Solar Fruit Drying

Report for SunDanzer (April 2023)

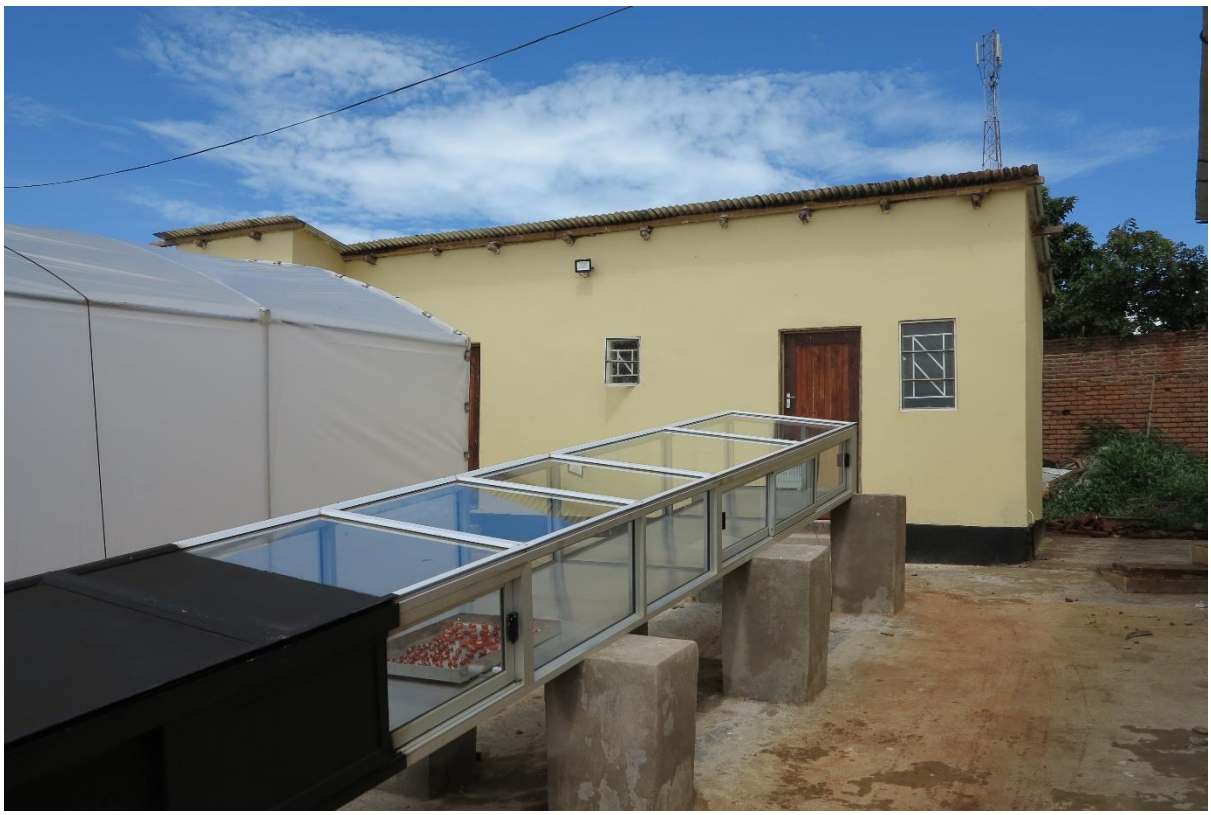
Background

The objects of the pilot project are:

