A Consensus-based Road Map for Reducing Global Postharvest Losses

Developed at

The First International Congress on Postharvest Loss Prevention

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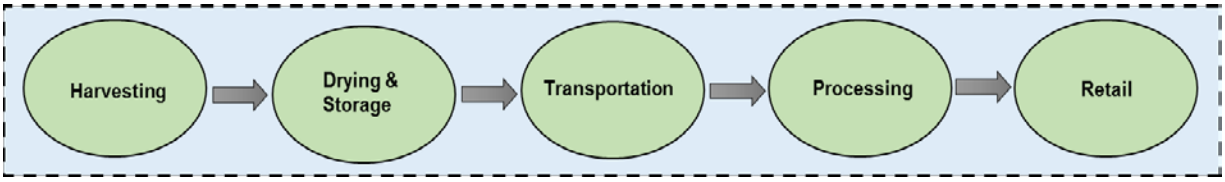
Foreword

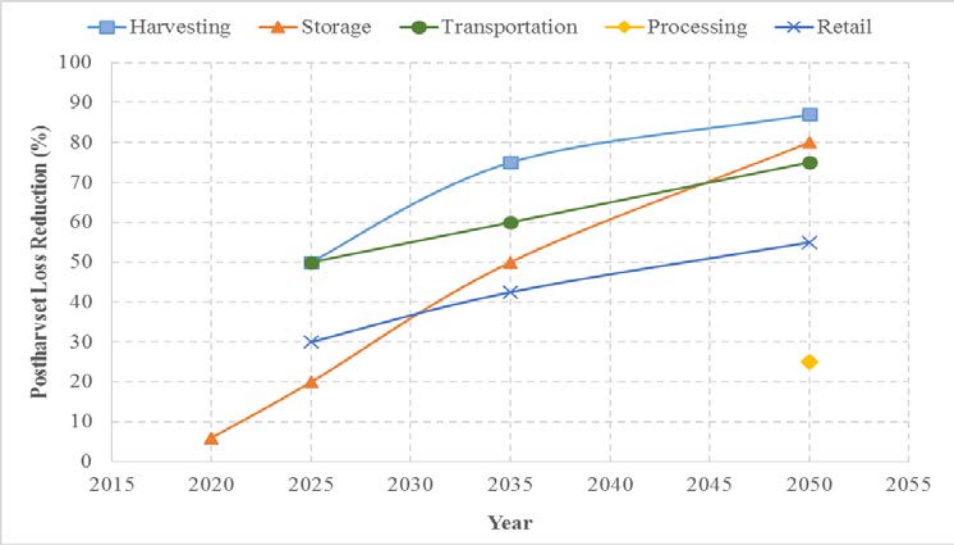
At the First International Congress on Postharvest Loss Prevention in Rome last year, we initiated a discussion to develop a road map to chart the pathways toward improving lives and livelihoods of a large number of smallholder farmers sustainably through postharvest loss reduction of key crops with minimal environmental impact. We targeted to focus the roadmap development within the scope of the following broader stages of the supply chain:



Postharvest losses can be reduced from each of the above supply chain stages by interventions that are defined as target intervention areas (TIA). The TIAs are Markets, Technology, Policy, and Education and Training. We had 5 breakout groups based on the five supply chain stages. Each group focused on of the supply chains and answered the following questions:

- What are the 3-5 major causes of postharvest losses in this stage?
- For the first most critical TIA, what are/could be the 3-5 best practices and/or most promising approaches?
- For the first most critical TIA and the approaches identified, what is needed to implement these solutions with significant impact?
- Based on answers to the above questions, by how much can postharvest losses be reduced by 2050 to improve the quality of lives and livelihoods of a large number of smallholder farmers?

Each group identified the major causes of postharvest losses in developing countries, ranked the TIAs (1 = most critical to 4 = least critical) and proposed best practices and/or most promising approaches for loss reduction solutions for key crops.



The groups them presented their finding to the entire Congress attendees, and based on feedback from entire audience, modified their findings. The final task of the group was to present % postharvest loss reduction for each supply chain stage. The following graph presents the consensus reached by all groups on postharvest loss reduction.

- Prasanta Kalita,
Director, ADM Institute
for the Prevention of Postharvest Loss

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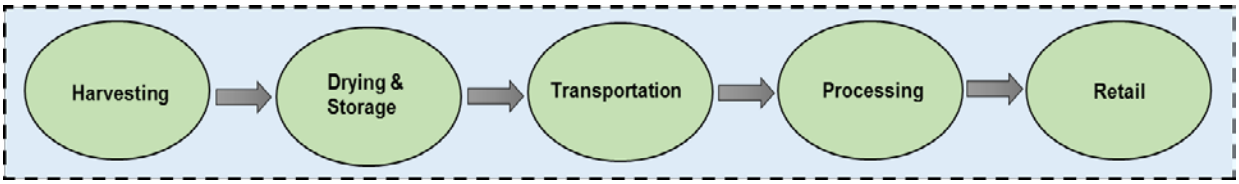
Part 1

Building a Consensus Road Map for Reducing Global Postharvest Losses

1.1 **Purpose:** To develop a road map that charts the pathways towards improving lives and livelihood of a large number of smallholder farmers sustainably through a significant postharvest loss reduction of key crops with minimal environmental impact.

