Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss

Innovation Labs Directors Meeting
Lilongwe, Malawi
April 20-23, 2015

Dirk E. Maier, Ph.D., P.E.

Professor, Grain Science & Industry

Senior Post-Harvest Engineer, IGP Institute

Co-Director & Lead PI, Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss (www.reducePHL.org)

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FEED THE FUTURE INNOVATION LAB Post-Harvest Loss Reduction

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Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss

Funded by:
USAID: Global Hunger and Food Security Research Strategy: Climate Resilience, Nutrition, and Policy
(RFA-OAA-12-000036)

Program Area 5:
Reduced Post-Harvest Losses and Food Waste

Focus Countries

Bangladesh
Ethiopia
Ghana
Guatemala

University Partners:

Kansas State University
University of Illinois at Urbana-Champaign
Oklahoma State University
Fort Valley State University
South Carolina State University
University of Nebraska, Lincoln
University of Kentucky

USDA-ARS Center for Grain and Animal Health Research

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Post-Harvest Loss Reduction

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Post-Harvest Loss Innovation Lab

Objectives:

- *Provide global leadership in food security by reducing post-harvest loss and food waste of durable staple crops (grains, oilseeds, legumes, root crops, seeds) and their processed value-added products*

- *Implement a strategic and applied research and education program aimed at confronting constraints on integrating smallholder and subsistence farmers, producer cooperatives and agribusiness enterprises with market-based value chains from seed to end-user*

Website: www.reducephl.org

A More Specific Perspective: Rice in SE Asia (IRRI; 2011)

In SE Asia, physical losses range from 15-25% (loss in quantity)

Quality losses range from 10-30% (loss in value)

PHL Innovation Lab Goals

- Enhancing **capacity** to improve drying, conditioning, handling, storage, pest management, transportation, grading, standardization and marketing of their crops
- Expanding access to Post-Harvest Service Centers utilizing "Warehouse Receipt Systems" (WRS) (**value chain access**)
- Pilot testing of promising “on the shelf” and “in the field elsewhere” **best practices and technologies**
- Using local artisans, business people and workers to create and develop **locally-produced tools and technology** to aid in sustainability of resources and practices
- Employing advanced **information technology-based** systems to more rapidly evaluate and disseminate promising PHL reduction innovations

Improve On-farm Drying

Improve On-Farm Grain Storage

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PHL Innovation Lab Approach

- **"On-the-shelf" Technologies**
  - ✓ Low-cost, microchip-based sensors for grain moisture determination
  - ✓ Simple tools to detect fungal infection and measuring mycotoxin levels
  - ✓ Sensors to monitor CO_2
  - ✓ Drying grain within enclosures by sun or mechanical means
  - ✓ Locally available inert dusts (diatomaceous earths), silica nanoparticles, and/or botanicals as alternative insecticides
  - ✓ Storing grain in insecticide-coated pest proof polypropylene bags
  - ✓ Demonstrating benefits of hermetic Purdue Improved Crop Storage (PICS) bags (*triple bagging*)
  - ✓ Using commercial GrainPro hermetic bags/cocoons
  - ✓ Use of small metal silos and plastic or metal drums for pest proof and hermetic extended storage
  - ✓ Food and pheromone-baited traps for monitoring insects inside and outside warehouses and strategic grain reserve sites

Affordable Moisture Meter

USDA-ARS developed moisture meter could sell for $50-$70

Solar Dryers (German & IRRI Designs)

