

## The Postharvest Education Foundation

[www.postharvest.org](http://www.postharvest.org)

*Empowering people to reduce food losses...*

1



**Founder: Dr Lisa Kitinoja**  
**[kitinoja@postharvest.org](mailto:kitinoja@postharvest.org)**  
**The Postharvest Education Foundation**  
**PO Box 38**  
**La Pine, Oregon 97739 USA**

**Website: [www.postharvest.org](http://www.postharvest.org)**

**The Postharvest Education Foundation**



2



## Need for Postharvest Capacity Building

- ✓ The proper knowledge and training in postharvest handling of crops is critically lacking especially in developing nations.
- ✓ Capacity building, education and training about factors affecting food loss and wastage and suitable remedies is essential to reduce food loss and wastage.
- ✓ Create cadre of well-trained postharvest professionals.

**Mission: provide innovative programs that motivate and empower people to reduce FLW**

3

## The Postharvest Education Foundation

### What we do..?

- Train young professionals through **postharvest e-learning programs**.
- Free postharvest training materials and long-term mentoring.
- Trained more than **180 postharvest specialists** from **34 different countries**.
- Provide access to **postharvest tools and basic equipment**.
- **Postharvest workshops** – train the trainers.
- Advice and guidance for establishing local **Postharvest Training and Service Centers (PTSC)**.



4

## The Postharvest Education Foundation (PEF)

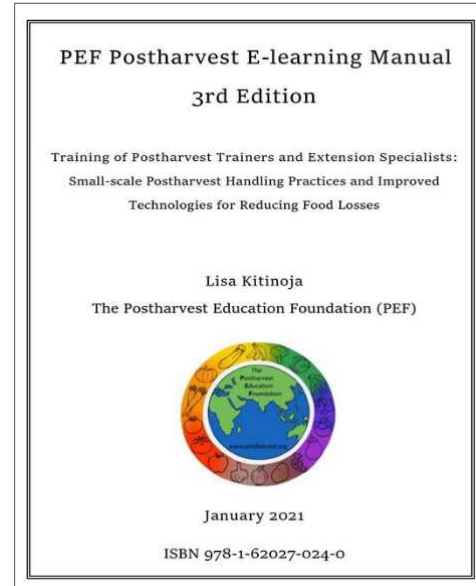
[www.postharvest.org](http://www.postharvest.org)

