Case Country Evaluations

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World Food Logistics Organization
WFLO
The Refrigeration Research & Education Foundation ®

Postharvest Education Foundation

WFLO and the Postharvest Education Foundation (PEF)

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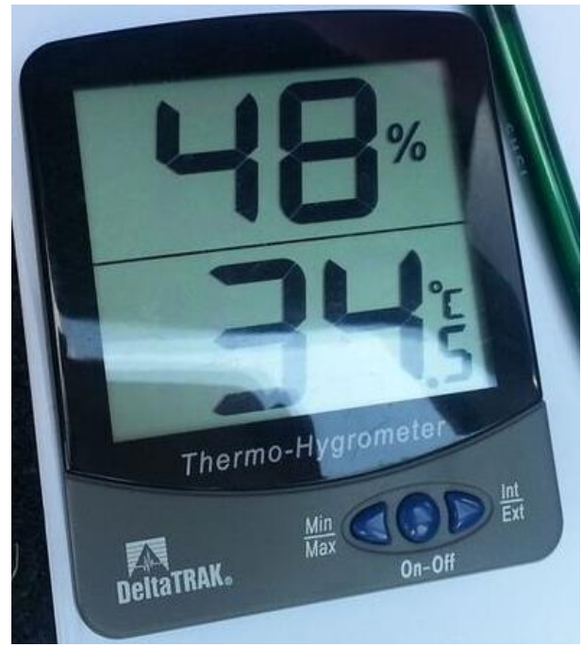
Case Study Methodology

- Value chain assessments conducted using a modified CSAM.
- CSAM is a systematic data collection using surveys, interviews, observations and direct measurements.
- Assessments focused on the pre-production and production periods, up to harvest and farm gate
- A standardized data collection worksheet was used by each of the field teams to measure losses and quality of the crops on-farm.
- Each case study focused on one commodity in one country, on six farms.

Methodology: Farm Visits

- Questions to farmers and field workers
- Direct measurements of food losses
- Observations of harvesting and handling practices
- Photos documented of food damage, defects or decay
- Detailed face-to-face surveys with national researchers, extension officers, private sector representatives

Methodology: Direct Measurement



Case Study Presentation Overview

- Report focused on:
  - Status and Importance
  - Assessment of Losses and Economic Burden
  - Causes of On-Farm Losses
  - Measure and Strategies Implemented for On-Farm Loss Reduction in Uganda
  - Lessons Learned
- This presentation will focus on causes of on-farm losses and lesson learned.

Case Study 1: Maize in Uganda

On-Farm Losses at Six Maize Farms in Uganda

- Location: SW Uganda
- Size range: 4 to 20 ha
- On-farm range losses:
  - 10-45% with extreme defects or decay
  - 5-15% with moderate defects or decay
- After 2 weeks-1 month of on-farm storage
- Economic losses at US$70-126 million
- Conservative Estimate of On-Farm Losses: 10-15%

On-Farm Practices in Uganda

- Drying
  - In maize crib, on cobs, on the ground, in the garden, on a tarpaulin on-farm
  - Moisture content: 14%, 18%, 20%, 25%
- Shelling: Motorized sheller or beating with sticks
- Storage on-farm for 2 weeks to 1 month in woven sacks
- Decay is up to 40% in 3 weeks

Factors Causing On-Farm Losses for Maize

- Improper use of fertilizers and herbicides.
- Poor pest and disease management practices.
- Poor harvesting practices: leaving cobs behind in the field
- Poor drying practices:
  - allow maize to become decayed,
  - attract insect and bird pests and
  - also be a source of aflatoxin contamination
- Poor shelling practices, such as beating the cobs with sticks or trampling the cobs.
- Other:
  - No grading, the same price per kg is offered even sorted
  - There are no local or national regulatory standards

Lessons Learned & Recommendations

- Maize threshed by beating and dried on-farm without using a crib is slow to dry and develops decay, fungal infestations, molds, and potential aflatoxin/mycoxtoxin
- Farmers should:
  - Harvest maize when stalks have dried and moisture of grain is about 30%.
  - Use harvest tools such as carts, wheel barrows, bags and baskets.
  - Harvest gently, using a picking bag.
  - Dry on-farm to 12-15% moisture before shelling or threshing, packaging, transport or storage.
  - Keep grain clean by drying on cement floor or on tarpaulin to reduce chance of soil contamination.
  - Avoid beating maize to shell kernels from cobs

Case Study 2: Sweetpotato in Nigeria

On-Farm Losses at Six Sweetpotato Farms in Nigeria

- Location: Ogun State.
- Size range : 0.5 -2 ha
- On farm losses:
  - 1-2% sorted out and discarded
  - 10-40 % moderate defects and decay
  - 5-20% extreme defects and decay
- Conservative estimate of on-farm losses: 2-5%.

