

Food loss and waste across the value chain

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Key facts

- Reducing food loss and waste can contribute to food security and sustainability
- Our lack of clear knowledge about the real magnitude of food loss and waste is a major barrier to addressing the problem
- Estimates of global magnitude varies widely from 27% (1 Billion Tons) to 32% (1.3 Billion Tons) of all food produced in the world
- There are significant differences across studies at the commodity group and commodity level

FLW as policy priority

- FLW is global problem
- Focus on: reduction as a top priority at global, regional and national levels
 - ✓ *Coordination and consensus on coherent terminology and definition, systematic framework for measurement and reporting*

FLW as policy priority at global, regional, national, and local level



➤ Agenda 2030

- *Global Food Loss Index*; SDG 12.3 is on FLW; link to SDG 2, 12.5, 11, 17
- *Global Strategy to Improve of Agricultural and Rural Statistics*

➤ Committee of World Food Security (CFS)



➤ Zero Hunger Challenge

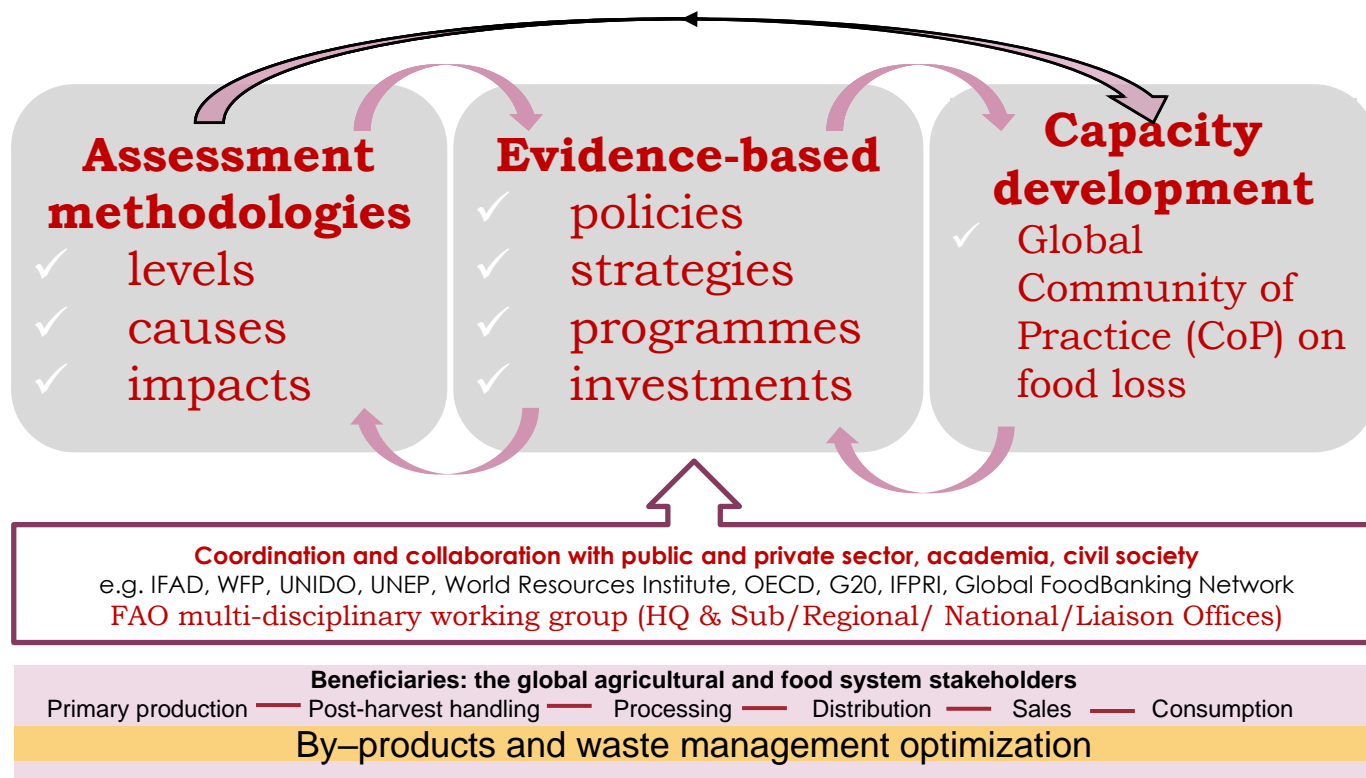
➤ Second International Conference on Nutrition (ICN2)

