
SUSTAINABLE COLD CHAINS

Frank Findlow = Triple EFF Consulting

EFF
TRIPLE EFF CONSULTING

Executive Summary

There is fantastic work happening across the globe all designed with waste reduction and sustainability at the core.

With this report Triple EFF Consulting want to highlight working models and suggest that many lessons have been learned and should be copied/duplicated where possible in order to sustain the environment that we live in.

Overview (Global stats)

Of the total food produced for human consumption, an estimated 14 per cent is lost (Food and Agriculture Organization of the United Nations [FAO] 2019), and an estimated 17 per cent is wasted (UNEP 2021), costing the global economy an estimated \$936 billion a year (FAO 2014a).

The lack of effective refrigeration is a leading contributor to this challenge, directly resulting in the loss of 526 million tons of food production, or 12 per cent of the global total, in 2017 (International Institute of Refrigeration [IIR/IIR] 2021a).

This is enough to feed an estimated 1 billion people in a world where currently 811 million people are hungry and 3 billion are unable to afford a healthy diet (FAO 2022).

The unavailability of robust food cold chains to maintain the quality, nutritional value and safety of food products has ramifications for people's health. A food cold chain is an integrated temperature-controlled food distribution system that ensures that perishable produce and/or temperature-sensitive products are kept at their optimum temperature and environment, from source to destination.

It is a complex system that has many static and moving elements and that requires accountability from multiple levels, including farmers, aggregators, processors and manufacturers, distributors, retailers, and consumers. Populations in most developing

countries depend heavily on agriculture for their livelihoods, making the development of food cold chains a powerful tool to boost incomes and foster economic growth.

Food loss during the postharvest period reduces the income of 470 million smallholder farmers by as much as 15 per cent (Rockefeller Foundation 2013).

The example below is from a colleague of Triple EFF Consulting carried out in the Philippines



Improving the Quality of the Banana Supply Chain
After much research, here are Freshport Asia's concise
recommendations to improve the quality of
the banana supply chain in the Philippines:



Perspective Indonesian cold chain

The current National Logistics Capacity for all materials is 31,000,000 Tons. * (latest numbers) Of which cold chain sector is 1,920,000 tons.

Majority of Cold Chain operations companies are registered in ARPI the Asosiasi Rantai Pendingin Indonesia (Indonesian Cold Chain Association) and ALFI the Asosiasi Logistics Freight Forwarders Indonesia.

This includes Pharmaceuticals, F&B Industries, Fresh Food products, Fish & Seafood, Dairy & Ice Cream.

Capacity as of October 2020 was 2.4mm Pallets @ 750-1,000kg per pallet.

By 2030, Indonesia is projected to become the 7th largest cold chain market in the world, driven by the consumer population, as the 4th largest in the world. (McKinsey study).

By contrast the global food cold chain capacity has been growing in recent decades. However, this growth is uneven. Many developing countries need substantial additional capacity at all stages to ensure uninterrupted connectivity from farm to fork, as well as the skills required to install and maintain cooling equipment.

Even in developing countries where cold chain infrastructure is growing, the expansion of throughput may be limited due to less-than-optimal utilization of the existing capacity. Challenges include a lack of relevant engineering capacity (resulting in poor equipment maintenance and downtime), misapplied business models and mismanaged forward or backward linkages, among others.

The result is inefficiencies in energy and resource use, lower returns on investment, and unwarranted financial overruns.

Rapid development in sustainable food cold chain infrastructure and technology requires parallel updating of skillsets and best practices, to minimize operational challenges as well as food and financial losses.

The food cold chain also has implications for global climate change and the environment. Emissions from food loss and waste due to lack of refrigeration totaled an

estimated 1 gigaton of carbon dioxide (CO₂) equivalent in 2017 (IIF/IIR 2021). Overall, the food cold chain is responsible for around 4 per cent of total global greenhouse gas emissions, including emissions from cold chain technologies and from food loss and waste due to lack of refrigeration (IIF/IIR 2021).

Emissions from the cold chain itself are set to rise significantly as new cooling-related infrastructure comes online in developing countries

Indonesian cold chain users

Prospects for cold storage space in Indonesia is growing at 15-20% YoY, verified by most cold storage warehouses being at or near capacity.