On-Farm Practices in Nigeria

- Harvested early morning a day before sale
- Harvest only expected to sell at the farm gate.
- Remaining tubers left in situ until next sales
- Manual harvest by family members using hoes and cutlasses at maturity
- Women involved in cultivation and harvesting
- Harvested tubers placed in woven baskets
- Packaged mostly with sacks made from polypropylene materials.

Summary: Factors Causing On-Farm Loss in Sweetpotato

- Rodent bites, cuts or bruised roots, broken roots, circular rot, sunburn, infected termite bites, pests
- Heavy rainfall or not enough rainfall
- Storage diseases are caused by fungi, several rot types
- Lack of best practices such as adequate weeding
- No curing on farm before sale (increased scuffing damage, abrasions)
- Use of very large packages (100kg sacks)
- Lack of shade during the day between harvest and sale at the farm gate

Estimated losses in Weight, Value and Calories

- Estimate of on-farm physical losses of 2-5%
- Total annual production of 3.45 million tonnes
- ∴ Losses are in the range of 69,000 to 172,000 tonnes/ yr.
- Damage and defects reflected in the low offered prices
  - Average farm gate value of $87.50-$100 / tonne,
  - On-farm losses of 69,000-172,000 tonnes
  - Economic losses of farmers is US$ 6-17.2 million/yr
- Sweetpotatoes food value of 860 kilocalories per kg.
  - Loss in food value of 59.34 billion kilocalories / 69,000 tonnes
  - Could feed 65,000 persons for a full year at 2,500 kcal/day.

Lessons Learned & Recommendations

- Pay attention to harvest indices (days from planting) for optimum quality and yield.
- Provide improved pest control if roots are left in the field after full maturity.
- Gently harvest and dig roots and tuber crops to prevent physical damage.
- Avoid rough handling after harvest; do not step on or sit on heaps of harvested crops.
- Provide shade for harvested crops during transport delays from field to market.
- Streamline the value chain to decrease delays in transport from the farm

Case Study 3: Cassava in Nigeria

On-Farm Losses at Six Cassava Farms in Nigeria

- Location: Ogun State
- Size range : 2-30 ha
- On farm losses:
  - 0 - 1.5% sorted out and discarded
  - 10-15 % moderate defects and decay
  - 5-10% extreme defects and decay
- Conservative estimate of on-farm losses: 2-5%

On-Farm Practices in Nigeria

- Quality grade based on:
  - Starch content (measured at the processing plant)
  - Roots size,
  - Diseases
  - Cleanliness and trimming
- Very small roots are generally left on the farm.
- Cassava roots to be processed into gari or fufu can be of lower quality (since the small sized and broken roots are still eaten).

Estimated losses in weight, value and Calories

- Price per kilogram will differ by season and time of year.
- With a conservative estimate of on-farm losses of 2-5% physical losses in Nigeria and a total production of 45 million tonnes, the losses equal 900,000 to 2,250,000 tonnes of cassava roots per year.
- At a market value of $20-40 per tonne, economic losses to farmers range from $18 to $90 million per year.
- Cassava has a food value of 1,600 kilocalories per kg. The on-farm losses in food value at a minimum equals approximately 14.4 trillion kilocalories. This could feed 15.78 million persons for a full year at 2,500 kcal/day (10% of Nigeria's population).

Factors Causing On-Farm Loss in Cassava

- Generally, farmers will delay harvest for a higher price
- Storage in situ or unharvested after maturity.
- Leaving the crop in the ground for too long can reduce quality and increase rotting pest attacks from insects, rodents, and fungi.
- Rough digging and handling during harvesting leads to broken roots
- Rough handling after harvesting causes physical damage.
- Farmers need to be aware

Lessons Learned & Recommendations

- Offering price incentives for quality and quantity leads to producers paying attention to harvest indices (days from planting).
- On-farm losses can be reduced if improved pest control for insects and rodents is practiced.
- Gentle harvesting and digging can prevent physical damage.
- Avoiding rough handling after harvest such as stepping on or sitting on the heaps of crops can reduce physical damage.
- Providing shade for harvested crops during delays in transport from the field to the market can reduce produce temperatures and reduce on-farm losses.
- Streamlining the value chain, such as creating direct links from the farm to the final buyer, decreases delays in transport from the farm.

