



Winrock's Jennifer Holthaus (right) interviews William Nyson (center) at Chisoni irrigation scheme. Photo: Robert Foster

Malawi Market Needs, KAP and Technology Assessment Report

November 14, 2019

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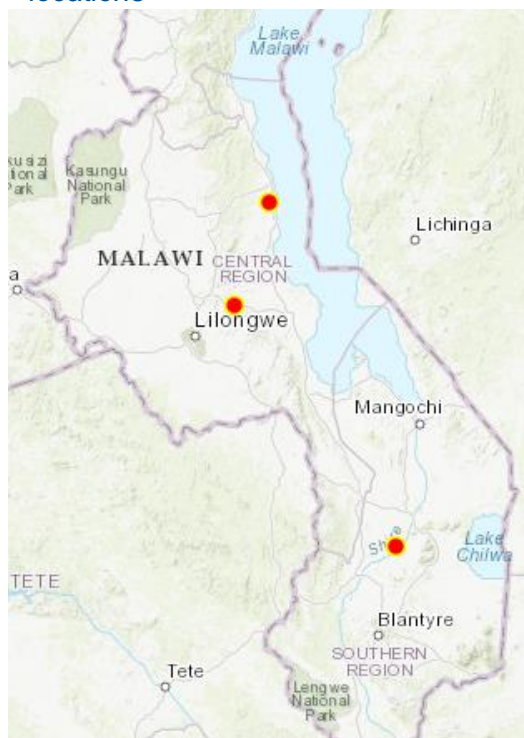
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Introduction

SunDanzer Refrigeration Incorporated is implementing the Green Technologies to Facilitate Development of Value Chains for Perishable Crops and Animal Products (GreenTech) program, funded by the International Fund for Agricultural Development (IFAD). GreenTech's goal is to develop one or more commercially viable solar cooling products which can be sold, without subsidy, into dairy, fish or agriculture supply chains in east/southern Africa. In Malawi, GreenTech's goal is to specify and commercialize a solar cold room for use by smallholder vegetable farmers. GreenTech seeks to cooperate with IFAD's 2016-2023 Programme for Rural Irrigation Development (PRIDE), which aims to develop 15 smallholder irrigation schemes in eight districts, reaching nearly 20,000 beneficiaries. This report fulfills Activities 1 and 2 of Component 1, and Activity 4 of Component 2, in SunDanzer's GreenTech contract with IFAD.

Winrock International, a U.S.-based non-profit organization with global expertise on solar applications for agriculture, is a subcontractor to SunDanzer on the GreenTech project. During an August 2019 visit to Malawi, Winrock met with smallholder vegetable farmers, horticulture aggregators, financial institutions and solar equipment distributors to conduct a rapid market assessment of chilling in the horticulture sector and gather information on knowledge, attitudes and practices (KAP). Winrock worked with a local consultant, Jacinta Nyaika, an agronomist and lecturer at Lilongwe University of Agriculture and Natural Resources. Winrock and Ms. Nyaika reached out to staff of the IFAD Sustainable Agricultural Production Programme and the Crop Development Department, and called other donor-funded horticulture projects and horticulture companies to select field sites to visit where farmers were already producing horticulture crops. Winrock interviewed smallholder vegetable farmers in three locations (**Figure 1**): Chisoni irrigation scheme, located north of Blantyre (9 interviews, including 3 women); Mgwirizano Horticultural Cooperative, located northeast of Lilongwe (9 interviews, including 4 women); and the Kalusa Pineapple Club, located south of Nkhotakota near Lake Malawi (5 interviews, including 2 women). Market assessment and KAP questions were combined into one survey instrument for smallholder farmers. The survey questions and raw data are attached in **Annex A**.

Figure 1: Malawi farmer survey locations



Winrock met with the following agencies and companies:

Winrock met with the following agencies and companies:

Horticulture aggregator

- Agricos (Blantyre)

Commercial horticulture producers

- Igwe Farms (Balaka)
- Horticultural Cooperative Union of Malawi (Hortcum - Lilongwe)
- Horticulture Farmers Cooperative (HOFACOL - Lilongwe)

Financial institutions

- FDH Bank (Salima branch)

Solar distributors

- Natsons/Su-Kam Solar Malawi (Blantyre)
- Team Planet (Lilongwe)
- Zuwa Energy (Lilongwe)
- Nyasa Food Processing and Fishery Machinery company (Lilongwe)

Cold room retailer

- Henkus Investments (Blantyre)

Artisanal fisheries stakeholders

- Nkhotakota District Fisheries Office
- Lozi village fish landing site (Lake Malawi)
- Chia fish market (Nkhotakota)

Winrock also visited the Ngolowindo Horticultural Cooperative, near Salima, which installed a cold room for horticulture in 2009. And we met with the Director of the Crop Development Department of the Ministry of Agriculture, Irrigation and Water Development.

I. Energy Access in Malawi

Grid electricity. The US Agency for International Development (USAID) Power Africa¹ program reports that electricity grid access in Malawi is less than 11% (46% urban, 1% rural), and that installed capacity includes 384 MW of hydroelectric power. Power Africa is assisting the Government of Malawi to develop 70 MW of new solar electricity generation capacity. Domestic pre-paid users pay a monthly charge of MWK 47.5 (US \$0.06) for the first 50 kWh, then MWK 67.25 (US \$0.09) for electricity above 50 kWh.

Solar. The landed solar panel price in Malawi is approximately US \$0.68/Watt. Net metering is not yet allowed. Solar panels are subject to a 16.5% value added tax (VAT). According to Malawi law, solar products should be duty free. However, Zuwa Energy, a solar home system distributor in Malawi, reported having trouble importing solar televisions in mid-2019 because the customs officer saw no difference between the solar TV and a regular TV. Zuwa Energy had the same difficulty with solar batteries, because the customs officer thought they looked the same as car batteries. Because the customs officer would not give the solar batteries the exemption for solar products, Zuwa Energy was forced to pay a 30% duty, a 25% excise tax, and the 16.5% VAT. This presents a risk for importing solar compressors for cold rooms.

II. Smallholder Vegetable Chilling Knowledge, Attitudes and Practices

In Malawi the predominant model for smallholder horticulture is selling to local markets, either directly or through informal middlemen. The US Department of Agriculture (USDA)-funded Agribusiness Investment for Market Stimulation (AIMS) program (2014-19) reports that commercial agriculture in Malawi has focused for many years on maize and tobacco, while

¹ USAID Power Africa Malawi Webpage, <https://www.usaid.gov/powerafrica/malawi>, accessed 11 November 2019

horticulture is grown by smallholders under subsistence conditions, resulting in low productivity.² There is no clear policy on horticulture, and production is not optimized according to the climate in different parts of the country. Working with our local consultant, Winrock attempted to identify horticulture aggregator companies in Malawi that source from smallholders. The \$17 million USDA-funded Malawi Strengthening Inclusive Markets for Agriculture (MSIKA) project (2017-22) aims to support 42,000 smallholder farmers, 210 farmer-based organizations, and 24 processors in the Southern and Central regions of Malawi, focusing on horticulture value chains including tomatoes, onions and chilies. Winrock reached out to an Agribusiness Specialist on the MSIKA staff, who reported that the project has created 146 farmer business organizations for fruits and vegetables, but they have not been able to find aggregators looking to source from smallholders, so smallholders are selling to small vegetable traders. We were able to identify only one horticulture aggregation company sourcing from smallholders; the company, Agricos, profiled below, is a possible pilot partner for testing solar cold rooms.