1.2. Supply Chain Stages: We target to focus the roadmap development within the scope of the following broader stages of the supply chain:



1.3. Targeted Intervention Areas: Postharvest losses can be reduced from each of the above supply chain stages by the following interventions that are defined as target intervention areas (TIA). The TIAs listed below are not in the order of priority nor are the listed examples exhaustive.

- **TIA #1 Markets:** Increased market value of commodities for smallholder farmers
  - Creating markets and linking farmers to the markets
  - Availability and access to marketing and pricing information
  - Quality expectations of end-users for better price

- **TIA #2: Technology:** Availability of affordable, environment-friendly technologies
  - Awareness about technologies and their use
  - Improve conventional technologies and their adaptability and adoption
  - Develop advanced level technologies

- **TIA #3: Policy:** Policies that enable effective implementation of the best postharvest loss reduction solutions for smallholder farmers
  - Reducing access barriers such as financing
  - Providing incentives and subsidies

- New policy and infrastructure development

- **TIA #4: Education and Training**: Knowledge sharing and capacity-building for overcoming barriers at all levels (individual, community, regional, national, international)
  - Awareness of problems, and potential solutions and impact
  - Human and institutional capacity building at all levels (for all stakeholders)
  - Implementing programs to empower women and self-help groups

1.4 Breakout Group Discussions

We had 5 Breakout groups based on the five supply chain stages. Each group focused on one stage of the supply chain. And answered the following questions

Q. 1: What are the 3-5 major causes of postharvest losses in this stage? For each cause, rank the "Target Intervention Areas (TIA)" according to their criticality, and lastly select the top two most critical TIAs. (Note: Ranking: 1-4 (1 being most Critical & 4 being least critical))

Major Causes of Losses in this Stage	**Interventions**			
	Markets	Technology	Policy	Education

Overall first most critical TIA…….. Overall second most critical TIA……

Q. 2a: For the first most critical TIA, what are/could be the 3-5 best practices and/or most promising approaches?

Best Approaches or Solutions	**Current Actors**	**Current Impact**	**Targeted Communities**

Notes:

- **Actors could be stakeholders** (e.g., researchers, technology developers, entrepreneurs, policy makers) **or specific person/organizations**
- **Impact –** Social, Gender, Economic, Environmental
- **Communities:** Smallholder farmers, larger farmers, state, country

Q. 2b: For the first most critical TIA and the approaches identified in Q. 2a, what is needed to implement these solutions with significant impact?

TIA Name:						
Best Approaches or Solutions	**What component is missing**	**Potential Actors**	**Potential Impact**	**Timeline**		
				Short	Med	Long

Notes:

- **Component:** technology, extension, funding, etc.
- **Timeline:** Short Term: 5 years; Medium Term: 10 years; Long Term: 10+ years

Q. 3: Repeat questions 2a and 2 b for the 2nd most critical TIA

Q. 4: Based on answers to the above questions, by how much can postharvest losses be reduced by 2050 to improve the quality of lives and livelihoods of a large number of smallholder farmers?

Provide target estimate of postharvest loss reduction by the following years:

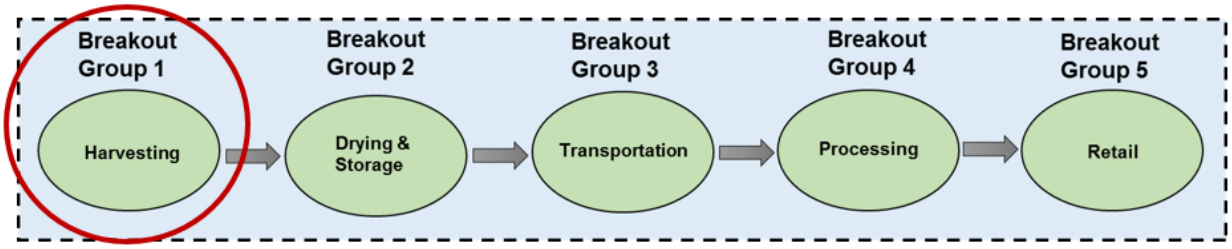
	2020	2025	2035	2050
Loss Reduction (%)				

Q. 5: List 5-7 key areas or messages that were not discussed or addressed in this Congress but are needed to sustainably reduce postharvest losses with minimal environmental impact (For complete supply chain)**.**

Part 2

Outcomes from Breakout Group Discussion

2.1 Harvesting



Discussion from the breakout session on "Harvesting" has been summarized in sections "A-D" and observations by designated panel members from the harvesting and storage related presentations throughout the congress have been summarized in section "E".