### Key: self-guided e-learning program

Each participant selects a crop

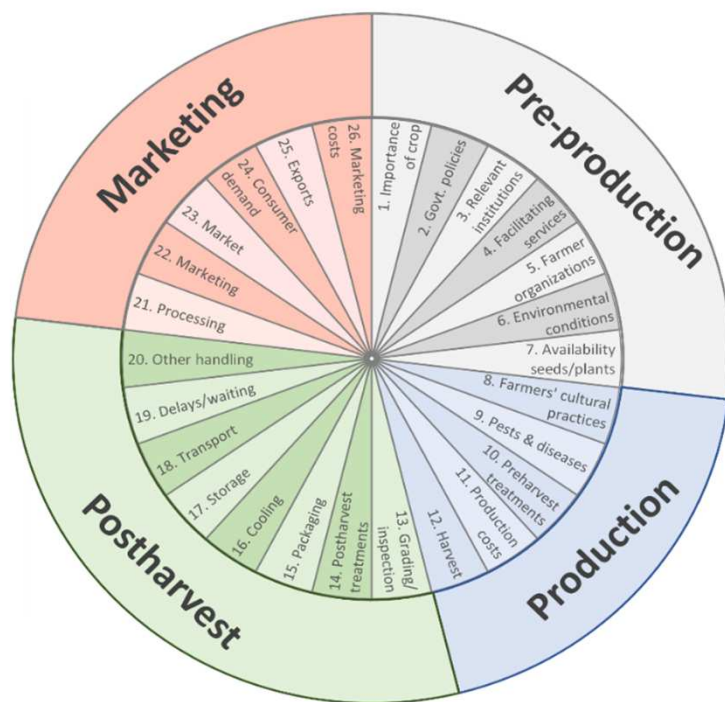
& all assignments are on this crop

- CSAM
- Improved practice and ROI
- Training workshop



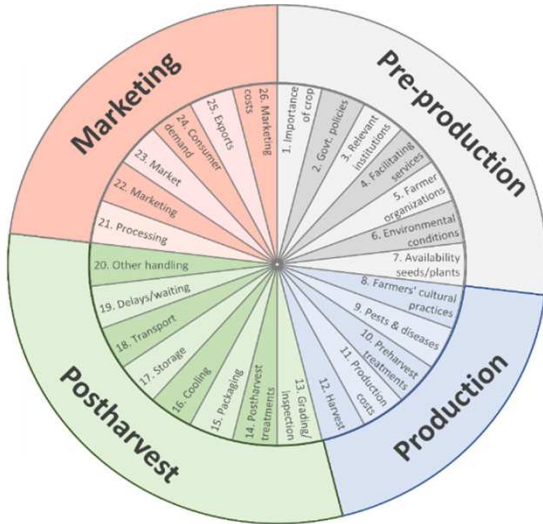
5

### CSAM: Commodity Systems Assessment Methodology



6

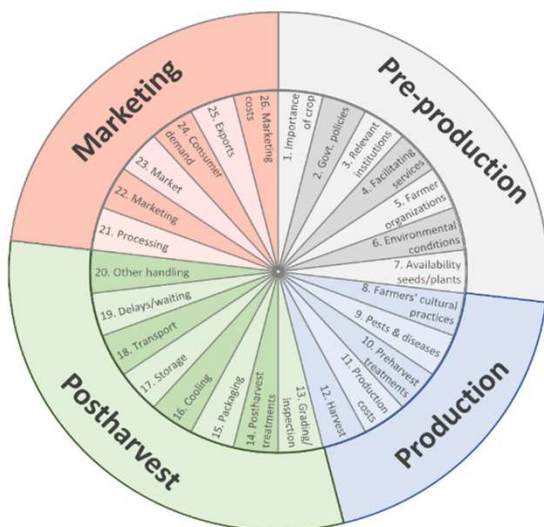
## CSAM: Pre-production



1. Importance of crop
2. Govt. policies
3. Relevant institutions
4. Facilitating services
5. Farmer organizations
6. Environmental conditions
7. Availability seeds/plants

7

## CSAM: Production

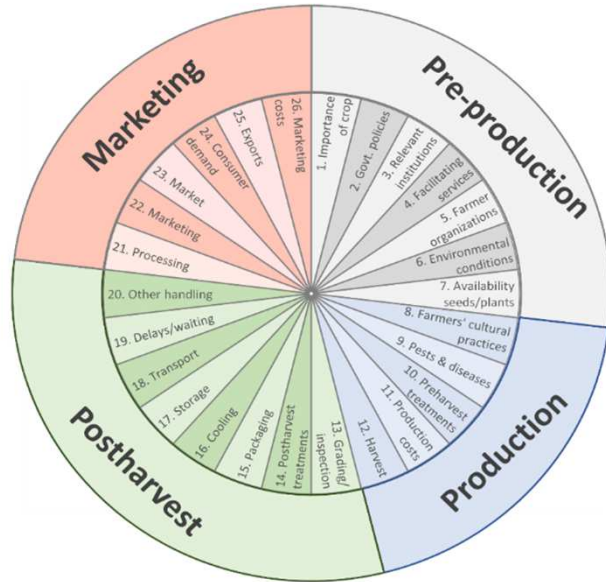


8. Farmers' cultural practices
9. Pests & diseases
10. Preharvest treatments
11. Production costs
12. Harvest

8

### CSAM: Postharvest (includes logistics)

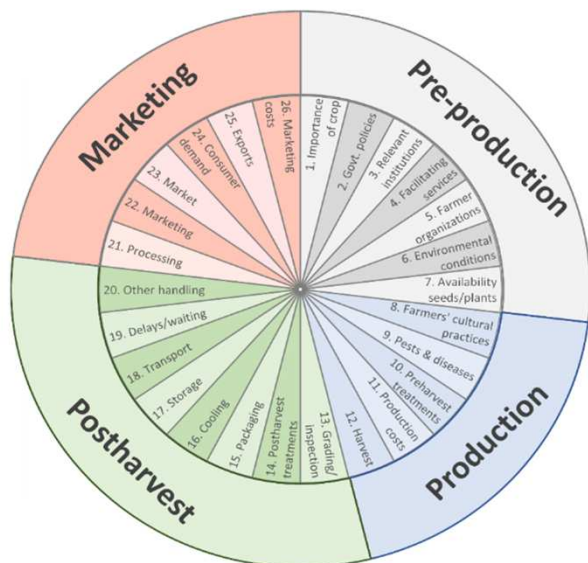
- 13. Grading & inspection
- 14. Postharvest treatments
- 15. Packaging
- 16. Cooling
- 17. Storage
- 18. Transport
- 19. Delays/waiting
- 20. Other handling