A. SMALLHOLDERS SELLING TO LOCAL MARKETS

Chisoni Irrigation Scheme

The Chisoni irrigation scheme is located 26 km south of Liwonde. The scheme serves 80 smallholders on 8 hectares using flood irrigation and gasoline-powered pumps. Each smallholder has 0.1 hectare within the irrigation scheme, and many also grow plots on other land using water from the same irrigation scheme, but supplying their own energy for pumping. Smallholders interviewed by Winrock reported plot sizes ranging from 0.2 hectare to 1.6 hectare, on which they grow crops during two or three seasons each year. Smallholders reported growing 1-2 staple crops and 3-6 vegetable crops during the year. Vegetable crops include cabbage, tomatoes, rape, eggplant, green beans, okra, and mustard. Eight of nine smallholders interviewed reported selling their produce to middlemen from Balaka, Blantyre and other local markets; one smallholder reported selling her own produce at the local Phimbi market. Smallholders do not use any form of cold storage or transport. Local markets do not use cold storage; produce is piled on the ground or on boxes by the side of the road (**Figure 2**).

Mgwirizano Horticultural Cooperative

The Mgwirizano Horticultural scheme, located 50 km northeast of Lilongwe, includes 252 farmers on 14 hectares. Members source river water to grow staple crops and vegetables including cabbage, tomatoes, onions, rape, green peas, green beans and mustard. Smallholders interviewed by Winrock reported plot sizes ranging from 0.15 hectare to 1 hectare, on which they grow crops during two or three seasons each year. Three of the nine smallholders interviewed reported taking their produce to sell at the local market

Figure 2: Cabbage for sale at Ntcheu market near Balaka



² AIMS Program: Developing the Horticulture Sector in Malawi, <https://reliefweb.int/report/malawi/aims-program-developing-horticulture-sector-malawi>, accessed 5 November, 2019.

(Chezi). Seven smallholders reported selling to middlemen who come directly to their farms from Salima and Lilongwe.

Winrock conducted interviews in a brick building constructed by a Japan International Cooperation Agency program called One Village One Product (OVOP) (**Figure 3**). Cooperative members contributed bricks and locally available materials for the walls and foundation, and OVOP constructed the roofs and an electricity transformer. The building is not yet connected to the grid, and smallholders reported they have been waiting a long time for OVOP to install a promised tomato processing plant. The cooperative decided to look for other alternatives, and applied for a MWK 16 million (US \$21,600) loan from FDH Bank. They received an initial tranche of MWK 5 million (US \$6,763) to purchase green maize, beans, ground nuts and soy bean for storage, with the plan of selling them when prices are high. The group has another warehouse nearby funded by the EU Farm Input Diversification Program

Figure 3: Winrock's Jennifer Holthaus (right) interviewing Francis Lungu (center)



(FIDP), and they are working with the Agricultural Commodity Exchange for Africa (ACE) to connect them to markets where they can sell their commodities for a higher price. They plan to invest their profits into the tomato processing plant. They plan to spend the remaining MWK 11 million (US \$14,880) loan on a vehicle to transport the produce.

Kalusa Pineapple Club

The Kalusa Pineapple Club (**Figure 4**), located 15 km south of Nkhotakota in Chilimbikitso village, was formed in 2011 and includes 40 members on 10 hectares. Each member has their own plot, averaging 1 acre.

In addition to pineapple, smallholders interviewed reported growing mustard, tomatoes, and cabbage in addition to staple crops. Each member contributes MWK 10,000/year (US \$13.50/year) to transport pineapples for sale in Lilongwe, Salima, Dwangwa and Mzuzu. Members reported that middlemen come to their farms to buy pineapple and vegetables, and that they also sell directly to locals in nearby towns.

Members said the club was receiving ongoing technical assistance from the EU FIDP.

Members source water from a shallow well and water crops by hand. The Winrock team noted that the group could likely benefit from using an inexpensive treadle pump, as the well was next to the fields.

Figure 4: Interview with Kalusa Club member Alfred Mang'ango



Ngolowindo Horticultural Cooperative Society

Winrock made a brief stop at this cooperative, located near Salima. The Italian foundation Fondazione Basso had funded a solar water pumping, lighting and refrigeration project in 2009. Winrock consultant Jacinta Nyaika had visited the cooperative in 2013, when they were growing tomatoes and mangoes, and making jam and juice. At that time in 2013, the cold room was not working. They had a refrigerated van but had problems maintaining it. At the time of Winrock's visit the cold room was still defunct (**Figure 5**), and we saw only staple crops being grown.

Figure 5: Horticulture cold room not in use at Ngolowindo



Selling Price for Produce

Predictably, price varies tremendously in the informal market. **Table 1** shows the range of selling prices for cabbage and tomatoes reported by farmers at the Chisoni and Mgwirizano irrigation schemes and the Kalusa Pineapple Club, using the interbank exchange rate for August 28, 2019. The price paid by grocery stores was reported by Igwe Farms and the Horticulture Farmers Cooperative of Lilongwe (HOFACOL). It is notable that the low price reported by some farmers is higher than the high price reported by others. We assume the explanation of this is either that some farmers have better market connections than others, or that we may have incorrectly interpreted the price per kilogram, as many farmers reported only a price per “bundle” or “bag” of vegetables.

Table 1: Market price of cabbage and tomatoes in Malawi

	Chisoni Irrigation Scheme	Mgwirizano Irrigation Scheme	Kalusa Pineapple Club	Grocery Stores (price paid to supplier)
Cabbage				
Low price/head (USD)	0.07 – 0.13	0.03 – 0.20		0.34 – 0.40
High price/head (USD)	0.13 – 0.69	0.09 – 0.40		0.47 – 0.94
Tomatoes				
Low price/kg (USD)	0.04 - 0.27	0.02 – 0.20	0.13 – 0.27	0.44
High price/kg (USD)	0.19 – 0.67	0.09 – 0.54	0.27 – 0.40	0.67

Chia Fish Market

Winrock visited the Chia Fish market south of Nkhotakota and talked with members of the fishing cooperative there. They reported that in 2008 the Malawi-based non-profit organization Total LandCare paid for a brick building which houses a 3.1 kW (6'x6'x8') grid-connected cold room (**Figure 6**), as well as a roof structure for the outdoor fish market adjacent to the building. Initially the cooperative operated the cold room, which they kept at -30C. After some years they accumulated a large electricity bill (MWK 250,000, US \$340) which they could not pay. An individual entrepreneur took over the cold room and charged MWK 400/night (US \$0.54) to store a 6 kg crate of fish. They estimated they could fit 15 crates in the chiller and more fish on the floor, for a total of about 100 kg of cold storage. Later the entrepreneur raised the price to MWK 1,500/night (US \$2) per crate. Fish could be stored up to one month. They reported that the entrepreneur still was not making sufficient profits to pay the electricity bill. Eventually the compressor stopped working and a technician quoted them MWK 800,000 (US \$1,000) to fix it. Because of these challenges, they stopped using the cold room in 2015.

The industry temperature for frozen fish is -18C; it seems that the group wore out the compressor by keeping it at the very lowest setting, and this would also explain the high electricity bill. It is also likely that there was no regular maintenance performed on the compressor. However, this example provides an interesting model of a cooperative running a cold room and charging artisanal fishermen a nightly fee to store fish. This model could be used by horticulture cooperatives, though the technical challenges would remain – the cooperative would need to have at least one person in charge who understands at what temperature to keep the produce, ensures that sufficient funds are saved to cover regular maintenance, and is capable of sourcing affordable repairs/replacement when needed.

