Lessons from Solar Cooling for Horticulture in Uganda

Awan Horticulture Business Case

Fee for Service

Horticulture

Innovation Fund

Cooling

endev

Summary

In 2022, GIZ Uganda provided technical assistance to African Women Agribusiness Network (AWAN) under the SEFFA project to pilot solar cooling for fruits and vegetables accessed through a Cooling as a Service (CaaS) model. Market vendor groups were identified and selected to demonstrate the solar cooling technology and CaaS business model at market level.

Solar cooling technologies have the potential to reduce the challenge of post-harvest losses suffered by farmers and handlers at various nodes of the horticulture value chain. The technology can be operated in various settings, both in on-grid and off-grid areas. In on-grid areas, the technology can work as a backup alternative to hydropower. While the initial investment is high, the operational costs of solar cooling are very low.

This project showed that solar cooling through the CaaS model does not have a good business case in situations where the cold chain cannot be preserved all the way until final consumption. However, solar cooling is a potentially profitable investment for enterprises in the horticulture value chain using the aggregator model. Therefore, the technology is highly recommended for enterprises that are involved in the export or distribution of fruits and vegetables to supermarkets and hotels because these customers can continue with the cold chain after buying.

Quick Facts

Uganda

Solar Cooling for Horticulture

EUR 22,500

African Women Agribusiness Network (AWAN)

GIZ Uganda

Increase the adoption of solar cooling technologies among fruits and vegetables value chain actors in order to :

- To reduce the post-harvest losses among smallholder women producers, aggregators and vendors
- To improve the profitability of women-led enterprises involved in the aggregation and supply of fruits and vegetables to differentiated local and export markets.

- 103 women in horticulture sensitised about solar cooling
- 22,000 people sensitised over the whole project AWAN trained 20 artisans (7 females and 13 males)
- in the construction and maintenance of solar-powered cold storage units.

Innovation Fund

- Cooling capacity installed: 8 cubic metres
- Temperatures: 8-12 Ć
- Utilisation rate: Variable

Mixed fruits and vegetables (tomatoes, pineapples, leafy greens)

Problem statement

Post-harvest losses can be as high as 40% in Sub-Saharan Africa, presenting a significant waste of resources and impact on agriculture's C02 emissions. PUE technologies have potential to reduce these losses however there are challenges in adoption due to awareness, access and affordability challenges.

A baseline study for this project validated overall loss of 20-30% in fruit and vegetable value chains in Uganda and that there was low awareness of solar cooling technologies among women involved in horticulture. However, 64% of the participants believed such technologies are needed to prolong the shelf-life of fruits and vegetables.

Assumptions

- The challenges are primarily due to a lack of appropriate technology solutions rather than other systemic or environmental factors.
- Reducing post-harvest losses leads to increased incomes since products that would otherwise have been lost are available for sale.
- The introduction of solar-powered technologies would be met without significant resistance or scepticism.