➤ Milan Urban Food Policy Pact



G 20 request FAO and IFPRI: work together on FLW

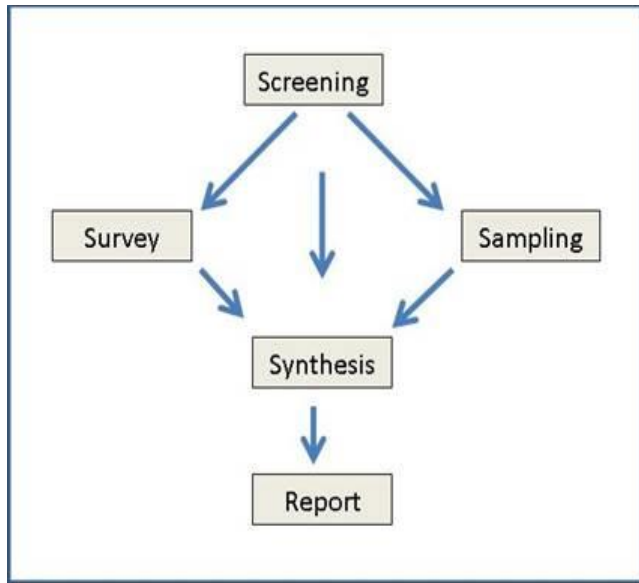
FAO Global Initiative on FLW Reduction



The *Global Initiative on FLW Reduction* is providing information to the *Technical Platform on the Measurement and Reduction of FLW*

FAO Global Initiative on FLW Reduction

Example of action implemented by the Global Initiative on FLW Reduction ➡ with Governments' request
Improvement of Primary data on Food Loss through Food supply chain level case studies



➤ **Identification of Consultants**

- Subsector Specialist, actor
- Agricultural Economist

➤ **Selection of Food Supply Chains**

- Based on smallholder producers
- Significant scale of food production
- Preferably including agro-processing and urban market

➤ **Multi-stakeholder validation workshop**

➤ **Food Loss Reduction Strategy**

➤ **Investment program to reduce food losses**

Currently : ongoing assessments in 21 countries for 48 FSCs

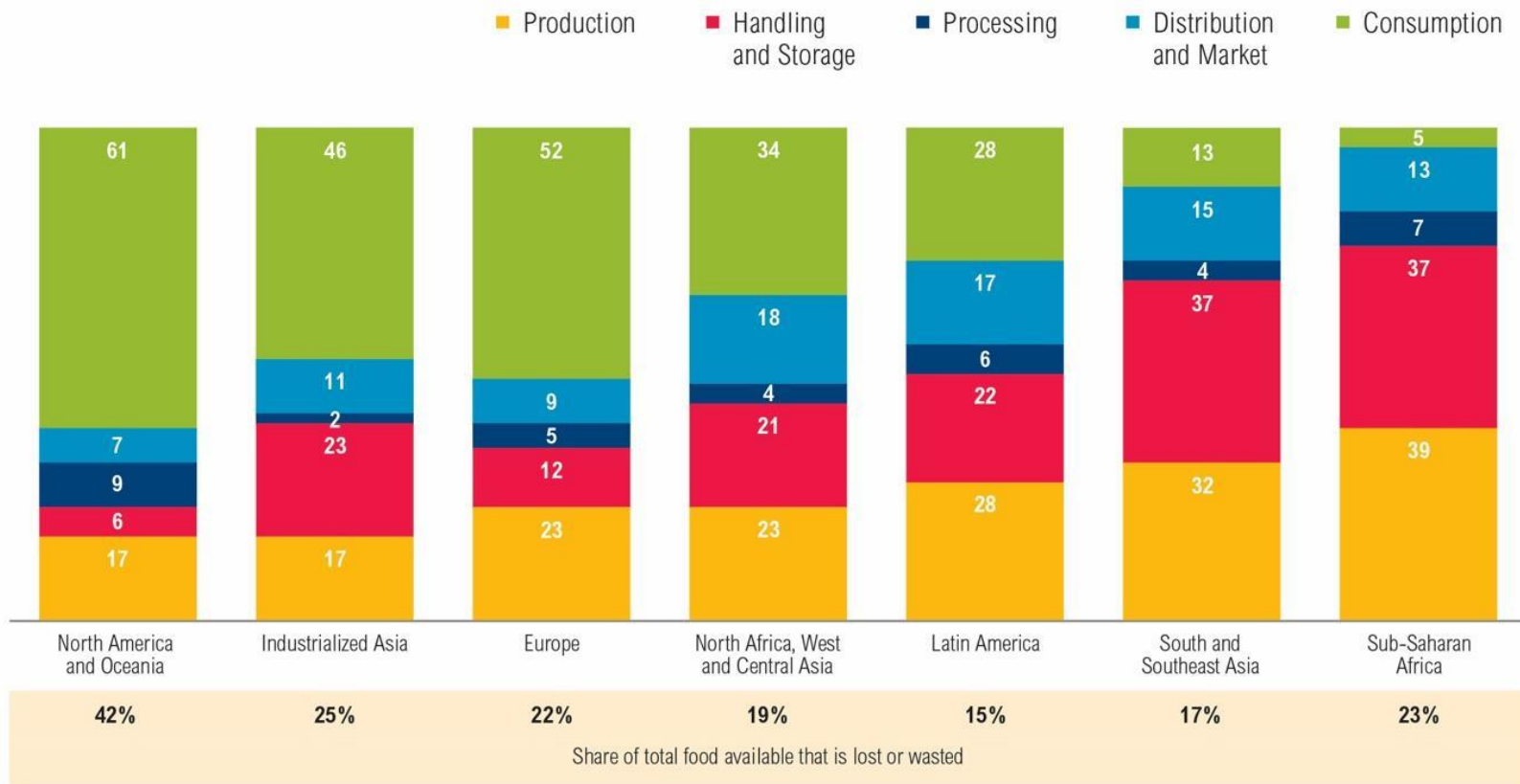
Community of Practice on Food Loss Reduction