Figure 6: Cold room not in use inside Chia Fish Market building, Nkhotakota



B. SMALLHOLDERS SELLING TO HORTICULTURE AGGREGATORS

Agricos

Agricos, a start-up horticulture aggregation company based in Blantyre, began operations in 2017. Agricos provides technical expertise and market linkages to smallholder farmers in all districts of Malawi for a fee. Once a smallholder signs up with Agricos, the company visits the smallholder's farm 12 times over a 3-month season to advise on which crops to grow and good agricultural practices. For new farmers the registration fee is MWK 50,000 (US \$68), and farm visits are free up to one hectare for the first growing season. During subsequent seasons, farmers pay MWK 8,500 (US \$11.50) per visit. If the smallholder makes a profit from that season, Agricos takes 4.9% of the profits. Currently Agricos sources from 480 smallholders with plots as small as 0.1 hectares. Agricos also sources from larger farms up to 15 hectares.

Agricos hires non-refrigerated vans to transport produce from local markets to customers, typically in 3-ton shipments. The company supplies all the major supermarket chains in Malawi, including Spa, Food Lovers, Peoples, Metro, Express, Shoprite, and Chipiku. Agricos does not own or lease any cold storage facilities; as a result, its smallholder suppliers suffer high losses, as Agricos is only able to buy from them what can be sold the same day to its customers. Agricos expressed a need for refrigerated vans and cold storage facilities at the local produce markets where they buy from smallholder suppliers.

C. FINANCIAL INSTITUTIONS SUPPORTING SMALLHOLDER AGRICULTURE

Winrock met with the FDH Bank branch in Salima to understand the typical terms for agriculture-related loans. FDH is a commercial bank founded in 2008. FDH's agribusiness department makes loans to farmers for inputs, with a 25% annual interest rate and tenor up to 1 year. Non-profit organizations or large cooperatives guarantee the loans. Tobacco is a sector of particular focus, especially for the Salima branch. Tobacco aggregators like Alliance One and Japan Tobacco International provide first-loss guarantees for farmer input loans. In the past

FDH offered asset finance; farmers could buy equipment that served as its own collateral. Now the bank is reducing asset loans because of high default; title deeds are required as collateral.

If financing is needed for solar cold rooms in Malawi, Winrock would reach out to additional banks to determine the best partner for the GreenTech project.

III. Other Products that Increase in Value through Chilling

SunDanzer tasked Winrock to assess which products in Malawi currently increase their value most through chilling and/or cold storage, to determine possible immediate commercial market channels for solar cold rooms. Henkus Investments, which supplies grid-connected cold rooms, reported that most of the demand for cold storage comes from the meat and fish sectors. Slaughterhouses have grid-connected chillers, but vendors do not have chilling in rural areas, so they must sell meat on the same day that they collect it from the slaughterhouse. Henkus reported that the poultry sector is seeing some aggregation companies emerging, but confirmed that the horticulture sector has no domestic aggregation companies. Middlemen buy produce in bulk from farmers; some have 15-20 trucks. Henkus knew of one company exporting fresh mangoes and mango puree from their own farm.

Figure 7: Cold room for frozen fish constructed by Henkus Investments at



Henkus took us to the site of a new cold room they had just completed for a fish retailer in Blantyre (**Figure 7**). The cold room was 4.4 meters x 4.4 meters x 3 meters, with an 8-horsepower compressor, designed for -18C, the standard freezing temperature for fish.

Malawi has a vibrant artisanal fishing sector at Lake Malawi, the fourth largest freshwater lake in the world. Species sold commercially include tilapia, catfish and a local sardine. Winrock met with an artisanal fishing cooperative at Lozi village, on the western shore of Lake Malawi. The cooperative reported using lake water to cool the

fish after it is caught. When they arrive in a larger town or city, they buy ice to put in their cooler boxes. They also dry fish in the sun on long mats near the boat landing site. There are no companies sourcing fish from small fishermen/women on the western shore of Lake Malawi.

The Nkhotakota District Fisheries Office, near the western shore, had two cold rooms on site which were meant to be used by artisanal fishermen, but they were not in use (**Figure 8**). One cold room was 9'x20'x10' and the other was 8'x9'x9'.

MALDECO, based on the eastern side of Lake Malawi, is the largest commercial fishing and processing company in Malawi, and the largest supplier of fish; they maintain a fleet of trawlers and sell fish through retail outlets throughout Malawi, with a complete cold chain. Working with a

Figure 8: Cold rooms not in use at Nkhotakota District Fisheries Office



commercial fish retailer to pilot a solar cold room for use in sourcing from off-grid fishing cooperatives may be a good option for a second market channel in Malawi, to assist in getting the technology started and demonstrated in country.

IV. Feasibility of Solar Cold Rooms Within Existing Business Models

Winrock considers that if a solar chiller pays for itself in less than five years, it could be considered a commercial product. If a solar chiller takes longer than 5 years to generate sufficient additional revenue to pay back the initial cost, it may require a government or donor subsidy to be viable. In the latter case, the solar chiller may still be worth public investment for the benefits to smallholders. In Malawi, produce is chilled at grocery stores, but the rest of the cold chain is entirely missing – there is no refrigerated storage at markets or in transport vehicles. Solar cold rooms could still help solve the post-harvest waste problem by allowing farmers to store crops during the peak harvest season. The stored crops could then be delivered short distances to buyers. Given the abandoned cold rooms we saw as part of past donor-funded smallholder horticulture and fisheries projects, it will be important to ensure that any solar cold room we demonstrate in Malawi has an owner who will run the cold room as a private business, and either purchase the cold room at the end of the demonstration period, or pay back the cost through a rent-to-own arrangement.

A. HORTICULTURE AGGREGATORS SOURCING FROM SMALLHOLDERS

Agricos has expressed interest in piloting a solar cold room in an off-grid area where they source from smallholder growers. Agricos could derive revenue from the cold room by storing up produce during the high production season, when the price is low, and selling to its grocery store clients weeks or months later when they can get a higher price. Off-grid cold storage could assist the company in meeting their contracts to supply produce to grocery stores. Given that the horticulture sector in Malawi is informal, with no other horticulture aggregator companies sourcing from smallholders, off-grid cold storage is only one of many challenges Agricos faces in growing its business. It remains to be seen whether off-grid cold storage will be a high priority for the company. GreenTech will continue to seek other horticulture aggregation companies to ensure we can launch at least one successful pilot in Malawi.

B. PROJECTED ECONOMICS OF SOLAR COLD ROOMS

GreenTech plans to use SunDanzer's slow-start compressor, called a monoblock, to test the market in Zimbabwe and Malawi. SunDanzer will ship the monoblock and controller and try to achieve a customs tax exemption, while the panels and container will be sourced in country. For purposes of a preliminary return on investment analysis, we make the following assumptions about the solar cold room:

- Owned by a horticulture aggregation company or cooperative which charges smallholder \$0.005/kg/day to store produce
- 10-ton storage capacity
- Operates at an average of 40% of capacity throughout the year
- Owner takes out a two-year loan with 20% down

Given these parameters, **Table 2** shows an internal rate of return of 19%. In the next phase of the GreenTech project we will seek to ground truth this analysis by working with at least one pilot partner in Malawi to gather real data on each of these parameters.