Case Study 4: Groundnuts in Benin

On-Farm Losses at Six Groundnuts Farms in Benin

- Location: Bogandji, Benin
- Size range: 4000m^2 to 1ha
- On-farm range losses:
  - 10-15% with extreme defects or decay.
  - 15-20% with moderate defects or decay
- Conservative Estimate of On-Farm Losses: 10 to 20%
- Aflatoxin contamination in groundnuts in Benin is the main cause reported for loss

On-Farm Practices in Benin

- Harvested: In morning, by hand pulling up the plant
- Drying
  - The plants are then dried in the sun to avoid aflatoxin contamination
  - Up to 10% moisture before stripping by hand or mechanically.
- Handling: Dried pods remain on the ground 2 to 3 days,
- Transport:
  - On motorbike, motorcycle taxi, bicycles, or walking.
  - In raffia baskets or polyethylene bags
- The distances between fields to storage or market is three to eight kilometers
- Storage
  - at home during 3 months open
  - or in polyethylene bags.

On-Farm Practices In Benin Cont.

- Sieving is on-farm or at the collecting point with a hexagonal or cylindrical cage. It eliminates some trash, sand, straw & broken pods, but not pods of other varieties, empty pods, immature pods.
- Manual shelling by women or children.
- Shelled product is dried by gradually lowering the humidity to 8-10%.
- Storage has the most significant losses and occurs in polyethylene bags inside the house or attic.
- Attics and storage areas are treated only with rat poison to fight against rodents.
- According to the producers and sampling for measurements, losses can reach 25-30%.
- Some processing occurs into oil and groundnut sticks.

Factors Causing On-Farm Loss in Groundnuts

- Groundnut seeds are fragile.
- They are stored in pods to reduce attacks from pests.
- The pods are shelled by hand 10-15 days before planting
- Seeds are sorted to remove non-viable seeds (moldy, small or infected by insect)
- Producers interviewed do not treat seeds
- Sown seeds have a germination rate of 80-90%.
- Application rates of fertilizer are often not met
- No phytosanitary treatment is applied during planting in peanuts in Benin

Lessons Learned & Recommendations

- Disinfect seeds by dusting with a mixture of fungicides and insecticides at a dose of 2%.
- Apply fertilizers and pesticides at correct rates at different stages.
- Dry harvested plants outside in the sun for 6-7 days. Cover in rain.
- Harvest at 15% moisture and continue drying until the moisture content is reduced to 6-8%.
- Avoid exposing pods in the sun for long. Both kernel quality and seed germination will be affected.
- Harvest when mature or when 70-80% of the inside of the pods shells have dark markings and the kernels are plump.
- Encourage on-farm, low-cost drying process that is able to bring down the moisture content of crops to 8% as fast as possible
- Use hermetic storage Perdue University bags (PICS bags) which reduce aflatoxin contamination in groundnut.
- Use hand or manual shellers for reducing damage to kernels during shelling

Case Study 5: Tomatoes in Egypt

On-Farm Losses at Six Tomato Farms in Egypt

- Location: Nile Delta region in the Behaira Governorate.
- Size range : 4-12 ha
- On farm losses:
  - 0-30 % sorted out and discarded
  - 5-45 % moderate defects and decay
  - 15-35% extreme defects and decay
- Conservative Estimate of On-Farm Losses: 15-20%

On-Farm Practices in Egypt

- Lack of pruning and thinning;
- Poor blossom end rot control;
- Improper maturity at harvest;
- Lack of stems from rough harvesting reduce market value;
- Leaving non-marketable fruits on the plants or in the field;
- Leaving fruits exposed to the sun after harvest.

Factors Causing On-Farm Loss in Tomatoes

- Rough harvesting practices damage the plants
- Use of rough palm rib crates causes severe physical damage to tomatoes
- Lack of protection from sunburn
- Major pests including:
  - Early blight disease caused by Alternaria solon
  - Whitefly transmitted gemini viruses, specifically Tomato Yellow Leaf Curl Virus (TYLCV)
  - Tuta aboluta (tomato leafminer or tomato borer)
  - Blossom end rot

Lessons Learned & Recommendations

- Control of white flies (virus vector) and tomato leaf miner.
- Apply calcium to the soil at intervals, irrigation should be managed properly to avoid blossom end rot.
- Provide shade, to reduce sunburn damage.
- Improved harvesting at proper maturity.
- Gentle harvesting to reduce damage.
- Improved containers and use liners for palm rib crates, smooth the inside of the crates with sand-paper, and use reusable plastic vented crates.
- Temperature management using shade for the crops after harvesting and before transport, especially when temperatures are above 25 C.

