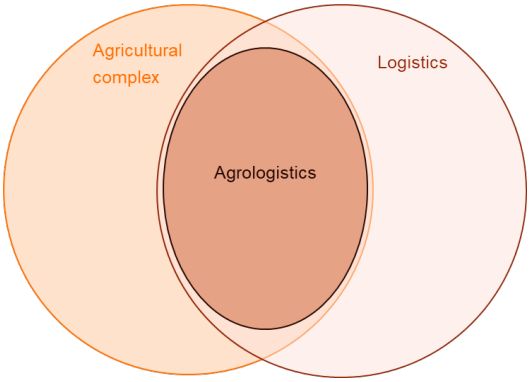

Figure 1: Positioning of agrologistics (source: Castelein et al., 2022).

The most important (export) products were selected by WUR using a multi-criteria analysis based on data from FAOSTAT (2020a), FAOSTAT (2020b), UNComtrade (2019) and UNComtrade (2021). The goal was to select fresh Peruvian fruits or vegetables that provide opportunities for increased export to the Netherlands. Therefore the minimum criteria for selection included: 1) the product should have at least a 10% growth in production volume in the last 10 years (2010-2020), 2) a minimal import volume by the Netherlands of

>10.000 tons and 3) being produced in one of the coastal areas of Peru. Other 'scoring' criteria included export volume trend in Peru in the last 10 years (2010-2020), production value and world market import trend in 2020. The complete multi-criteria analysis, including the selected criteria, can be found in Annex 1. Table 1 shows the nine selected fruits and vegetables for further analysis. The scope includes the main agricultural and value chain beneficiaries (from agricultural producers till export) along the coastal regions of Peru (Figure 2), since the agro-export companies are located in this part of the country. The coastal regions feature dynamic, highly productive and commercially successful agricultural systems that are integrated into local and/or international value chains (World Bank, 2017).

Table 1: Selected products.

SELECTED PRODUCTS
Asparagus
Avocado
Banana
Blueberry
Ginger
Mandarin
Mango
Pomegranate
Table grape

Figure 2: Peru geographical areas by provinces and regions (source: BID, 2015).

1.3 Methodology

Information on the agricultural and logistics sector was collected by National Agrarian University - La Molina (Universidad Nacional Agraria La Molina (UNALM)) between March and June 2022. Data was collected in two ways.

First, data was collected via interviews by phone and field visits to production areas on the coast. UNALM visited 35 main agro-export companies (packing houses) located in the regions of Piura, Lambayeque, La Libertad, Ancash, Lima, Ica, Arequipa and Junin. Information was gathered from representatives of Peruvian companies exporting the selected agro products and public organizations with specific relevance to the sector. The agribusiness companies visited by region and export products can be found in Annex 2.

Secondly, information from bibliographic sources and from governmental entities was gathered. This included 1) registered data from National Agricultural Health Service (through the SENASA website (Servicio Nacional de Sanidad Agraria del Perú, [SENASA])), and 2) Peruvian Customs and Tax Authority (ADUANAS) (through the SUNAT website (Superintendencia Nacional de Aduanas y de Administración Tributaria, [SUNAT])). Part of these bibliographic sources and governmental information was sourced from the private company INFORMACCION. This company collects and aggregates information on agricultural export, sourcing information from reports of government offices, such as SUNAT, SENASA and MIDAGRI (Ministerio de Desarrollo Agrario y Riego).

This report provides an overview of the agrologistics and cold chain infrastructure which includes the agricultural sector, overview of the supply chains, transport network, agricultural business environment and stakeholder mapping. Thereafter the opportunities in the field of agrologistics and cold chain infrastructure are identified, which include the technical gaps and opportunities, and recommendations for improvement.

2 Agrologistics and cold chain infrastructure

2.1 Agricultural sector

Peru produces fresh fruits and vegetables for both the domestic market and the export market. In 2020 Peru produced 10.3 million tons of fresh fruits and vegetables (FAOSTAT 2020a). Agricultural production is growing rapidly in the coastal areas of Peru. This growth was caused by the establishment of the FTA, in combination with the expansion of the total cultivated area and by replacing cultivated low-value crops with high-value export crops (World Bank, 2017). The fruits and vegetables are produced on a total acreage of 683 thousand hectares and the main fresh crop produced is bananas, followed by grapes and avocados (Figure 3) (FAOSTAT, 2020a).

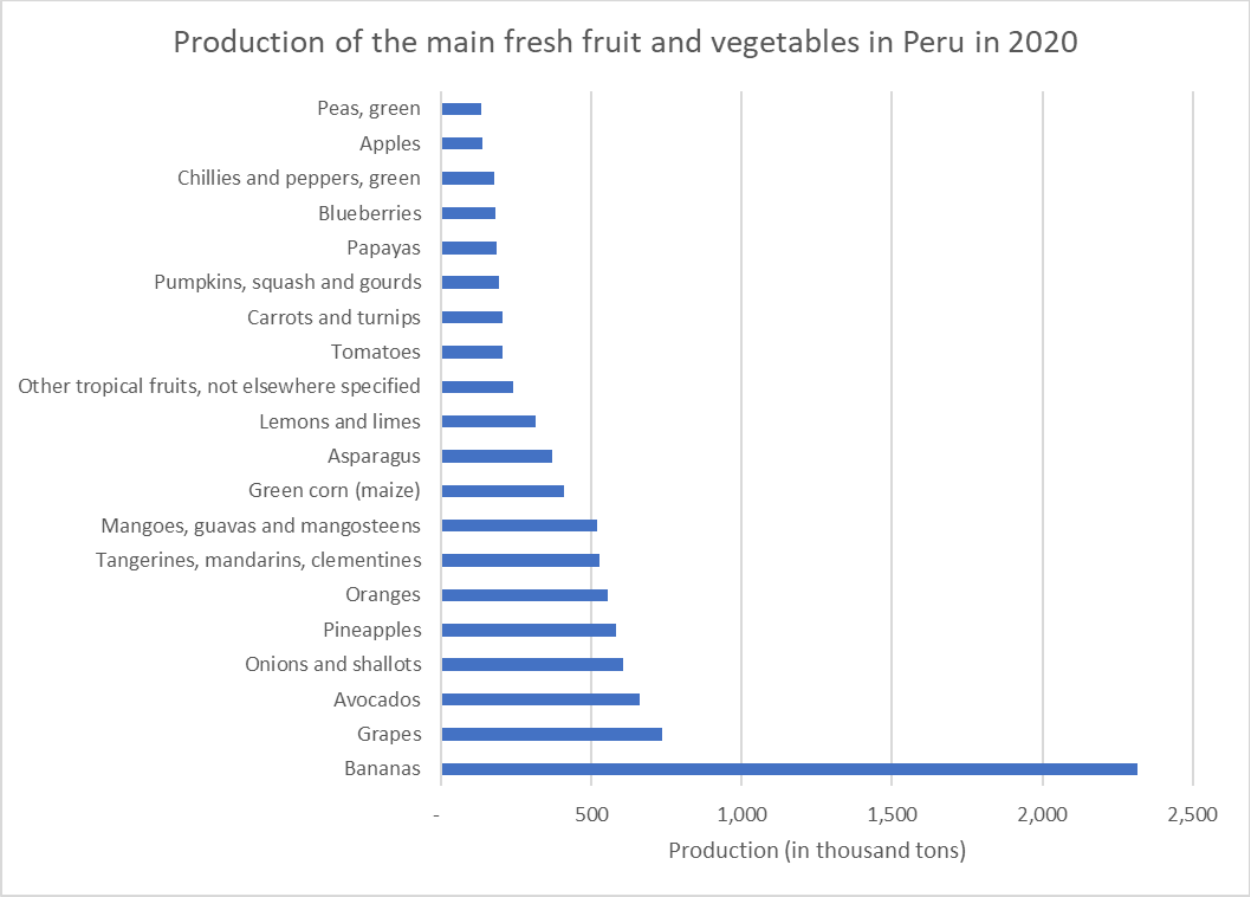

Figure 3: Production of the main fresh fruits and vegetables produced in Peru in 2020 (source: data retrieved from FAOSTAT, 2020b).

The main exporting production areas per product are shown in Table 2. Exported banana, ginger, mango and pomegranate originate mainly from one specific area, while exported avocado is produced in multiple areas at a large scale. A large amount of the total cultivated products in Peru are exported to foreign markets. For example, 91% of the produced amount of ginger is exported, 90% of the blueberries produced is exported, 62% of the avocados, 57% of the table grapes, 46% of the mangoes, mangosteens, and guavas, 41% of the tangerines, mandarins, clementines, and satsumas, and 34% of the asparagus (FAOSTAT, 2019-2020).

Table 2: Main exporting production areas per product (source: data retrieved from Informaccion, 2021).

PRODUCTS	MAIN PRODUCTION AREAS
ASPARAGUS	La Libertad and Ica
AVOCADO	Lambayeque, La Libertad, Lima and Ica
BANANA	Piura
BLUEBERRY	Lambayeque and La Libertad
GINGER	Junin
MANDARIN	Lima and Ica
MANGO	Piura
POMEGRANATE	Ica
TABLE GRAPE	Piura and Ica

In 2021, Peru exported a total value of 4.7 billion US$ of edible fruits and nuts, and 746.8 million US$ of edible vegetables and certain roots and tubers. Main export destinations for these product categories include the United States of America (USA), the Netherlands, United Kingdom (UK) and Spain (Figure 4) (UNComtrade, 2021). The Netherlands account for a large fraction of the total exported volume of avocado, banana, blueberry, ginger, mandarin, mango, and pomegranate from Peru (Table 3).

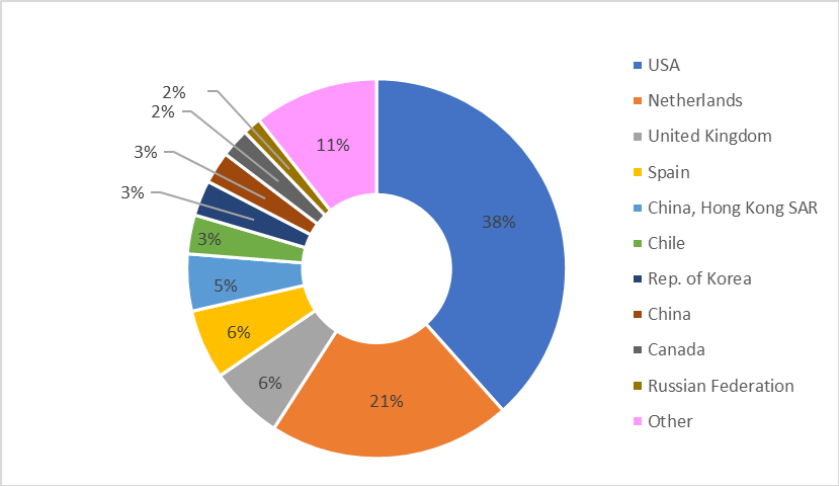

Figure 4: Export value of edible fruits and nuts, and edible vegetables and certain roots and tubers (US$), Peru 2021 (source: UNComtrade, 2021).

