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TECHNICAL BRIEF

Sustainable Food Cold Chains: The Missing Link for Sustainable Development

CONTRIBUTING ORGANIZATION

United Nations Environment Programme
Cool Coalition
Food and Agriculture Organization
International Renewable Energy Agency

This technical brief is developed with the support of the contributing organizations to inform the 3rd Global Conference on Strengthening Synergies between the Paris Agreement and the 2030 Agenda for Sustainable Development.

The findings, interpretations, and conclusions expressed in this document do not necessarily reflect the views of any of the contributing organizations or the conference coordinating organizations.

I. Abstract

The world is grappling with many inter-connected crises. The triple planetary crisis of climate change, nature and biodiversity loss, pollution and waste is accelerating and leading to huge impact on Energy-Food-Environment nexus. One third of global food is being lost at various stages of supply chain and the conflict in Ukraine is exacerbating food price inflation in emerging markets and threatening food security in many nations. New age supply chain infrastructure is also important for the global healthcare and vaccine delivery particularly the Pandemic has highlighted the vulnerability of our healthcare and agrifood systems. These crises are undermining efforts to achieve the Sustainable Development Goals. **Ensuring robust supply chain infrastructure for food delivery based on clean cold chain technologies to reduce food loss and improve food quality globally is key to support the achievement of the Paris Agreement objectives and Sustainable Development Goals.**

Sustainable food cold chains are key to reduce food loss, increase farmers income and strengthen food security. Today, over 828 million people go hungry and 3.1 billion cannot afford a healthy diet (FAO 2022). Food loss post-harvest reduces the income of 470 million smallholder farmers by as much as 15 per cent, and developing countries are hit the hardest (Rockefeller Foundation 2013). **The lack of effective refrigeration is a leading contributor to food loss**, directly resulting in the loss of 526 million tons of food production, or **12 per cent of the global total**, in 2017 (IIF/IIR 2021a).

Current food cold chain technologies are energy intensive and require refrigerants, and emissions are set to rise significantly as new cold chain and cooling-related infrastructures are created in developing countries. Emissions from cold chain technologies and emissions from food lost due to lack of refrigeration combined amount to 4 percent of global GHG emissions (IIF/IIR 2021). To feed the projected global population of 9.7 billion in 2050, cold chain capacity will need to increase to store and transport produce (UN 2019). **A business-as-usual approach to food cold chain development will exacerbate climate change challenges: a shift to sustainable food cold chains can help avoid trade-offs and help reach a net positive outcome.**

II. Interlinkages, synergies and trade-offs

The contribution of sustainable cold chains to the SDGs spans multiple areas and supports the achievements of the Paris Agreement and Montreal Protocol (UNEP & FAO, 2022). Specifically, sustainable food cold chains are key for improving economic conditions and livelihood of farmers and rural communities (SDG 1 and 8); reduction of food loss, waste of resources used to produce it, and preservation of food quality (SDG 2, 12, 14 & 15); reduce the emissions from food lost and inefficient cooling equipment (SDG13).

“Leaving no one behind” should sit at the core of sustainable food cold chain provision. This is because the social and economic costs of lack of access to cold chains fall disproportionately on poor, disadvantaged, and often marginalized rural communities, farmers and fishers, as well as on women and girls. Efforts to expand and improve cold chains, if planned carefully to take into account equity issues, may further reduce inequalities.

Climate-compatible and inclusive technology solutions are increasingly available and demonstrated. Decentralized renewables-based cooling infrastructure is being deployed in several settings across Sub-Saharan Africa and South and Southeast Asia to reduce post-harvest losses and maintain quality in food, dairy and fishery value chains with resulting benefits for farmers and cooperatives (IRENA and FAO, 2021).

To ensure that the deployment of sustainable food cold chain has positive social, economic, and environmental benefits, **it is critical for this sector to harness synergies between climate goals under Paris Agreement and SDGs while minimising the negative trade-offs** (UNEP & FAO, 2022). To do so, it is key that governments, policy makers, technology providers, cold chain stakeholders and financiers understand the main drivers and barriers to the development of sustainable food cold chains and use this knowledge to identify the most cost-effective pathway for transitioning to smarter, decarbonized, and resilient agrifood systems, as well as enable better cohesion across sectors to reduce the investment risk.

The importance of cold chains in delivering the SDGs and ambitious climate targets has been increasingly recognized globally. The international community has also recognized the role of cold chains in food systems in the [Rome Declaration to the Montreal Protocol](#) and in a 2019 UN Environment Assembly resolution. The Rome Declaration, signed by around 84 Parties as of 2021, aims to highlight the role of the cold chain in implementing the 2030 Agenda.