Table 2: IRR evaluation of 20' solar cold room with 10-ton capacity

	Year 1 Q1	Year 1 Q2	Year 1 Q3	Year 1 Q4	Year 2 Q1	Year 2 Q2	Year 2 Q3	Year 2 Q4
Fixed Costs								
Cooled chamber \$4,000 (container or concrete/stone building with shelves); \$6,000 for solar-adapted monoblock, controller, panels, insulation for container, installation; total cost \$10,000	3,222	1,222	1,222	1,222	1,222	1,222	1,222	1,222
Operator salary	150	150	150	150	150	150	150	150
Total Fixed Costs	3,372	1,372	1,372	1,372	1,372	1,372	1,372	1,372
Revenue								
Price of chilling (\$/kg/day)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Days of chilling	90	90	90	90	90	90	90	90
Solar cold room capacity (kg)	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Kg stored (40% of total capacity)	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Total Revenue	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
Gross Profit	(1,572)	428	428	428	428	428	428	428
Internal Rate of Return (IRR)	19%							

V. Current and Potential Competing Products

The rapid decline in solar panel prices – more than 90 percent in the past decade – has prompted many refrigeration companies to include solar chilling in their product offering. Current and potential competing off-grid cold storage products are summarized in **Table 3**; to our knowledge, none of these products are currently in use in Malawi. SunDanzer uses a slow-start, direct current compressor designed to draw less power from solar panels, making the solar cold room more efficient and allowing the use of smaller solar panels. Many of the products in this table are simply standard alternating current compressors which have been connected to solar panels, making them less efficient and likely more expensive than SunDanzer's product. Another characteristic of many of the products on this list is that the buyer must purchase and ship the entire container. This can be expensive, as containers are bulky and heavy. SunDanzer plans to ship only the solar-adapted monoblock and controller, allowing buyers to buy or build a container in-country. One interesting development is that companies like ColdHubs (Nigeria) and SolarFreeze (Kenya) are starting to provide off-grid chilling as a service, using pay-as-you-go technology. GreenTech will assess whether the Pay-As-You-Go payment model for off-grid chilling could work in Malawi.

Table 3: Current and potential competing off-grid cold storage products

Vendor	Capacity	Technology	Notes
Monoblock			
Vink Koeltechniek (Netherlands) vinkkoeltechniek.com	20-foot or 40-foot shipping container Refrigeration range 0.5 – 5°C or freezing -24 to -18°C	Solar Monoblock projects in Tanzania (crops) & Ghana (fish)	
Sahar Co (UAE) www.saharco.ae	Monoblock for solar cold rooms	PV VC batteries	Pilot projects in Ghana & Tanzania
Pay As You Go			
ColdHubs (Nigeria & USA) coldhubs.com	150 crates per module Can store at 15C for vegetables, or -5°C for fish	PV VC batteries	Pay-as-you-go subscription model: farmers pay daily flat fee per crate of food stored
SolarFreeze (Kenya) solarfreeze.co.ke	20 ft ISO container	PV VC batteries	For purchase or Pay-as-you-go through M-Pesa, pilot stage
Container			
Coldinnov (France) coldinnov.com	10 m ³ cold room: 2 kWp PV 20 m ³ cold room: 6 kWp PV Refrigeration range 0-10°C	PV VC & ammonia gas adsorption from waste heat	Cold rooms sold as disassembled kits for transport; PV plug & play
Ecozone (India) ecozonesolutions.com	5 metric tonnes	Solar with thermal storage or PV VC	
InspiraFarms (UK) inspirafarms.com	30 m ² – 120 m ² , refrigeration range 2-14°C	Off-grid solar option, 3-12 kW	
Heuch Pty Ltd/Black Stump (Australia) heuch.com.au	20 or 40 foot ISO containers 24,000 liters internal storage	PV VC batteries	
Inficold (India) inficold.com	20 or 40 foot ISO containers 7 & 14 kWp	Solar with thermal energy storage	
PT Contained Energy (Indonesia) containedenergy.com	20 or 40 foot ISO containers	PV VC batteries	
Refriend Ice Systems (China) refriendicesystem.en.ecplaza.net	20 foot ISO containers	PV VC batteries	Pilot stage
Solar E. Technology (Bangladesh) solar-e-technology-bd.com	20 foot ISO containers	PV VC batteries	Pilot stage
Focussun (China) focusun.com	20 foot ISO containers	PV VC batteries	Pilot stage
Vacker Global (UAE) vackerglobal.com	Many flat packed custom sizes	Solar & grid	

VI. Potential Solar Distribution Partners in Malawi

Winrock met with four solar distributors in Malawi: Natsons/Su-Kam Solar Malawi (Blantyre), Team Planet (Lilongwe), Zuwa Energy (Lilongwe), and Nyasa Food Processing and Fishery Machinery company (Lilongwe). Winrock verified the size and type of each company's solar

projects, the cost and brands of solar equipment used, and their engineering and design capacity.

Team Planet, founded in 2015, is owned by Tobias Dowidat, an engineer trained in Germany with PV power system design experience. Team Planet has worked with SunDanzer's distribution partner African Energy and is familiar with SunDanzer products. They had the apparent best engineering capabilities of any solar company WI visited in Malawi. Because of their design and installation experience, Team Planet is a good potential partner for solar cold room pilot testing in Malawi.

Henkus Investments is another potential distribution partner. They saw the need for solar chilling in the horticulture sector, and said they could assist with importing demonstration units, increasing awareness through marketing, and identifying a fruit company as an initial buyer.

VII. Next steps

SunDanzer and Winrock will pursue the following next steps in Malawi during the first and second quarters of 2020:

- Sign collaboration agreement with at least one local horticulture agribusiness partner
- Co-design solar cold rooms with local partner(s)
- Determine specifications and business model for pilot solar chiller unit, including location, sizing and design of cold room (kg/day added; kg stored/week; compressor kW; # compartments needed), and expected additional revenue
- Confirm duty/vat on solar compressor
- Determine total price of system (monoblock, panels, container)
- Prepare payback analysis for poultry, horticulture
- Ship test units to local partners, and install locally
- Work with pilot partners to host at least ten groups during the first year to see the solar cold room in operation, to include smallholder farmers, banks, government agriculture officials, and the IFAD PRIDE team