Table 3: Exported fresh produce per export destination (source: data retrieved from Informaccion, 2021).

PRODUCTS	EXPORT FRACTION TO THE USA	EXPORT FRACTION TO THE NETHERLANDS
ASPARAGUS	±75%	±5%
AVOCADO	±15%	±35%
BANANA	±25%	±30%
BLUEBERRY	±55%	±25%
GINGER	±30%	±30%
MANDARIN	±5%	±20%
MANGO	±35%	±35%
POMEGRANATE	±0	±55%
TABLE GRAPE	±45%	±15%

2.2 Supply chain analysis

2.2.1 Sourcing

Agricultural export supply chains are organized around individual products. Actors involved in the Peruvian agro-export supply chain include agricultural producers and exporters, and in case multiple small agricultural producers are involved, a trader can be included in the supply chain. Other relevant stakeholders include input and service providers, transporters, ports and shipment lines.

Export companies source produce from own production fields and/or independent agricultural producers. 85% of the interviewed agro-export companies indicated that they source produce from their own production fields, a minority of 33% of whom source produce from independent agricultural producers or producer groups (producer associations) as well (Figure 5). This additional sourcing is done for products like asparagus, avocado and mango. 15% of the interviewees indicated they source produce from independent agricultural producers, producer groups or intermediaries only. This type of sourcing is especially the case for organic bananas and ginger. The agro-export companies set the quality criteria for agricultural producers, with product sanitary aspects as the main quality standard, to meet the demand from the export markets.

The interviewed agro-export companies that source from independent agricultural producers or producer groups purchase the products directly from the agricultural producers, depending on who offers the best price. The relationship between independent agricultural producers and agro-export company is often weak, and independent producers sell their produce to whoever offers the best price. Loyalty is absent and long-term contracts do not exist. In a study by Ramos et al. (2018) it was found that sourcing blueberries is often based on a causal relationship, and coordination between suppliers and export companies is limited. This results in a lack of collaboration, breaks in the cold chain and frequent shortages (Ramos et al., 2018). The blueberry agro-export companies interviewed in this current study sourced blueberries from own production field.

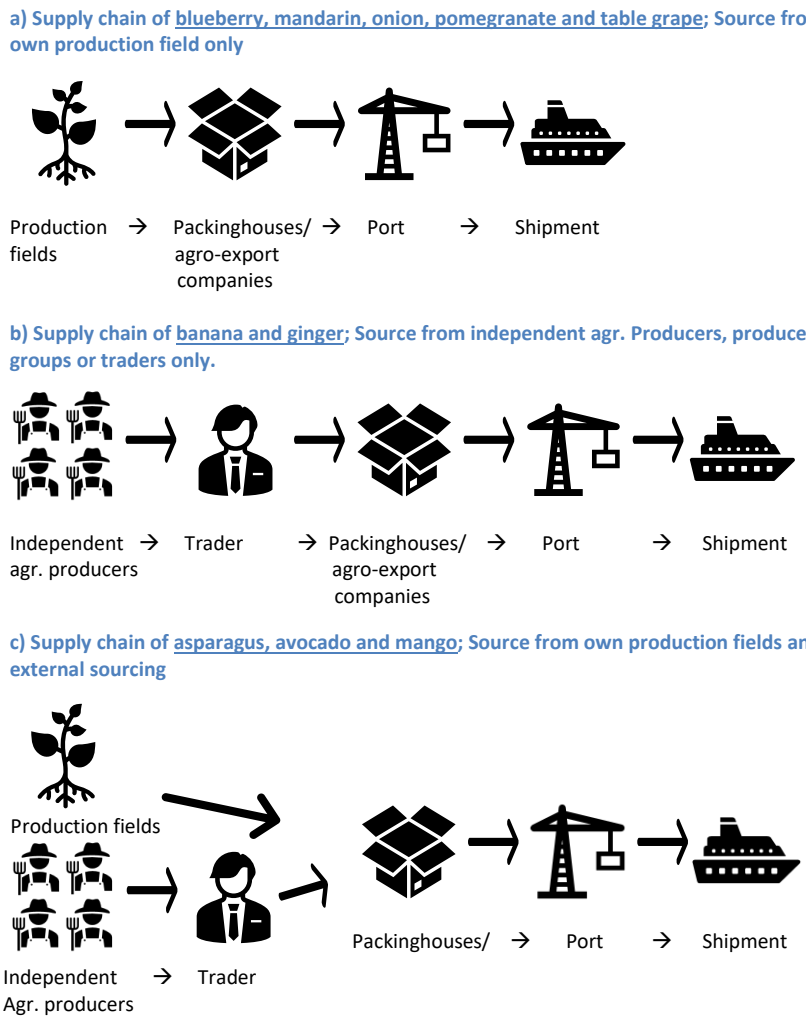

Figure 5: Three different types of supply chains of interviewed agro-export companies: a) most agro-export companies have their own production fields near the packing houses, b) for some products sourcing in only done from independent agricultural producers, producer groups or intermediaries, or c) some agro-export companies source additional produce from independent agricultural producers.

2.2.2 Post-harvest activities

The agricultural producer is responsible for transport from the production fields to the export companies' packing houses. Most interviewed agro-export companies mentioned that unrefrigerated transport modalities are used for transportation between production fields and packing houses, as the packing houses are often close to the production fields, the products are produced in regions with a low temperature, such as Arequipa, or since the products do not require a very cold environment, as is the case for banana. In case the production fields are far from the packing houses, and the product is sensitive such as blueberry and asparagus, agro-export companies built a type of collection centre (with some basic packing facilities) to pack the produce, keep the produce cool and transport them to the main packing house together in refrigerated vehicles.

Especially non-climacteric fruits require tree maturation and pre-cooling directly after harvesting, as they do not ripe after harvesting. This includes fruits such as blueberry and table grape. Also asparagus require pre-cooling as soon as possible. Products such as avocado and banana are climacteric fruits that ripen after harvest. As a result, the time between harvest and cooling is much less strict for avocado compared to table grape and blueberry. For example, the quality of avocado remains good till 6 hours after harvesting and for mango 11 hours after harvesting when you keep them in the shade with sufficient ventilation possibilities. However, ripening and softening can be delayed by pre-cooling the fruits immediately after harvest and placing them in an ethylene-free storage at optimum temperature. Delayed ripening is an advantage when

producing for distant export markets. Also, it is important to focus on the initial quality and damage prevention for these products.

For most export products, the cold chain starts at arrival in the packing house or after the packed produce are stored in the packing house. Only asparagus and blueberry are pre-cooled in the field directly after harvesting. For avocado, the product is only transported under refrigeration when produced in Lambayeque due to the high temperature in that production region. Avocados produced in other regions such as Lima, but also pomegranate and table grape, are pre-cooled as soon as the products arrive at the packing house (Table 4). Especially for table grape this can cause problems, as they require rapid removal of the field heat and cooling to 0-1 Celsius degrees.

For the products that are cooled in the packing houses, the cold chain is maintained from the moment of arrival in the packing house till and including international shipment. After packing and storage, the refrigerated packages of fresh fruits and vegetables are transported in refrigerated trucks or refrigerated containers to the airports or ports respectively. Maintaining the cold chain is obliged by most destination countries, such as the EU, USA, China and Japan.

Table 4: Organization of the cold chain per activity per product by interviewed agro-export companies

PRODUCTS	PRODUCTION FIELD	TRANSPORTATION	PACKING HOUSE
ASPARAGUS	Pre-cooling	Refrigerated	Cold
AVOCADO	None	Refrigerated by some	Cold
BANANA	None	None	None
BLUEBERRY	Cold storage	Refrigerated	Cold
GINGER	None	None	None
MANDARIN	None	None	None
MANGO	None	Refrigerated by some	None
POMEGRANATE	None	None	Cold
TABLE GRAPE	None	None	Cold

All the interviewed agro-export companies have their own packing house. The post-harvest activities at arrival in the packing house include reception, cleaning/washing, cooling, packaging and storage. More than half of the interviewed export companies also provide cutting and/or drying. The visited packing houses rely (partly) on hand labour to perform the different activities. All visited packing houses are high tech facility with cold storage capacity in place to store all products that are ready for shipment, by using their own storage infrastructure (almost all interviewed agro-export companies) or renting additional storage capacity. Visited packing houses face problems with post-harvest diseases causing decay problems of fruits and vegetables once they are packed. Due to the strict foreign market requirements, pesticides can be used only to a limited extent in post-harvest handling. Most agro-export companies work together with external logistics service providers to prepare the cargo for international transport (by air or sea). Sea transport is mostly used for the selected fruits and vegetables. Only a part of the asparagus, mangoes and avocados are exported by air in specific cases. For example, when special export orders are made and a good price is paid by the destination market.

2.2.3 Development of the agro-export sector

Since the coastal areas developed into dynamic, highly productive and commercially successful agricultural systems years ago, export of agricultural products has grown over time. Some export supply chains already exported >10,000 tons of product since 1995, such as the supply chain of asparagus and mango, while other products export supply chains only developed during the last 10 to 15 years, like the ginger- and blueberry supply chain (see Figure 6). Actors active in export supply chains that were established a long time ago have had a long time to invest and further optimize their supply chains, compared to more newly developed supply chains. These newly developed supply chains had only the last 10-15 years for their investment, which means that they may face other types of challenges. For example, in the blueberry supply chain, export companies mentioned that they strongly rely on manual labor to handle the fruits during the packing house process, with limited automation. However, the learning curve is steep since they can learn from more

experienced exporters of other products. Overall all supply chains have their own product-specific challenges to solve.