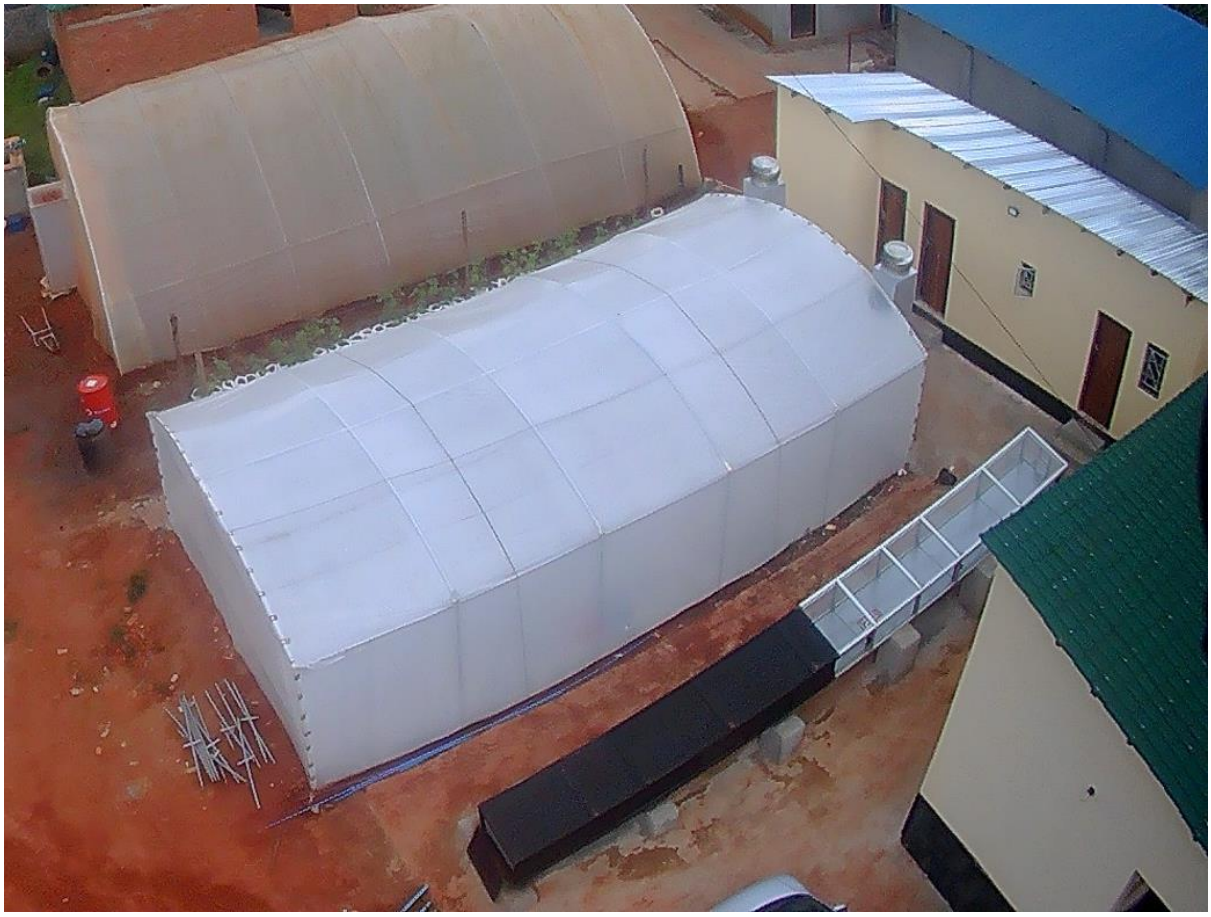
1. To design and build two different types of dryer using solar/battery for any power requirements.
2. To test the dryers with a variety of fruits, measure the results, and refine the process to get a consistently high-quality product.
3. Investigate the market for dried products including wholesale and retail packaging requirements.
4. Write up a case study, share that widely, and participate in events as required to share the learning.

The dryers themselves

Two types of dryer have now been designed and built and one of these, a tunnel dryer, has already had some initial tests. After a visit from the Malawi Bureau of Standards, it became clear that if we want to sell the product, we would need to have a dedicated pack house with a clean environment for fruit preparation, packing and storage.



Pack house adjacent to the dryers – solar panels are on the roof and batteries are in the building.



Dryers and pack house

The Tunnel Dryer has an extraction flan, drawing the air across the heat collector and over the trays of fruit. The Tunnel dryer is up and running and, so far, we have peaked at 52 degrees which is a bit short of the 60 degrees we would like to get to. However we have had a few attempts at drying tomatoes with mixed success. The first ones dried okay but turned black - we researched some more and this seems to be because the tomatoes weren't fresh enough. It's an oxidisation process that occurs and starts as soon as the fruit is picked, so the learning here is that we need to use very fresh tomatoes.

