Energising Change

Lessons from a Pilot for Inclusion of Smallholder Farmers in Horticulture Value Addition

Shambani Enviu Business Case

Dryers

Horticulture

Innovation Fund

endev

Summary

Shambani Pro Agri Innovations was supported by GIZ through the SEFFA project's Innovation Fund to run a pilot project aimed at validating a business case for solar drying in value addition of horticulture produce in the avocado value chain, both on-farm and at satellite centralised hubs.

Shambani Pro designed a project to pilot solar drying and oil pressing for avocados rejected by the export and local market (2nd grade avocados). The solar drying was planned in two locations: at the farm and at an aggregation centre (micro-factories).

In partnership with Dedan Kimathi University of Technology (DKUAT), Shambani Pro designed and installed a prototype solar dryer at a micro-factory, capacitated farmers on the pre-processing activities to transform 2nd grade (rejected) avocado into dried chips, procured dried chips from smallholder farmers (SHFs), then pressed crude oil which was sold to aggregators and local cosmetic companies.

The main driver for commercial sustainability for avocado oil is quality, which is determined by free fatty acid (FFA) levels which in turn determines the price the oil can fetch from the market. The market preference is for FFA levels of between 1-4% FFA, however this is only achievable if the right variety of avocado fruit is used and the methods for deriving oil from avocado minimise the effects of factors such as UV light. The business case pilot only achieved an average of 8% FFA which commands very low prices making the pre-processing business case within the avocado value chain not viable.

The results of the pilot for the business case indicate a negative commercial position within the avocado value chain, and Shambani will attempt to find viability in other value chains e.g. mango and banana.

Quick Facts

Kenya

Solar Drying, Horticulture

EUR 22,500

Shambani Pro Agri Innovations

GIZ

To pioneer inclusion and empowerment of SHFs in value addition by creating a business for solar drying in value addition of horticulture produce

- Increased participation of smallholder farmers in post-harvest value addition
- Technical feasibility and financial viability of solar drying for pre-processing in avocado value chain was invalidated

Innovation Fund

- 900kg Drying capacity installed
- Time savings and quality output were not achieved

Avocado

Problem statement

Horticultural value chains in Kenya, which are dominated by SHFs, struggle with post-harvest food loss with 50% of produce going to waste before it reaches the consumers amounting to a yearly loss of approximately USD 1.1 billion. Besides, horticultural produce meant for premium markets (e.g. export) only take up 1st grade quality produce, leaving the lower grade produce being sold at very low prices or left at the farm to waste.

Assumptions

- Avocado oil can be processed using solar technologies at farm level and micro-factories to a sufficient quality for export oil markets.
- Market prices and costs would remain stable.

Business Case Details

Kenyan horticultural value chains struggle with post-harvest food loss with 50% of produce going to waste before it reaches the consumer. This amounts to a yearly loss of approximately USD 1.1 billion . SHFs who already live below the poverty line bear the brunt of this loss. Farmers lose opportunities to make greater income and face extortion from middlemen who only offtake 1st-grade quality produce, leaving the lower grade produce to waste off at the farm. Existing value-addition technologies are in urban areas, far removed from rural areas and use expensive machinery, making them inaccessible to the majority of SHFs.

Because of this, farmers lack knowledge of value addition opportunities, lack technical knowledge, and are unaware of the potential value of their lower grade produce rejected by markets.

Shambani Pro's proposed business case sought to increase income of SHFs by creating access to solar-powered micro-factories for value addition and training on

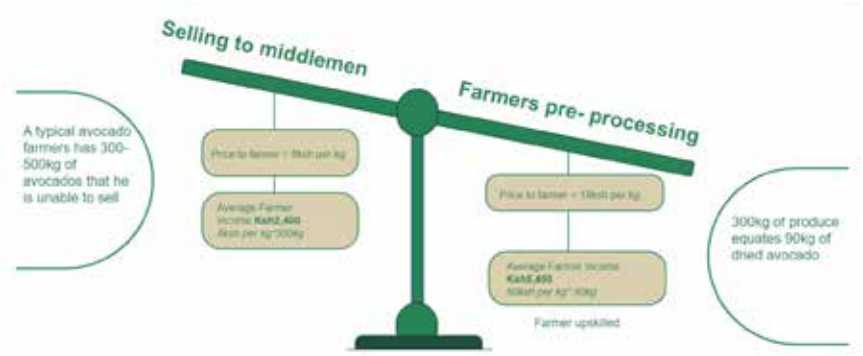


Figure 1 Business case for preprocessing

pre-processing of lower grade farm produce. With value addition, SHFs will drive down post-harvest losses and unlock greater income.

In partnership with Dedan Kimathi University of Technology (DKUAT) and with funding from the SEFFA project, Shambani Pro designed and installed a prototype solar dryer and screw pressing machines at a micro-factory, and capacitated SHFs on the pre-processing activities to transform 2nd grade (rejected) farm produce to dry chips. The dried chips would then be procured from the SHFs and pressed crude oil to be sold to aggregators and local cosmetic companies.

