The Container Mini-Pack house: Affordable demonstration facility for sorting, packaging and storage of fresh produce for small/medium scale farmers

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BACKGROUND

Tanzania is one of the least developed countries located in the eastern part of Africa endowed with potential climatic conditions for production of different horticultural crops. Horticulture subsector has an annual growth rate of 8-10% and accounts for 22% of the national foreign earning (HODECT, 2010; NBS, 2012). Vegetable and fruit growers in the country are struggling to meet production quantities and quality standards to access high value local and export markets. Availability and access to cooling and packing facilities have been a challenge for most small-medium scale fresh fruit and vegetable farming enterprises in the country. Farmers in Tanzania experience a postharvest loss of 20 – 50 % depending on crop due to poor handling practices and limited availability of packing and cooling facilities. Poor handling practices at harvest and preceding stages increases postharvest losses and reduce produce compliance with quality and safety standards to access high value markets. It is clear that an affordable produce handling unit becomes a necessary structure to improve quality, safety and shelf-life of produce for access to high value markets. Sokoine University of Agriculture (SUA) in collaboration with Kansas State University (KSU), and University of Florida (UF) through the project "Capacity building on produce postharvest management in Tanzania" has designed and established an affordable mini-pack house from used marine shipping containers to unlock the barriers.

The unit is intended to serve as model for dissemination of practical knowledge and skills on postharvest handling of fresh horticultural crops in the country for high value markets.

OBJECTIVES

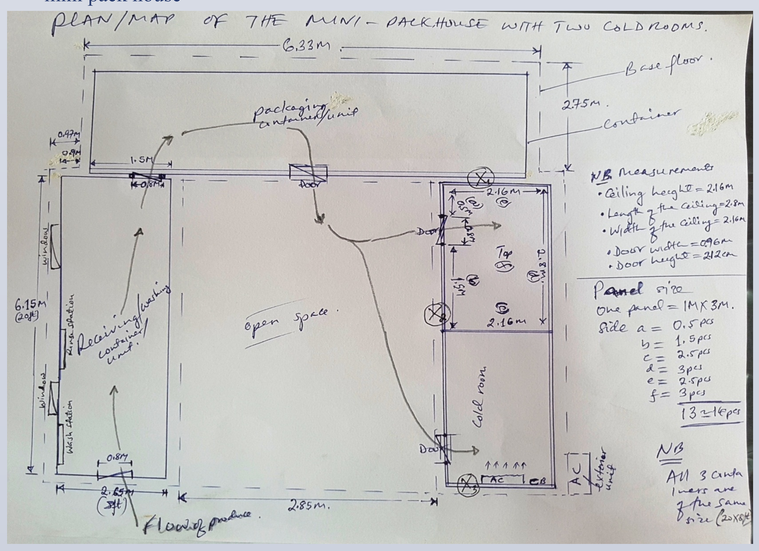
The overall objective of this design/ construction work was to improve postharvest handling, quality and safety of fresh produce for high value market access through establishment of an affordable mini pack-house using old used marine containers.

Specifically the project focused on;

(i) To develop a blueprint and establish type and amount of locally available materials for construction of a mini pack-house with cold rooms

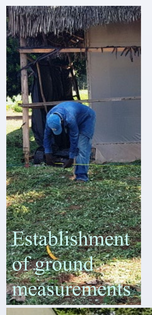
(ii) To establish a mini-pack house with cold rooms for improvement of produce handling

(iii) To improve the knowledge and skill base of rowers, traders, and students on good postharvest handling practices through training using the mini pack house



MINI - PACKHOUSE CONSTRUCTION

Step by step construction process of the mini-pack house


Establishment of ground measurements


Trench making for establishment of the foundation


Alignment blocks on the foundation


Concrete base to which the containers will be alighted on


Welding work on the used marine shipping containers


Inside look of the containers prior fabrication


Final look of the mini pack house


Final interior look of the containers

COOLER CONSTRUCTION

Main considerations for cooler building includes; quality of the insulation materials, room size, and air condition type and capacity. Rigid structurally insulated panel (RSIPs) with 4" closed cells foam (polyisocyanurate, off-white, 6.8 R^{-1}") were used. Painted aluminum layer on either side of panels help to retain their R value for long period under moist conditions. One of the three shipping marine containers of the mini pack house unit was converted into two cold rooms of 2.43 m (W) x 2.59 m (H) x 3.05 m (L) by partitioning using SIPs. Similarly, side walls and ceiling were insulated with RSIPs and the floor fitted with timber followed by a tarazo concrete finishing. Metal insulated panel door was fixed to each cold room and an 18,000 BTU Split LG air conditioner (AC) was installed. A Coolbot system was then fitted to the AC in each cold room to enhance the cooling capacity.