ANNEX A: Survey Questions and Data

A. SMALLHOLDER VEGETABLE FARMER SURVEY

	1	2	3	4	5	6	7	8	9
Survey Completion Date	8/26/2019	8/26/2019	8/26/2019	8/26/2019	8/26/2019	8/26/2019	8/26/2019	8/26/2019	8/27/2019
Participant Name	James Yohane Chisoni	William James in car	Eliza Lazarus black polka dot tank top	William Nyson (green short sleeve shirt striped top)	Gilbert Shonga (JN)	Ellena Bernado (JN)	Poison Bomani (JN)	Eliza Kondwani (JN)	Mr Brightone Chiluzi (JN)
Participant Location	Chisoni	Chisoni	Chisoni	Chisoni	Chisoni	Chisoni	Chisoni	Chisoni	Chisoni
How many vegetable crops do you grow each year?	3	3	3	2	2	2	3	4	2
What vegetable and other crops did you grow in the past year (July 2018 - July 2019)?	Tomato, mustard, eggplant, green beans	tomato, green pumpkins, eggplant, okra, Chinese, rape, cabbage, maize, sweet potato, cassava	Rape, Chinese, green beans, pumpkin leaves, green peas, tomatoes, eggplants, okra, sweet potato, cassava, spinach, maize	tomato, eggplant, green beans, okra	Tomato, cabbage, pumpkin, rape, Chinese, mustard, cowpea leaves	Tomato, pumpkin, mustard, Chinese, rape, mango	Tomato, eggplant, cabbage, mustard, okra	tomato, mustard, pumpkin leaves, rape	Tomato, eggplant, okra
In which months did you plant each vegetable crop?	Tomatoes Nov; eggplant perennial - harvest sale plants whole year; mustard Jun/Jul; green beans Mar	Tomato Jul, Nov, Feb, green pumpkin Dec, Jul, eggplant Jan, Nov; okra Jun, Nov; Chinese May, Nov; rape May, Nov; cabbage Apr	Tomatoes Jun, Oct, Dec; green beans May, Aug, Dec; rape/Chinese Feb, Jul, Sept; pumpkin leaves Apr, Jun, Sep; green peas May, Oct; spinach Jun, Dec; eggplant Apr, Dec; okra May, Sept	Tomatoes Apr, Sept; eggplant Apr, Sept; green beans Jun; okra April	Tomatoes Sep, cabbage Mar, all the rest Mar	Tomato Mar, Sept; leafy veg Mar, Aug	Tomato Mar, Oct; eggplant, cabbage, okra, mustard Jul	Tomatoes Mar, Sep; pumpkin leaves Aug; mustard Jun	Tomato Mar, Aug; eggplant Mar; Okra Jun
For each vegetable crop, how many acres did you grow in each season?	Tomatoes 0.2 ha; mustard 0.05; eggplant 0.2 green beans 0.2	Tomato 0.2; green pumpkin 0.2; eggplant 1 acre; okra 0.2 ha; Chinese 0.1 ha; rape 0.1 ha; cabbage 1 acre	Tomatoes 0.2 ha; green beans 0.1; rape 0.1; Chinese 0.1; pumpkin leaves 0.2; green peas 0.1; eggplant 0.2; okra 0.2; spinach 0.1	Tomato 0.1 ha; eggplant 0.1 ha; green beans and okra 0.1 ha	Tomato 0.1 acre, cabbage 0.1 ha, mustard/Chinese 0.05 ha, cowpea leaves 0.02 ha	Tomato 0.1 ha, leafy veg 0.05 ha, pumpkin 0.05 ha	Tomato 0.1 ha, eggplant, cabbage, okra 0.05 ha each	Tomato 0.1 ha; mustard 0.05 ha; rape 0.05 ha; pumpkin leaves 0.05 ha	Tomato 0.1 ha; eggplant 0.1 ha; okra 0.05 ha
In which months did you harvest each vegetable crop?	Tomatoes 2 months; mustard 1 month; green beans 3 months Jun	Tomatoes 2 months; green pumpkin 1 month; eggplant 3 months; okra 2 months; Chinese/rape 1 month; cabbage 4 months	Tomatoes Aug, Dec, Feb; green beans Aug, Dec, Mar; rape/Chinese Jul, Sep, Dec; pumpkin leaves July, Sep, Dec; green peas Jul, Dec; eggplant Aug, Mar; spinach Aug, Mar; okra Aug, Jan	Tomatoes July, Dec; eggplant July, Dec; green beans Sept; okra Jul	Tomato Dec, cabbage Jun, leafy veg Apr	Tomato Jun, Dec; leafy veg Apr	Tomato Jul, Dec; cabbage Oct; okra, eggplant Oct; mustard Aug	Tomato Dec, Jun; mustard Sep	Tomato Jul, Dec; eggplant Jun; okra Jul
What was the lowest price you received for each vegetable crop in each season? (MVK)	Tomatoes 400/10 kg; mustard 50/5 leaves 0.2 kg; green beans - just to consume at home; eggplant 50/5 (0.5 kg)	Tomatoes 500/10 kg; green pumpkin 300/10 kg; eggplant 2,000/10 kg; okra 1,500/10 kg; Chinese 200/10 kg; rape 100/10 kg; cabbage 1,000/10 kg	Tomatoes 1,500/basket (10 kg); green beans 3,000/5 kg; rape 600/basket (10 kg); Chinese 600/10 kg; pumpkin leaves 400/10 kg; green peas 500/10 kg; eggplant 2,000/10kg; spinach 450/10 kg; okra 2,500/10 kg	Tomato 500 MVK/basket (15 kg); eggplant 100/dozen (1.5 kg); green beans 100/few pods 0.2 kg; okra 20/5 okra (.15 kg)	Tomato 150/kg; cabbage 100/head; leafy veg 100/kg	Tomato 200/kg; leafy veg 120/kg	Tomato 200/kg; cabbage 50/head, eggplant 150/kg; okra 300/kg; mustard 100/kg	Tomato 200/kg; mustard 250/kg; pumpkin leaves 150/kg; rape 300/kg	Tomato 100/kg; eggplant 150/kg; okra 150 kg
For each vegetable crop, which week of which month was the lowest price?	Tomatoes Jul; mustard Jul; eggplant Jul/Aug	Tomato Aug; green pumpkin Aug - for all veg	Tomatoes all of Aug; green beans Aug - all veg	Tomatoes 3rd week of July; eggplant 3rd of July; green beans 1st week Sept; okra 1st week July	Tomato 2nd week Jan, cabbage 3rd week Jul, leafy veg 1st week Apr	Tomato 4th week July, 2nd week Dec; leafy veg 1st week Apr	Tomato 3rd week Jul; cabbage 1st week Oct; eggplant 4th week Oct; okra 4th week Oct; mustard end of Jul	Tomato 3rd week July; pumpkin leaves 1st week Oct; mustard/rape end of Jul	Tomato 1st week Jul-Aug; eggplant end of Jul; okra end of Jul
About how much of each vegetable crop did you sell for the	Tomatoes 75%; mustard 75%; eggplant 75%	Tomatoes 50%; green pumpkin 25; eggplant 25%; okra 25; Chinese	Tomatoes 50%; green beans 25%; eggplant 50%; rape/Chinese 25;	Tomatoes 75%; eggplant 75%; green beans 25%; okra 25%	Tomato 25%; cabbage 30%; leafy veg 50%	Tomato 15%; leafy veg 20%	Tomato 20%; cabbage 10%; eggplant, okra 10% each; mustard 40%	Tomato 50%; pumpkin leaves 20%; mustard/rape 10%	Tomato 40%; eggplant 30%; okra 30%