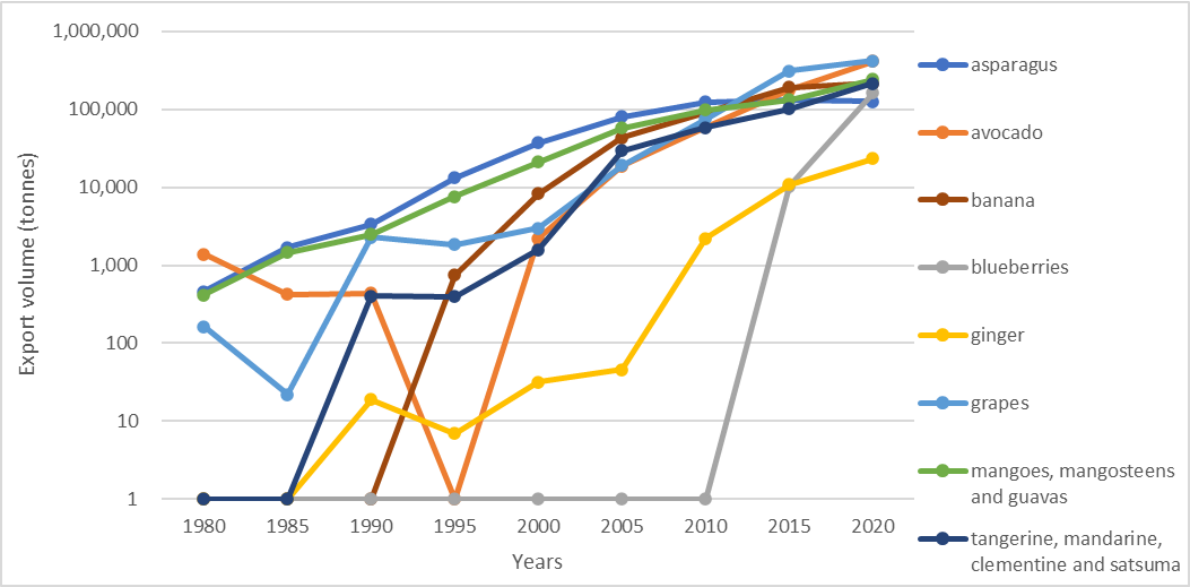

Figure 6: Export volume development for 8 products between 1980-2020 (source: data retrieved from UNComtrade, 2020).

Supply chains directed to export markets are organized by both small- and medium enterprises (SME's) and large agro-export companies. In total, >600 agro-food export companies, exporting one of the selected products, are active in Peru in 2021 (INFORMACCION). The number of agro-export companies and the size per company depend on the product. For example, for blueberry over 40 agro-export companies are located in Peru, including companies exporting around 12 thousand tons/year to companies exporting over 4 million tons/year, but all only contribute to a small share of the total export volume. Contrary, the export of mandarin is done by 10 agro-export companies and dominated by two large export companies, exporting >70% of the total volume of exported mandarins (Informaccion, 2021).

2.3 Transport network

The transport network includes the management of means, modes of transport, loading and unloading, terminal infrastructure and the transport activities themselves, which include both domestic as well as international transportation (Caballero Nonalaya, 2021). Domestic transport includes the road and rail freight from production areas to actors further downstream in the supply chain, while international transport includes road and rail freight, air transport and sea transport crossing national borders.

2.3.1 National transport network

Compared to Colombia and Ecuador, Peru has the highest road user costs (RUCs) with $1.95 per vehicle-km. These are the costs of using a road (in dollars/ton-kilometre), the vehicle operating costs and value of time costs. For comparison, the costs in Colombia are $1.90 and in Ecuador $1.48 per vehicle-km. The RUCs are mainly dominated by fuel price (48%) and costs for maintenance and parts (30%) (Briceño-Garmendia et al., 2015).

The total road network of Peru, including the national road network, departmental highway network and neighbourhood road network, has a total of almost 170 thousand km, of which around 15% is paved. The primary road network, which is assigned based on functionality and importance, comprises more than 70,000 km of roadways. The roads in the coastal areas are well-maintained and paved. The longitudinal road in the coastal region, part of the Pan-American Highway that goes from north to south of Peru, is a totally asphalted road that stretches 2,376 kilometres through the provinces of Tumbes, Piura, Lambayeque, La Libertad, Ancash, Lima, Ica, Arequipa, Moquegua and Tacna (DLCA, 2021). Peru is a very centralized

country, with almost a third of the population living in the capital region. Connectivity between other cities is poor, which can also be seen in the road network. The primary road network is situated in the coastal areas, which shows that the other regions are not well connected with this coastal region (Briceño-Garmendia et al., 2015).

The road infrastructure is not in optimal condition, which result in an unstable and insecure infrastructure. The unstable and insecure infrastructure lead to losses in costs, time and products. First, vehicles are forced to drive slowly along roads in poor condition (Caballero Nonalaya, 2021). The average driving speed is 67 km/hour at primary roads, 51 km/hour on secondary roads and 36 km/hour on tertiary roads (Briceño-Garmendia et al., 2015). This leads to long transportation times and loss of products. Secondly, slow driving vehicles are an easy target for crime. Freight agents find themselves in need to purchase various insurances against theft and claims as a result, which increases the transportation costs (Caballero Nonalaya, 2021). Furthermore, the good quality primary roads in the coastal areas face capacity problems and cannot cope with the current traffic. Therefore Banco Mundial (2016) suggests to promote redundancy with the strengthening of alternative highway routes or a multimodal solution that encourages the use of the railway (Banco Mundial, 2016).

The Railway Network in Peru consists of a total of 1,940 km consisting of the Public Network (189 km), Public Concession Network (1,512 km) and the Private Network (239) km (DLCA, 2021). This is equal to a rail density of 0.2 km of rail per km^2 of land area, which is below the average in South America (0.5 km/km^2) (Briceño-Garmendia et al., 2015).

Figure 7: Peruvian road network (Source: DLCA, 2021).

2.3.2 International transport network

International transport includes road and rail freight, crossing the national borders, and air- and sea transport. Approximately 90% of the overseas exported fresh horticultural products are transported by sea (Banco Mundial, 2016). There are four port terminals for fresh produce in Peru; Callao (Lima region), Paita (Piura region), Pisco (Ica region) and Salaverry (La Libertad region), of which the ports of Paita and Callao regularly export fresh fruits and vegetables to global markets (see Figure 8) (McShane, 2015). Agro-export companies organize their shipments according to annual planning based on their estimated production and market demand. This planning is thereafter shared with shipping companies to coordinate their shipping requirements. Thereafter agreements are made and the products are transported to the seaports at the scheduled time. The interviewed agro-export companies stated that the main challenges related to the ports and the planning include the frequency of vessel departures and the number of ports that can be used for container shipments to their markets. Banco Mundial (2016) stated that the port of Callao is difficult to reach, as the capacity of the roads that have access to the entrance of the port of Callao is not sufficient. Proper circulation of trucks is lacking and space for loading and unloading is too limited. Therefore Banco Mundial (2016) advised promoting decentralization of customs and secondary services, the introduction of a front-port area with dedicated access to the port, and the development of a truck management system (Banco Mundial, 2016). The port of Paita cannot assist in limiting the pressure on the port of Callao, as it is quite far from the main production and export areas for companies located in the Southern coastal areas. The port of Pisco is already used as a complementary docking terminal for the port of Callao, but is now mainly used for fishing and agro-industrial activities, and other non-food related trade.

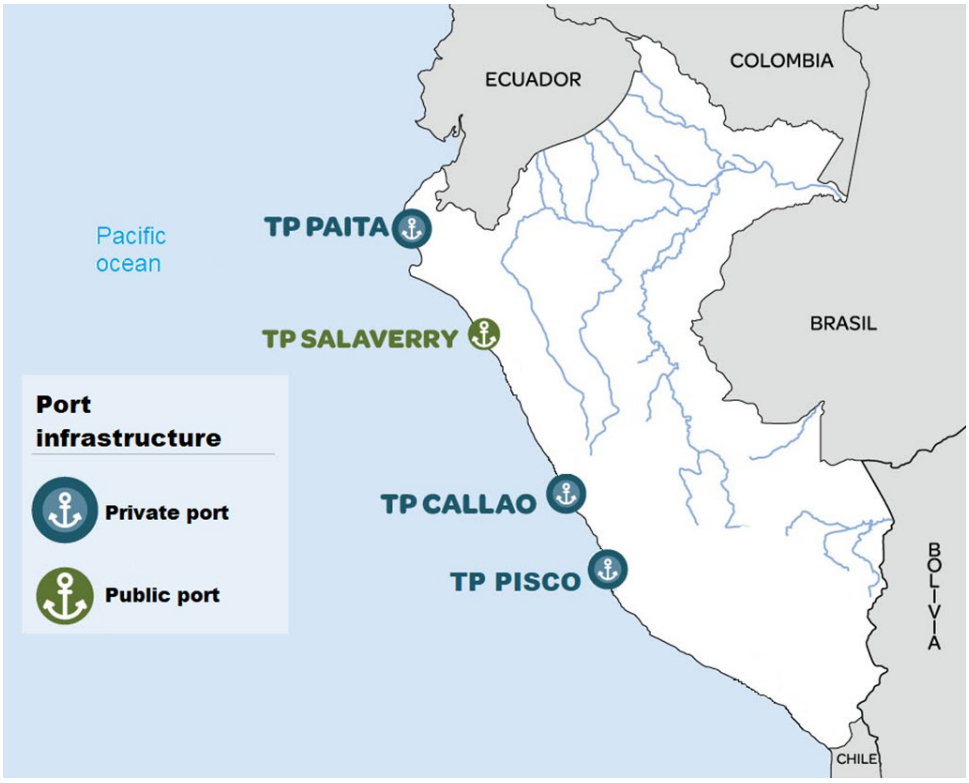

Figure 8: Port terminals dedicated to the logistics of food in Peru. (Source: based on ASPPOR, 2016 and McShane, 2015).

Another challenge is to preserve the quality of the produce at the ports. Physical inspections conducted by SENASA and SUNAT/Customs at the ports have negative consequences on the product quality, due to product damages and breakage of the cold chain. Currently between 10%-30% of the grapes exported to foreign countries go through physical inspection. Secondly there is a lack of coordination between the inspecting authorities, such as SENASA and SUNAT/Customs, which results in unnecessarily long waiting times and duplications. To speed up the port transaction and protect the cold chain, Banco Mundial (2016) advises developing and establishing physical inspection protocols, and operation and coordination protocols to avoid duplications and delays. This will also reduce the incidence of arbitrary container openings (Banco Mundial, 2016).

The agro-export companies collect information to make sure products are shipped under the right conditions. Data is collected at the beginning of the shipment, when the container leaves the packing house or is placed on the ship, and upon arrival at the place of destination. Real-time information is lacking on the temperature, humidity and atmosphere composition during the shipment itself. Although this type of technology exists, it is not used yet by Peruvian agro-export companies.

2.4 Agricultural business environment

Peru created a good business climate for investment in foreign technology to further optimize the Peruvian agro-export sector. Through a series of policy reforms implemented over many years, the government of Peru created a favourable enabling environment for agribusiness by removing distortionary price policies, improving the functioning of the land market and access to especially land, water, and labor, liberalizing trade regimes to provide easier access to global markets, and directing public investment to critical infrastructure in the irrigation, transport, and energy sectors. The Coastal region in Peru is a good example of this favourable investment climate, as this region developed a dynamic and highly productive commercial agriculture-oriented area, focussing on high-value export crops. In these years, the private sector in Peru demonstrated its ability to bring in improved production technology and knowledge of international markets, and mobilize the financial resource needed to become competitive, under the right incentives and conditions (World Bank, 2017).