Table 1: Specifications of insulation materials for cold room insulation

Insulator specifications/quality			
Foam Insulation	**Color**	**R –Value per inch**	**R-value loss yr^{-1}**
Polyurethane	Yellow	6.25	50%
Extruded polystyrene (XPS)	Pink, Blue, Gray	5	20%
Expanded polystyrene (XPS)	White	4	60-80%
Polyisocyanurate	Off-white, pale yellow	6.8	
Thermo-insulators	Reflective-silver		
Air conditioner specifications			
Air conditioner (AC) brand working with CoolBot	**Dimensions of the Cooler**	**AC Capacity (BTU)**	**Minimum Temp (°C)**
Auto restart AC with digital display are preferred; LG (any model), Danby (≥2011), Haier (any except HWE), Frigidaire (>2015), Samsung and some models of General electronic (GE).	1.2m x 1.2m x 2.4m	8,000	3-7°C under good room insulation
	1.83m x 1.83m x 2.4m	8,000	
	1.83m x 2.4m x 2.4m	10,000	
	2.4m x 2.4m x 2.4m	12,000	
	2.4m x 3.05m x 2.4m	15,000	
	2.4m x 3.66m x 2.4m	18,000	
	3.05m x 4.27m x 2.4m	24,000	

Source: Rivard et al., 2016; Johnny's Seeds (2018)

MATERIAL COSTS

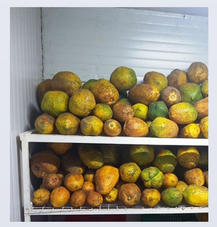
Total estimated cost for fabrication of the mini-pack house unit excluding the cost of marine shipping containers, plumbing work, and electricity installation was $8,150. We did not buy the used marine shipping containers but the current unit price is estimated at $795 each. The cost of plumbing and electricity installation (including material purchase) were $ 419 and $1,904, respectively. The cost of construction of such mini pack house in other countries may vary with cost of materials and labour charges. In our case, the construction cost were elevated by the cost of cold-room doors, SIPs and fabrication labour charges. Indicative materials and costs for construction of similar mini pack house are presented in Table 2.

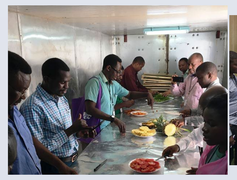
Table 2: Material and labour costs for construction of a mini-pack house with two cold rooms

NB: *Material s and labour cost estimates for construction of a mini pack house with a cold room in Tanzania (Table 2).*

MINI-PACK HOUSE	Cost (USD)
Painting materials and painting work	523.4
Tarazo (tarazo sand, aggregate, grinding stones and polish)	944.3
Aluminum window (2 Pcs)	107.8
Insulated metal cold room doors (5 Pcs)	1,985.0
Labor charges (cutting, welding, painting, insulation)	1,736.0
Insulation - (13Pcs SIPs)	1,436.5
Blocks (350 pcs)	185.0
Subtotal 1	6,918
COLD ROOM	
1800 BTU LG - Split Air Conditioner	661
CoolBot unit	350
Air conditioner Installation	221
Subtotal 2	1,232
Grand total	8,149.94


Type of cold room door used





USES OF THE MINI PACK HOUSE AND COLD ROOM

Since establishment (May 2018) the unit has been serving as a model demonstration site for teaching best postharvest handling practices of fruits and vegetables to SUA students, government extension workers, marketers, and traders. By December, 2018; 86 BSc. Horticulture students taking a postharvest physiology and management course, 60 trainers, and over 100 farmers were trained at the unit. The unit is also expected to be used for the following; (i) handling of fruits and vegetables produced at the Training Model farm, (ii) MSc. and BSc Horticulture students' research projects, (iii) and Instructors' research. Currently the unit has attracted a number of stakeholders; small and medium scale farmers, nongovernment organizations, and private individuals dealing with handling of fruits and vegetables for local, regional and export markets.

Limitations of the mini-Pack house

- Cold room needs reliable source of electric power (solar or others)
- Poor control of RH, hence need humidifier or frequent misting
- May be too expensive for individual small-scale farmer

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