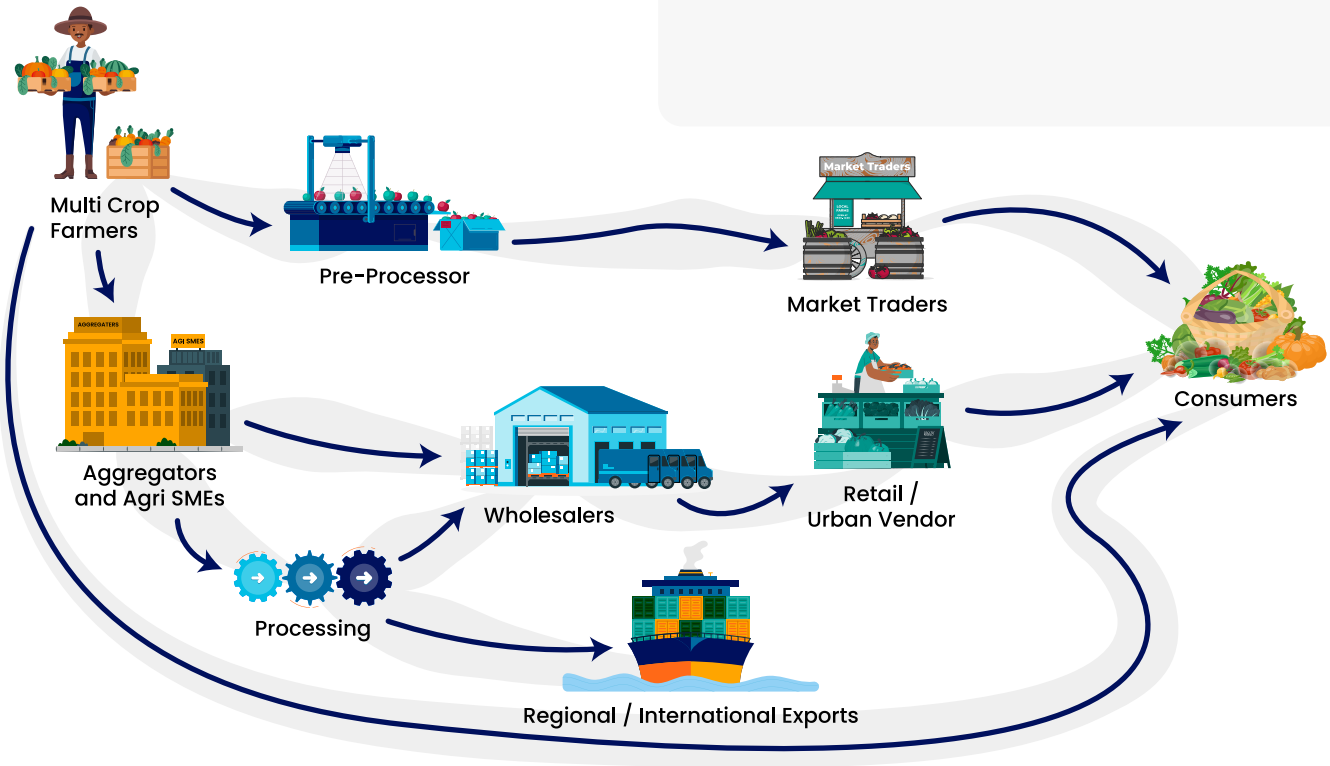
Business Case Details

The "Improving the performance of fruits and vegetable value chain through the promotion of solar-powered cold storage technologies" project was implemented by Africa Women Agribusiness Network Uganda Chapter (AWAN) with funding from Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH under an Energizing Development (EnDev) initiative called SEFFA. The project with AWAN aimed at promoting the adoption of solar cooling among women involved in the horticulture value chain in central Uganda. The intervention was informed by the need to address the challenge of high post-harvest losses suffered by women involved in horticulture and was implemented for 14 months between 2021 and 2023.

A CaaS model was introduced where the customer (the women market vendors) pays for the cooling of their products, rather than the infrastructure that delivers the cooling. In this model, AWAN installed and maintained the cooling equipment, recovering the costs through periodic payments made by the customer. Different modalities such as daily charge, rent to buy, monthly rates, and charge per kilo of items stored were presented to the women and a higher preference was made for charging per kilogram per day.

AWAN was able to design, develop and install a 2*2*2 meter (8 Cubic Metres) solar-powered cooling unit with a capacity to carry 3 tonnes (3000kgs) of tomatoes at its full capacity. The first product developed had a capacity of 325 Wp and only 4 hour energy usage. This was not sufficient since the purpose of this innovation was to have a fully solar-powered cooling system. AWAN applied for an upgrade which was approved allowing upgrade of the system from 325 Wp to 2KWp with 24 hour usage.