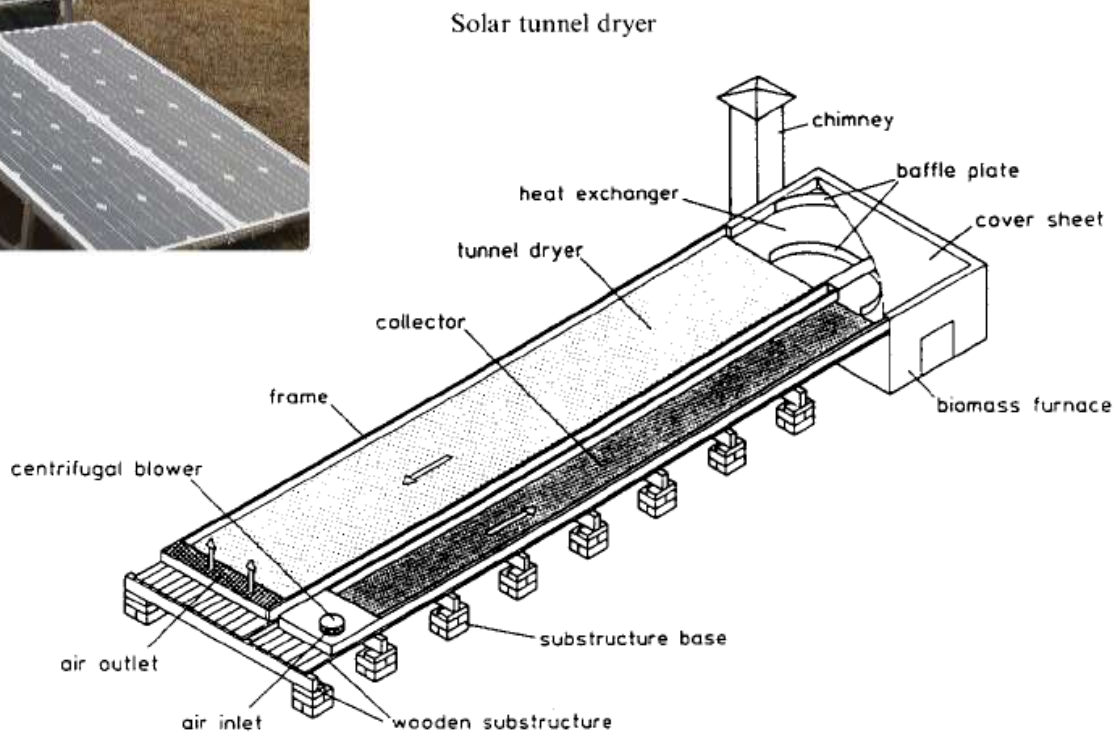

Fig. 1. Solar tunnel dryer with integrated collector and biomass furnace.

Small-scale Hermetic Storage Systems

Pest-proof Polypropylene Storage Bags

Zerofly® Storage Bag

Zerofly® Storage Bag is a deltamethrin (DM)-incorporated bag used to prevent damaging pest infestations

ZeroFly®
Storage Bag | by VESTERGAARD

SMALL (<100kg) Option 2: Zero Fly Bags.
Insecticide infused polypropylene bags provided a powerful killing action against insects, limiting infestation of the grain within the bag. Not hermetic. Short period where insects were able to survive before contact with inner lining of bag.
Life: 2-3 harvests

Price: $1.20 per unit

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Small-scale Metal Silos (CIMMYT/SDC Design)

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PHL IL Ethiopia Project and Team

- **U.S. Team:**
  - Bhadriraju Subramanyam , Kingsly Ambrose, Shannon Washburn, Dirk Maier, Venkat Reddy; Kansas State University
  - Rizana Mahroof; South Carolina State University

- **Ethiopia Team:**
  - Abay Fetien, Mekelle University
  - Eneyew Tadesse, Bahir Dar University
  - Girma Demissie, EIAR

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Postharvest Loss Assessment Survey Results: Ethiopia

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Number of farmers surveyed by region

Region	Wheat	Maize	Chickpea	Sesame
Tigray	30	51	50	90
Amhara	66	85	60	80
Ooromiya	80	70	60	30
SNNPR	15	74	50	----
Total	**191**	**280**	**220**	**200**

Farmer perceptions: Maize survey

Prevalence and severity of storage insect pests

Description	Farmer's response	No. responding (%)
Prevalence	Prevalent	169 (93.9)
	Not prevalent	11 (6.1)
Severity	Not severe	28 (10.0)
	Moderately severe	70 (25.0)
	Severe	169 (60.4)
	Not able to judge	13 (4.6)

Farmer perceptions: Maize survey

Prevalence and severity of rodents in storage

Description	Farmer's response	No. responding (%)
Prevalence	Prevalent	254 (90.7)
	Not prevalent	26 (9.3)
Severity	Not severe	36 (12.8)
	Moderately severe	59 (21.1)
	Severe	158 (56.4)
	Not able to judge	27 (9.6)

Farmer perceptions: Maize survey

Prevalence and severity of molds in storage

Description	Farmer's response	No. responding (%)
Prevalence	Prevalent	197 (70.4)
	Not prevalent	83 (29.6)
Severity	Not severe	62 (22.1)
	Moderately severe	47 (16.8)
	Severe	87 (31.1)
	Not able to judge	84 (30.0)