Storage of proteins, poultry, meat products, fish, seafood, vegetables, fruits and the like. Driven by the increasing Indonesian economic growth, accompanied by the development of the user industries.

A contributing factor is the large population with a changed consumption pattern that requires efficiency and speed.

The continued development of the retail sector and restaurant chain stores have also encouraged the development of cold storage business in Indonesia.

These retail networks have many outlets spread across several locations, this requires compliant handling and a professional distribution network to ensure the goods arrive at their destination “Fit for Purpose.

This is also a requirement for export and import business of fishery products, meat, fruit and vegetables and the ice cream industry.

An example of a major protein producer is shown below.

Company overview

Core competencies across the value chain



Indonesian cold chain players

Based on a survey conducted by CIC, at the end of 2018, there were around 69 major cold storage companies throughout Indonesia with a total capacity of 370,000 tons per year.

The number one Company being PT Enseval Putera Megatrading Tbk (EPMT), which is responsible for delivering pharmaceuticals for Kalbe and third-party principal products to over 1 million outlets in Indonesia.

In addition, Kalbe has also expanded the business portfolio of the Division to include raw material trading, medical device trading and retail and health services.

Kalbe's distribution and Logistic network for pharmaceuticals products is the most extensive in Indonesia.

The table below shows the top 10 companies.

No.	Name of Company	Capacity (Ton)	Share (%)
1	Enseval Putra Megatrading Tbk, PT	59,000	15.9
2	Unilever Indonesia, PT (Wall's ice cream)	50,000	13.5
3	Sukanda Djaya, PT	45,000	12.2
4	Kiat Ananda Cold Storage, PT	30,000	8.1
5	Mega Internasional Sejahtera, PT	21,000	5.7
6	Indomaguro Tunas Unggul, PT	15,000	4.1
7	Dharma Samudera Fishing Industries, PT	14,000	3.8
8	Savina Cold Storage	9,000	2.4
9	Wahana Cold Storage, PT	7,000	1.9
10	Lion Super Indo, PT/Super Indo	6,600	1.8

To maintain a cold storage facility requires a substantial investment, and it's not surprising that many companies do not have their own cold storage facilities. Rather, many of them rent or cooperate with cold storage owners. This makes it is very difficult to know the exact amount of cold storage operation in Indonesia.

Indonesian cold chain capacity is growing

Projection of Potential Demand for Cold Storage in Indonesia, 2019–2024 Capacity (tons)
Additional Production Capacity (thousand tons):

2019 462,750 an annual increase of 92,550t
2020 548,359 an annual increase of 85,609t
2021 631,161 an annual increase of 82,802t
2022 692,384 an annual increase of 61,223t
2023 765,084 an annual increase of 72,700t
2024 824,760 an annual increase of 59,677t

- **YoY Tonnage increase since 2021 Averaging 61,100t**

The cold chain logistics market continues to be dominated by cold storage in the form of warehousing rather than transportation. Cold Storage services include refrigerators, chilled rooms, thawing rooms, freezer rooms, blast chillers and blast freezers.

Greater Jakarta has more than 40 cold chain companies with major locations of cold storage being North Jakarta, West Jakarta, and Bekasi.

The basic storage types can be divided simply into Industrial and Commercial. Commercial sites are for business activities such as logistics and supply chain management hubs and generally have a capacity of below 500 tons, these units are generally leased or rented.

The industrial storage facilities have more than 500 tons capacity and function usually as a part of production facility. However, there is a growing trend of newly built cold storage warehouses.

One of the noted changes evident post the pandemic is that Cold Chain and refrigerated Cold storage always used to be pallet in and pallet out.

Now, like many sectors, refrigerated is transitioning to pallet in and case out or pallet in and singles out.

This is largely driven by Ecommerce and cold chain players recognizing that the increase of more B2C (Business to Consumer) & D2C (Direct to Consumer). Which in turn will require more, smaller, storage spaces, usually for fulfilment purposes.

Indonesia is the largest archipelagic country in the world and the second largest producer of seafood.

Data from the latest Statista report indicate that revenue in the Indonesian Processed Fish & Seafood segment will be US\$6.93bn in 2022. The market is expected to grow annually by 6.87% (CAGR 2022-2027). Consumption numbers in relation to total population figures, per person revenues of US\$25 will be generated in 2022.