A. Major Cause of Losses:

- Lack of locally available technology
- Lack of know-how and education
- Lack of transportation
- Lack of knowledge about markets for crops and a transparent value chain
- Lack of equipment for harvesting, drying, storage and measurement of moisture and quality factors

B. Critical Interventions Causing Losses in Current Stage:

- Policy
- Markets

C. Best Approaches to Reduce Losses:

- Highlight early adopters stories Extension/Farmers field schools and transition to business schools and transition to business schools
- Train-the-trainers Demo plots and practices
- Pilot best practices Private sector involvement
- Future farmers training Cluster farming, e.g. as practices in the Philippines.

D. Target Loss Reductions:

	2020	2025	2035	2050
Loss Reduction (%)		**50**	**75**	**87**

E. Designated Panel Summary:

Major cause of losses in current stage

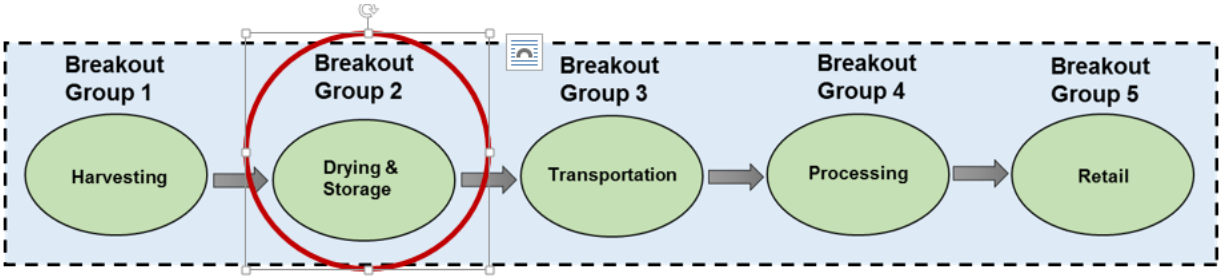
- Machine not operated by owners, less efficient
- Combine operating conditions
- Infestation before harvest
- Manual shelling (maize)
- Poor grading of horticulture crops
- Improper harvesting time
- Delay between harvest and packing
- Inconsistency of regulations on aflatoxin
- Surplus production
- Poor handling (horticulture)
- Improper threshing
- Shattering losses
- Inadequate cleaning

Interventions and approaches to reduce postharvest losses in current stage

- Government Extension Agencies
- Increased Awareness
- Training on equipment operation
- Incentives
- Affordable moisture content measurement
- Accessibility to technology
- Government Policy to Encourage Adoption
- Threshers (rice)
- Local equipment manufacturing
- Harvest at appropriate time

- Use nontoxic fungal strains to compete with toxic strains
- Women-compatible tools
- Extension

2.2 Drying and Storage



Discussion from the breakout session on "Drying and Storage" has been summarized in sections "A-D" and observations by designated panel members from the drying and storage related presentations throughout the congress have been summarized in section "E".

A. Major Cause of Losses:

- Moisture determination & regulations:
  - Technology:
    - Meters, calibration, reliability, accuracy
  - Policy:
    - Political vs market determining at what moisture content commodity is traded at (bought & sold)
- Storage facilities
  - Markets:
    - Demand for storage, buyer not rewarding quality, cost:benefit ratio, quality attributes, decentralized vs concentrated storage (farm vs community vs coop vs private vs government)
  - Technology:
    - Quantity, quality, cost, appropriateness for the farmer (gender considerations; ease of physical access such as heights; ease of use; practical, cultural context; reliability), transporting product, adaptability, lack of infrastructure
  - Policy:
    - Standard for the crop quality
  - Education:
    - Knowledge about facility management, awareness and accessibility of services for hire

- Timeliness drying
- Appropriateness and affordability of drying technology
- Access to information, then ability to use information
- Lack of experts with practical experience with the appropriate technology
- Access to Finance
- Lack of quality management system

B. Critical Interventions Causing Losses in Current Stage:

- Technology
- Infrastructure

C. Best Approaches to Reduce Losses:

- Technology:
    - Metric/measurement use/transparency of data
    - End users involved in development
    - Supply chain of technology manufacturers locally
    - Sustainability of tech management:
        - Training, follow up, assessment, feedback, assessment of technology, unbiased estimates (gender)
- Infrastructure:
    - Impact pathway to follow through with assessment of impact
        - Good agriculture extension need long term implementation time awareness
        - Organization and development of all stakeholders
        - Making information data accessible
    - Engagement of private sector-develop incentives
    - Access to financing-loans
    - Appropriate training throughout value chain