2.4.1 Laws and regulations

During the 1990s and early 2000s, the primary focus of policy makers was to support the development of the agro-export sector, mainly in the Coastal regions and to some extent in the Selva region. This was facilitated by creating a favourable business environment to stimulate private investment while at the same time exposing agribusiness companies to competition. This favourable business environment was created by introducing a coordinated set of policy reforms and economic incentives. The Peruvian government put together a value proposition that facilitated access to productive resources (land and water), allowed private firms to share investment risks via tax concessions and other incentives, and demonstrated a strong commitment to trade openness. The following laws, incentives, and instruments contributed to enabling actions towards improved competition, which included possibilities to invest in the cold chain as well (World Bank, 2017):

- Decree Law 22342 (1978): A core feature of the government's campaign to support agribusiness development has been the regulation of labor markets to increase flexibility and promote formality.
- Agrarian Law 27360 (2000): A special regulatory regime covering the agriculture sector, which established specialized labor regulations for agricultural workers and a series of tax incentives favourable to the agricultural sector, including reductions in income tax, exemptions from valued added tax (VAT), and a VAT drawback mechanism (applied only to exports) relating to input costs and customs duties. In addition, investments related to irrigation benefit from additional tax exemptions.
- Law 28846 (2006): Strengthening productive value chains by providing a mechanism through which the government could co-finance business plans put forward by agricultural entrepreneurs in the Sierra region and more recently also the Selva region.
- Creation of SENASA (1992): The agency has played a key role in consolidating market opportunities for the Peruvian agro-export sector by facilitating access through compliance with sanitary and phytosanitary requirements. SENASA also plays a leading role in ensuring the reliability of the framework for organic production.
- Funding: Support productive investments in the agriculture sector in Peru to strengthen producer organizations (associations) and promote technology adoption among small-scale producers.

Currently, tax rebates are available for agro-export companies to share investment risks, but subsidies to invest in the supply chain are non-existent. It is the responsibility of the private sector to invest in further optimization of the supply chain. Intensifying the collaboration of agricultural producers in associations is supported by the government in the form of promoting technology adoption (e.g. building small packing houses or pre-cooling facilities) to be able to offer better products to agro-export companies. Furthermore,

programs such as AGROIDEAS, PROCOMPITE and AGRORURAL have demonstrated the impacts that can be achieved when farm-level investments are linked to downstream investments in value chain development (World Bank, 2017).

2.4.2 Trade agreements

Trade policy reforms and additional reforms, introduced in the 1990s and early 2000s, resulted in the significant opening of the Peruvian trade for the agricultural sector. The first wave included the unilateral reduction of many non-tariff and tariff barriers, while the second wave included a series of bilateral and regional trade liberalization agreements in which the agricultural sector was specifically targeted and FTAs were introduced (Briceño-Garmendia et al., 2015; World Bank, 2017). The FTAs Peru has signed are summarized in Table 5. The establishment of the FTAs, in combination with reduced trade tariffs, encouraged the flow of goods and services tremendously (Van der Werf, 2021).

Table 5: Trade agreements of Peru (source: Acuerdos Comerciales del Perú, n.d).

	MEMBERSHIP OF TRADE ORGANIZATIONS/BLOCS		**BILATERAL AGREEMENTS**	
A**GREEMENTS**	ANDEAN community of Nations (CAN)[1]	Asia-Pacific Economic Cooperation (APEC)	Australia	Bolivia
			Canada	Chile
	Comprehensive and Progressive Trans-Pacific Partnership (CPTPP)	European Free Trade Association (EFTA)[2]	China	Costa Rica
			Cuba	Honduras
			Japan	Mexico
	European Union[3]	MERCOSUR countries[4]	Panama	Singapore
	Pacific Alliance[5]	World Trade Organization (WTO)	South Korea	Thailand
			UK	USA
SIGNED, BUT NOT IN FORCE AGREEMENTS	TPP (Trans-Pacific Partnership)		Brazil	Guatemala

1. ANDEAN Community of Nations includes Bolivia, Ecuador, Colombia, and Peru.
2. the European Free Trade Association includes the European Union (EU) and Iceland, Liechtenstein, Norway and Switzerland).
3. European Union (EU) includes 28 member countries located in Europe.
4. MERCOSUR includes Argentina, Brazil, Uruguay, and Paraguay (all founders), Venezuela (suspended), Bolivia (pending for full membership), Chile, Colombia, Ecuador, Guyana, Peru and Suriname (all associate members)
5. Pacific Alliance includes Chile, Colombia, Mexico and Peru.

2.5 Stakeholder mapping

This chapter includes the stakeholder mapping of private companies, governmental bodies and Non-Governmental Organizations (NGO's) and research institutes.

2.5.1 Private Companies

Peruvian agro-export companies

UNALM (N.P.) listed the top 20 agro-export companies per product, including the volume of the product exported in the years 2020-2021. These lists include the large, multinational agro-export companies, but also SMEs. Table 6 provides an overview of the agro-export companies in the function of the level of

production, classified in small, medium or large export volume (in tons) per product. An agro-export company producing and exporting 19,000 tons of blueberries and 19,000 tons of avocados can be classified as a large blueberry agro-export company and a small avocado agro-export company. Banana production and export is done by cooperatives, so they produce, collect and export fresh fruits, similar to how private agro-export companies do for other products. More detailed information on the Peruvian export companies can be found in Annex 3.

Table 6: Classification of agro-export companies with own production fields (source: UNALM, N.P. based on data retrieved from Informaccion, 2021)

PRODUCT		TYPE OF COMPANIES		
		SMALL	MEDIUM	LARGE
ASPARAGUS	Export volume range (tons)	<3,000	3,000 – 7,000	7,000 – 11,000
	No of companies	23	9	3
	Export volume share (%)	38%	39%	23%
AVOCADO	Export volume range (tons)	<20,000	20,000 – 40,000	40,000 – 60,000
	No of companies	15	4	2
	Export volume share (%)	38%	34%	28%
BANANA	Export volume range (tons)	<8,000	8,000 – 16,000	16,00 – 26,000
	No of companies	42	2	2
	Export volume share (%)	66%	9%	25%
BLUEBERRY	Export volume range (tons)	<9,000	9,000 – 18,000	18,000 – 29,000
	No of companies	63	3	1
	Export volume share (%)	53%	25%	22%
GINGER	Export volume range (tons)	<1,600	1,600 – 3,200	3,200 – 5,200
	No of companies	61	7	2
	Export volume share (%)	54%	29%	17%
MANDARINS	Export volume range (tons)	<4,600	4,600 – 9,500	9,500 – 15,000
	No of companies	39	0	1
	Export volume share (%)	50%	0%	50%
MANGO	Export volume range (tons)	<6,333	6,333 – 12,666	12,666 – 20,000
	No of companies	13	5	3
	Export volume share (%)	34%	32%	34%
POMEGRANATE	Export volume range (tons)	<1,400	1,400 – 2,800	2,800 – 5,000
	No of companies	59	5	1
	Export volume share (%)	50%	35%	16%
TABLE GRAPES	Export volume range (tons)	<17,333	17,333 – 43,666	43,666 – 53,000
	No of companies	24	4	2
	Export volume share (%)	50%	26%	24%

Suppliers of enabling technology, products and services

Investments in agrologistics and cold chain facilities can be made in multiple categories to further optimize the export supply chain. According to Castelein et al. (2022) enabling technology, products and services can be divided into the following categories:

- Sorting and packaging technologies
- Transportation and storage technologies
- Air conditioning and refrigeration technologies
- Product processing and handling technologies
- Packaging materials
- Quality control
- Training and advice
- Information technology (IT) and data solutions

Available agrologistics technology, products and services in Peru are mainly imported from Chile, USA and Spain. During the development of Peru as an export country, most technology was imported from Chile, as Chile was more advanced in fruit and vegetable transportation compared to Peru. During the last years, Peru started to import cold chain technology, such as climate-controlled packing houses and refrigerated

transportation equipment, from the USA. Technologies and products to automatize processes, such as selection- and packing machines, are mainly imported from Spain, the Netherlands and Germany. The Netherlands is also experienced in providing selection sensors for sorting- and packing lines, vertical farming technology, seed technology and robotics. However, different companies located worldwide can facilitate the installment of high-end technology, such as the USA, Spain, the Netherlands, Germany, Japan and China.

The Netherlands has a long history of successfully applying the so-called "Triple Helix" concept to stimulate innovation and collaboration between business, government and knowledge institutes, utilizing an industry-focused approach. An extended approach named the "Dutch Diamond Approach" adds non-governmental organizations (NGOs) to the scope to ensure more integrated and inclusive solutions (Castelein et al., 2022). For the different categories of enabling technology, products and services, illustrative examples of Dutch technology and companies are shown below:

- Sorting and packaging technologies can improve the efficiency of activities including sorting, grading, packaging and labelling with the help of adaptive robotics, computer vision, and machine learning. Companies such as Crux Agribotics are players in this field.
- Transportation and storage technologies are based on product-specific knowledge to meet specific transportation and storage requirements. For example, Dutch companies like Praxas Cargo provide technologies to reduce temperature fluctuations and control humidity in cargo transportation and storage, which helps to reduce the risk of food losses.
- Air conditioning and refrigeration technology play a central role in quality preservation in post-harvest chains where cooling efficiency is key. For example, Weber Cooling adopts hydronic cooling that can ensure the shortest cooling time. These coolers also take advantage of free cooling to reduce energy use. In addition to temperature control, Dutch players like Van Amerongen also provide world-class controlled atmosphere (CA) technology for storing fruits and vegetables, which can further extend the shelf-life through gas manipulation to suppress the respiratory effects of the products.
- Product processing and handling technologies can add significant value to the product. For example, Finis Food processing Equipment B.V. provides peeling and cutting machines for all kinds of vegetables. They have supported many large food processing companies in improving their processing plants and creating added value in food processing. Interko develops advanced systems for high-quality fresh fruits ripening, which allows the operators to conduct precise and customized ripening for different types of fruits.
- Packaging materials provide protection for fresh products in post-harvest chains. Remmert Dekker Packaging produces custom-printed cardboard packaging for fresh produce, food, snacks and beverages. It has designed a fully recyclable blueberry cardboard packaging to replace the traditional plastic bucket. This innovation does not only provide better protection of the products but also contributes to creating more environmentally friendly agri-food chains.
- Quality control refers to services related to quality monitoring and management specifically for agro products. Wageningen University & Research (WUR) has developed a High-Speed 3D Scanner that can help the agrifood chain players objectively assess the quality of their products in a non-destructive and non-contact manner.
- IT and data solutions for infrastructure and connectivity help to ensure efficient quality control in agri-food supply chains. For example, Infitiv develops a sensor and decision support software that can send early warning messages for quality degradation and spoilage to enable the company to take timely responses and optimize its sales strategy.