9

### CSAM: Marketing

- 21. Processing
- 22. Marketing intermediaries
- 23. Market information
- 24. Consumer demand
- 25. Exports
- 26. Marketing costs



10

## CSAM: Cassava Ghana



### C. Post-harvest

12 Harvest	Manual harvest, preferably when soil is moist. Harvesting equipment is available. Harvested 10 to 18 months after planting. Harvesting 18 to 24 months- lower starch & higher decay Transported in baskets, headpans or sacks.
13 Grading, sorting, inspection	No grading besides culling decayed tubers Inspection is not mandatory
14 Post-harvest treatments	Curing is not usually practiced Very perishable tubers; shelf life 3 days > 3 days - flesh browning & weight loss
15 Packaging	Either packed in sacks or loaded directly onto trucks. Poor packaging results in bruising and rapid spoilage Packing sound tubers small boxes (<10 kg) increases SL
16 Cooling	None.

Buyinza, T. and L. Kitinoja (2018). Commodity Systems Assessment of Cassava in Uganda. PEF White Paper No. 18-01.

11

## CSAM: Cassava Ghana

16 Cooling	None.
17 Storage	Postharvest losses can be 100% with poor harvest, handling, transport. Often stored in heap cover with wet jute sacks Sometimes, stored in pits or moist saw dust. Typical storage is 26-35°C and 50-60% RH Storage for 2 months at 2-5°C and 90-95% RH.
18 Transport	Transported in baskets, head pans, or sacks to markets or processors Trucks, carts or bicycles transport can be used Trucks transport tubers to distant markets Tubers are damaged by rough (un)loading
19 Delay/Waiting	Delays are not typical.
20 Other operations	There is sufficient labor but workers are untrained do not harvest and handle well



Buyinza, T. and L. Kitinoja (2018). Commodity Systems Assessment of Cassava in Uganda. PEF White Paper No. 18-01.

12



## CSAM: Cassava, Ghana

### D. Processing & Marketing

21 Agro-processing	<p>Processed products: <i>gari</i>, <i>agbelima</i>, <i>fufu</i>, flour, cassava, starch, ethanol, glucose syrup, tapioca.</p> <p>Producing <i>gari</i> or <i>agbelima</i> is more common - lower capital required</p> <p>Equipment for processing into starch/flour not readily available</p>
22 Marketing intermediaries	<p>Less common to sell directly to consumers or processors</p> <p>Typically various intermediaries between grower and wholesaler, retailer, exporter or processor.</p> <p>Intermediaries finance farmers, control production &amp; price.</p> <p>Large scale processors contract growers directly</p>
23 Market information	<p>Mobile phones provide accurate, reliable market prices</p> <p>Many farmers and marketers don't use these services - unaware, do not have mobile phones, or limited by language</p>

13

## CSAM: Cassava, Ghana

24 Consumer demand	<p>Local consumers: fresh, unwaxed tubers (no size preference)</p> <p>Exporters: medium, straight tubers</p> <p>Processors: fresh tubers - delays in processing reduces starch</p> <p>Jun-Oct (rainy) - oversupply; Dec-May (dry) - limited</p>
25 Exports	Export demand is low.
26 Marketing costs	<p>Either sold at the farm or local markets.</p> <p>Cost of transportation paid wholesaler or aggregator.</p>



14

## ROI: Solar Dryer for Maize, Bhutan

Typical postharvest losses of maize = **63%**

Solar dryer postharvest losses = **25%**

minimized fungal decay and protected the crop from pests (Yangden, 2016).

Table: ROI on a solar dryer for maize.

Factors	Current Practice	Solar dryer
<b>Cost of practice (Nu)</b>		<b>5840</b>
Initial weight (kg)	400	400
Marketable maize (%)	37%	75%
Amount for sale (kg)	150	300
Value (Nu)/kg	90	90
<b>Market value (Nu)</b>	<b>13500</b>	<b>27000</b>
<b>Profit (Nu) (value-cost)</b>	<b>13500</b>	<b>21160</b>



15

## Cost Of Maize Crib For Drying In Uganda



Table: Cost of materials.