Maize: Some key findings

- Maize is stored in traditional gotera (68% of farmers, *n* = 276), and it is stored for 7-12 months
- 82% (*n* = 279) farmers measure moisture mostly by biting with their teeth (91%, *n* = 265).
- 20 and 65% of farmers use malathion and pirimiphos-methyl to protect grain in storage from insects (*n* = 275)
- Only 26% of 280 farmers indicated ever receiving any postharvest loss prevention training
- More than 80% of surveyed farmers expressed a need for…
  - training in harvesting, packing, transportation, drying, cleaning, moisture measurement, insect, mold, and vertebrate pest management, proper storage, use and safe handling of pesticides, and marketing of grain

Estimated postharvest losses in wheat

Harvest and postharvest stage	Wheat losses (%)*	*n*	Calculated estimates under two scenarios**	
			No rain at harvest	Rain at harvest
Harvesting	6.8	183	6.8	16.3
Threshing	3.5	178	3.5	3.5
Cleaning	2.1	175	----	----
Packaging/bagging	0.2	168	----	----
Transportation (farm to storage)	1.1	165	1.2	1.2
Farm Storage	2.7	180	2.7	2.7
Transportation (storage to market)	0.2	165	1	1
Market storage	0.1	166	2.7	2.7
Milling/Crushing/Grinding	0.4	172	-	-
Total	**17.1**		**14**	**23**

*Calculated by SPSS; **Calculated by APHLIS calculator.

Farmer perceptions: Chickpea survey

Prevalence and severity of storage insect pests

Description	Farmer's response	No. responding (%)
Prevalence	Prevalent	189 (85.9)
	Not prevalent	31 (14.1)
Severity	Not severe	11 (5.8)
	Moderately severe	88 (46.6)
	Severe	90 (47.6)
	Not able to judge	----

n = 220

Farmer perceptions: Chickpea survey

Prevalence and severity of rodents in storage

Description	Farmer's response	No. responding (%)
Prevalence	Prevalent	121 (55.0)
	Not prevalent	99 (45.0)
Severity	Not severe	11 (9.1)
	Moderately severe	58 (47.9)
	Severe	52 (43.0)
	Not able to judge	----

n = 220

Farmer perceptions: Chickpea survey

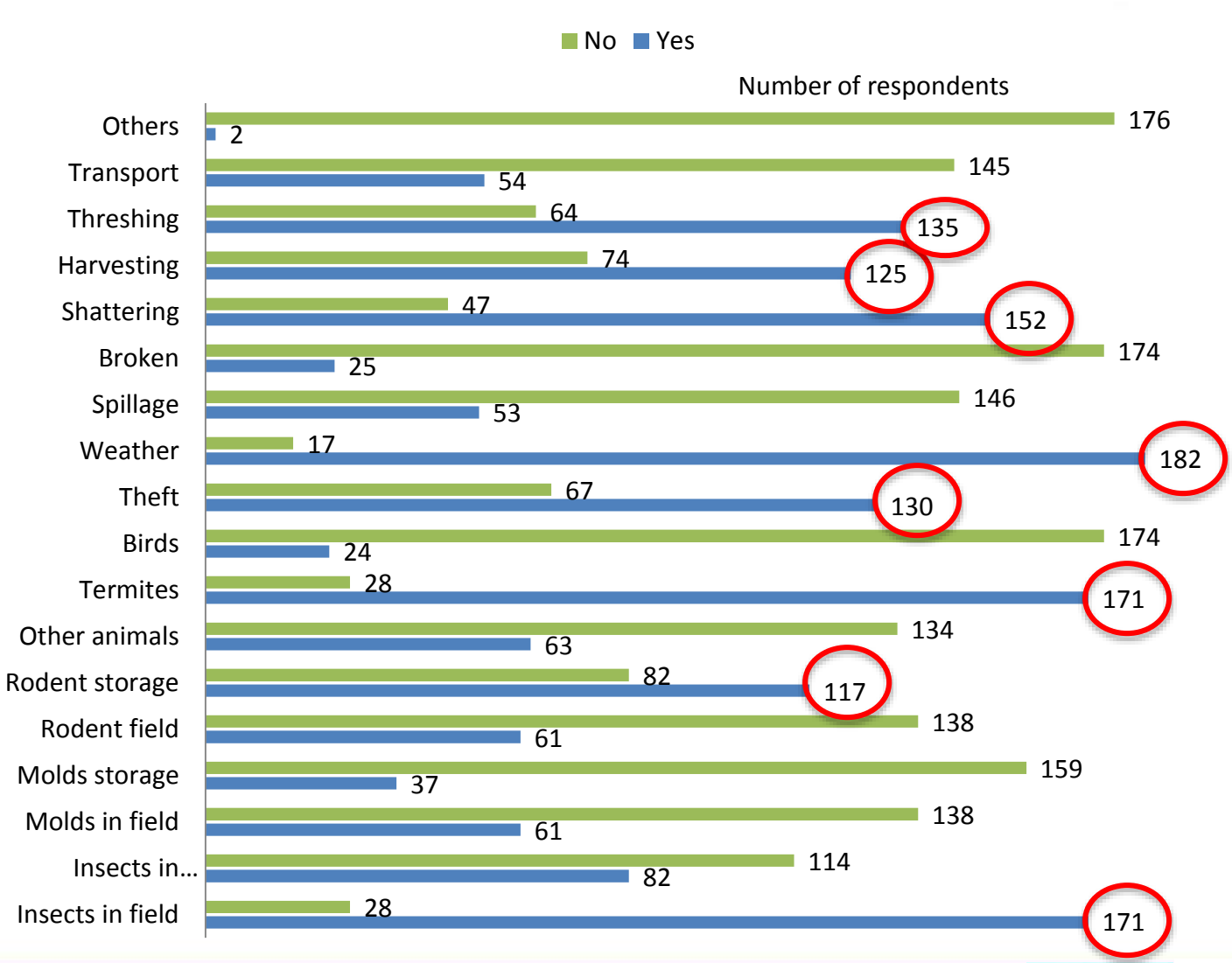
Prevalence and severity of molds in storage