In the Processed Fish & Seafood segment, volume is expected to amount to 892.5mkg by 2027.

The Processed Fish & Seafood segment is expected to show a volume growth of 4.2% in 2023.

The average consumption volume per person in the Processed Fish & Seafood segment is forecasted to be 2.8kg in 2022.

The marine fisheries, food industry, which includes fishing, freezing, cooling, processing, and preserving, as well as industry and trade supporting business activities.

Importance of the Indonesian cold chain

Consumers are rarely aware of the backstage actions that occur when you order a product, online or in-store. We purchase medications, food, and beverages from businesses and shops, with no second thought about how they arrived there.

Or we enjoy a nice dinner at a local restaurant, unaware of how the meat was delivered. But we do expect a quality product. At the same time, eCommerce has driven changes in consumer demand for the speedy delivery (two-day, one-day, same-day) of quality, fresh goods.

Consumers want their product in the best condition, and they want it quickly.

Cold chain logistics involves preparing, storing, transporting, and monitoring the products through various elements.

Manufacturers rely heavily on cold chain logistics to ensure their products are in good shape “Fit for purpose” when they arrive at their destination.

Fit for purpose product conforms with a set of interlinked steps involved in the production, storing, processing, marketing, distribution, and consumption of food. Food producers are at one end of the value chain, while consumers are at the other end.

Between the point of food production and the point of consumption, various processes and actors in the value chain add value to the food product, in several ways. This includes primary processes (such as sorting and grading), packaging, precooling, storing, food processing and transport, all of which allows the product to reach the consumer in a manner that upholds a food’s quality and safety, minimizing both food and economic losses.

Figure 1 outlines the main steps through which food passes before reaching the consumption stage.

Figure 1. A generic food value chain



Source: FAO 2021, Puri, M., Rincon, L., & Maltsoğlu, I. (2021). Renewable energy for agrifood chains: Investing in solar energy in Rwanda. FAO 2016, Puri, Manas. How access to energy can influence food losses. A brief overview.

For perishables, such as meat, dairy, fruit, and vegetables, having access to refrigeration and a cold chain is imperative to maintain food quality and safety, and to reduce losses along the supply chain.

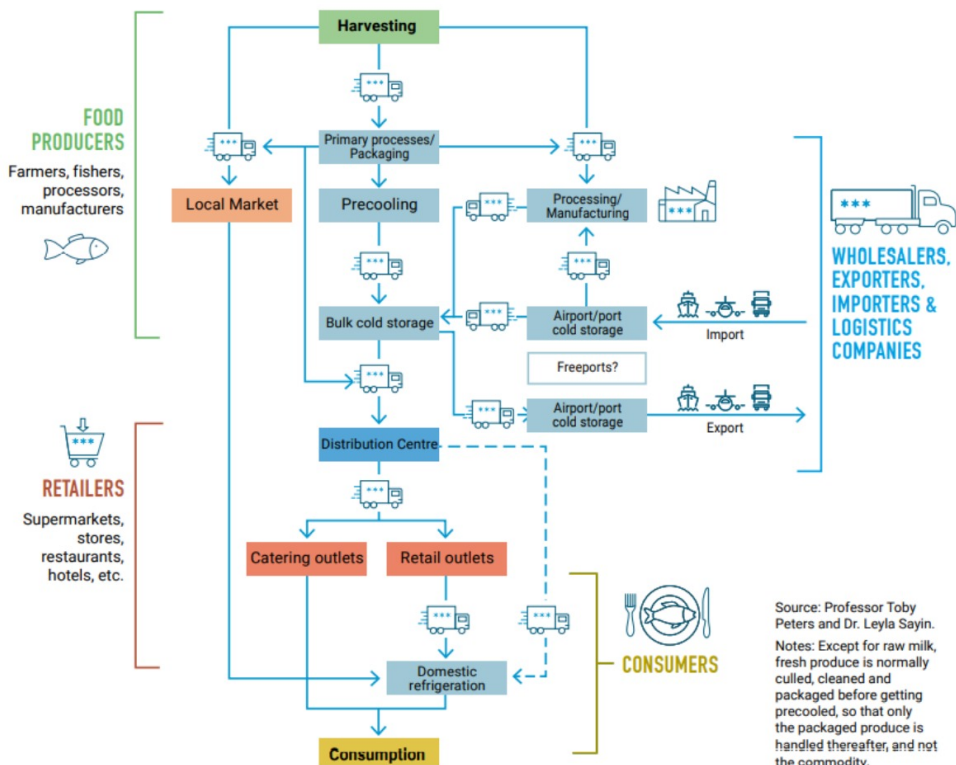
However, temperature control and cooling are energy-intensive processes and, if powered by fossil fuels, can result in significant greenhouse gas emissions. Furthermore, conventional refrigeration equipment in the food cold chain uses refrigerants with high global warming potential (GWP), which can further exacerbate total greenhouse gas emissions from the cold chain.