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lowest price in each season (kg)?		20; rape 20%; cabbage 50%	pumpkin leaves 50%; spinach 25%; okra 50%						
What was the highest price you received for each vegetable crop in each season? (MWK)	Tomatoes 10,000/10 kg; mustard price didn't change; eggplant price didn't change	Tomatoes 4,000/10 kg; green pumpkin 500/10 kg; eggplant 3,500/10 kg; okra 3,000/10 kg; Chinese /rape 500/10 kg; cabbage 3,500/10 kg	Tomatoes 3,500/10 kg; green bean 1,500/10 kg; eggplant 3,000/10 kg; rape 1,800/10 kg; Chinese 1,400/10 kg; pumpkin leaves 850/10 kg; spinach 1250/10 kg; okra 2,800/10 kg	Tomatoes 3,000/15 kg; eggplant 200/4 eggplant (300 g); green beans 200/0.2 kg; okra 200/five (0.15 kg)	Tomato 140/kg; cabbage 510/head; leafy veg 110/kg	Tomato 400/kg; leafy veg 140/kg	Tomato 350/kg; cabbage 100/head; eggplant 250/kg; okra 350/kg; mustard 150/kg	Tomato 500/kg; pumpkin leaves 200/kg; mustard/rape 300/kg	Tomato 200/kg; eggplant 150/kg; okra 200/kg
For each vegetable crop, which week of which month was the highest price?	Tomatoes 2 nd and 3rd week Nov	Tomatoes Dec; green pumpkin Oct/Nov; eggplant Nov; okra Dec; Chinese/Dec; cabbage Nov	Tomatoes Oct-Jan; green beans Oct-Jan, same for all	Tomatoes 1st week Dec; eggplant 4th week July; green beans 4th week Sept; okra 4th week of July	Tomato Jan; cabbage late Sept; mustard early Apr	Tomato end of Dec-Jan; leafy veg early Apr	Tomato early Jul, Jan; eggplant 2nd week Nov; cabbage end of Oct-Nov	Tomato Jan; pumpkin leaves early Jul; mustard/rape early Jul	Tomato early Oct and early Jan; eggplant end of Jun; okra end of Aug
About how much of each vegetable crop did you sell for the highest price (kg)?	See question about lowest	See totals for lowest - didn't have time	Tomatoes 50%; green beans 50%; eggplant 75%; spinach 50%; okra 75; rape 50; Chinese 25; pumpkin leaves 50	Tomatoes 50x15 kg; eggplant not sure; green beans	Tomato 60%; cabbage 50%; leafy veg 40%	Tomato 80%; leafy veg 20%	Tomato 80%; cabbage 90%	Tomato 50%; pumpkin leaves, mustard, rape 30%	Tomato 60%; eggplant 70%; okra 70%
What was your total revenue from each vegetable crop in the last year (July 2018 - July 2019)? (MWK)	Tomatoes 80,000, mustard 25,000, eggplant 25,000	Tomatoes 50,000; green pumpkin 3,500; eggplant 60,000; okra 40,500; Chinese 2,500; rape 2,500; cabbage 35,000	Tomatoes 35,000; green beans 15,000; eggplant 40,000; pumpkin leaves 12,000; rape 4,000; Chinese 3,600; spinach 2,700; okra 5,000	Tomato MWK 300,000; eggplant 200,000; green beans 150,000; okra 250,000	Tomato 180,000; cabbage 250,000; leafy veg 25,000	Tomato 170,000; leafy veg 25,000 each	Tomato 150,000; cabbage 100,000; eggplant 150,000; okra 75,000	Tomato 200,000; pumpkin leaves 15,000; mustard/rape 25,000	Tomato 300,000; eggplant 250,000; okra 200,000
Who do you sell your vegetables to?	Middlemen who come here from Blantyre, Balaka	Middlemen who come from Balaka, take them to Lilongwe and Blantyre	She takes them herself to the local market, Phimbi market	Local middlemen from Balaka and other towns; they come to the farm to collect, market is not reliable	Sells to vendors and takes produce himself to Phimbi Market (local trading center)	Sells herself in Blantyre, and to vendors who come to the farm	Vendors	Local villagers, sells to them herself, also to vendors	Vendors
How long would you have to chill and store each vegetable crop to get a better price after the peak harvest time?	2-3 months	3 months	Tomatoes chill Aug crop until Oct - applies to everything harvested in Aug	Tomatoes 1 month; eggplant 1 month also green beans and okra	Tomatoes 2 weeks, cabbage 2 weeks, leafy veg 4 days	Tomato 4 weeks; leafy veg 7 days	Tomato 3 weeks; cabbage 5 weeks; eggplant, okra 3 weeks	Leafy vegetables we sprinkle with water, show decay on 2nd day; tomatoes we store in our houses	Tomatoes 4 weeks; eggplant 4 weeks; okra 2 weeks
What price could you get for each vegetable if you could chill and store each crop as long as needed? (MWK)	300,000 for his whole 0.2 ha	Tomatoes 5,000/10 kg; green pumpkin 700/10 kg; cabbage 4,500/10 kg; okra 2,500/10 kg	Tomatoes 5,000/10 kg	Could get highest price previously mentioned for each vegetable	Tomato 280/kg; cabbage 600/head; leafy veg 150/kg	Tomato 450/kg; leafy veg 150/kg	Tomato 250/kg; cabbage 180/head; eggplant 200/kg; okra 120/kg	Tomatoes 500/kg; mustard 280/kg; pumpkin leaves 160/kg; rape 300/kg	Tomato 500/kg; eggplant 180/kg; okra 150/kg
x	35.11123884	35.11120138	35.11121026	35.11121647	34.32383951	34.3591124	34.36272869	34.32376902	33.7655755
y	-15.26586432	-15.26587961	-15.26615261	-15.26615274	-13.12396678	-13.68507677	-13.68963934	-13.12419074	-13.97240422