Materials	Total
Timber	1,000,000
Welded mesh	416,000
Poles	300,000
Iron sheets	500,000
Nails, wire, clips	200,000
Gutters	98,000
Cement	250,000
Sand, Aggregate	230,000
Labour	2,000,000
Subtotal	4,994,000
Overhead costs	499,400
<b>Total (UGX)</b>	<b>5,493,400</b>
<b>Total (US\$)</b>	<b>\$2,113</b>

16



## ROI: Maize Crib For Drying In Uganda

Current Practice:

Drying maize in the sun

New Practice:

Drying and storing maize in crib

Benefits of crib:

- Excludes rodents
- Minimizes fungal decay,
- Minimal discolouration,
- Higher nutritional value,
- Less losses
- Higher value (Muyomba, 2013).

Table: ROI (in US\$) on a maize crib.

Factors	Current Practice	New Practice
Crib		2,113
Handling (to and from store)	791	
Sacks (107 @ \$0.38 each)	41	
Tarpaulin	58	
<b>Relative costs (\$)</b>	<b>890</b>	<b>2,113</b>
Initial amount (kg)	30,000	30,000
Losses (%)	15	3
Amount for sale (kg)	25,500	29,100
Value(\$)/kg	0.23	0.31
<b>Market value (\$)</b>	<b>5,865</b>	<b>9,021</b>
<b>Profit (value-costs)</b>	<b>\$4,975</b>	<b>\$6,908</b>

17

## Cost Of ZECC in Uganda

Cost of materials to construct a ZECC

Materials	Quantity	Cost US\$
Clean sand	700 kg	17
Bricks	800	44
Plastic crates	6	45
Thatch		56
Spades	2	8
Bush knives	2	6
Small buckets	4	9
Poles	6	16
Hessian cloth (m)	2.5	14
Basins	2	3
Nails, binding wire		17
<b>Total</b>		<b>234</b>



Cost of ZECC

(Nantambi, 2016)

18

## ROI: ZECC for Storing Passion Fruit



**Table: ROI of using a ZECC for storing passion fruit.**

Factors	Current Practice	New Practice
Fruit wt (kg)	1000 kg	1000 kg
Cost of practice		\$234
Loss	40%	3%
Fruit for sale	600 kg	970 kg
Market value	\$500	\$1347
<b>Profit (value-costs)</b>	<b>\$500</b>	<b>\$1113</b>



19

## Graduates (2021)

Country	Number	Country	Number
Bangladesh	3	Lebanon	1
Benin	2	Malawi	1
Bhutan	7	Malta	1
Botswana	1	Namibia	1
Burkina Faso	5	Nepal	2
Cambodia	4	Nigeria	7
Cameroon	3	Pakistan	5
Chile	1	Peru	1
Egypt	2	Rwanda	27
Ethiopia	15	South Africa	1
Germany	1	Sri Lanka	1
Ghana	12	Tanzania	25
India	8	Togo	2
Indonesia	1	Uganda	8
Iran	1	USA	14
Kenya	13	Zambia	2
<b>Total</b>	<b>178</b>		

20

20

## Graduates from Africa (as of 2021)


Country	Number	%	Country	Number	%
<b>Botswana</b>	<b>1</b>	<b>0.6</b>	Nigeria	7	3.9
Burkina Faso	5	2.8	<b>Rwanda</b>	<b>27</b>	<b>15.2</b>
Cameroon	3	1.7	<b>South Africa</b>	<b>1</b>	<b>0.6</b>
Egypt	2	1.1	<b>Tanzania</b>	<b>25</b>	<b>14.0</b>
<b>Ethiopia</b>	<b>15</b>	<b>8.4</b>	Togo	2	1.1
<b>Kenya</b>	<b>13</b>	<b>7.3</b>	Uganda	8	4.5
<b>Malawi</b>	<b>1</b>	<b>0.6</b>	<b>Zambia</b>	<b>2</b>	<b>1.1</b>
<b>Namibia</b>	<b>1</b>	<b>0.6</b>			
<b>Africa</b>	<b>114</b>	<b>63</b>	<b>Total</b>	<b>178</b>	<b>100</b>

21

21

## Resources at The Postharvest Education Foundation

ABOUT DONATE PROGRAMS NEWSLETTER SUPPORT 100 Under



**RESOURCES**

Select your area of interest:

- [PEF White Papers](#)
- [ADMI Postharvest Loss Work](#)
- [Publications](#)
- [Presentations](#)
- [Postharvest Tool Kit](#)
- [Postharvest Innovation Plan S](#)
- [Videos](#)
- [Educational Links](#)

**VIDEOS**

All PEF produced videos and video presentations are available on our YouTube channel - ['PostharvestOrg'](#)


Videos on the use of postharvest tools, as well as Technical Notes created to describe the principles b accessible from Diane's UC Davis website:

<http://www.fruitandvegetable.ucdavis.edu/Fruit - Vegetable Videos/>


Some other interesting videos:

**FAO Videos:** <http://www.fao.org/food-loss-reduction/resources/multimedia/en/>


[Dr Diane Barrett YouTube Channel](#)



How to Use a Color Chart to Increase Market Value



How to Use a Refractometer



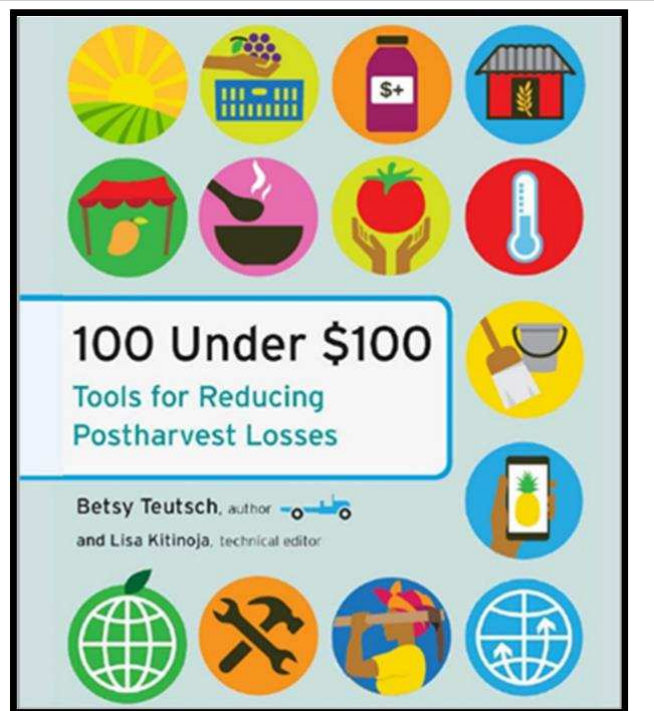
How to Measure Temperature and Relative Humidity

22

## Resources

Free download:

<https://www.jotform.com/form/91651837849876>



23

## Postharvest toolkit

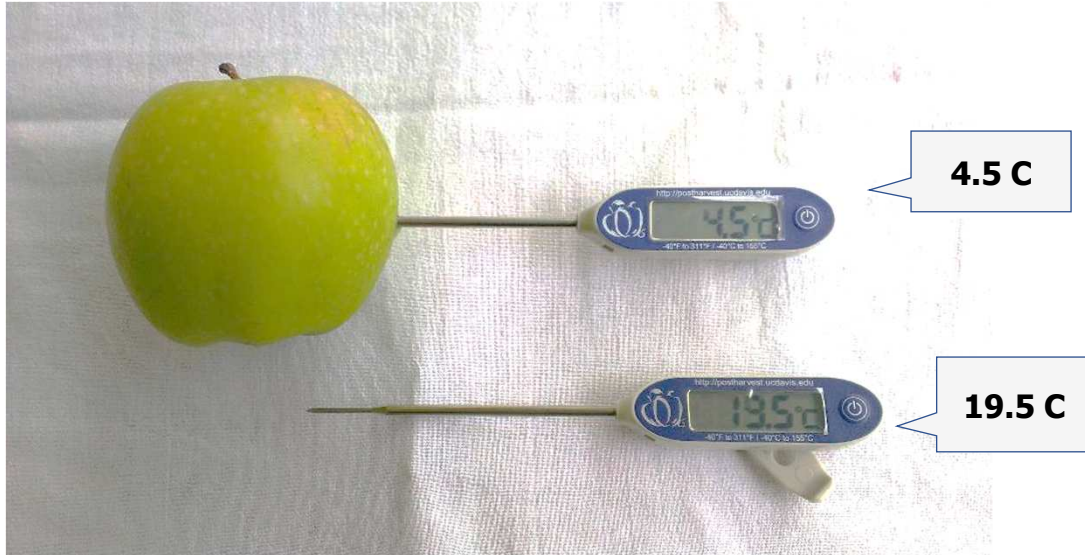


- Digital temperature probes
- Handheld refractometers,
- pH test strips
- Chlorine test strips
- Digital scale
- Callipers
- Fruit Sizing Rings
- Colour charts