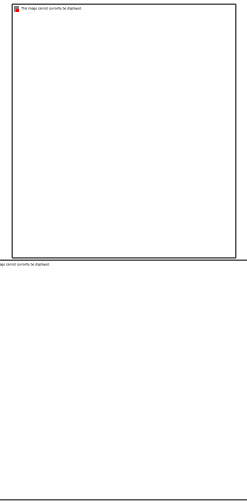
Description	Farmer's response	No. responding (%)
Prevalence	Prevalent	46 (20.9)
	Not prevalent	174 (79.1)
Severity	Not severe	19 (41.3)
	Moderately severe	24 (52.2)
	Severe	3 (6.5)
	Not able to judge	----

Estimated postharvest losses in chickpeas

Harvest and postharvest stages	Chickpea losses		*n*
	(%)	Kg	
In-field Drying/Harvesting	4.2	42.2	219
Threshing (oxen/stick)	1.9	18.6	134
Winnowing/Cleaning	1.4	14.4	138
Transportation (farm to storage)	0.34	3.4	172
Farm Storage	2.9	29.4	91
Total	**10.7**	**107**	

Causes of sesame losses





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Factors affecting selection of pest control methods

Factor for selection	Respondents (%)
Traditional practice or Custom	79
Ease of use	53
Locally available materials	39
Effectiveness of method	30
Affordable price	28
Prior positive results	17
Received training	10
Others	7

n = 191

Farmer's reasons for choosing a pest control method

No.	Reason for choosing control method	Responding farmers (*n* = 220)	
		Number	Percent
1	Effectiveness of method	151	68.6
2	Ease of use	149	67.7
3	Price affordability	119	54.1
4	Local availability	108	49.1
5	Prior experience	84	38.2
6	Tradition	49	22.3
7	Training	18	8.2