A cold chain is an integral part of the food value chain. It is an integrated temperature-controlled food distribution system that ensures that perishable produce and/or temperaturesensitive products are kept at their optimum temperature and environment (which can differ depending on specific food characteristics) to maintain their quality, nutritional value, and safety, from source to destination. It involves a broad range of activities, from farm to fork, as well as various stakeholders, from producers to consumers.

A food cold chain is a complex system that has many static and moving elements (Fig. 2). As such, it requires accountability from multiple levels, including farmers, aggregators, processors and manufacturers, distributors, retailers, and consumers. It typically

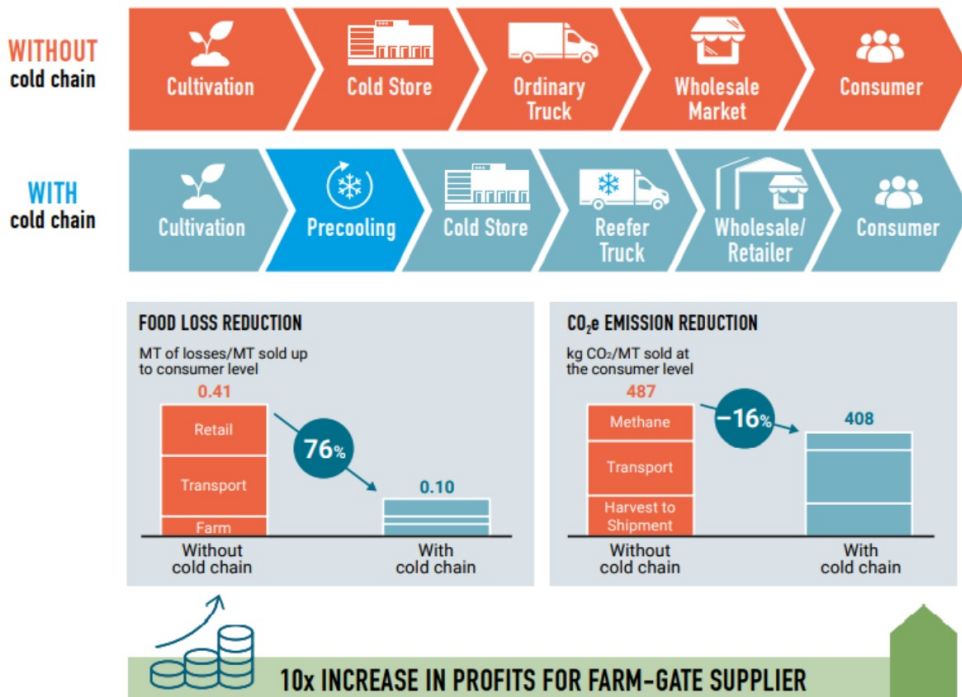
involves stages including primary processing (such as sorting and grading), packaging, precooling, refrigerated warehouses, cold storage at the wholesale/retail level, catering, mobile components (such as refrigerated carriage on trucks, ships and aircraft, and cooled street vending carts) as well as domestic storage until consumption.

Figure 2. Typical food logistics cold chain steps and stakeholders



The benefits of getting it right

The pilot was designed to measure **the impact of cold chain** from **farm-gate to terminal market** across **2,500 kilometres**, a 4-5 day journey **by truck**. The supply was executed both with cold chain and without the cold chain, and over a four-month period.



Note: AC = air conditioning
Source: Pawanexh Kohli 2017

Most of this stuff is common sense, but how often do we see operations operating with common sense?

More importantly one of the steps to operate an efficient cold storage facility is to understand the difference between pre-cooling and cold storage.

The difference between pre-cooling and cold storage.