D. Target Loss Reductions:

	2020	2025	2035	2050
Loss Reduction (%)	**6**	**20**	**50**	**80**

E. Designated Panel Summary:

Major cause of losses in current stage

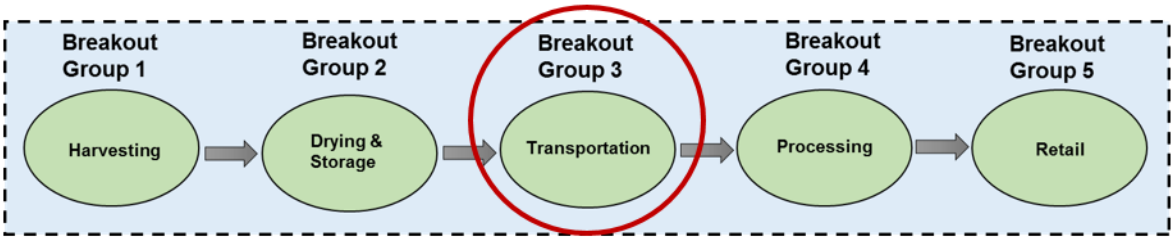
- Aflatoxin (Maize)
- High moisture content (Maize)
- Insect infestation (grains)
- Lack of storage facilities

Interventions and approaches to reduce postharvest losses in current stage

- Government Extension Agencies
- Increased Awareness
- Mobile dryers
- Drying shelters
- Infrastructure
- Training of farmers
- Hermetic Storage Bags
- Incentives
- Affordable moisture content measurement
- Evaporative coolers (horticulture)
- Rapid mycotoxin detection tools
- Accessibility to technology
- Government Policy to Encourage Adoption
- Local equipment manufacturing
- Low cost batch dryers
- metallic silos
- Adequate fumigation
- Affordable sensors (temperature, moisture content, etc.)
- Bio-insecticides
- Efficient solar dryers
- Mobile storage
- Women-compatible tools
- In silo dryer

- ZeroFly bags
- Extension
- Animated Videos
- Training of storage managers

2.3 Transportation



Discussion from the breakout session on "Transportation" has been summarized in sections "A-D" and observations by designated panel members from the transportation related presentations throughout the congress have been summarized in section "E".

A. Major Cause of Losses:

- Lack of infrastructure
- Materials handling

B. Critical Interventions Causing Losses in Current Stage:

- Research for local solutions
- Policy
- Proper transportation means

C. Best Approaches to Reduce Losses:

- Policy:
    - Government Investment to upgrade systems
        - Emphasize rural areas
        - Allocate sufficient budgets
    - Public-private partnership
        - Build better roads
        - Create win-win situations for technology development
- Proper transportation means:
    - Appropriate packaging
    - Refrigeration vehicle
- Research for local solutions:

    - Low cost and environment friendly solutions
        - Develop effective aggregation systems
    - Encouraging investment in research
        - Develop sound implementation plan
        - Create economic benefits and better values
- Packaging materials:
    - Training operators
        - Teach best practices
        - Provide live demonstrations
    - Local production of appropriate packaging materials
        - Create enabling environment

D. Target Loss Reductions:

	2020	2025	2035	2050
Loss Reduction (%)	**10**	**50**	**60**	**75**

E. Designated Panel Summary:

Major cause of losses in current stage

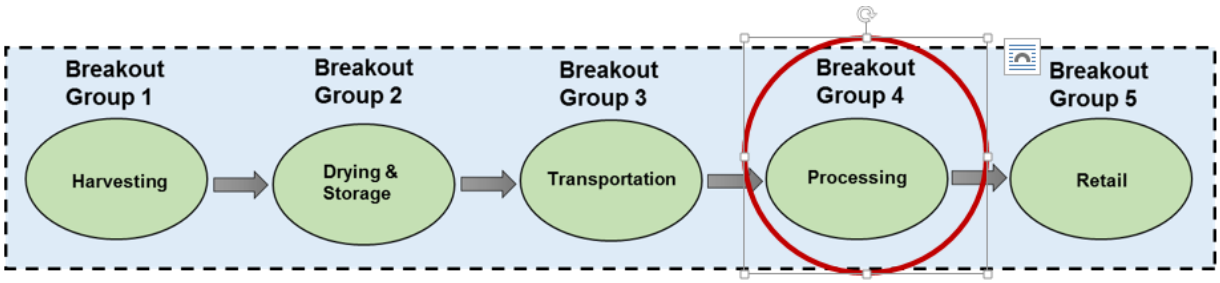
- Non-refrigerated transportation (horticulture)
- Overfilling of shipping crates (horticulture)
- Long time for loading and loading (horticulture)
- Poor road conditions (horticulture)
- Improper packaging