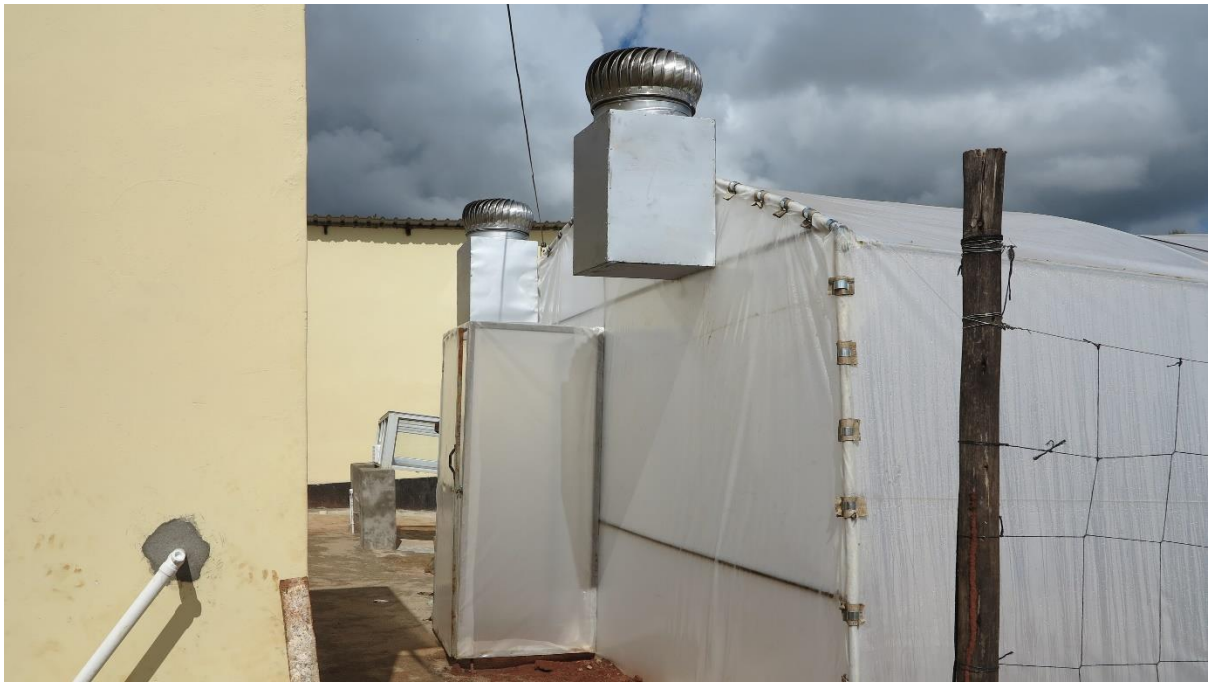
The second, fourth and fifth attempts have all been better in terms of the colour of the finished product and the taste is great - very intense. But all of these took nearly 72 hours to dry and this has resulted in mould on some of the fruits. We are at the tail end of the rainy season and is has rained most nights even though it's hot and sunny through the day. We think this is the problem - the ambient air is just too humid to permit good drying.

This leaves the third attempt which was great - well dried, great flavour and colour, and no mould. It didn't rain at that point and we dried within the recommended 36 hours. This proves it will work during the long dry season (from now till December) although June and July are cooler so we'll see what happens there.

The greenhouse type dryer is not quite finished but what is interesting is that we have been able to get the same temperature in there, without a heat collector. It remains to be seen how that temperature falls when we have the fans running and how that compares. We are

thinking that we should also try a version of the greenhouse type, where we attach a heat collector to the rear so that the air going into the dryer passes over that.

A visitor to the office, on seeing the greenhouse dryer, placed an order for two of them! We explained that we haven't finished testing yet, but he wants them for drying chillies after harvesting, in preparation for market. The dryers will certainly achieve that, and we don't think they will need powered ventilation for that purpose – we have designed two extraction chimneys which work on convection and airflow alone.