Avocado was selected as the first value chain for the pilot because of its high value in the export market and because avocados experience high post-harvest losses due to strict export guidelines.

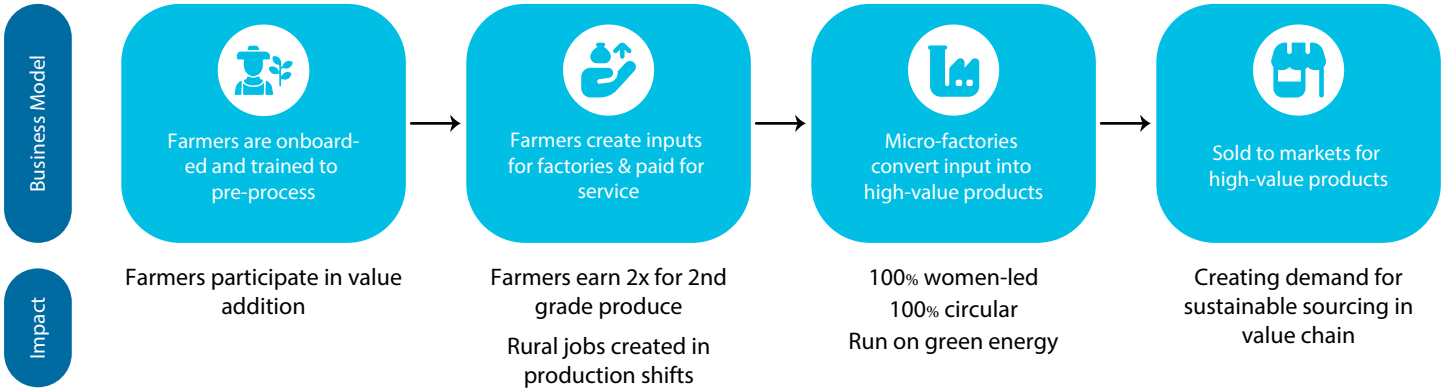


Figure 2: Planned pre-processing model

The objectives of the project were to build a business case for two variations of a solar dryer:

a. An affordable and low capacity on-farm solar dryer, to be used by individual SHFs costing no more than EUR 100.
b. A centralised high-capacity solar dryer to be used and managed by a farmer group costing about EUR 2,200.

During the pilot project, important data points were collected to validate the commercial viability of the business case, including:

- Drying capacity: Technical drying capacity of the solar dryer
- Drying period: Days for drying a certain quantity of avocado chips in the solar dryer
- Conversion factors of dried chips to oil
- Oil quality: FFA and PV levels determined by lab tests
- Market prices: Avocado and crude avocado oil

Business case analysis found that Shambani Pro would be in a negative financial position from the pre-processing business model within the avocado value chain. SHFs will as a result not be able to fetch better prices in both the on-farm and centralised solar dryers.

Below are the factors explaining the lack of business case viability:

Exposing avocado chips to UV rays affects the free fatty acid (FFA) composition of the oil. The higher the FFA percentage, the lower the quality of oil and the market preference is between 1%- 4% FFA. Shambani Pro's solar drying process was able to achieve a minimum of 8% FFA levels which resulted in low market prices.

The capital cost of installing a solar dryer is high and its drying capacity of 900Kgs per week does not allow SHFs to generate sufficient revenues for a reasonable payback period.

	Capacity	Cost	Cost per Kilo
Recommended Dryer Design	3500 kgs per 7 days	KES 400,000	KES 114
DKUT Centralised Dryer	900 kgs per 7 days	KES 320,000	KES 356

Figure 3: Project centralised dryer capacity and cost vs recommended capacity and cost

III. Global pricing volatility affected the bottom line in the following ways:

- Increase in global prices of 2nd grade avocado. Although it was good news for farmers, it meant lower margins for Shambani Pro.
- Decrease in global crude avocado oil prices driven by an increase in supplies of low-quality oil by new market entrants, leading to a dip in price per litre.