24

24

## Pulp temperature



25

## Penetrometers

How to use

<https://www.youtube.com/watch?v=zUnHLJxECs&t=4s>

<https://www.youtube.com/watch?v=y1VyPTA7vU4>

(not psi; pears uses 8 mm tip)

Four penetrometers/firmness testers:

Model	Max (kg)	Fruits
FT444	20	Firm avo
FT327	13	<b>Apple, pear, peach, ripe avo,</b> kiwifruit, <i>tomato</i>
FT011	5	Cantaloupe, honeydew, mango, watermelon, papaya, <i>citrus</i> , plum, other soft fruit
FT02	1	Strawberry, other small fruit



Each crop requires specific tip size

Tip (mm)	inch	Fruits
11	7/16	Watermelon, papaya, <b>apple, stone fruit SA</b>
8	5/16	Melons, mango, kiwifruit, <b>stone fruit, pear,</b> banana, tomato
3		Strawberry

26

# Colour charts



27

27

# Videos

[Dr Diane Barrett YouTube Channel](#)



How to Use a Color Chart to Increase Market Value



How to Use a Refractometer



How to Measure Temperature and Relative Humidity

28




28

# Postharvest Training and Service Centres

<http://www.mdpi.com/2077-0472/5/3/441/>

Open Access Communication

## Extension of Small-Scale Postharvest Horticulture Technologies—A Model Training and Services Center

by  Lisa Kitinoja <sup>1,\*</sup> and  Diane M. Barrett <sup>2,†</sup> 

<sup>1</sup> World Food Logistics Organization, 1500 King Street, Alexandria, VA 22314, USA

<sup>2</sup> Department of Food Science and Technology, University of California, Davis, One Shields Ave, Davis, CA 95616, USA

\* Author to whom correspondence should be addressed.

† These authors contributed equally to this work.

Academic Editor: Michael Blanke

*Agriculture* **2015**, *5*(3), 441–455; <https://doi.org/10.3390/agriculture5030441>

Received: 14 April 2015 / Revised: 23 June 2015 / Accepted: 9 July 2015 / Published: 15 July 2015

(This article belongs to the Special Issue Fresh Produce Wastage)

[View Full-Text](#)

[Download PDF](#)

[Citation Export](#)

29

29

### A Sampling of the 25 Postharvest Resource Centers Open as of 2018:

Arusha, Tanzania (World Vegetable Center)

Njiro, Tanzania (**Selian Agricultural Research Center** [[bit.ly/2L8LNMS](http://bit.ly/2L8LNMS)] -SARI)

Lushoto, Tanzania (Ministry of Agriculture and Food Security)

Njombe, Tanzania (Tanzania Horticulture Association—TAHA has three centers in Morogoro, Njombe, and Bajamojo, near Dar es Salaam.)

Zanzibar, Tanzania (**TAHA**, [[bit.ly/2N3cgx2](http://bit.ly/2N3cgx2)] Finnish Gardening Association)

Mulindi, Kigali, **Rwanda** [[bit.ly/2PsFRSi](http://bit.ly/2PsFRSi)] (National Agricultural Exports Board - NAEB)

Bushogo, Rwanda (University of Rwanda)

Dhaka, Bangladesh (Agro Tech Park, Bangladesh Agricultural Research Institute - BARI)

Karurumo, Kenya (Smallholder Horticulture **Aggregation and Processing Centre** [[bit.ly/2L8X5R7](http://bit.ly/2L8X5R7)], University of Nairobi)

Jimma, Ethiopia (Postharvest Technology Department, University of Jimma)

Tuskegee, Alabama, USA (University of Tuskegee, TU **Global Center** [[bit.ly/2BsRoxY](http://bit.ly/2BsRoxY)] for Postharvest Training and Research)

0

30



## Success Stories

**Noel Valentin Mulinda** (Rwanda)(2012):

- Started POLYTASK LTD. ([www.polytask.net](http://www.polytask.net)), a Postharvest Consultancy Services in Kigali.
- Trained 60 leaders of "IMPUYAKI COOPERATIVE", Rwanda (representing another 880 member farmers).