A more complete list of Dutch companies providing technologies, products and services internationally can be requested from RVO.

2.5.2 Government bodies and interventions

The Peruvian government, through their offices related to the production and exportation of agricultural products, are conscious that agribusiness activities need governmental support through clear and supportive legislation in agricultural matters as well as support in export logistics and opening of new markets. Important relevant government bodies such as MIDAGRI, SENASA, Peru's Export and Tourism Promotion Agency (Comisión de Promoción del Perú para la Exportación y el Turismo [PROMPERU]) and SUNAT are

engaged in helping agricultural producers and export-oriented producer associations improving their export activities and opening new markets.

MIDAGRI is the major Peruvian governmental body responsible for the agricultural sector in Peru. Its mission includes strengthening producer organizations and promoting training and technological adoption among small-scale producers. SENASA, an agency of MIDAGRI, is responsible for pests and disease projection in crops and livestock. PROMPERU is a decentralized entity governed by public law. It has the mandate to propose and execute plans and strategies to promote exports of goods and services. SUNAT has developed a mechanism called "EASY EXPORT" which simplifies the processes of Customs proceedings to promote export, especially for micro and small businesses with the aim of accessing international markets.

2.5.3 NGOs and research

To paint a picture of potential organizations for funding, support and research for Peruvian companies, organizations and policy makers, please find the following suggestions:

Funding

- World Bank – The World Bank is running projects to support energy-efficient cold chain development in countries in Latin America. WUR is leading the projects in Argentina and Guatemala. These projects include the identification of needed investments in cold chains in the agricultural sector and shaping the policies to support investments in energy-efficient cold chain technology. This is part of the World Bank Energy fund, known as ESMAP (ESMAP, n.d.).
- IFC – IFC is the private sector investment bank of the World Bank and has a special program on temperature-controlled logistics, which includes cold chain development. IFC is actively looking to make investments in cold chains in private sector companies in Latin America. IFC has a special 'Upstream' program, through which they are able to conduct feasibility studies co-financed by the potential investment taker (IFC, 2017).
- IADB Invest – IDB Invest is the private sector investment bank of the Inter American Development Bank (IADB). They have an established portfolio of investments in the agricultural cold chain sector in Peru.
- Invest International – Private sector development investor, always investing in Dutch solutions. Has a focus on Agri and food, which includes cold chain investments (InvestInternational, n.d.). They have two programs, known as the Dutch Good Growth Fund and the Dutch Trade and investment Fund.

Support

- RVO offers a range of support services including personal advice on doing business internationally and support schemes (RVO 2021). The Partners for International Business (PIB) program is also available at the website of RVO. Other relevant links and contacts for doing business in Peru are also listed on their website (RVO, 2018)
- TopSector Agri&Food, Topsector Horticulture and starting materials, and TopSector Logistics are active in the field of agrologistics. Two programs are highlighted:
    - Seed Money projects – to do a feasibility study and to set up collaborations and future research (Topsectoragrifood, n.d.). An example for Colombia can also be found on their website.
    - Public Private Partnerships (PPPs) - collaborative precompetitive research trajectory.
- Netherlands Food Partnership (NFP) – Connects and supports Sustainable Development Goal (SDG) 2 initiatives by Dutch organisations and partners from low and middle-income countries (NLFoodPartnership, 2021).

Research

- With respect to the most relevant research-institute stakeholders, UNALM is the National Agrarian University of Peru which is the major Peruvian research institute that provides scientific knowledge to address challenges in the agricultural sector. UNALM has an advantage to find context-based agrologistics solutions due to the local knowledge and network.

- From the Dutch side, WUR is the leading agricultural research institute that not only develops advanced post-harvest technologies and agricultural supply chain management knowledge but also provides tailor-made training programs to transfer those technologies and knowledge. WUR has also a long-term track record in implementing knowledge transfer projects in Latin America in the domain of agrologistics. Those aspects make WUR an important research stakeholder for the Peruvian agrologistics sector to collaborate with.

3 Identification of opportunities in the field of agrologistics and cold chain infrastructure

The aim of this chapter is to enable the identification of concrete opportunities for Peruvian companies, organizations and policy makers in the field of agrologistics and cold chain infrastructure. The main opportunities to create a sustainable and efficient cold chain infrastructure can be found at the production stage, and the post-harvest handling and processing stage.

3.1 Technological gaps and opportunities

Based on the literature and the findings from the interviews conducted by UNALM, strengths, weaknesses, opportunities and threats (SWOT) were found for the agro-export sector in Peru.

3.1.1 Production stage

Strengths - Many agro-export companies have their own production fields to produce (part of) the exported products. - Use of pre-cooling facilities in the production fields or -regions for the most fragile products such as blueberry and asparagus.
Weaknesses - No uniform production practices and standards at the production level for all agricultural producers. - Diseases and fungi in fruit-growing production fields affect the fruit in their post-harvest stages, such as *Botrytis spp*, *Cladosporium spp* and root rot. - Pre-cooling is not present at agricultural production level for all table grapes produced for the export market.
Opportunities - Developing strategies to reduce the impact of diseases active during the production stage and developing new active ingredients for fungicides that are in line with foreign regulations and counteract the action of fungi such as *Botrytis spp.* and *Penicillium spp*. - Installation of energy-efficient, low cost, cooling technology at collection centres in the production fields or -regions. - Delay ripening and softening of fruits by pre-cooling the fruits immediately after harvest and placing them in an ethylene-free storage at optimum temperature.
Threats - Weak relationships, and lack of long-term collaboration and coordination between external suppliers and agro-export companies.

At the production stage, the main technological gaps relate to:

1. Techniques to avoid the formation of fungi and other diseases in the production field for blueberry, table grape and mandarins.
2. Pre-cooling installations in or near production fields to pre-cool freshly harvested produce.

Ad 1) The formation of fungi and other diseases in the production field is a worldwide challenge that need to be tackled in collaboration with research institutes, seed companies and other input providers such as plant protection suppliers. Therefore new production techniques for seedlings need to be developed to reduce the number of cases of *Botrytis spp, Cladosporium spp* and root rot. Pre-cooling of products at an early stage can also reduce the spread of fungi.

Ad 2) Pre-cooling of freshly harvested produce is not applied in or near all production fields. Pre-cooling will delay ripening and softening of fruits in an early stage. The application of low-cost (moveable) cooling technology will help to overcome this challenge. Depending on the production season, portable cooling technology facilities can be shifted between different regions, villages or farms. In case of a year-round supply, also fixed cooling technology can be installed. Pre-cooling of produce directly after harvesting hampers the temperature increase occurring during waiting and transporting the produce to the packing house. Cooling helps to maintain the quality and shelf life of freshly harvested produce. The Dutch company BG Door International designed a moveable precool unit, specially designed to rapidly cool down (soft) fruits

and vegetables to the right temperature. Furthermore, multiple Dutch companies provide high-end cooling installations for fresh fruits and vegetables, such as Celtic Cooling and Geerlofs Refrigerations. However, more important is to focus on the initial quality and damage prevention for these products.

3.1.2 Post-harvest handling and processing

Strengths - Use of controlled temperatures in packing houses for some agro-export product, such as asparagus, avocado, blueberry, mango and pomegranate.
Weaknesses - High-tech systems in packing houses are not in place; a) activities in the packing house are conducted by hand labour, b) some packing houses (especially for processing ginger and turmeric) have only basic processing systems in place and c) software to manage the packing house is not developed for perishable products specifically. - Products face problems with post-harvest diseases in packing houses, such as fruit lenticel damage in avocado, fruit spot syndrome in mango and rhizome rot in ginger. - Not all packing houses have a controlled environment with cooling when performing the processing activities, such as packinghouses processing mangoes. - Lack of processes to reduce quality decay due to moisture loss of the fruits from the moment of the harvest till arrival at the export destination.
Opportunities - Large-scale monitoring of dry matter content along the processing line or in the production field to have a uniform maturation. - Installation of energy-efficient, low cost, cooling technology in the packing house processing rooms to maintain post-harvest quality. - Automatizing post-harvest handling practices (blueberry) or processing (ginger and turmeric), such as washing and drying to reduce the touching the products to minimize damages and quality decay. - Post-harvest management strategies to reduce moisture loss (for table grapes) and post-harvest diseases, such as fruit lenticel in avocado, fruit spot syndrome in mango and rhizome rot in ginger. - Developing eco-friendly packaging materials that maintain the same shelf life as current packaging material to meet the demand of importers regarding sustainability.
Threats - The presence of post-harvest diseases in shipments causing rejections at arrival of the entire container. - Problems with the ripening of the fruits at the export destination.

For off-farm post-harvest handling and processing the main technological gaps relate to:

1. Cold handling in production regions.
2. Post-harvest technology to prevent quality decay due to moisture loss and growth of micro-organisms.
3. Biodegradable packaging improving shelf-life.
4. Automatize post-harvest processing.
5. Monitoring dry matter.

Ad 1) Cold handling facilities are not in place in all regions in Peru. Companies located in hot, large production regions use high-tech facilities. However, most companies located in areas with lower production volumes do not have these high-tech facilities in place. Also, companies located in regions with a colder climate do not use these high-tech cold handling facilities yet. Companies indicated they will only invest in these facilities if the regions grow in terms of export product volume. When needed, these companies can learn from the agro-export companies that already have these facilities in place.

Ad 2) Post-harvest diseases and fungi are a huge challenge for fresh export products. Regulations of foreign export markets often demand reduction of the concentration of fungicides, insecticides and herbicides to be used, and forbid some active ingredients in these products. For this reason new, alternative, efficient products need to be developed to overcome these challenges. Dutch companies, such as AgroFresh and Janssen PMP, provide solutions for storage, packing and distribution losses through various application methods and fungicide formulations, fulfilling all European regulations.

Ad 3) Eco-friendly, biodegradable packaging is a topic with increased attention by importers worldwide. To follow the SDGs, the use of packaging material should be reduced and new reusable solutions should be promoted. Plastic packaging is used to maintain the shelf life of a product. Therefore, this cannot automatically be replaced by another packaging material. Research into and development of new solutions can help to overcome this challenge. WUR conducted multiple research projects to develop new, suitable and

sustainable packaging materials. Furthermore, Dutch companies developed multiple types of custom-made packaging materials for all types of fresh fruits and vegetables. For example, Remmert Dekker Packaging, which has a 125-year history, provides tailor-made packaging for fruits and vegetables including cups, bowls, trays, punnets, sleeves, boxes and crates. They claim their automated packaging solutions are customized to the type of fresh produce and their packaging materials are durable and environmentally friendly.