Pre-cooling or primary chilling is the controlled and rapid removal of heat from freshly harvested or slaughtered produce prior to storage or transport, ***(more on that later as it relates to poultry slaughterhouses RPHU in Indonesia).**

It requires high-capacity refrigeration and optimized operation to minimize weight loss from products. Precooling is an essential first step in the fresh food cold chain.

It is one of the most effective methods to maximize the shelf life of fresh produce (while maintaining nutritional quality) and to reduce the energy load in the remainder of the food cold chain (Sullivan, Davenport, and Julian 1996).

However, precooling is often overlooked in the developing world with the focus on cold storage. The cold store is a refrigerated warehouse with suitably sized chamber capacities for the storage of precooled produce. The cooling capacity of cold stores is designed to maintain the temperature of incoming goods and not to extract heat as is the case with a chiller/precooler.

Thus, it is important to consider precooling independently from cold storage, as it requires specially designed equipment.

There are a variety of precooling methods, such as chamber cooling, blast chilling, hydrocooling, ice cooling and vacuum cooling (see table 1).

Selection of the precooling method depends on several factors, including the product characteristics as well as criteria such as the air temperature, relative humidity, temperature reduction requirements, refrigeration load, desired cooling rate and operating cost.

Table 1. Examples of precooling methods for fruits and vegetables

Method	Description	Suitable produce types
Chamber cooling	The slowest precooling method, in which produce is placed in a refrigerated room where it is exposed to cold air.	Produce that does not deteriorate rapidly; however, not suitable for produce that require rapid and immediate cooling after harvest (e.g., strawberries).
Blast chilling	High-velocity cold air is circulated through produce. Provides a higher cooling rate than chamber cooling. Systems range from the most basic in which cool air is circulated through the produce in an insulated chamber by using fans, to conveyORIZED tunnels or spirals.	Many types of fruits and vegetables.
Hydro-cooling	Cold water is applied to produce through submersion or sprinkling/spraying. Removes heat at a faster rate than forced-air cooling, since the water has a much higher heat transfer coefficient than air, and a given volume of water can remove more heat than the same volume of air at the same temperature.	Many types of fruits and vegetables, but not suitable for produce susceptible to wetting (e.g., berries).
Ice cooling	Instead of cold water, crushed or slurry ice is used to rapidly cool down the produce.	Effective for produce with high respiration (e.g., broccoli), but not suitable for produce that could be damaged by such low temperatures (e.g., tomatoes, squash, cucumbers, onions) and/or susceptible to wetting (e.g., berries).
Vacuum cooling	A vacuum system evacuates the air in the chamber, causing rapid evaporation of water on the surface of produce, cooling it down. Can allow for faster cooling down of produce than other methods.	Produce with a high surface-to-volume ratio, such as leafy vegetables. May cause weight loss in the produce due to the removal of moisture. To prevent excessive water loss, water can be applied during the process.

Source: Elansari 2009; FAO 2009; James and James 2014; Dumont, Orsat, and Raghavan 2016; Mercier *et al.* 2019



Precooling is also an important step in the milk supply chain and can improve the quality of milk and reduce the storage refrigeration load, thereby reducing energy needs and costs.

Precooling reduces the difference between the milk temperature after milking and the required storage temperature of 4°C before entering the bulk tank to be cooled further.

This is typically achieved by plate or pipe coolers using water from the mains supply, well or groundwater. A plate cooler consists of a series of stainless-steel plates. Cold water flows along one side of each plate, and milk flows along the other in the opposite direction, and heat is transferred through the plates from milk to water.

Pipe coolers work similarly. A pipe cooler consists of two stainless-steel tubes, with one tube inside the other, where milk flows in the inner tube and water flows in the outer tube.



The food cold chain plays a significant role in any perishable food supply chain, as time and temperature are critical variables in post-harvest management. For example, many horticultural products deteriorate at the same rate in one hour at a high temperature of 25°C as they do in one week at a low temperature of 1°C.

Degradation processes start immediately after harvest, slaughter or collection and continue through the supply chain until the produce is spoiled or consumed.

***Point about Poultry supply chains in Indonesia:**

The largest poultry product integrator PT Charoen Pokphand Indonesia Tbk. Is always looking to increase poultry slaughterhouses with associated refrigerated warehouse facilities that are ready to operate in anticipation of fluctuations in chicken meat prices.