- Serves as a global convener and an integrator of knowledge related to post-harvest loss (PHL) reduction (via interactive tools: Forum)
- Offers a platform to facilitate linkages and information sharing amongst stakeholders and relevant networks, projects and programs such as Global Initiative on FLW Reduction ([SAVE FOOD](#))
- It is one of the major outcomes of the first joint project being implemented by FAO, IFAD and WFP (funded by Swiss Agency for Development and Cooperation) on [Mainstreaming Food Loss Reduction Initiatives for Smallholders in Food-Deficit Areas](#)

What are numbers?

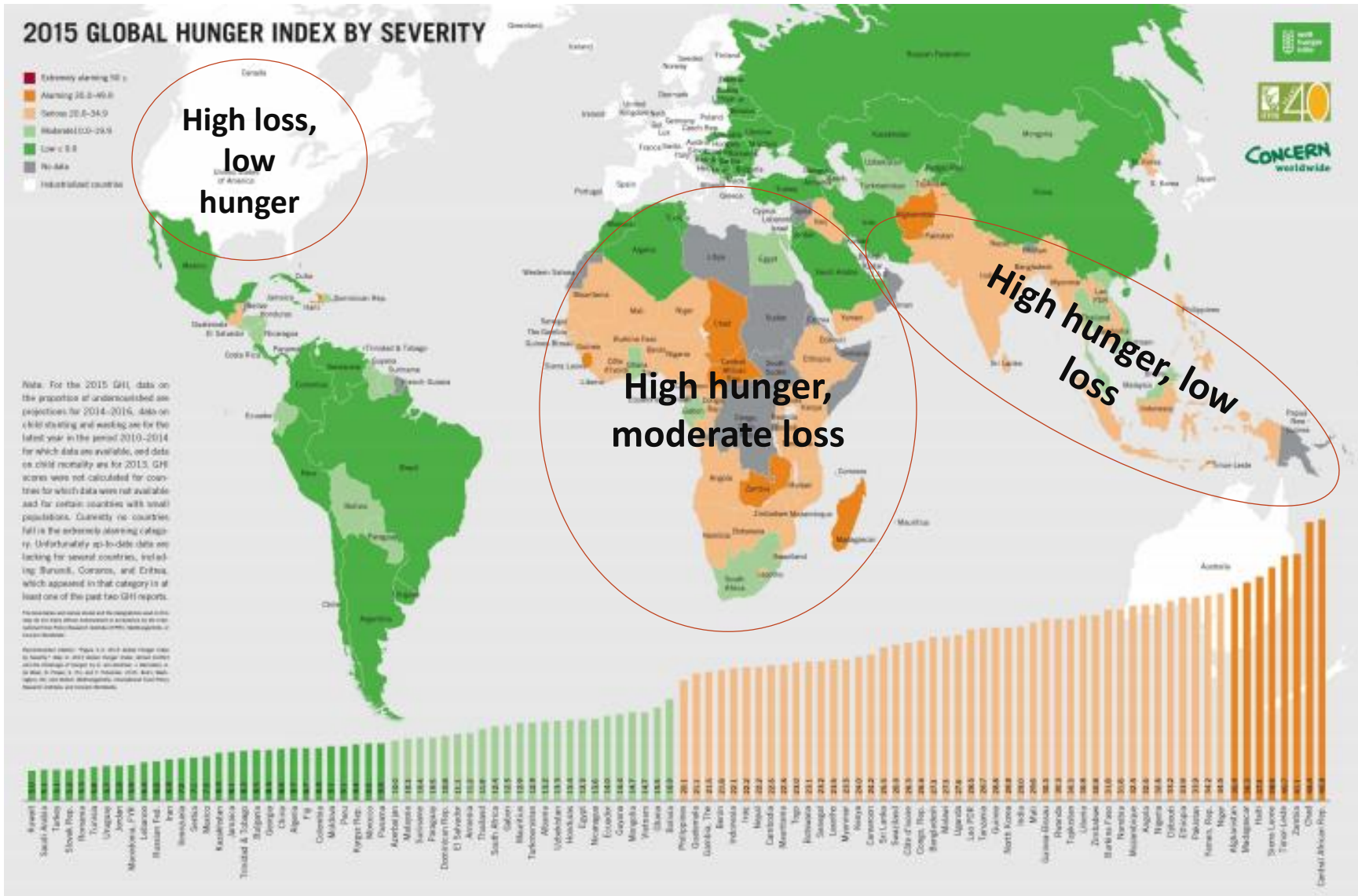
Diagnosis: Where?