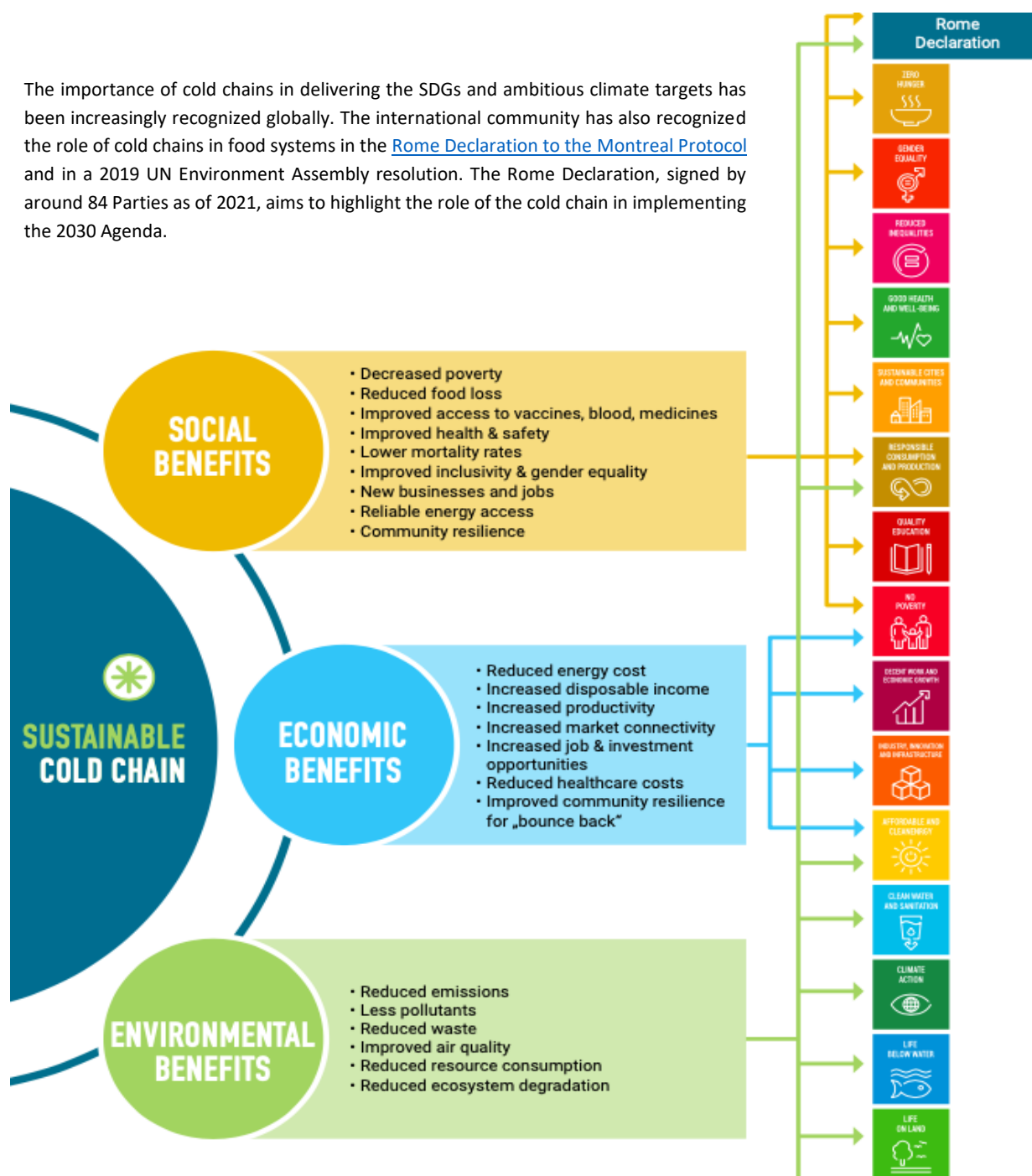


Figure 1: Multiple benefits of sustainable cold chains and linkages to international climate and development goals (Source: UNEP and FAO, 2022)

III. Lessons learned on opportunities and challenges

Global food cold chain capacity has been growing in recent decades. However, this growth is uneven: developing countries need substantial additional capacity to address the existing divide in cold chain infrastructure and ensure uninterrupted connectivity from farm to fork, as well as support capacity building to develop the skills required to install and maintain sustainable cooling equipment. Even in developing countries where food cold chain infrastructure is

growing, expansion may be limited due to less-than-optimal utilization of existing capacity, lack of integration of all concerned components of cold chain to function as an interlinked supply chain system. Increased understanding of this complex system and streamlining of policies and financial support for segments along the chain are key to ensure integrated and seamless cold chain development across all components.