The adoption of solar cooling technologies using the CaaS model faced its challenges. The model was good for addressing challenges of access and affordability. However, issues of trust, convenience, cost, and uncertainty about consumer's willingness to purchase pre-cooled fruits and vegetables affected the adoption. Due to these issues, AWAN switched to using an aggregator model: the cooling unit was moved to AWAN's premises and 20 farmers were selected from neighbouring areas of Wakiso and Kayunga to supply the fruits and vegetables, which would be cold stored by AWAN and then supplied to Growfront Enterprises Limited, a company engaged in the distribution of fruits and vegetables for both local and domestic markets. Preliminary data showed a reduction in losses of 5-10% reported by participating farmers, as they can harvest at any time and deliver to the cold storage. At the aggregator level, AWAN has had a 45% reduction in post-harvest losses. These findings show that solar cooling technology has the potential to reduce post-harvest losses in the fruits and vegetables sub-sector.



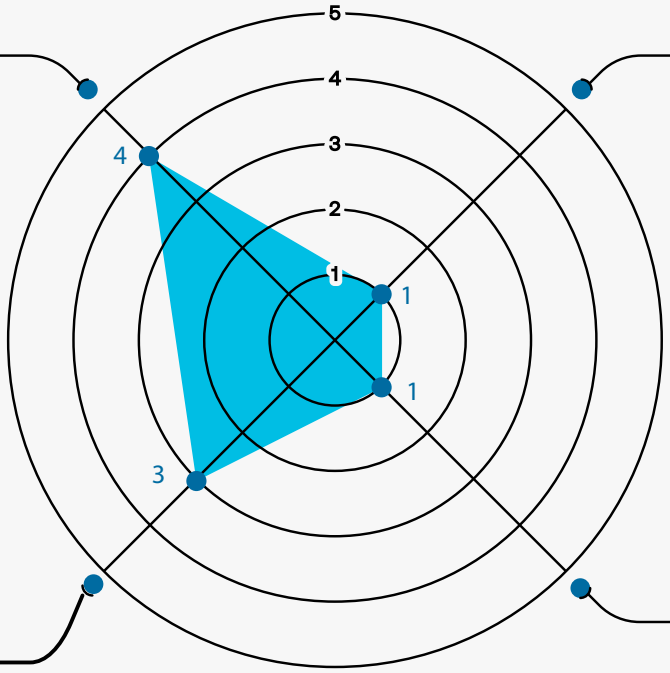
Business Case Attractiveness

Technical feasibility

Solar-powered cooling technologies are technically feasible, reliable, and somewhat adapted to the working conditions of the local market vendors end-users.

Business viability

Although the provision of CaaS is affordable for the target market, the local vendors do not wish to uptake the service. Without this product-market fit the business is not viable.



Financial viability

The solar cooling was offered to the market vendors on an as-needed basis. The CaaS model allowed them to access the service at an affordable price and convenient location proving financial viability.

Long-term outlook

Solar cooling in horticulture at the local market level is not sustainable. Acceptance of the technology would require a significant shift in how market traders do business and many of their customers are not able to maintain the cold chain post-purchase.

Outcomes

- 8 m3 solar cold storage installed (amounting to carrying capacity of 3 tonnes of tomatoes).
- 103 vendors sensitised and 20 trained as cold storage technicians.
- 5-10% reduction of post-harvest losses at farmer level and 45% post-harvest loss reduction at aggregate level.
- CaaS model was trialled for local market vendors and the business case was disproved in this case.

Key Takeaways

Project Design

- One month technical training on solar cooling construction which includes hands-on practice would be better than the 5 days offered on this project.
- Validation of a business case for over one year is needed to thoroughly test, refine, and establish both the financial and commercial viability of the solar cooling technology.

Overcoming Financial Barriers

- Affordability of solar cooling technology for horticulture is a major constraint to adoption for market traders and small aggregators.

Overcoming Logistical Barriers

- As an aggregator, AWAN has seen a 45% reduction in post-harvest losses.
- To further improve shelf life, the cold solar rooms need to be properly managed with attention to temperature, relative humidity levels, air flow, space between storage containers, and storage of compatible produce.