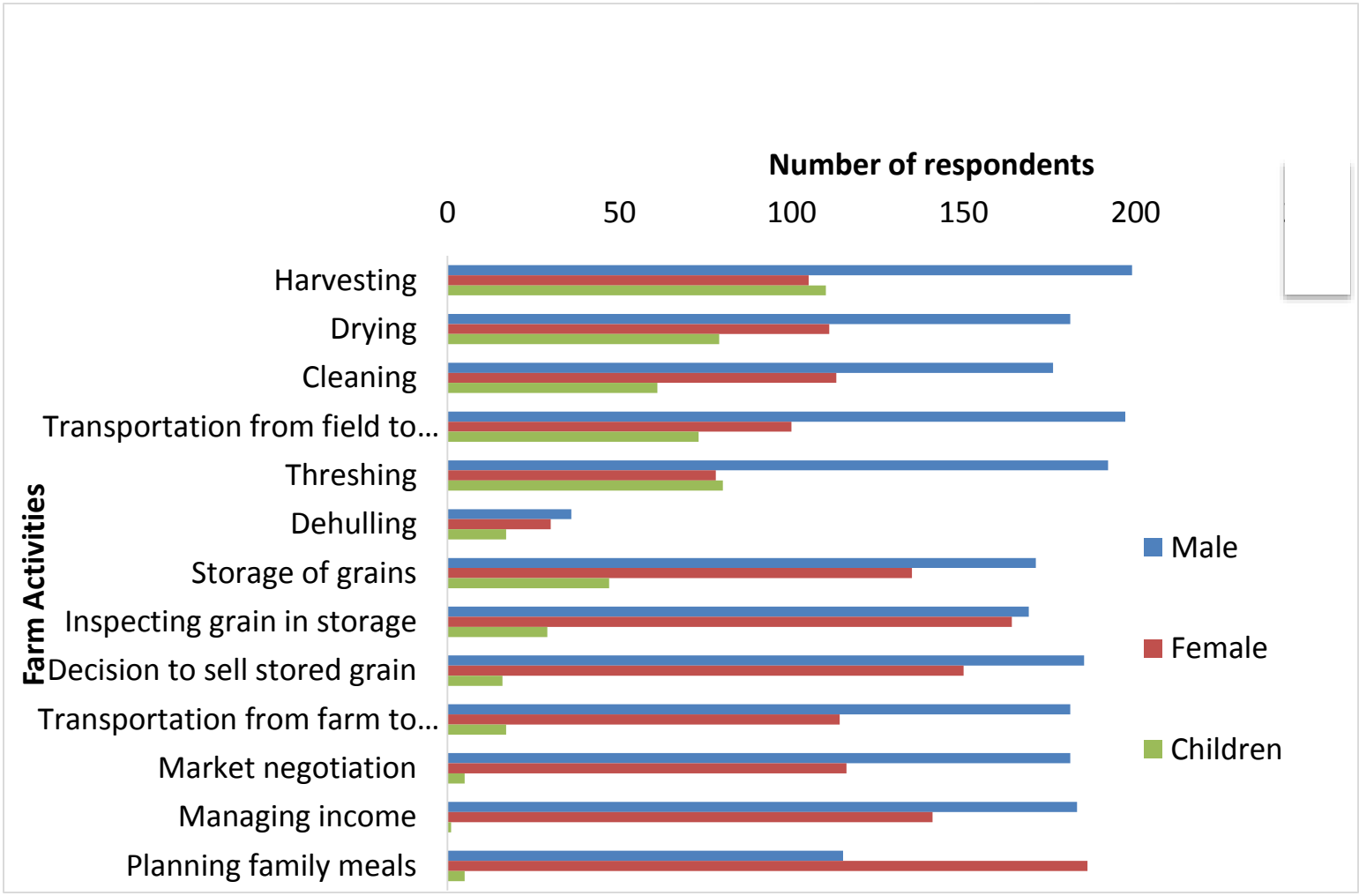
Sources of information for farmers

- Primary sources included:
  - Through large meetings
  - Fellow farmers
  - Radio programs
  - One-on-one delivery
  - Demonstration trials
  - Most of the training was on seed production
  - Farmers are interested in training on moisture measurement, harvesting, drying, pest identification and control, safe and proper use of pesticides

Farmers' training needs

No	Area of training need	Responding farmers	
		Number	Percent
1	Harvesting	148	67.3
2	Threshing	73	33.2
3	Packing	72	32.7
4	Transport	46	20.9
5	Drying	76	34.5
6	Cleaning	107	48.6
7	Insect Identification	179	81.4
8	Mold identification	78	35.5
9	Pesticide usage	197	89.5
10	Pesticide handling	179	81.4
11	Proper storage	148	67.3
12	Rodent and other animal control	111	50.5
13	Bird control	55	25.0
14	Marketing	116	52.7

Roles of gender in farming/marketing



Capacity Building (Year 1 / 2014)

- Set up and equipped 5 mycotoxin testing laboratories in partnership with Romer Labs
  - Mekelle University and Bahir Dar University (Ethiopia)
  - Bangladesh Agricultural University (Bangladesh)
  - University del Vale (Guatemala)
  - KNUST (Ghana)
- Provided tools and protocols for mycotoxin and insect sampling
- Provided 100 probes for grain moisture measurement in partnership with USDA-ARS and 40 hand-held moisture meters in partnership with John Deere Foundation
- Graduate students (18 total):
  - Ethiopia: Mekelle U (3 PhD), Bahir Dar U (3 PhD), KSU (1 PhD)
  - Bangladesh: BAU (6 PhD)
  - Ghana: KNUST (2 MS), OK State (1 MS), KSU (1 MS)
  - Guatemala: UNL (1 PhD)