Delivering whole-system, sustainable food cold chain design starts with assessing the end-to-end food chain needs along with climatic, demographic, socio-economic statistics, infrastructure, and industry mapping, as well as an audit of existing and emerging technologies, policies, goals, targets, commitments, and initiatives. The optimum mix of fit-for-market sustainable food cold chain solutions can be delivered by **reducing** cooling demand, **shifting away from unsustainable practices**, making **improvements with better technologies and efficiencies**, and aggregating needs to **optimize system performance**.

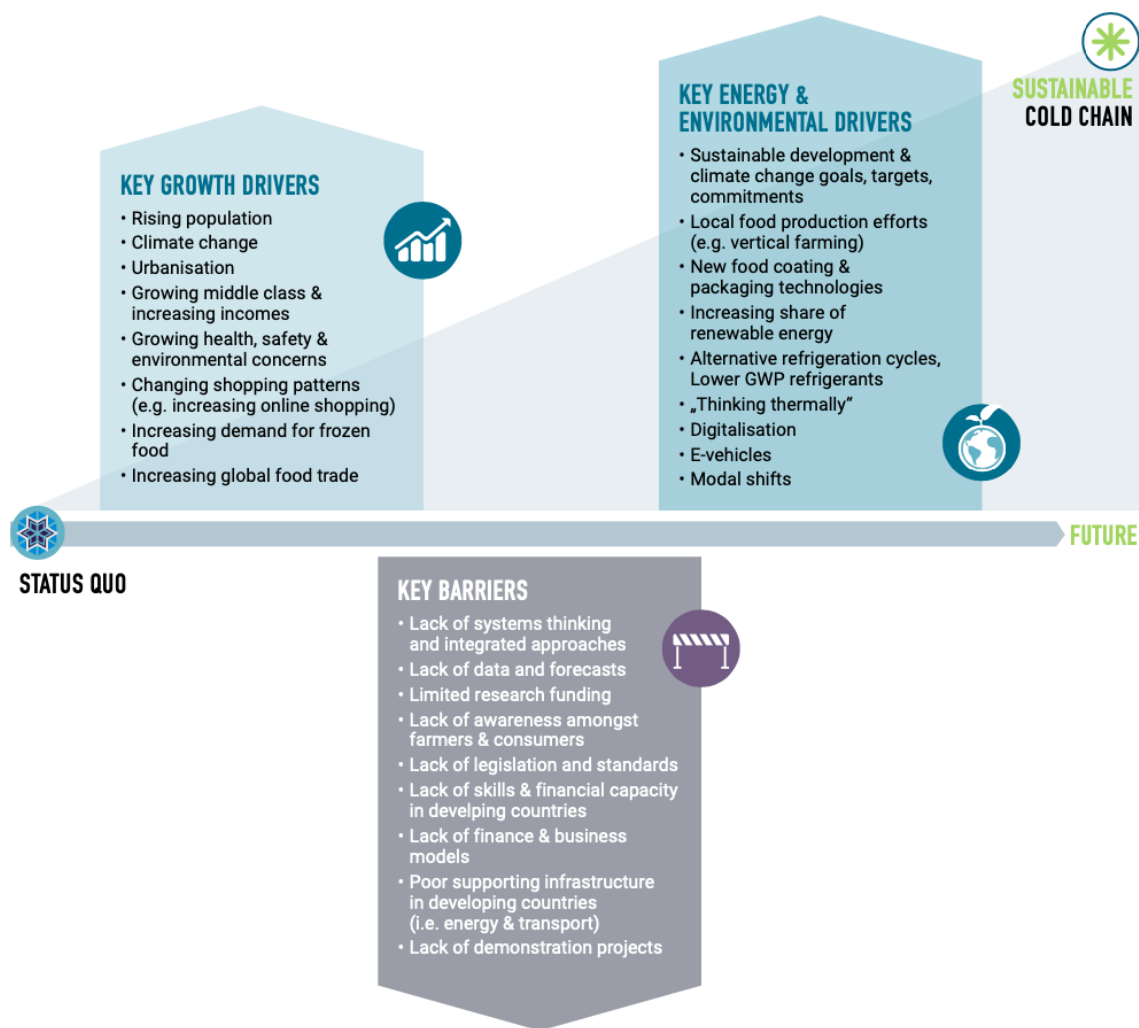


Figure 2: Key drivers and barriers for sustainable food cold chains (Source: UNEP and FAO,2022)

There is an urgent need to facilitate cooperation among governments of developed and developing countries, the private sector, academia, and international organizations, to incentivize and accelerate innovation and market transformation in relation to food cold chains. This can occur through policy actions that support innovations, awareness raising about issues among governments, businesses end-users/stakeholders and international development partners, and develop the skilled workforce required to facilitate the deployment, operation and maintenance of new technologies as well as protect against counterfeit refrigerants and components in developing countries and emerging economies.