President Director of Charoen Pokphand Indonesia has said that the Indonesian poultry business has good prospects despite some obstacles, such as an oversupply which causes price fluctuations, but when demand decreases, the oversupply of chicken causes prices to fall, sometimes even below the cost of production.

To overcome this, mitigation efforts are required, including establishing a poultry slaughterhouse business and its cold chain [cold storage] a (RPHU) this will dampen volatility and allow prices to remain stable.

It is of interest that the latest data of Nationally certified RPHU's (Poultry Slaughterhouses) of July 2020 show that there were only 269 RPHU's.

The problem is RPHU development cannot be done arbitrarily, careful planning is needed to establish necessary land and potential productivity of RPHU operations in the future.

Further only half of the 269 units hold the required NKV (Veterinary number), according to the Director of Veterinary Public Health (Kesmavet) Directorate General of PKH, the absorptive capacity and RPHU facilities that meet the requirements are still below 30% of the annual requirement.

Therefore, most broiler sales conducted are still in the form of live birds. The targeted development of policies in the livestock sub-sector will be shifted to the downstream side, to ensure all poultry integration businesses, provide RPHU and facilities for cold storage and frozen supply chains in the future.

Demand drivers of growth

The growth in demand for food cold chains worldwide is influenced by a broad range of factors. These include, among others, population growth and urbanization, rising incomes, climate change, global food trade and changes in shopping patterns and food preferences, as discussed in the following sections.

Population growth and urbanization the global population was estimated to increase 1 per cent in 2020, with many regions experiencing growth at double or triple this median rate (UN 2019). Food production is set to rise to feed the projected global population of 9.7 billion in 2050 and to close the large gap between food supply and demand relative to 2010 (UN 2019; WRI 2019).

Higher food production will increase the need for food cold chains, which are critical to translate production at the source into supply at the demand end. Meanwhile, the share of the world 's population living in cities is expected to rise from 55 per cent in 2018 to 68 per cent by 2050 (UN Department of Economic and Social Affairs 2018), with much of this growth occurring in developing countries.

This means that more people will live farther from food sources, and, simultaneously, food producers will be pushed farther from the demand due to loss of agricultural land caused by urban expansion.

This will result in greater demand for robust cold chain logistics, with perishable products needing to travel greater distances.

Equally, there will be greater demand for refrigeration at urban retail and hospitality outlets to meet the urban food demand.

Growing middle-class (and higher) income levels will potentially result in greater food consumption. Combined with growing health, safety, and environmental concerns, this will lead to changes in dietary patterns, with consumers demanding higher-quality, fresh and organic produce.

This will inevitably increase the demand for cold chains. For example, global consumption of meat proteins is projected to grow 14 per cent by 2030 compared to

the 2018-2020 average (Organization for Economic Co-operation and Development [OECD] 2021). Similarly, the share of fresh dairy products in world food consumption is expected to rise over the coming decade, with substantial increases in India, Pakistan, and Africa (OECD 2021).

Triple EFF's View

In this briefing we have provided you with some insight into the Global Cold Chain Landscape, courtesy of information gleaned from the “sustainable food cold chains” from the United Nations environment program, with some points of interest from Indonesia.

We have briefly touched on the impacts of Global Climate Change and will explore this further in upcoming eBooks.

Triple EFF has worked in Logistics & Supply Chain in Indonesia for almost 15 years and before that I have worked on four continents in 13 countries and along the way have accumulated a lot of knowledge.

We are of the firm belief that ***“Knowledge not shared is Energy wasted”***.

This is one of the main reasons why we have prepared this paper, the other reason is to help you on your way to get to ***“What good looks like for your business”***.



To learn more

Contact Us

Call Us - +62 818150373

Email: findus@tripleeffconsulting.com

Service Offerings

- Supply Chain Operational Health Checks
- White paper preparation on industry specific topics
- Safety Obsessed Health & Safety Reviews
- Supply Chain Diagnostics, considering maturity of Control Towers
- Blockchain Transparent Supply
- Real Time Transport Visibility Platform (RTTVP)
- Creative Problem Solving.
- Industry related training programs
- 1 on1 consultations
- Project management
- Project implementations

More information available on our website www.tripleeffconsulting.com