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Survey Completion Date	8/27/2019	8/27/2019	8/27/2019	8/27/2019	8/27/2019	8/27/2019	8/27/2019	8/27/2019	8/27/2019
Participant Name	Efrieda Jossam. Yellow headdress and dress	Francis Lungu. black suit	Judith Tchika orange polka dots	Christina Kanyemba	Bartice Banda	Mr Medison Numeri Mwale (JN)	George Chinkhota (JN)	Mr Wangstoni Bulaki Kapata	Mr Andrea Chimpeni (JN)
Participant Location	Mgwirizano	Mgwirizano	Mgwirizano	Mgwirizano	Mgwirizano	Mgwirizano	Mgwirizano	Mgwirizano	Mgwirizano
How many vegetable crops do you grow each year?	4	4	4	2	2	3	1	3	3
What vegetable and other crops did you grow in the past year (July 2018 - July 2019)?	Tomato, onions, mustard, rape, green beans, potato, green maize	Tomato, cabbage, onions, green beans, Chinese, mustard, green maize	Tomato, cabbage, onions, mustard, green maize	Tomato, onions, cabbage, green peas, rape, maize	Tomato, cabbage, onions, green beans, maize	Tomato, cabbage, onion	Tomato, cabbage, onion	Tomato, cabbage, onion	Tomato, cabbage, onion, mustard, Chinese, pumpkin leaves
In which months did you plant each vegetable crop?	Tomato Dec, Apr, Aug; onions Dec, Mar, May; mustard, rape, green beans Dec, May, Aug	Tomatoes Dec, May, Sep; onions same as tomatoes; green beans same as tomatoes; Chinese and mustard same as tomatoes (intercropping everything)	Tomatoes Mar, Jun, Oct, Nov; cabbage Jun, Jul, Oct, Jan; onions May, Jun, Oct, Jan; mustard Mar, Oct	Tomatoes Dec, May; cabbage Dec, Jun; green peas Dec, Jun; rape Jun, Dec	Tomatoes Apr, Sep; cabbage Jun, Sep; onions Dec, Jun; green beans Sept	Tomato May, Dec; cabbage Apr, onion Jun-Jul	All in Mar	Tomato Dec; cabbage May; onion Sept	Tomato Dec; cabbage Apr; onion May; leafy greens Jun
For each vegetable crop, how many acres did you grow in each season?	Tomato 0.25 acre; onions 0.25 acre; mustard less than 0.25 acre, rape less than 0.25 acre, green beans 0.25 acre. Total 1 acre	Tomatoes 0.25 acre; onions less than 0.25 acre; green beans less than 0.25 acre; Chinese and mustard less than 0.25 acre	Tomatoes 0.25 ha; cabbage 0.25 ha; onions 0.25, mustard 0.25	All vegetables 0.5 acre	Tomatoes 0.25 ha; cabbage 0.25 ha; onions 0.25; green beans 0.25	Tomato 0.1 ha, cabbage 0.1 ha; onion 0.1 ha	Tomato 0.1 ha; cabbage 0.1 ha; onion 0.1 ha	Tomato 0.05 ha; cabbage 0.05 ha; onion 0.05 ha	Tomato 0.1 ha; cabbage 0.1 ha; onion 0.1 ha; mustard 0.05 ha; Chinese 0.05 ha
In which months did you harvest each vegetable crop?	Tomatoes Mar, Jul, Nov; onions Mar, Jul, Nov; green beans Feb, Jul, Oct	Tomatoes Mar, Aug, Dec; onions Feb, Jul, Nov; green beans Feb, Jul, Nov; Chinese Jan, Jun, Oct; mustard Jan, Jun, Oct	Tomatoes Aug, Oct, Feb, Mar; cabbage Sep, Oct, Feb, Apr; onions Aug, Sept, Jan, Apr; mustard May, Dec Jan, Jun, Oct	Tomatoes Apr, Aug; cabbage Mar, Aug; onions Apr, Sept; green peas Mar, Aug; rape Jan, July	Tomatoes Jul, Dec; cabbage Sep, Dec; onion Dec; green beans Nov	Tomato Mar, Aug; cabbage Jul-Aug, onion Sep	All in Jun	Tomato Mar/Apr; cabbage Jul-Aug; onion Dec	Tomato Apr-May; cabbage Jul-Aug; onion Sept; Chinese/mustard Jul
What was the lowest price you received for each vegetable crop in each season? (MWK)	Tomatoes 500/30 kg; onions green beans 2,500/50 kg; green beans 400/kg	Tomatoes 1,000/30 kg; onions 4,000/50 kg; green beans 500/kg; Chinese 100/bunch; mustard 100/bunch	Tomatoes 800/30 kg; cabbage 25/head; onions 5,000/50 kg; mustard 1,000/15 kg	Tomatoes 500/30 kg; cabbage 30/head; onions 2,000/50 kg; green peas 350/kg; rape 200/kg	Tomatoes 800/30 kg; cabbage 30/head; onions 2,500/50 kg; green beans 400/kg	Tomato 150/kg; cabbage 50/head; onion 100/kg	Tomato 100/kg; cabbage 30/head; onion 75/kg	Tomato 50/kg; cabbage 20/head; onion 100/kg	Tomato 100/kg; cabbage 150/head; onion 180/kg; Chinese/mustard 50/kg
For each vegetable crop, which week of which month was the lowest price?	Tomatoes Aug-Oct; onions Jul/Aug; green beans Jun	Tomatoes Aug; onions Aug; green beans Aug; Chinese Jul/Aug; mustard Jul/Aug	Tomatoes Aug; cabbage Jun; onions Sept; mustard Jul	Tomatoes Aug; cabbage Aug; onions Sept; green peas early Sept; rape Aug	Tomatoes Oct; cabbage Sep; onions Aug; green beans early Oct	Tomato end of Aug-1st week Sep; cabbage end of Jul-Aug; onion 1st week Oct	Tomato Jun-Aug; cabbage Jun-Jul; onion Aug	Tomato 2nd week Mar; cabbage 4th week Jul-2nd week Aug; onion 1st week Dec	Tomato end July-Aug; cabbage 3rd week Aug; onion Aug-Oct; Chinese/mustard Jul
About how much of each vegetable crop did you sell for the lowest price in each season (kg)?	Tomatoes 1,350 kg; onions 600 kg; green beans 150 kg	Tomatoes 1,500 kg; onions 300 kg; green beans 75 kg; Chinese and mustard 1,000 bunches	Tomatoes 1,500 kg; cabbage 1,000 heads; onions 250 kg; mustard 45 kg	Tomatoes 300 kg; cabbage 3,000 heads; onions 250 kg; green peas 200 kg; rape 500 kg	Tomatoes 600 kg; cabbage 100 heads; onions 200 kg; green beans 100 kg	Tomato 40%; cabbage 30%; onion 20%	Tomato 50%; cabbage 30%	Tomato 20%; cabbage 30%; onion 20%	Tomato 25%; cabbage 50%; onion 50%; Chinese/mustard 50%
What was the highest price you received for each vegetable crop in each season? (MWK)	Tomatoes 2,000/30 kg; onions 4,500/50 kg; green beans 800/kg	Tomatoes 7,500/30 kg; onions 10,000/50 kg; green beans 650/kg; Chinese and mustard 150/bunch	Tomatoes 5,000/30 kg; cabbage 70/head; onions 10,000/50 kg; mustard 2,000/15 kg	Tomatoes 3,000/30 kg; cabbage 70/head; onions 3,500/50 kg; green peas 500/kg; rape 350/kg	Tomatoes 2,000/30 kg; cabbage 80/head; onions 5,000/50 kg; green beans 500/kg	Tomato 300/kg; cabbage 200/head; onion 200/kg	Tomato 250/kg; cabbage 150/head; onion 200/kg	Tomato 200/kg; cabbage 200/head; onion 300/kg	Tomato 400/kg; cabbage 300/kg; onion 300/kg
For each vegetable crop, which week of which month was the highest price?	Tomatoes end Oct-Feb; onions Dec-Jan; green beans Dec-Feb	Tomatoes Mar; onions Mar; green beans Oct; Chinese's/mustard Dec	Tomatoes Dec; cabbage Jan; onions Mar; mustard Feb	Tomatoes Dec; cabbage Jan; onions Jan; green peas end of Sept; rape Jan	Tomatoes Dec; onion Dec; green beans end Oct	Tomato end of Apr-early May; cabbage 1st week Apr, Dec; onion Dec-Feb	Tomato Feb-Apr; cabbage Feb-Apr; onion Feb-Apr	Tomato 3rd week Apr; cabbage 4th week Aug-Dec; onion Jan-Feb	Tomato Dec-Mar; cabbage May-Jun; onion Dec-Feb; Chinese/mustard Apr-Jun
About how much of each vegetable crop	Tomatoes 450 kg; onions 350 kg; green beans 250 kg	Tomatoes 1,350 kg; onions 300 kg; green beans 75 kg;	Tomatoes 1,800 kg; cabbage 2,000 heads;	Tomatoes 250 kg; cabbage 1,500 heads; onions 150	Tomatoes 420 kg; cabbage 500 heads;	Tomato 85%, cabbage 70%; onion 75%	Tomato 70%; cabbage 60%; onion 40%	Tomato 5%; cabbage 10%; onion 10 %	Tomato 90%; cabbage 50%; onion