Interventions and approaches to reduce postharvest losses in current stage

- Government Extension Agencies
- Increased Awareness
- Incentives
- Training on proper filling
- Cold Chain
- Accessibility to technology
- Government Policy to Encourage Adoption
- Training for loading and unloading

- Extension
- Animated videos

2.4 Processing



Discussion from the breakout session on "Processing" has been summarized in sections "A-D" and observations by designated panel members from the processing related presentations throughout the congress have been summarized in section "E"

A. Major Cause of Losses:

- Access to Sustainable Market, Credit facility, Technology, Information
- Affordable technology and its components
- Awareness
- Commodity specific approach
- Innovations

B. Critical Interventions Causing Losses in Current Stage:

- Technology
- Policy

C. Best Approaches to Reduce Losses:

- Policy:
    - Sustainable Market
        - Actors: Entrepreneurs
        - Target communities: farmers
        - Missing component: Market availability, extension
    - Quality of products
        - Actors: Producers
        - Target communities: farmers
        - Missing component: Standardization of Quality, Quality Maintenance

- Identifying Creditors
    - Target communities: Smallholder farmers, larger farmers
    - Missing Component: Credit facilities
- Policy making and Enforcement
    - Actors: Policy makers
    - Missing component: Appropriate policies for sustainable development
- Public Private Partnerships
    - Actors: Policy makers, Entrepreneurs

- **Technology**:
    - Transfer of Technology
        - Actors: Extension workers
        - Missing component: Extension
        - Potential actors: Public and Private sectors, Extension workers
    - Indigenous knowledge
        - Actors: Farmers
        - Missing component: Compilation, Documentation
        - Potential actors: Researchers, Extension workers
    - Innovation
        - Actors: Technology developers
        - Missing component: Funding
        - Potential actors: Technology developers, Funding Agencies
    - Repair existing machinery
        - Missing component: Access
        - Potential actors: Entrepreneurs, Technology developers
    - Business Models
        - Actors: Entrepreneurs

D. Target Loss Reductions:

	2020	2025	2035	2050
Loss Reduction (%)				**25**

E. Designated Panel Summary:

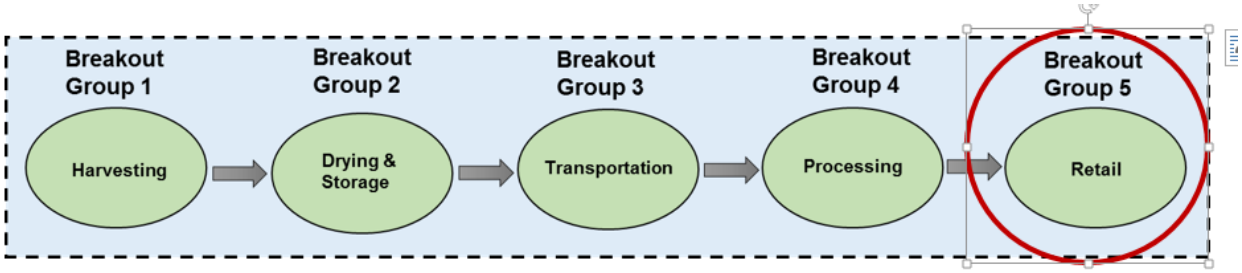
Major cause of losses in current stage

- Broken grains
- Spillage in traditional milling

Interventions and approaches to reduce postharvest losses in current stage

- Government Extension Agencies
- Increased Awareness
- Incentives
- Accessibility to technology
- On-farm primary processing
- Government Policy to Encourage Adoption
- Local equipment manufacturing
- Women leadership development in local food processing
- Women-compatible tools
- Animated videos

2.5 Retail



Discussion from the breakout session on "Retail" has been summarized in sections "A-D" and observations by designated panel members from the retail related presentations throughout the congress have been summarized in section "E".

A. Major Cause of Losses:

- Lack of education: training of employees, consumers
- Mechanical injuries: fruits & vegetables
- Seasonal fluctuation in availability

B. Critical Interventions Causing Losses in Current Stage:

- Cold storage/containers
- Policy
- Education & training

C. Best Approaches to Reduce Losses:

- Improved access to cold storage
- Packaging
- Talk to policy makers & express the value of losses
- Increase awareness

D. Target Loss Reductions:

	2020	2025	2035	2050
Loss Reduction (%)	-	30	42.5	55

E. Designated Panel Summary:

Major cause of losses in current stage

- Inconsistency of demand (horticulture)
- Cheap imports (horticulture)
- Lack of market

Interventions and approaches to reduce postharvest losses in current stage

- Government Extension Agencies
- Increased Awareness
- Incentives
- Access to finance
- Market Linkages
- Accessibility to technology
- Government Policy to Encourage Adoption
- Animated videos

Part 3

Draft Roadmap for Global Postharvest Reduction

Group process: Consider one of the five general links of the food supply chain (FSC) and the four Targeted Intervention Areas (TIAs) of Markets, Technology/Infrastructure, Policy, and Education/Training, then identify the major causes of postharvest losses in developing countries, rank the TIAs (1 = most critical to 4 = least critical) and propose best practices and/or most promising approaches for loss reduction solutions for key crops.