Case study 6: Bananas and Plantains in Uganda

On-Farm Losses at Six Bananas and Plantains Farms in Uganda

- Location: Western Uganda
- Size range : 1.8 - 22 ha
- On farm losses:
  - No discards by traders unless fruits are ripe
  - 10-30 % moderate defects and decay
  - 0-20 % extreme defects and decay
- Conservative estimate of on-farm losses: 5-15%.

On-Farm Practices in Uganda

- Market value determined by size of bunch and estimated weight.
- No containers are used for the harvested fruits.
- Plantains are handled as bunches.
- Dessert bananas are occasionally harvested, ripened and then fingers are cut the and stuff into a large woven sacks.

Factors Causing On-Farm Loss in Bananas and Plantains

- Losses in plantains and bananas in Uganda relatively low due to the direct market linkages with buyers
- Obvious causes of on-farm losses:
  - Rough handling, heaped in stacks
  - Long delays between harvesting and loading (~2 days)
  - After harvesting, produce is not cooled

Lessons Learned & Recommendations

- Rough handling and dropping of bunches during harvesting and handling caused physical damage.
- Fruits left in heaps exposed to the sun became very hot and suffered from rapid quality deterioration.
- Reduce rough handling: Training.
- Proper harvesting (timing and handling practices): Training
- Improved harvesting practices: 2 people harvest together.
- Temperature management: Pre-cooling or provision of shade.

Case Study 7: Broiler Meat in Turkey (Desk Study)

Assessment of On-Farm Losses for Broiler Meat in Turkey

- Estimated mortality rates for on-farm chickens range from 4-8% (Gustavsson 2011; SIK 2013).
- Most Turkish poultry farms are “intensive” and are well managed. Mortality losses estimated at 4%.
- Most mortality occurs in the first or last week of life.
- Equals 42,000 tonnes of food lost per year.
- Food value of 2,400 kilocalories per kg, of which 27% is high quality protein (162 g per kg).
- Equals approximately 101 billion kilocalories and 11.4 billion grams of protein.
- The lost food could have provided enough protein nutrition for 625,000 persons for a full year at 50 g/day

Factors Causing On-Farm Food Loss in Broiler Meat in Turkey

- Improper poultry house management
  - overcrowding,
  - lack of ready access to water,
  - poor quality feeds
  - poor temperature management.
- Viruses such as avian flu and Newcastle disease are another cause of losses.
- These are highly contagious and easily spread in crowded poultry production houses.
- Contribute to lowered market access.

Lessons Learned & Recommendations

- Proper feeding and lighting programs
- Immunization programs
- Proper management of space, water, feed and light.
- Individual administration of live vaccines against New Castle disease
- Healthy chicks are vaccinated as early as day 1-4 of life.

Case study 8: Fish and Shrimp Aquaculture in Indonesia (Desk Study)

Assessment of On-Farm Losses for Fish and Shrimp in Indonesia

- On-farm losses are very low, 5% or less.
- There is low productivity due to lack of quality and certified fry as well as high feeding costs
- Farm gate prices depend on size and quality of harvested product.
- With 3.8 million tonnes of aquaculture produce per year in Indonesia and on-farm losses of 5%, 190,000 tonnes are lost per year.

Factors Causing On-Farm Food Loss for Fish and Shrimp in Indonesia

- Poor quality starting materials such as fry or seeds
- Poor production practices
- Aquatic insects
- Ponds are too small to allow proper growth of fish
- Poor quality stock (fry, seeds, fingerings) reduces productivity;
- Diseases during production
- Poor quality feed
- Pests and predators including insects and birds that eat fish/shrimp;
- Poor harvest timing which leads to rapid deterioration during and immediately after harvesting
- Lack of ice, cold storage, or aerated water tanks for use during delays between harvesting and selling.

Lessons Learned & Recommendations

- The actors in the food supply chain, especially the producers, seemed aware of the possibility of losses and the strategies to overcome them
- Producers should:
  - Start with good quality seed or fish fry
  - Use high quality feeds
  - Protect fish and shrimp from predators
  - Prepare nursery ponds
  - Develop larger ponds; the recommended optimum size is 0.4 ha – 1.0 ha

Consequences of On-Farm Losses in the OIC Member Countries

Economic Impacts (Examples)