A wide range of efforts are being implemented to accelerate sustainable food cold chain development, from data collection, technology development and demonstration, testing of finance and business models, capacity building and training, local and international policies, but efforts need to be scaled up.

IV. Recommendations for action: means of implementation and partnerships to accelerate progress

UNEP launched the Cool Coalition in 2019 at the First Global Conference on Synergies between the 2030 Agenda and Paris Agreement. The Coalition became an official outcomes and transformation initiative put forward by the Executive Office of the Secretary-General for the UN Climate Action Summit.

In close collaboration with FAO and through its global network of countries, industry players and leading experts, the Coalition led coordinated mobilisation to **put the food cold chain on the international agenda, including at the UN Food Systems Summit and the Meeting of the Parties of the Montreal Protocol and COP 26**. The Coalition developed a set of recommendations to ensure accelerated progress on food cold chains:

- Governments, working with industry and others, should **quantify and benchmark energy use and emissions** in the existing food cold chain, and identify opportunities for reductions.
- Governments and other cold chain stakeholders should take a **holistic systems approach to food cold chain provision**, recognizing that cooling technologies alone are not sufficient, and interventions will be required across the value chains to maximize benefits and viability.
- Governments and other cold chain stakeholders should collaborate and undertake food **cold chain needs assessment and develop costed and sequenced National Cooling Action Plans** to provide the underlying direction for holistic infrastructure creation and rationalize food cold chain programmes across relevant ministries.
- Governments should implement and enforce ambitious **minimum efficiency standards and robust monitoring and enforcement to prevent illegal imports** of inefficient cold chain.
- Governments should develop costed and sequenced **five-year plans, missions, policies, and dedicated agencies/departments, and provide financial assistance and capacity support** for sustainable cold chain components, with the aim of achieving seamless movement of food from farm to fork and medical products from factory to patients.
- Governments, working with industry and relevant stakeholders, should **build necessary skills and capacity as well as finance and business models in developing countries** to support cold chain industry engagement and technology deployment at scale.
- Governments, working with industry and relevant stakeholders, should build **digital twins to guide “build-to-suit” projects** for local implementation of integrated food cold chain.
- Industry, backed by governments, should run **large-scale system demonstrations** to show impact and how interventions can work together to create sustainable and resilient solutions at scale.
- Governments and other cold chain stakeholders should collaborate with relevant institutions to **quantify and value the broader socio-economic impacts** of sustainable cold chains, taking into account poor, disadvantaged and marginalized communities.
- To encourage a collaborative ecosystem, **governments should institute a multi-disciplinary centre for cold chain development, similar to that recently established in Rwanda**. Such centers for cold chain development should be established in every country.

The implementation of these concrete recommendations on the field has shown that quick incremental wins are being delivered, enabling the achievement of the goals set by the SDGs. **In Nigeria**, a project to install 54 operational ColdHubs prevented the spoilage of 42,024 tonnes of food and increased the household income of 5,240 small-scale farmers, retailers, and wholesalers by 50 per cent. In **Colombia**, through more efficient use of available natural resources and low GWP refrigerants, and the adoption of circular economy strategies, a company reduced energy consumption per kilogram of freeze-dried coffee from 40 kilowatt hours (kWh) in 2015 to 34 kWh in 2018. Finally in **India**, a cold chain pilot project for fruit supply, developed by the National Centre for Cold Chain Development (NCCD), resulted in a 76% reduction in food losses, higher incomes for farmers and a 16% reduction in system-wide greenhouse gas emissions.

V. Guiding questions

- What mechanisms can be put in place to support countries to set up inter-ministerial collaboration framework to develop national sustainable food cold chain strategies?
- How can governments and industry better collaborate to incentivise and support development and large-scale deployment of sustainable cold chain technologies and innovative business models?
- How can dedicated financing be designed for end-users and enterprises along the cold chain supply chain to facilitate the adoption of both decentralised and centralised sustainable cooling solutions?
- What do users need to strengthen their capacity to properly install and service the next-generation of more technically complex, data- and system-connected food cold chain equipment?
- How can monitoring and local data availability be ensured to facilitate informed energy and agriculture policy making and enhance transparency in the design and deployment of sustainable food cold chains?

References and additional reading list

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