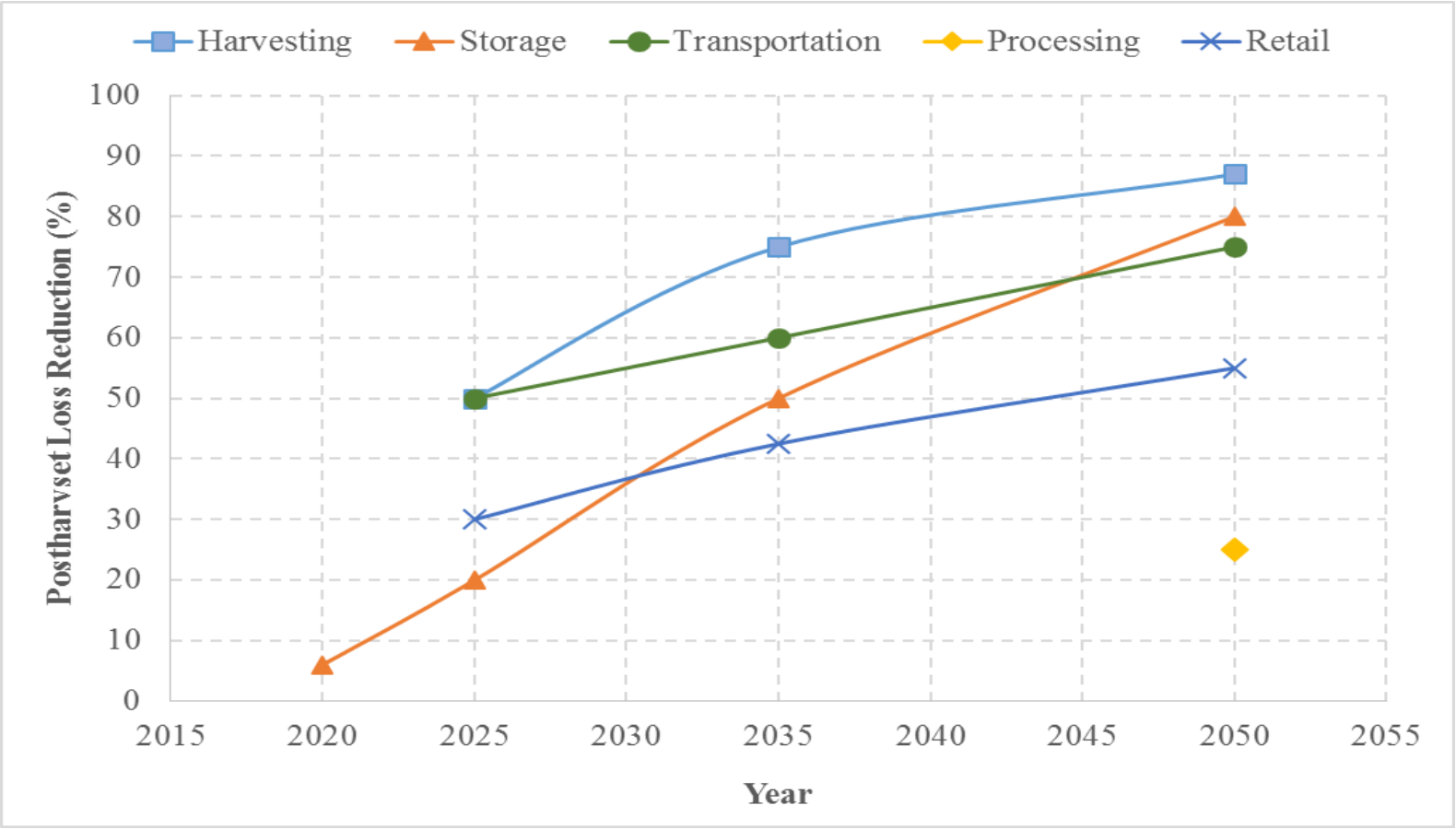
3.1 Summary: Consensus reporting and expert validation of food loss reduction targets by FSC step for key crops