31



## Success Stories



**Esther Mwisango** (Tanzania) (2012)

- Established a new packinghouse in Lushoto, Tanzania following simple design based on "**Small-scale Postharvest Handling Practices**" manual.
- The packinghouse serves 3500 members of 2 local vegetable producer cooperatives.

32





## Success Stories

**Dr. Olubukola Odeyemi** (Nigeria)  
(2013)

- Trained many in different topics related to production and postharvest handling of vegetables.
- Postharvest consultant and volunteer trainer for her local community
- New board member



33



## Success Stories



**Roseline Marealle**

(Tanzania, 2014):

- Conducted postharvest training for >800 participants.
- Zero Energy Cool Chamber (ZECC) and solar drying of vegetables.



34



## PEF sponsored postharvest conferences

- First Africa-wide Postharvest Food Loss Reduction Conference and Exhibition (University of Nairobi, Kenya 2017).




- Ethiopian Society of Postharvest Management (ESPHM) Inaugural and First International Conference (Addis Ababa, Ethiopia 2018)




35



## Partner Organisations

PEF's partners have included WFPC, WRI, Save Food, GAIN, ABA Inc, WFLO, ADMI, GKI and Champions 12.3 .



















36



## Books and Literature Reviews

- ✓ Book project with CRC Press -**Postharvest Capacity Building and Extension Education in Developing Countries**. Edited by PEF board members **Dr. Majeed Mohammed** and **Vijay Yadav Tokala**.
- ✓ Several publications are in the development stage, on "**Postharvest education, extension and capacity building**" and on "**Issues and opportunities for improved measurement of postharvest losses in plant based food crops**".
- ✓ **Dr. Lisa Kitinoja, PEF board members & WFLO colleagues** reviewed the existing literature on food loss measurement and food loss reduction for the **World Bank** to design postharvest projects around the world.

37

## The Kader Awards in Postharvest Training



This honor is announced annually on December 10, the anniversary of the passing of

**Dr. Adel A. Kader**

to the PEF e-learning program graduate who has had the greatest impact in providing postharvest education.



The Kader Award in Postharvest Training includes:

- An award certificate signed by the chair of the PEF Board of Directors
- A trip to participate in one of our PEF sponsored events
- A cash prize of US \$500.

38

## Kader Award Winner - 2018



**Vijay Yadav Tokala (India)**

2012 PEF e-learning graduate:

- ✓ Serving on the board of directors for The Postharvest Education Foundation.
- ✓ As a volunteer has developed and is editing quarterly PEF newsletters, edited a CRC Press book on 'Postharvest Extension and Capacity Building' with Dr. Majeed Mohammed.
- ✓ Assisted Dr. Lisa with journal articles and chapter writing, plus editing and reviewing for PEF White Papers and the e-book "100 under \$100: Tools for Reducing Postharvest Losses.
- ✓ Current President

39



**2011 Founding Board of Directors**  
**L to R: Dr Adel A. Kader, Dr Diane M. Barrett,**  
**Dr Lisa Kitinoja (Founder), Dr Devon Zagory, Mr. Patrick D. Brown**

40

## Directors 2022-2023

Dr. Lisa Kitinoja (Treasurer)

Dr. Vijay Yadav Tokala (President)

Dr. Diane M. Barrett (Secretary)

Dr. Deirdre Holcroft (Vice-President)

Ms. Bertha Mjawa

Mr. Edoh Ognakossan Kukom (Antonio)

Mr. Guy Kodjogbe

Dr. Olubukola Odeyemi

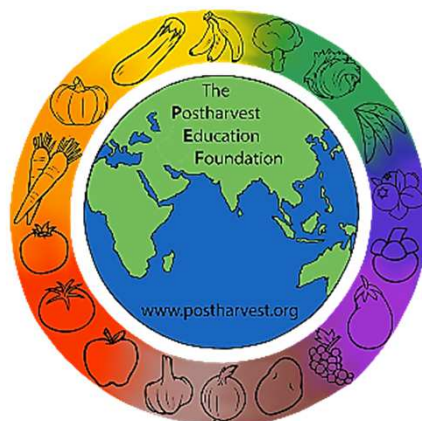
Dr. Aditya Parmar

Dr. Zaharan Hussein Mgina

Dr. Ratna Suthar



41



## The Postharvest Education Foundation

*Empowering people to reduce food losses...*



42