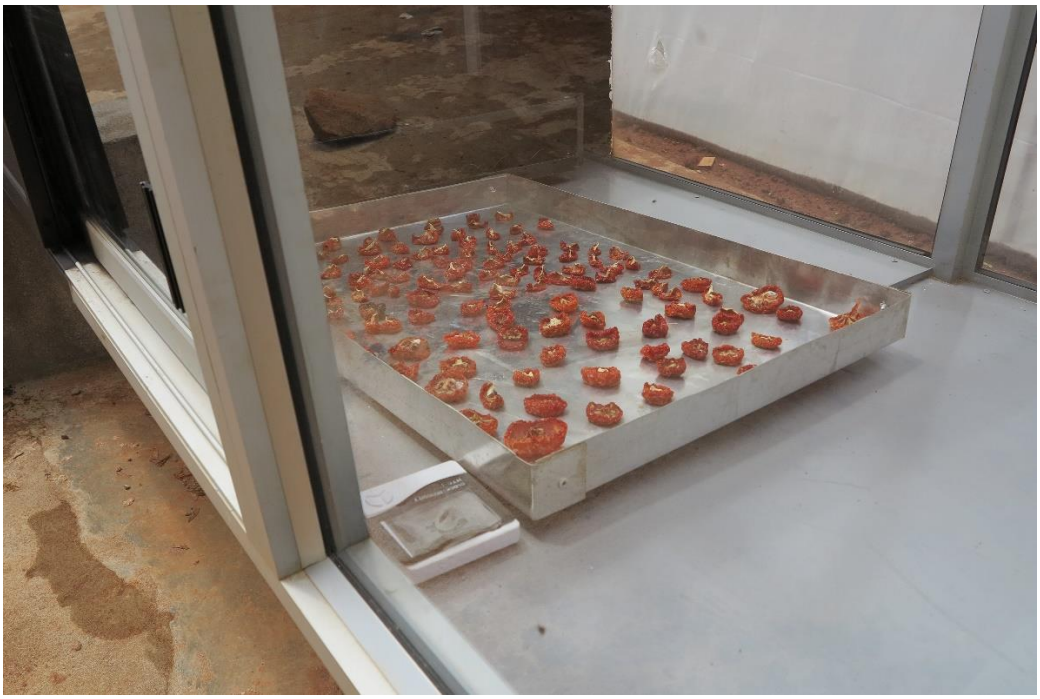
Extraction units on the greenhouse type dryer

The dried fruit

We are learning as we go, and these are the key points so far:

- We need to use top class, very fresh fruit to prevent oxidisation (turning black).
- We need to dry within 36 hours to avoid mould developing. This needs both heat and dry air.
- The dryers won't achieve a 36-hour drying time during the rainy season (Mid December to mid-April)

The rains are easing off in Mzuzu so further testing, and the testing of the greenhouse type dryer, can be conducted in the dryer ambient conditions. The aim is to get a consistent product in terms of taste and appearance. We will continue with tomatoes and try treating with lemon juice and saline solution (separately) before drying. We have tested some bananas and red pepper – the peppers dried very well but the bananas are challenging: we will keep trying.



We are experimenting with both metal and plastic trays, with and without holes

Blackened tomatoes because they weren't fresh enough at the outset

Investigating the market

The next step is to understand what the market for the product might be and this market research can run in tandem with, or slightly behind, the product refining stage - we need to have consistently good samples to present to potential buyers. We want to understand the following:

- Do potential buyers appreciate the product?
- Would they like to see it developed in terms of added spices or olive oil?
- Do they want it in bulk or in retail packaging?
- In what quantities should it be packed?
- How much would the customer buy in a month?
- How should the price be pitched?

The larger Malawi market will be in the cities so we have to get in front of potential customers there. However, we may find a tourist market for a product presented as a "village industry", with the customer supporting women's enterprise through buying the product. Our greenhouses are all managed by women so this is a good angle to take.

This packaging would work and is resealable (like some cereal packaging). It can be printed both sides with branding and product information

Finances

Spending to date (USD) is as follows:

Item	Spent to date	Still to be spent	Notes
Solar, batteries and fans	3125	0	
Construction of Tunnel Dryer	4375	250	We want to add more metal sheets to the heat collector
Construction of greenhouse dryer	3250	1500	We want to try adding a heat collector on the air intake side. (if required, we will test as is first.) We also need racking for the fruit trays.
Construction of packing house	6500	1000	We need to add preparation tables, WC and some tiling and painting for easy cleaning.
Totals	**17,250**	**2,750**	

We received $15,000 initially from Sundanzer so we have spent $2,250 more than this and need to spend another $2,750 = $5,000. This for Stage 1.

Estimates of funding requirements for stages 2 (testing) and 3 (marketing) which will run together are as follows:

Item	Monthly	Total in 2022	Notes
Staff member to run multiple tests in both dryers and record all results	250	1,750	Total employment costs with medical and pension requirements. Assume May to December)
Packaging equipment		1,500	Heat sealer and vacuum packing machines
Design and printing of packaging materials		2,500	At least two designs (general market and fair-trade type market). Different sizes may be required and different designs for different products.
"Consultant" in Lilongwe to identify and engage with potential buyers	500	3,000	Assume a budget of $500 per month all in, and see what we can get for that. They will use their own transport and we won't pay extra for that. Assume July to December.
Totals		**8,750**	

This gives an immediate funding requirement of $13,750 ($5,000 + $8,750), taking the total to date to $28,750.