5 Steps of the FSC	**HARVESTING**	**STORAGE**	**TRANSPORTATION**	**PROCESSING**	**RETAIL**
FSC step includes activities such as:	Harvest timing, methods, tools and containers	Preparation and storage, on-farm handling practices, sorting, drying (cereals/ pulses) , or cooling (fresh produce)	Vehicle loading, stacking, container types, travel, delays and unloading	Transformation of raw crops to more stable forms, value addition via drying, canning, grinding, cooking, packaging, etc.	Display, temporary storage, resorting, cleaning/trimming, sales to final consumer
Major causes of losses (based on individual experiences, posters and conference presentations)	Lack of knowledge on proper harvesting practices Lack of locally available technology, tools, equipment	Lack of tools (moisture meters), appropriate equipment Lack of knowledge on appropriate handling, drying or cooling practices and storage management	Lack of transport options at the farm level Lack of transport infrastructure, loading docks, shade, cold chain (fresh produce) Rough handling, overloaded containers	Lack of access to sustainable markets Lack of appropriate processing technologies and innovations for smallholders Lack of awareness, information	Rough handling (damage to fresh produce, mechanical injuries), lack of shade Lack of awareness, knowledge of sellers, consumers on proper handling,

5 Steps of the FSC	**HARVESTING**	**STORAGE**	**TRANSPORTATION**	**PROCESSING**	**RETAIL**
	Rough handling, damage and spillage in the field	Lack of storage infrastructure Aflatoxins, insect pests, high moisture content (cereals/pulses), rough handling and damage (fresh produce)	and vehicles, damage and spillage	Lack of access to credit for making needed investments Breakage, spillage	sanitation and marketing practices Seasonal fluctuations in supply (gluts) Competition from imports (fresh produce)
Top 2 ranked TIAs for the FSC step	Education &Training Policy	Technology & Infrastructure Education/Training	Infrastructure Education/Training	Technology Policy	Policy Education/Training
Best practices or promising approaches	Demonstrations on the farms Train the trainers Private sector involvement – encourage business development Cluster farming Promote quality standards based on nutrition rather than only	Local development and manufacture of technologies Including women, FSC actors in assessment, training & evaluation of technologies Provide appropriate training and extension	Improved containers (stackable, protective) and vehicles (refrigerated for fresh produce) Improved roads (reduce delays and mechanical damage) Training on improved handling, packing, loading and transport practices	Creating sustainable markets via improved extension, credit access, market information, quality standards, public-private partnerships Repairs of existing equipment, improved maintenance, access to needed tools and spare parts Improved extension of information on technology,	Increase awareness of policy makers and consumers regarding high levels of food losses Improve access to shade, display tables, cool/cold storage and innovative packaging Promote quality standards based on nutrition rather than only appearance,

5 Steps of the FSC	**HARVESTING**	**STORAGE**	**TRANSPORTATION**	**PROCESSING**	**RETAIL**
	appearance, color or size			indigenous knowledge sharing, training on processing innovations and business models	weight, color or size
Loss reduction estimates	Current harvest losses: 5 to 10% (cereals/pulses) 20 to 30% (fresh produce)	Current storage losses: 10 to 20% (cereals/pulses) 20 to 30% (fresh produce)	Current transport losses: 2 to 5% (cereals/ pulses) 5 to 10% (fresh produce)	Current processing losses: 5 to 10% (cereals/pulses) 10 to 20% (fresh produce)	Current retail losses: 2% (cereals/pulses) 5 to 10% (fresh produce)
2020	25%	6%	10%		
2025	50%	20%	50%		
2035	75%	50%	60%		
2050	87%	80%	75%	25%	

3.2 Target Postharvest Loss Reduction by 2050



Part 4

Recommendations

4.1 Best practices or approaches for the HARVESTING step

	Recommendations for FSC actors and target audience(s)	**What is missing?**
Markets	Formation of farmer groups, associations or cooperatives to access new markets	Links to non-traditional markets Adequate knowledge of market requirements in terms of crop variety, quality, food safety
Technology	Use of harvest indices Use of mechanized harvesting methods when appropriate (cereals and pulses) Use of plastic buckets and plastic crates on the farm (fresh produce)	Appropriate, low cost harvesting equipment and tools such as moisture meters, color charts Systems for repair, cleaning and sharing harvesting equipment, tools, plastic crates
Policy	Private sector involvement Cluster farming e.g. as practices in the Philippines	Incentives for adoption of improved practices or technologies Regulations (food safety, aflatoxin control) Societal awareness of losses due to rejection of foods at harvest due to quality standards based on appearance or size
Education & Training	Highlight early adopters stories Train-the-trainers Demo plots and practices Pilot best practices for farmers	Strong, well trained extension / advisory services Funding for capacity building of trainers Funding for outreach/extension work on harvesting practices