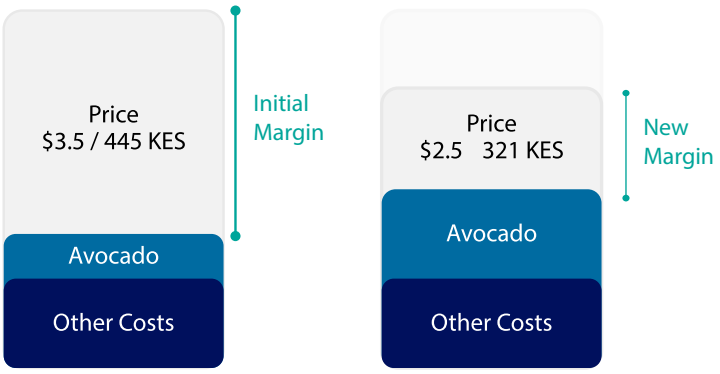


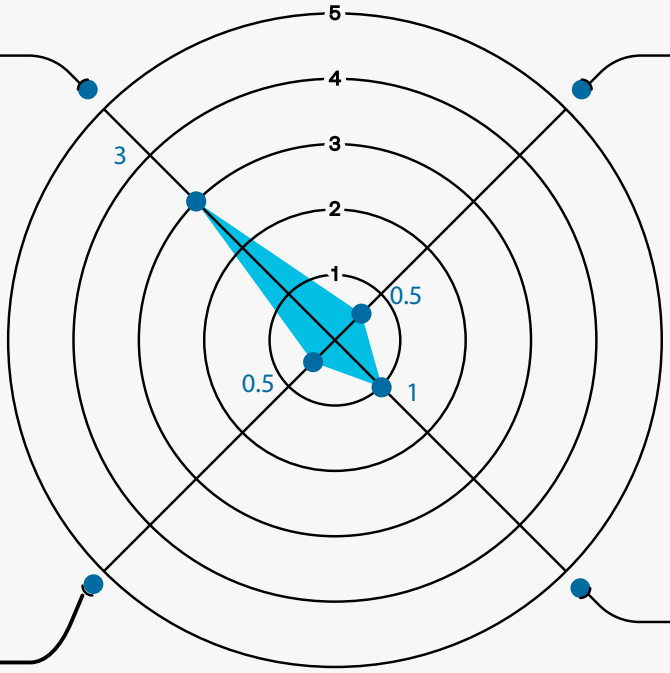
Figure 4: Global price volatility decreased margins

This pilot demonstrated that solar power is effective in drying farm produce. Additionally, a centralised high-capacity drier is a more appropriate model than an individually owned small scale dryer. However, solar drying was determined to be unsuitable in processing in value chains like avocado where quality of outputs is affected by intensity of UV light. Shambani Pro intends to pivot and identify other value chains that will be appropriate for the centralised dryer. For example, mangoes and bananas have the best prospects for solar drying for several reasons: local and global markets, presence of farmer co-operatives, good profit margins, high post-harvest losses, and simpler processing technology for value addition.

Business Case Attractiveness

Technical feasibility

The centralised solar dryer can be installed in rural areas and managed by produce groups made up of SHFs although the cost for installation is an initial barrier. However, the solar dryers may not be able to produce sufficient volumes of produce. They may also be unable to provide conditions necessary to produce output (crude avocado oil) with required quality to fetch premium prices in the market.



Business viability

Shambani Pro failed to make a profit from the business case given the capacity and output quality limitations.

Financial viability

Two determinants of financial viability are capacity and the price of the output produced. The solar dryer designed produced 4 times less dried chips per week than desired and the quality of the output (crude avocado oil) was low quality and commanded about 50% less than expected price.

Long-term Outlook

This pilot determined that the business case for solar dryers in avocado value chains is not viable and sustainability in the short-term is not foreseen. However, more iterations of the driers can be explored to improve on the limitations as well as trials in other horticulture value chains to determine appropriateness.

Outcomes

- Solar drying is effective in the drying of farm produce and a centralised high-capacity dryer is an appropriate model compared to an individually owned small scale drier.
- Solar drying was determined to be unsuitable for processing in value chains like avocado where quality of outputs is affected by intensity of UV light.
- Shambani Pro will therefore pivot on the results of this pilot to identify other value chains that will be appropriate for the centralised dryer, for example mangoes and bananas.

Key Takeaways

Several layers of barriers to the adoption of PUE technologies.

Project Design

- Partnership with innovative private sector actors is essential in designing support initiatives for SHF.
- Programme design for innovation should welcome negative results and quantitive data to disprove business cases.

Overcoming Financial Barriers

- Centralised high-capacity solar drier is an appropriate model to overcome affordability and longer payback period issues associated with this technology.

Overcoming Logistical Barriers

- Due to the design of the pilot, it did not reveal any information on removing logistical barriers.

Overcoming Farmers' Barriers

- There is a need for further drier pilot testing and research to find the correct cost/efficiency for suitable driers and value chains for SHFs to operate.

Overcoming Technology Specific Barriers

- The capacity of a solar drier to produce economical volumes is limited by its operations during the day; hybrid models for 24 hours drying will be a good consideration.
- In its current design, the solar drier was not able to provide required quality of the output, however iterations on the design can be explored as well as trials in other horticulture value chains.

Overcoming Value Chain Specific Barriers

- Market linkages and partnerships are important to overcoming barriers associated with smallholder agriculture, especially to manage post-harvest losses.
- Solar drying is likely to be more suitable to aggregators, cooperatives, and producer groups than individual SHFs due to economies of scale.

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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Norad

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

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SNV