Overcoming Farmers' Barriers

- Farmers delivering to the AWAN cooling facility have reported a 5-10% reduction in post-harvest losses. Hence, solar cooling technology shows great potential.
- To fully capitalise on the benefits of reduced post-harvest losses, farmers need to time harvests correctly to minimise deterioration of produce before it reaches the solar cold room.
- Farmer training must underline the need to promptly deliver harvested produce to the cold room facility to initiate the cooling process before natural deterioration occurs due to heat and humidity. Failing to do so could lead to the aggregator rejecting the produce due to poor quality, potentially impacting farmers' income.

Overcoming Technology Specific Barriers

Cooling

- Building local technical capacity to design and assemble walk-in solar cold rooms is crucial for the business case.
- The solar cooling technology for horticulture in Uganda is still in its early stages, with very few suppliers capable of customising the technology to meet the specific needs of end users.
- The quality of most solar components on the market is not guaranteed and many cooling systems are assembled as needed from these components.

CaaS

- Cooling for fruits and vegetables using CaaS model is limited because the products may not survive after being re-introduced to normal temperatures on the food stalls (i.e. temperature shock in and out of the cooling system)
- Operational challenges for CaaS are plentiful: Regulating access to produce, labour associated with loading and offloading produce, avoiding cross contamination and governance on responsibilities on the cost of losses in case damage.
- In African local markets, there is uncertainty about consumer's acceptance of the pre-cooled produce since it would be perceived as 'overstayed'.

Overcoming Value Chain Specific Barriers

- Solar cooling needs to focus on aggregators as technology adopters and to target parts of the supply chain where the cold chain can be preserved all the way to final consumption.
- As an aggregator, AWAN has seen a 45% reduction in post-harvest losses, showing the potential to impact food supply chains.

Several layers of barriers to the adoption of PUE technologies.

Iconography

Financial Instruments

Result-Based Financing

Innovation Fund

Fee-for-Service

Consumer Credit

Lease-to-Own

Types of Barriers

Farmer

Logistics

Technology Related

Financial

Value Chain Related

Agriculture Chain

Dairy

Horticulture

Technologies

Irrigation

Cooling

Drying

Other

Total Budget

Farm Size

Location

Ethiopia

Kenya

Uganda

About SEFFA

The Sustainable Energy for Smallholder Farmers (SEFFA) in Ethiopia, Kenya and Uganda project was designed by leveraging over 15 years of practical experience of EnDev. The strategic partnership identified lack of modern energy access as one of the critical development barriers in rural areas since it undermines agricultural productivity, exacerbates pre- and post-harvest loss, and makes it challenging to store and process produce. The IKEA Foundation has provided an €8 million grant to support EnDev's efforts. Learn more about the project here.

About the IKEA Foundation

The IKEA Foundation is a strategic philanthropy that focuses its grant making efforts on tackling the two biggest threats to children's futures: poverty and climate change. It currently grants more than €200 million per year to help improve family incomes and quality of life while protecting the planet from climate change. Since 2009, the IKEA Foundation has granted €2 billion to create a better future for children and their families. In 2021 the Board of the IKEA Foundation decided to make an additional €1 billion available over the next five years to accelerate the reduction of Greenhouse Gas emissions.

Learn more at: www.ikeafoundation.org or by following them on LinkedIn or Twitter.

About EnDev

EnDev improves the lives of the most vulnerable by providing access to sustainable energy in 20 countries worldwide. Currently, EnDev is funded by Germany, the Netherlands, Norway, and Switzerland and coordinated jointly by GIZ and RVO. The strategic partnership is working with experienced implementers, with SNV being one of the most prominent partners. Learn more at www.endev.info or by following them on LinkedIn.

Funded by:

german cooperation
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Ministry of Foreign Affairs of the Netherlands

Norad

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

Co-financed by:

IKEA Foundation

Coordinated and implemented by:

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Netherlands Enterprise Agency

SNV