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did you sell for the highest price (kg)?		Chinese/mustard 100 bunches	onions 350 kg; mustard 75 kg	kg; green peas 150 kg; rape 250 kg	onions 350 kg; green beans 200 kg				70%; Chinese and mustard 40%
What was your total revenue from each vegetable crop in the last year (July 2018 - July 2019)? (MWK)	Tomatoes 140,000; onions 50,000; green beans 85,000	Tomatoes 270,000; onions 57,000; green beans 90,000; Chinese/mustard 14,000	Tomatoes 95,000; cabbage 110,000; onions 38,000; mustard 25,000	Tomatoes 150,000; cabbage 120,000; onions 90,000; green peas 180,000; rape 100,000	Tomatoes 150,000; cabbage 100,000; onions 80,000; green beans 100,000	Tomato 450,000; cabbage 280,000; onion 90,000	Tomato 250,000; cabbage 150,000; onion 180,000	Tomato 70,000; cabbage 150,000; onion 60,000	Tomato 150,000; cabbage 120,000; onion 80,000; Chinese/mustard 16,000
Who do you sell your vegetables to?	She takes produce to local market (Chezi), sells to vendors from Salima and Lilongwe	Vendors from Salima and Lilongwe come to his farm; they sell direct to consumers from fresh produce stands	Vendors come to her farm from Salima, Lilongwe, doesn't know where they sell to	Local market Chezi trading center	Local market; middlemen come to the market	Vendors who come to the farm	Wholesale at Chezi to vendors	Vendors come to farm	vendors come to the farm
How long would you have to chill and store each vegetable crop to get a better price after the peak harvest time?	See other info from Malawi	See other info on Malawi	See other info from Malawi	See other info from Malawi	Tomatoes 5 months	Tomato 2 weeks; cabbage 1-2 months; onion 3 months	Tomato 2 weeks; cabbage 2 months; onion 3 months	Tomato 2 months; cabbage 3 months; onion 2 months	Tomato 1 month; cabbage 2 months; onion 6 months; Chinese/mustard 7 days
What price could you get for each vegetable if you could chill and store each crop as long as needed? (MWK)	Tomatoes 7,000/30 kg; onions 12,000/50 kg; green beans 800/kg	Tomatoes 15,000/30 kg; onions 15,000/50 kg; green beans 1,000/kg; Chinese/Mustard 200/bunch	Tomatoes 25,000/30 kg; cabbage 250/head; onion 15,000/50 kg; mustard 3,000/15 kg	Tomatoes 10,000/30 kg; cabbage 150/head; onions 50,000/50 kg; green peas 800/kg; rape 700/kg	Tomatoes 7,000/30 kg	Tomato 700/kg; cabbage 300/head; onion 800/kg	Tomato 600/kg; cabbage 300/head; onion 350/kg	Tomato 350/kg; cabbage 300/head; onion 300/kg	Tomato 600/kg; cabbage 500/head; onion 1,200/kg; Chinese/mustard 220/kg
x	34.0543143	34.05433986	34.05434682	34.054262	34.05443927	33.77067547	33.80128518	33.78567997	33.75718296
y	-13.72342096	-13.72341665	-13.72347188	-13.72348466	-13.72348282	-13.9814628	-13.94457446	-13.96642989	-13.97496192

	19	20	21	22	23
Survey Completion Date	8/28/2019	8/28/2019	8/28/2019	8/28/2019	8/28/2019
Participant Name	Anes Tembo. Black lace shawl w/roses, green skirt	Esther Jusa. Blue/white striped shirt, yellow skirt	Alfred Mang'ango. Yellow dress shirt	Charles M'baya	Robert Liwenga
Participant Location	Kalusa Pineapple Club	Kalusa Pineapple Club	Kalusa Pineapple Club	Kalusa Pineapple Club	Kalusa Pineapple Club
How many vegetable crops do you grow each year?	2	2	2	1	Plant pineapple once, harvest for year; also mustard, cabbage, mostly for home consumption
What vegetable and other crops did you grow in the past year (July 2018 - July 2019)?	Pineapple, mustard, sweet potatoes	Pineapple, tomato, mustard, sweet potato, rice	Tomato, mustard, rape, pineapple	Pineapple, rice	Pineapple, mustard, cabbage
In which months did you plant each vegetable crop?	Dec	Pineapples Dec; tomatoes Apr, Sept; mustard Apr, Oct	Pineapple Dec; tomatoes Dec and May	Dec	Pineapples Dec
For each vegetable crop, how many acres did you grow in each season?	Pineapple 1.5 acres	Pineapple 2 acres; tomato 0.5 acre; mustard 0.5 acre	Pineapple 1 ha; tomatoes 0.1 ha	2 acres	1 ha
In which months did you harvest each vegetable crop?	Dec/Jan is the peak, start in Jun	Pineapple Jun-Dec; tomatoes Jun/Jul, Dec/Jan; mustard May/Jun, Nov/Dec	Pineapple start harvesting in June but small quantities. Higher quantities in Nov, Dec, Jan, Feb; tomatoes Aug and Mar	Year-round, big harvest Dec and Jan; small quantities rest of year	Start harvesting a few in June, keep on harvesting, quantity peaks in Dec
What was the lowest price you received for each vegetable crop in each season? (MWK)	250/kg	Pineapples 250/kg; tomatoes 50/4 tomatoes (0.5 kg); mustard 200/kg	Pineapple 200/kg; tomatoes 200/kg for Dec season; August season 100/kg	200/kg	200/kg
For each vegetable crop, which week of which month was the lowest price?	Jan	Pineapples Dec; tomatoes Jun; mustard Jun	Pineapples Nov/Dec; tomatoes Aug/Sep/Oct	Jan	Jan
About how much of each vegetable crop did you sell for the lowest price in each season (kg)?	1,000 kg	Pineapple 3,000 kg; tomatoes 300 kg; mustard 10 kg	Pineapples 3,000 kg; tomatoes 150 kg	500 kg	5,000 kg
What was the highest price you received for each vegetable crop in each season? (MWK)	500/kg	Pineapple 500/kg; tomatoes 200/kg; mustard 230/kg	Pineapples 500/kg; tomatoes 300/kg	300/kg	1,000/kg (1 pineapple weighs 1 kg)
For each vegetable crop, which week of which month was the highest price?	Jun	Pineapple end of Feb; tomatoes Dec; mustard Dec	Pineapples Jan/Feb; Tomatoes Nov/Dec	Dec	Early Dec
About how much of each vegetable crop did you sell for the highest price (kg)?	1,000 kg	Pineapple 2,000 kg; tomatoes 320 kg; mustard 6 kg	Pineapple 2,000 kg; tomatoes 120 kg	500 kg	4,000 kg
What was your total revenue from each vegetable crop in the last year (July 2018 - July 2019)? (MWK)	130,000	Pineapple 600,000; tomatoes 300,000; mustard 100,000	Pineapples 1,600,000; tomatoes 80,000; sold seedlings for 2 million total	250,000	2 million
Who do you sell your vegetables to?	Vendors come to the farm; sometimes she goes to local towns to sell directly. Vendors take pineapple to Lilongwe.	Pineapple: vendors come to the farm, also they hire a truck and send 1 person to cities (see Robert interview). Tomatoes and mustard: vendors come to farm	Pineapples sold to vendors in Nkhotakota, vendors come from Salima, also club takes pineapples to cities. Tomatoes - vendors come here; also sell to local people	Vendors from Salima and Mzuzu	Vendors come to the farm and buy; and the club organizes transport and sells in Lilongwe, Salima, Blantyre, Mzuzu. Vendors sell the pineapples in the same markets. At markets, sell to consumers and also agents from hotels, grocery stores
How long would you have to chill and store each vegetable crop to get a better price after the peak harvest time?	3 months	Pineapple 6 weeks; tomatoes 5 weeks	Pineapples 2-3 months; tomatoes 3 months	2 months	2 months. Traditional storage on wet sacks in houses, can store for 1 week.
What price could you get for each vegetable if you could chill and store each crop as long as needed? (MWK)	1,000/kg	Pineapple 500-1,000/kg; tomatoes 400/kg	Pineapples 500-700/kg; tomatoes 500/kg	500-1,000/kg	1,500/kg
x	34.28197626	34.28202655	34.28202295	34.28197961	34.28198364
y	-13.05822717	-13.05825287	-13.05824712	-13.05822525	-13.05826607



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