4.2 Best practices or approaches for the DRYING & STORAGE step

	Recommendations for FSC actors and target audience(s)	**What is missing?**
Markets	Improved quality management systems to meet market demands	Involvement of private sector
Technology & Infrastructure	Improved equipment for smallholders (threshing, drying, cooling, etc) such as mobile dryers, low cost batch dryers, hermetic storage bags, metal silos, evaporative coolers. Appropriate storage infrastructure	Appropriate, low cost equipment and tools such as moisture meters, threshers, dryers, cool rooms, rapid mycotoxin detection tools, bio-insecticides, women-compatible tools Systems for repair, cleaning and sharing equipment, tools, storage facilities
Policy	Use of standardized metrics/measurements and improved use/transparency of data	Incentives for adoption of improved practices or technologies Regulations (food safety, aflatoxin control)
Education & Training	Appropriate training of farmers, storage managers, and FSC actors Extension of best storage practices (increased awareness) Use of animated videos	Agriculture extension needs long term implementation time and improved postharvest awareness Strong, well trained extension / advisory services Funding for capacity building of trainers Funding for outreach/extension work on storage practices and management

4.3 Best practices or approaches for the TRANSPORTATION step

	Recommendations for FSC actors and target audience(s)	**What is missing?**
Markets	Develop effective aggregation systems	Shared modernized transport hubs, adequate marketplace access for vehicles, parking, paved and well maintained to avoid weather damage/mud/potholes
Technology & Infrastructure	Improved transport infrastructure (for loading, unloading, vehicles of all sizes/types for improved food transport)	Appropriate transport vehicles, loading docks, shaded loading and parking/waiting areas Improved containers and packages (low cost, protective)
Policy	Improved roads (smooth to reduce postharvest damage, paved to prevent rain related damage, wide enough for safety) Improved containers and packages to protect foods during transport	Funding for farm to market roads Government incentives for private investments Regulations on the design and use of improved containers (size, type, quality)
Education & Training	Training on improved postharvest handling practices, proper loading/unloading Training on improved containers, packages, teach best transport practices, vehicle management and maintenance Animated videos on loading/unloading best practices	Strong, well trained extension / advisory services Funding for capacity building of trainers on food transportation Funding for outreach/extension work on transport practices and management

4.4 Best practices or approaches for the PROCESSING step

	Recommendations for FSC actors and target audience(s)	**What is missing?**
Markets	Improved quality management systems to meet market demands	Involvement of private sector
Technology & Infrastructure	Improved equipment for smallholders (milling, drying, canning, juicing, etc) Appropriate processing facilities (products meeting consumer demands, size, scale, cost effectiveness)	Appropriate, low cost equipment and tools, women-compatible tools Systems for repair, cleaning and sharing equipment, tools, processing facilities
Policy	Promote on-farm primary processing Promote local equipment manufacturing	Incentives for investments in tools, equipment Funding/Support of training of farmers Awareness, training of manufacturers
Education & Training	Training on improved postharvest handling practices, proper milling, processing methods Training on improved handling, packages, teach best processing practices, equipment maintenance / repairs Animated videos on food processing	Strong, well trained extension / advisory services Funding for capacity building of trainers on food processing, especially for women and small and medium scale enterprises (SMEs) Funding for outreach/extension work on processing practices and management

4.5 Best practices or approaches for the RETAIL MARKETING step

	Recommendations for FSC actors and target audience(s)	**What is missing?**
Markets	Formation of farmer groups, associations or cooperatives to access new markets	Links to non-traditional markets Adequate knowledge of market requirements in terms of crop variety, quality, food safety
Technology	Improved packaging materials (all foods) Access to cooling, cool storage and /or cold storage (fresh produce)	Incentives for adoption of improved handling practices, packaging or cold chain technologies
Policy	Promote private sector involvement	Incentives for adoption of improved handling practices, packaging or cold chain technologies, improved access to credit for making the needed investments Regulations (food safety, aflatoxin control) Societal awareness of losses due to rejection of foods at harvest due to quality standards based on appearance or size
Education & Training	Training of producers, traders, retail workers, consumers in food loss reduction	Local awareness of the importance of training Funding for training programs

Appendix

Major Themes/topics Discussed during the Conference

Day 1:

Day 2:


Tomato
Hermatic
Extension
Storage
Moisture
Community
Chaine
Aflatoxin
Cold
Practice
Training
Awareness
Oranges
Packing
Wheat
Bangladesh
Mango
Incentives
Maize
Climate
Africa
Videos
Value
Education
Fisheries
Rice
Kenya
Brazil
Drying
Cooling
Biocontrol
India
Shattering
Nigeria
Change
Gender
Insects
Refrigeration
Uganda
Rodents
Added
Crabs
Information