Ad 4) Automatized post-harvest processing lines and software are developed for specific products already. In the Netherlands, companies such as VISCON specialized in offering total logistics solutions for post-harvest processes of fruit and vegetables and can help design complete packing areas to process fresh produce with optimal precision. It offers a wide range of packing machinery and software to provide automatic packing solutions including packing the retail ready products into boxes and crates.

Ad 5) Monitoring product quality on large scale-processing lines is developed during the past few years. WUR developed an automated sorting and packing line that is able to measure and sort-out products that have internal quality decay. This robotized sorting and packing line adopts 3D sensors and hyperspectral imaging to collect the visual information of fresh products and translate it into product quality information using deep-learning algorithms. A new development at WUR is to combine the non-image historical data of the products and environmental parameters with visual information to improve quality prediction accuracy.

3.1.3 Transportation and logistics

Strengths - Access to international ports and airports which result in a large export market for fresh fruits and vegetables to countries all over the world. - Use of cool transport from production fields to packing houses for some product-production region combinations, for products such as asparagus, avocado, blueberry and mango. - Decentralization of packing houses to limit the transportation time between the production field and the packing house - A good business climate for investment in (foreign) technology to further optimize the Peruvian agro-export sector.
Weaknesses - Cool transport between production fields and packing houses are not used for all type of products that require cooling to maintain quality such as table grape. - Inadequate transport modalities used in transporting produce from the production fields in some regions to the packing house; cooling requirements and characteristics of the vehicle.
Opportunities - Installation of energy-efficient, low cost, cooling technology for transport. - Improve the settings of controlled atmosphere in oversea transport containers to improve the supply of gasses per product, such as CO_2 and O_2, to maintain product quality. - Monitor the settings of controlled atmosphere in transport containers during transport to be able to find causes for low-quality produce at arrival, and to adapt settings when needed.
Threats - High domestic transportation costs compared to other neighbouring countries. This limits their competitive advancement. - The port of Callao reaches its current maximum potential and needs structural updates - Political problems (Ukraine – Russia conflict).

For transport, logistics and policies, the main technological gaps relate to:

1. Cooled transport from production regions to packing houses.
2. Monitor conditions during storage and oversea transport.

Ad 1) Strict foreign market requirements regarding cold chain infrastructure resulted in large investments by the Peruvian industry in the cold supply chain in Peru during the last couple of years. Agro-export companies are conscious about temperature management. Currently, support is needed to optimize transport between production areas far from packing houses. For example, small-scale grape production is quite far (±1500 km) from packing houses and international ports in Peru. For this reason, there is a need for cooled transportation and knowledge about controlled atmosphere to maintain the quality of the harvested grapes early in the supply chain. Currently knowledge is lacking, as they cannot treat grapes produced in the northern highlands the same way as grapes produced in Ica, which is near the packing houses.

Ad 2) Temperature, humidity levels and CO_2 and O_2 levels should be set at the right settings to optimize the shelf life of fresh produce. WUR did research on multiple types of products to find the optimal settings during

storage and transportation. Different sensors have been developed by both WUR and other Dutch companies such as Environmental Monitoring Systems (EMS) BV, which makes the real-time monitoring of these settings with the internet of things (IoT) technology already possible.

3.2 Recommendations

Collaboration between Peruvian actors, international suppliers of technology, products and services, and governmental support can drive improvements and technological investments. In this paragraph the next steps to create a more sustainable and efficient cold chain infrastructure are provided. Tackling the issues often requires a combination of activities that can be implemented by different types of stakeholders.

- Arrange long-term partnerships (vertical integration) in the supply chain between external agricultural producers (groups) and agro-export companies. Long-term partnerships increase trust, cooperation and collaboration, and provide opportunities to link farm-level investments with downstream investments in the value chain. Besides the current tax rebates and governmental support to intensify the collaboration of agricultural producers in associations, more effort should be aimed at supporting the establishment of new partnerships and collaboration between agricultural producers and actors further downstream in the supply chain. Governmental- or non-governmental support can be in the form of providing financial support for companies that collaborate with multiple smallholder producers, such as in the ginger- and organic banana supply chain or agro-export companies that work with avocado producers in the highlands, or by providing training to help the establishment of producer associations.

- Transport between production fields and the packing houses is for most products organized via unrefrigerated transport modalities. Transport between the highlands in the north and the main ports is challenging, as well as transportation from production fields outside the coastal areas. Support is needed to transport the freshly harvested produce from these areas to the packing houses and maintain the product quality at the same time. There is a need to improve the logistics infrastructure outside the coastal areas to facilitate possibilities for agricultural producers outside the coastal areas, and to include refrigerated transportation modes to transport the fresh produce from production areas far away from the packing houses. Investments in the agrologistics network, and collaboration between private actors, governmental- and non-governmental organizations can further stimulate the uptake of refrigerated transport equipment.

- Post-harvest quality preservation can be realized by optimizing multiple factors which include 1) achieving an uninterrupted cold chain, 2) applying gentle handling and optimizing packaging, 3) providing appropriate, sustainable fungicides, insecticides and other techniques to reduce post-harvest diseases, 4) use the right storage techniques and settings, and 5) decrease the processing- and waiting time. There is a need for eco-friendly, approved, sustainable inputs to maintain quality. Furthermore increasing automation and handling standardization is desirable, especially for upcoming agro-export crops. One suggestion is to collaborate with foreign technology and service providers, and research institutes and universities, as the needed research, technology or services often already exist. The business climate for foreign companies to settle is good, and foreign embassies, universities, and governmental and non-governmental organization can assist in connecting private actors.

- Knowledge sharing and uptake on controlled atmosphere during transport from packing houses to the foreign export destination oversea should be improved. There is a need for improving and monitoring settings, and monitoring the quality of the produce during transport. Currently, the cold atmosphere settings and product quality are measured before transportation and at arrival, but live monitoring and adjusting settings is not possible. To realise this uptake collaboration between research institutes, providers of real-time trackers and software and agro-export companies should be set to share knowledge, provide technology and set up pilots to measure the impact of such real-time monitoring.

- Peru can become more competitive on the international market by reducing the logistics costs while maintaining the product quality. Improving the amount and frequency of vessel calls, and the connection between the roads and the ports will limit unnecessary waiting time. To achieve this, the infrastructure of the port of Callao needs to be updated by investing in a truck management system, decentralization of customs and secondary services and introduction of a front-port area with dedicated access to the port. Furthermore, investment is needed to improve the coordination between authorities to establish physical inspection protocols, and operations and coordination protocols.

4 Conclusions

This study on the Peruvian agrologistics sector and cold chain infrastructure provides a comprehensive situation analysis of the agro sector of Peru and enables the identification of concrete opportunities for further improvements in the field of agrologistics and cold chain infrastructure.

The agrologistics and cold chain infrastructure sector in Peru includes high-tech facilities and a good road connection in the coastal areas. The main agro-export companies have their own production fields and control the supply chain from production to shipment. Agro-export companies that source from independent agricultural producers or producer groups do this based on who offers the best price, as the loyalty between these actors is absent and long-term contracts do not exist. Transport from the production field to the packing houses is arranged by the agricultural producers by using unrefrigerated transport modalities as the distances are often short or the products do not require a very cold environment. For sensitive produce, such as blueberry and asparagus, collection centres are built near the production fields to pack the produce, keep it cool and transport it to the main packing house in refrigerated vehicles. For most products, the cold chain starts at arrival in the packinghouse or after the packed produce are stored. These packing houses are high-tech facilities, with technology for cooling, sorting and packing, and storage. For the different activities, the agro-export companies rely (partly) on hand labour. For the products that are cooled in the packing houses, the cold chain is maintained from the moment of arrival in the packing house till and including international shipment.

Opportunities for collaboration between the Netherlands and Peru in the field of agrologistics and cold chain infrastructure can be found in further improving the internal logistics network. This includes improving the capacity of the ports, starting and maintaining the cold chain network when sourcing from external sources and preserving the post-harvest quality. Pre-cooling installations near external production fields or -regions are absent in some areas. Furthermore, the transport between production fields and packing houses does not take place in refrigerated vehicles for all products. These challenges can be found in specific production regions of Peru, often far from the packing houses. Actors mention that they do not consider it a huge problem at this moment, but admit they see it as an opportunity in the near future. Peru has a good business environment to further improve its competitiveness. Private investments in technology and knowledge can stimulate production quality and maintain the quality of the product in the post-harvest stage. External opportunities are related to monitoring product quality during shipment and setting the right conditions during international transport.

To seize these opportunities, governmental and non-governmental organizations can support private actors by establishing new partnerships and collaboration between agricultural producers and actors further downstream in the supply chain. Governmental and non-governmental support can be in the form of providing financial support for companies that collaborate with smallholder producers or by providing training to help the establishment of producer associations. Even more so when previous programs demonstrated that high impacts can be achieved when farm-level investments are linked with downstream investments in value chain development. Furthermore, research institutes and universities play a vital role in gathering and sharing knowledge insights on post-harvest quality preservation research, such as developing the knowledge for the optimal storage conditions settings for each product.

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Annex 1 Selection of export supply chains

A multi-criteria analysis is an objective way that can be used to target the value chains with high potentials against the conditions and a list of predefined criteria. Thereafter the results are discussed internally, including soft criteria, to decide upon the product selection. Soft criteria are aspects of a supply chain (SC) that cannot (effectively) be taken into account by using data only.

1) Setting conditions and selection criteria

Conditions:

a. The product is a fresh fruit or fresh vegetable
b. The product is produced or can be produced in one of the selected regions in this project
c. The product should have at least a 10% growth in production volume trend in the last 10 year. (2020 - 2010)
d. The product should be imported by the Netherlands

Criteria:

Based on the discussion within our research team, the following criteria are selected
Crit. 1: production volume trend (in %) Peru last 10 years
Crit 2. Product value Peru (farmgate price)
Crit 3. Export volume trend Peru last 10 years
Crit 4. World market consumption/import for Western-Europe, Northern-America and China

2) Data collection and product ranking

Collection

33 products were included in this analysis. This included all fresh plant-based products produced in Peru that had at least a 10% production growth in production volume in the last 10 years (2010-2020).