Crop Country Population (pop) Market Value	Total Annual Production	Total Economic Value	Reported % On-Farm Losses*	Total Volume Lost (Estimated)	Economic Value Lost per Year
Olive, Morocco 33 million pop US$500/ton	1.18 million tonnes	$590 million	30%	354,000 tonnes	$177 million
Tomato, Turkey 72 million pop US$100/ton	11 million tonnes	1.1 billion	28%	3.1 million tonnes	$308 million
Groundnut, Mali 13.9 million pop US$400/ton	220,000 tonnes	$88 million	20%	44,000 tonnes	$17.6 million
Tomato, Nigeria 160 million pop US$60/ton	1.5 million tonnes	$90 million	20%	300,000 tonnes	$18 million
Rice, Bangladesh 151 million pop US$350/ton	50 million tonnes	$17.5 billion	14%	7 million tonnes	$2.45 billion

Effects of Lost Food on Production

- Lost revenue for producers
- Wasted resources and yield gap for smallholder farmers (Land use, time, money, input,)
- Increased pressures on farmers to produce more food.
- If sorted and left on the field, can be sources of inoculum and diseases to the next crop.

Effects of Lost Food on Use

- When food is produced for consumption, lost food is lost calories and lower nutrition for consumers.

- When foods are produced for export, on-farm losses are lost potential revenue for farmers and marketers.

Effects of Loss on Food Security

- Lost food means lost calories and lowered nutrition for consumers in the OIC Member Countries, which immediately reduces food security for the community, country and region.
- On-farm food losses impact smallholder farm family consumption usually in reduction of quantity.
- Malnutrition occurs as vegetables and fruits are replaced by cereals which are less perishable.

Effects of Lost Food on the Environment

- Lost inputs like seeds, fertilizer, and labor and wasteful use of arable land or water resources, diesel for machinery.
- Water
- High energy consuming food production such as animals have a negative impact on the environment when they are being lost.
- Global warming when foods decay and release methane gas to the atmosphere

Effects of Lost Food on Food Safety

- Food security and food loss reduction efforts go hand in hand with promoting improved food safety (Kader 2012)
  - Pesticide residues
  - Aflatoxin
  - Food hygiene, handling and safety measures
  - Animal feed safety
  - Salmonella in poultry
  - Cold chain infrastructure from farm to market

General Recommendations

Extension or Training Needs

Most of the causes of on-farm losses identified in this study can be immediately addressed via targeted training, extension and outreach activities.

Research Needs

Technical issues in general appear to be well addressed, within available resources. Global research institutes readily share their findings and solutions with other potential users.

Advocacy Issues

- Problems at the macro level that must be addressed by policy makers and investors including:
  - missing infrastructure
  - lack of access to extension services
  - poorly regulated input suppliers (poor quality seeds or feeds)
  - poorly regulated contracting practices
  - lack of access to credit

Specific Recommendations

Domestic Policies (1)

1. Close Knowledge and Data Gaps :
   - Identify gaps in knowledge and information for key crops
   - Find specific causes for on-farm food losses

The OIC Member Countries can offer to lead loss assessments and/or can participate in FAO-sponsored food loss assessment case studies.

Domestic Policies (2)

2. <u>Investments in Upgrading the Food Supply Chain:</u>
   - Understand local supply chains
   - Determine when and where to invest directly to better connect farmers to buyers.
   - Shortening the chain between farmers and end-users to:
     - Reduce on farm food losses
     - Reduce time for spoilage
     - Reduce potential risk from spillage and infestations

Domestic Policies (3)

3. <u>Capacity Building</u>
   - Address gaps in the technical and training capacity of on-farm food loss researchers and extension specialists.
   - Key resource persons are the providers of practical information \on best practices in local languages for use by extension workers and producers.

Collaborative Efforts (1)

4. Establish and OIC core group of resource personnel to:
   - Contribute towards capacity building for farmers
   - Encourage them to undertake work on food loss prevention initiatives

Collaborative Efforts (3)

5. The OIC Member Countries should address gaps in the managerial capacity of national extension workers, farmers, fishers, ranchers and food supply chain workers.

Collaborative Efforts (3)

6. OIC Member Countries should develop projects to address losses in either durable or perishable value chains.

These projects should describe:

- Key actions
- Technology packages and
- Budgets that could be used to develop projects on reducing losses in the value chains.

Collaborative Efforts (4)

7. OIC Member Countries should implement a cycle of competitive funds where countries could receive funding for specific research and development projects to reduce on-farm losses.

It is recommended to do multi-disciplinary/ multi-institutional/multi-country studies

Conclusion

Implementing these general and specific recommendations will allow the OIC Member Countries to:

- Identify the priority focus areas in their countries and across regions
- Provide needed research and extension information on best practices that can be shared with other countries.