	Legenda
	Top 1-5
	Top 6-10
	Top 11-15
	Top 16-20
	Top 21-25
	Top 26-33
	No data

	Crit 1: production volume trend (in %) Peru last 10 years (2020-2010)	Crit 2. Product value Peru (gross production value in 1000 US$, 2019)	Crit 3. Export volume trend (in %) Peru last 10 years (2020-2010)	Crit 4. World market trend import in 2020 (China, Western-Europe and Northern-America)	Crit 5. Import Netherlands
Blueberries	601,000	No data	10,819	364,413	16,449
Ginger	1,308	No data	2,256	273,940	95,285
Avocados	358	516,308	690	2,047,439	414,175
Cauliflowers and broccoli	300	22,654	No trend	476,983	48,790
Grapes	262	471,758	555	2,370,584	401,920
Tangerines, mandarins, etc.	238	171,969	367	1,750,999	212,571
Olives	232	74,589	7	10,633	2,047
Apricots	209	442	-	102,174	5,394
Pineapples	188	116,435	292	2,153,041	301,494
Chillies and peppers, green	179	125,411	288	2,296,422	125,960
Spinach	161	9,543	No trend	137,059	10,018
Fruit, fresh nes	152	44,311	800	1,747,692	86,369
Grapefruit (inc. pomelos)	151	1,035	752	589,145	248,302
Garlic	144	81,341	322	264,368	41,287
Potatoes	143	1,809,532	34,281	6,662,050	1,651,026
Vegetables, fresh nes	143	36,506	5,941	1,644,795	101,398
Oranges	141	89,801	374	2,824,517	621,712
Lettuce and chicory	137	19,880	21	1,258,740	92,273
Coconuts	137	5,200	390	736,226	15,974
Fruit, tropical fresh nes	136	No data	No trend	1,404,530	242
Lemons and limes	135	50,147	747	1,860,191	306,316
Peas, green	132	66,359	144	221,445	34,458
Quinces	127	3,139	No trend	13,939	1,968
Cherries, sour	126	785	122	24,101	1,349
Watermelons	126	25,468	412	2,161,890	179,381
Melons, other (inc.cantaloupes)	126	4,931	122	1,235,245	205,735
Eggplants (aubergines)	125	139	No trend	275,915	19,268
Broad beans, horse beans, dry	123	57,997	214	103,083	33,444
Fruit, citrus nes	117	24,537	No data	No data	No data
Bananas	115	No data	28,887	11,803,443	1,274,827
Mangoes, mangosteens, guavas	113	136,972	247	1,073,736	277,727
Carrots and turnips	112	46,105	No trend	1,110,121	68,818
Asparagus	111	363,812	102	363,367	12,768

Ranking

Legenda
5 points
4 points
3 points
2 points
1 point
0 points
0 points

	Crit 1: production volume trend (in %) Peru last 10 years (2020-2010)	Crit 2. Product value Peru (farmgate price in 1000 US$, 2019)	Crit 3. Export volume trend (in %) Peru last 10 years (2020-2010)	Crit 4. World market trend import (China, Western-Europe and Northern-America)	Total
Grapes	5	5	4	5	19
Avocados	5	5	4	4	18
Potatoes	3	5	5	5	18
Tangerines, mandarins, etc.	4	5	3	4	16
Chillies and peppers, green	4	4	2	5	15
Pineapples	4	4	2	4	14
Oranges	2	4	3	5	14
Fruit, fresh nes	3	2	4	3	12
Vegetables, fresh nes	2	2	5	3	12
Lemons and limes	1	3	4	4	12
Blueberries	5	No data	5	1	11
Ginger	5	No data	5	1	11
Garlic	3	4	3	1	11
Watermelons	1	2	3	4	10
Bananas	0	No data	5	5	10
Cauliflowers and broccoli	5	2	0	2	9
Grapefruit (inc. pomelos)	3	0	4	2	9
Olives	4	3	1	0	8
Coconuts	2	1	3	2	8
Mangoes, mangosteens, guavas	0	4	2	2	8
Lettuce and chicory	2	1	1	3	7
Asparagus	0	5	1	1	7
Peas, green	1	3	2	0	6
Fruit, tropical fresh nes	2	No data	0	3	5
Melons, other (inc.cantaloupes)	0	1	1	3	5
Broad beans, horse beans, dry	0	3	2	0	5
Carrots and turnips	0	3	0	2	5
Apricots	4	0	0	0	4
Spinach	3	1	0	0	4
Fruit, citrus nes	0	2	No data	No data	2
Quinces	1	1	0	0	2
Cherries, sour	1	0	1	0	2
Eggplants (aubergines)	0	0	0	1	1

3) Discussion (soft criteria)

Soft criteria:

a. Political ambitions

b. Potential investor or cooperation

c. Cultural factors

Annex 2 Agribusiness companies visited by region

Table 7: Agribusiness companies visited by region

REGION	COMPANY	AGRICULTURAL PRODUCT
Ica 22 - 24 March	Agrícola Chapi	Table grape, Avocado
	AGROKASA	Avocado, Blueberries
	Agrícola La Venta	Table graspe, Pomegranate
	Sun Fruits	Table grape
		Avocado, Citrus
Huaral 30 - 31 March	Torre Blanca	Citrus, Blueberries, Pomegranate, Mango, Persimon
	AGRIHUSAC	Mandarine Satsuma Okitsu, Owari, Primosole, Clemenules, W Murcott, Tango, Río de Oro, Malvacea, Tangelos, Avocado Hass, Fuerte, Sutano, Ettinger, Naval, Mango, Arándano
	AGRILEZA	Avocado, Mandarines
	Campo Verde	Mandarine Satsuma, Avocado, Orange for juice
Huacho 31 March	AGROKASA	Avocado, Blueberries
Huacho 20 April	PEPAS	Green Asparagus
Barranca 31 March	INKABERRIES	Blueberries
Pichanaki 12 - 14 April	VANCARD PERU SAC	Ginger, Turmeric
	NATIVA PERU ORGANICS	Ginger, Turmeric
	La Campiña	Ginger, Turmeric
	Hamillton Farm	Ginger, Turmeric
Casma 18 - 20 April	ARA Export	Mango, Avocado, Table grape, Blueberries
	Luna Verde	Mango
	SOBIFRUITS	Mango
	PERUVIAN INKA FRUITS	Mango, Pomegranate, Avocado
Casma 1 July	FRUSABE	Mango
Piura 25 - 26 April	JUMAR PERU SAC	Kent, Edward, Haden, Ataulfo Mango
	Coop. Agraria de Productores Orgánicos SALITRAL	Organic Banana
	ECOSAC	Table grape, Avocado, Lemon
Olmos 27 April	AGROVISION	Blueberries, Table grape, Avocado, Asparagus
	Plantaciones del Sol	Blueberries
Lambayeque 28 April	Agrícola Cerro Prieto	Blueberries, Asparagus
Arequipa 16 - 17 May	Fundo América	Yellow sweet onion, Pomegranate, Table grape
	Agrícola Pampa Baja	Avocado, Mandarines, Onion, Table grape, Pomegranate
Caraz 22 - 24 June	FRG FARMS SAC	Holantao: Snow peas, Sugar snaps
La Libertad (Virú y Chao) 27 - 30 June	TALSA	White, Green asparagus; Hass and Maluma Avocado
	HORTIFRUT	Blueberries
	MISSION	Avocado
	VIRU	Avocado, Blueberries
	DANPER	Green asparagus, Blueberries, Avocado, Table grape

Annex 3 Peruvian export companies with own production

Tables 9 till 18 record the lists of the main fresh fruit export companies. The top 20 have been selected based on the export volume registered in INFORMACCION and CUSTOMS.

Table 8: Asparagus production (in tons) by agribusiness companies in Peru in 2021. (source: Informaccion).

FRESH ASPARAGUS EXPORTATIONS (NET TN) BY AGRIBUSINESS COMPANY		TN (2021)
1	COMPLEJO AGROINDUSTRIAL BETA S.A.	10,373,332.15
2	DANPER TRUJILLO S.A.C.	8,479,188.07
3	AGROEXPORTACIONES NATHANAEL S.A.C.	7,317,118.85
4	AGRO PARACAS S.A.	5,878,413.23
5	KIMSA FRESH E.I.R.L.	5,709,049.54
6	EMPRESA AGRO EXPORT ICA S.A.C.	5,676,880.67
7	SOCIEDAD AGRICOLA DROKASA S.A.	5,269,435.99
8	AGROVISION PERU S.A.C.	5,221,990.40
9	FLORIDABLANCA S.A.C.	4,337,647.85
10	FRESH EXPORT LA ARENITA S.A.C.	4,258,625.00
11	SANTA SOFIA DEL SUR S.A.C.	4,143,896.50
12	PEAK QUALITY DEL PERU S.A.	3,515,791.95
13	AGROINPER FOODS S.A.C.	2,838,843.69
14	SAN EFISIO S.A.C.	2,789,414.06
15	AGRICOLA LA VENTA S.A.	2,737,225.00
16	AGRICOLA HUARMEY S.A.	2,695,580.00
17	SOCIEDAD AGRICOLA VIRU S.A.	2,452,699.87
18	JG FRESH PRODUCE S.A.C.	2,314,581.30
19	TALSA AGROEXPORT S.A.C.	2,180,419.81
20	AGROEXPORTADORA VILLACURI S.A.C.	2,082,715.40

Table 9: Avocado production (in tons) by agribusiness companies in Peru in 2021. (source: Informaccion).

AVOCADO EXPORTATIONS (NET TN) BY AGRIBUSINESS COMPANY		2021 (TN)
1	AVOCADO PACKING COMPANY S.A.C.	59,294.07
2	CAMET TRADING S.A.C.	40,558.51
3	SOCIEDAD AGRICOLA DROKASA S.A.	37,313.35
4	AGRICOLA CERRO PRIETO S.A.C.	31,593.41
5	CAMPOSOL S.A.	28,507.86
6	SOCIEDAD AGRICOLA VIRU S.A.	25,313.68
7	CONSORCIO DE PRODUCTORES DE FRUTA	15,055.27
8	EXPORTADORA EL PARQUE PERU S.A.C.	11,841.05
9	PLANTACIONES DEL SOL S.A.C	11,767.26
10	AGRICOLA PAMPA BAJA S.A.C.	10,989.39
11	AVO PERU S.A.	10,847.14
12	AGRICOLA HOJA REDONDA S.A.	10,698.86
13	CORPORACION FRUTICOLA DE CHINCHA	10,271.78
14	ASR TRADING S.A.C.	9,615.90
15	COMPLEJO AGROINDUSTRIAL BETA S.A.	9,476.54
16	PROYECTOS TORINO S.A.C.	7,270.08
17	INCAVO S.A.C.	6,618.03
18	HASS PERU S.A.	6,105.89
19	AGRICOLA CHAPI S.A.	6,025.30
20	AGROINDUSTRIAL ESTANISLAO DEL CHIM	5,963.43

Table 10: Banana production (in tons) by agribusiness companies in Peru in 2021. (source: Informaccion).

BANANO EXPORTATIONS (NET TN) BY AGRIBUSINESS COMPANY		2021 (TN)
1	AGRONEGOCIOS LOS ANGELES S.A.C.	25,051
2	ASOCIACION DE PEQUEñOS PRODUCTORES DE BANANO ORGANICO DE SAMAN Y ANEXOS	19,700
3	PRONATUR S.A.C	10,473
4	ASOCIACION DE PEQUEñOS PRODUCTORES ORGANICOS DE QUERECOTILLO	6,027
5	ANDEAN NATURAL PRODUCTS EXPORT IMPORT S.A.C.	15,583
6	BANANICA S.A.C.	5,575
7	COOPERATIVA AGRARIA APBOSMAM	8,911
8	CAPEBOSAN - JIBITO	8,916
9	ASOCIACION DE PRODUCTORES DE BANANO ORGANICO VALLE DEL CHIRA	7,557
10	SOCIEDAD EXPORTADORA VERFRUT S.A.C.	2,569
11	APPFONORPE	4,114
12	ORGANICOS RIO VERDE S.A.C.	4,615
13	MUSTERION INCA DEL PERU S.A.C.	2,887
14	GREENWAY S.A.	3,714
15	COOPERATIVA AGRARIA ALTO GRANDE SANTA SOFIA - COOPAG	3,145
16	ASOCIACION DE MICRO-PRODUCTORES DE BANANO ORGANICO DEL ALTO CHIRA MARGEN IZQUIERDA	3,592
17	AGROEXPORTADORA SOL DE OLMOS S.A.C.	2,196
18	BAILEY FARMS PERU S.A.C.	3,326
19	IREN PERU S.A.C.	7,983
20	ANA BANANA S.A.C.	3,462

Table 11: Blueberry production (in tons) by agribusiness companies in Peru in 2021. (source: Informaccion).

	BLUEBERRIES EXPORTATIONS (NET TN) BY AGRIBUSINESS COMPANY	20/21
1	CAMPOSOL S.A.	28,519.45
2	AGROVISION PERU S.A.C.	12,162.06
3	COMPLEJO AGROINDUSTRIAL BETA S.A.	10,716.50
4	AGROBERRIES PERU S.A.C.	9,796.36
5	DANPER TRUJILLO S.A.C.	7,200.84
6	HFE BERRIES PERU S.A.C.	6,172.13
7	HASS PERU S.A.	5,861.71
8	BLUEBERRIES PERU S.A.C.	5,408.06
9	AGRICOLA SANTA AZUL S.A.C	5,303.11
10	HORTIFRUT-TAL S.A.C.	4,482.50
11	EXPORTADORA FRUTICOLA DEL SUR SA	3,965.79
12	CARSOL PIURA S.A.C.	3,562.94
13	VISON S S.A.C.	2,742.69
14	OZBLU PERU S.A.C.	2,711.51
15	AGUALIMA S.A.C.	2,655.62
16	SOCIEDAD AGRICOLA DROKASA S.A.	1,512.80
17	GIDDINGS BERRIES PERU S.A.C.	1,364.08
18	PLANTACIONES DEL SOL S.A.C	1,345.96
19	SOCIEDAD INDUSTRIAL MOCHE NORTE S.A.C.	1,305.72
20	FRUSAN AGRO S.A.C.	1,278.19

Table 12: Ginger production (in tons) by agribusiness companies in Peru in 2021. (source: Informaccion).

GINGER EXPORTATIONS (NET TN) BY AGRIBUSINESS COMPANY		2021 (TN)
1	JCH ORGANIC SOCIEDAD ANÓNIMA CERRADA	5,298
2	AGRONEGOCIOS LA GRAMA S.A.C.	3,460
3	KION EXPORT S.A.C.	2,716
4	FRUITXCHANGE S.A.C - FC S.A.C	2,450
5	ELISUR ORGANIC S.A.C.	2,414
6	STERLING PERU S.A.C. - EXPORTACIONES AYVAR	2,004
7	E & J GAVILAN EXPORT SOCIEDAD ANÃ"NIMA C	1,768
8	NATIVA ORGANICS S.A.C.	1,625
9	RTE AMAZON S.A.C.	1,618
10	DOÑA DOROTEA S.A.	1,390
11	VANCARD PERU SAC	1,382
12	AGROEXPORTACIONES LLACTA S.A.C.	1,285
13	SOBIFRUITS S.A.C.	1,275
14	AGRO DEVELOP PERU SOCIEDAD ANONIMA CER	1,112
15	EMPRESA AGRO EXPORT ICA S.A.C.	1,040
16	AGRICOLA NUESTRA TIERRA S.A.	1,013
17	LA CAMPIÑA PERU S.A.C.	928
18	INTERLOOM S.A.C.	893
19	TROPIC-X S.A.C.	835
20	ANAWI EXPORT S.A.C.	794

Table 13: Mandarin production (in tons) by agribusiness companies in Peru in 2021. (source: Informaccion).

MANDARIN EXPORTATIONS (NET TN) BY AGRIBUSINESS COMPANY		2021 (TN)
1	CONSORCIO DE PRODUCTORES DE FRUTA S.A	14,880.87
2	GRUPO COMERCIAL CAMPO VERDE S.A.C.	2,539.68
3	AGRICOLA LAS MARIAS S.A.C.	2,032.24
4	CORPORACION FRUTICOLA DE CHINCHA S.A.C	1,680.10
5	PROCESADORA TORRE BLANCA S.A.	1,104.92
6	SIEMBRA ALTA S.A.C.	977.75
7	AGROCOSTA PERU S.A.C.	901.60
8	ASESORIAS E INVERSIONES MUVA S.A.C.	836.18
9	AGROCROP SANTA PERU S.A.C.	636.34
10	CENTRAL SAN LUIS S.A.C.	591.04
11	SOCIEDAD AGRICOLA ARONA S.A.	563.94
12	FRUTO DE ORO S.A.C.	548.80
13	ANDES PREMIUM FRUITS S.A.C.	496.92
14	FUKUDA LENCI CARLOS YOSHIO	440.00
15	CULTIVOS ORGANICOS S.A.C.	286.48
16	TECFRUT PERU EXPORT E.I.R.L.	271.23
17	PROFRUTOS PERU E.I.R.L.	137.76
18	TA EXPORT S.A.C.	113.87
19	DIMAAN E.I.R.L.	91.84
20	WAMBRA CORP S.A.C.	88.82

Table 14: Mango production (in tons) by agribusiness companies in Peru in 2021. (source: Informaccion).

MANGO EXPORTATIONS (NET TN) BY AGRIBUSINESS COMPANY		2021 (TN)
1	SUNSHINE EXPORT S.A.C	19,096.68
2	CAMPOSOL S.A.	14,866.50
3	DOMINUS S.A.C	12,638.89
4	LUNA VERDE S.A.C.	9,653.03
5	FLP DEL PERU S.A.C.	9,648.77
6	ASICA FARMS S.A.C.	8,840.54
7	EXOTIC S PRODUCERS & PACKERS S.A.	8,544.96
8	JUMAR PERU S.A.C.	7,192.03
9	AGROCOSTA PERU S.A.C.	5,513.19
10	LOGIFRU S.A.C	5,500.76
11	AGRICOLA VIDAS SALUDABLES S.A.C.	4,875.93
12	PACHAMAMA FARMS S.A.C.	3,937.15
13	AGROPALL EXPORT S.A.C.	3,503.82
14	PASSION FRESH S.A.C.	3,446.44
15	INVERSIONES AGRICOLAS OLMOS II S.	3,382.76
16	M & C FRUITS COMPANY S.A.C.	3,132.60
17	ARA EXPORT S.A.C.	3,095.43
18	SOBIFRUITS S.A.C.	3,070.60
19	FRUTOS ORGANICOS DEL PERU S.A.C.	2,837.66
20	MANGOS Y HORTALIZAS DEL PERU S.A	2,666.05

Table 15: Pomegranate production (in tons) by agribusiness companies in Peru in 2021. (source: Informaccion).

POMEGRANATE EXPORTATIONS (NET TN) BY AGRIBUSINESS COMPANY		2021 (TN)
1	EXPORTADORA FRUTICOLA DEL SUR SA	4,355.00
2	AGRICOLA PAMPA BAJA S.A.C.	2,661.62
3	AGRICOLA SAN GALLAN S.A.C.	2,187.27
4	CORPORACION AGROLATINA S.A.C.	1,790.53
5	SOBIFRUITS S.A.C.	1,651.75
6	AGRO VICTORIA S.A.C.	1,421.75
7	COMPLEJO AGROINDUSTRIAL BETA S.A.	1,388.33
8	AGRICOLA LA VENTA S.A.	1,244.49
9	AGRICOLA HUARMEY S.A.	1,229.35
10	SIEMBRA ALTA S.A.C.	954.96
11	GREENLAND PERU S.A.C.	842.43
12	UVICA S.A.C.	827.52
13	AGRICOLA CUYUMA S.A.	760.61
14	ESPARRAGOS DEL PERU S.A.C.	718.38
15	SOCIEDAD AGRICOLA 3P S.A.C.	693.75
16	AGRICOLA LOS MEDANOS S.A.	580.53
17	AGRO PARACAS S.A.	543.23
18	COUNTRY HOME SA	429.99
19	WAMBRA CORP S.A.C.	362.44
20	INVERSIONES NIVAMA S.A.C.	332.61

Table 16: Table grape production (in tons) by agribusiness companies in Peru in 2021. (source: Informaccion).

TABLE GRAPE EXPORTATIONS (NET TN) BY AGRIBUSINESS COMPANY		2021 (TN)
1	SOCIEDAD AGRICOLA RAPEL S.A.C.	52,332.98
2	EL PEDREGAL S.A	31,329.32
3	COMPLEJO AGROINDUSTRIAL BETA S.A.	26,944.12
4	ECOSAC AGRICOLA S.A.C.	25,573.39
5	LOS OLIVOS DE VILLACURI S.A.C.	21,666.53
6	AGRICOLA ANDREA S.A.C.	16,950.34
7	CAMPOSOL S.A.	14,033.88
8	RVR AGRO	12,871.95
9	AGRO VICTORIA S.A.C.	10,782.38
10	AGRICOLA DON RICARDO S.A.C.	10,733.09
11	CORPORACION AGROLATINA S.A.C.	10,364.83
12	SOCIEDAD AGRICOLA SATURNO SA	10,040.30
13	SOCIEDAD AGRICOLA DROKASA S.A.	9,061.79
14	EXPORTADORA SAFCO PERU S.A.	8,897.95
15	AGRICOLA HOJA REDONDA S.A.	8,215.48
16	AGRICOLA PAMPA BAJA S.A.C.	7,171.49
17	AGRICOLA SAN JOSE S.A.	6,757.25
18	FRUTAS DE PIURA S.A.C.	6,497.23
19	AGROEXPORTACIONES MANUELITA S.A.C.	6,245.22
20	UVICA S.A.C.	5,887.54

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