Food loss and waste occurs more 'near the fork' in developed regions and more 'near the farm' in developing regions (Percent of kcal lost and wasted)



Note: Number may not sum to 100 due to rounding.

Are today's hungry people in areas where losses are high?



Can we feed the hungry in 2050 by reducing loss and waste?

Population at Risk of Hunger in 2050

Region	Million People				% Change from baseline		
	Baseline	Reduced losses, developing world (6% by 2025)	Reduced losses, global (10% by 2030)	Faster productivity growth, no change in losses (.4% crops, .2% livestock)	Reduced losses, developing world	Reduced losses, global	Faster productivity growth, no change in losses
East Asia and Pacific	126	118	116	115	-6.3	-7.5	-8.6
Europe and Central Asia	38	37	37	37	-2.9	-3.7	-4.1
LAC	48	45	44	44	-6.0	-7.7	-8.6
MENA	38	37	36	36	-3.9	-4.9	-5.8
South Asia	162	138	134	131	-15.3	-17.6	-19.2
SS Africa	137	116	112	108	-15.8	-18.6	-21.2
Developing	509	452	442	434	-11.2	-13.1	-14.7
Developed	59	56	55	55	-4.7	-6.1	-6.9
World	568	508	497	489	-10.5	-12.4	-13.9

Calculations from IFPRI IMPACT Model version 3. Source: Rosegrant et al., 2015. Returns to Investment in Reducing Postharvest Food Losses and Increasing Agricultural Productivity Growth. Food security and nutrition assessment paper. Copenhagen Consensus Center.

Avoided loss can help feed the hungry...

...but will not do the full job and costs money.

Even with lower food prices, many poor people will be hungry.

Access matters!
Feeding programs, food stamps, and special distribution networks must improve access.



School feeding program in Kibera slums, Nairobi, Kenya GPE/ Deepa Srikantaiah, 2012. [Flickr](#)

What about middle and high income countries?

Poverty: Income inequality

Access: Food deserts

Skills: Food preparation



This photo by **Amy Toensing** illustrates the *National Geographic Magazine* article by Tracie McMillan [The New Face of Hunger](#)

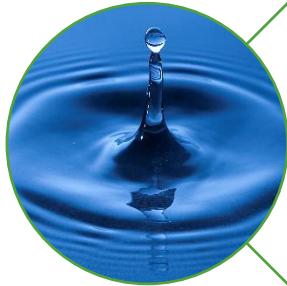
What role for reduced waste?

Prices: Modest

Food stamps: Major, but not enough

Special distribution: Food pantries, kitchens: important, innovations appearing

The circular economy focuses attention on environmental aspects of waste and loss



Resources used in production (environmental externalities, such as water)



Environmental footprint of disposal

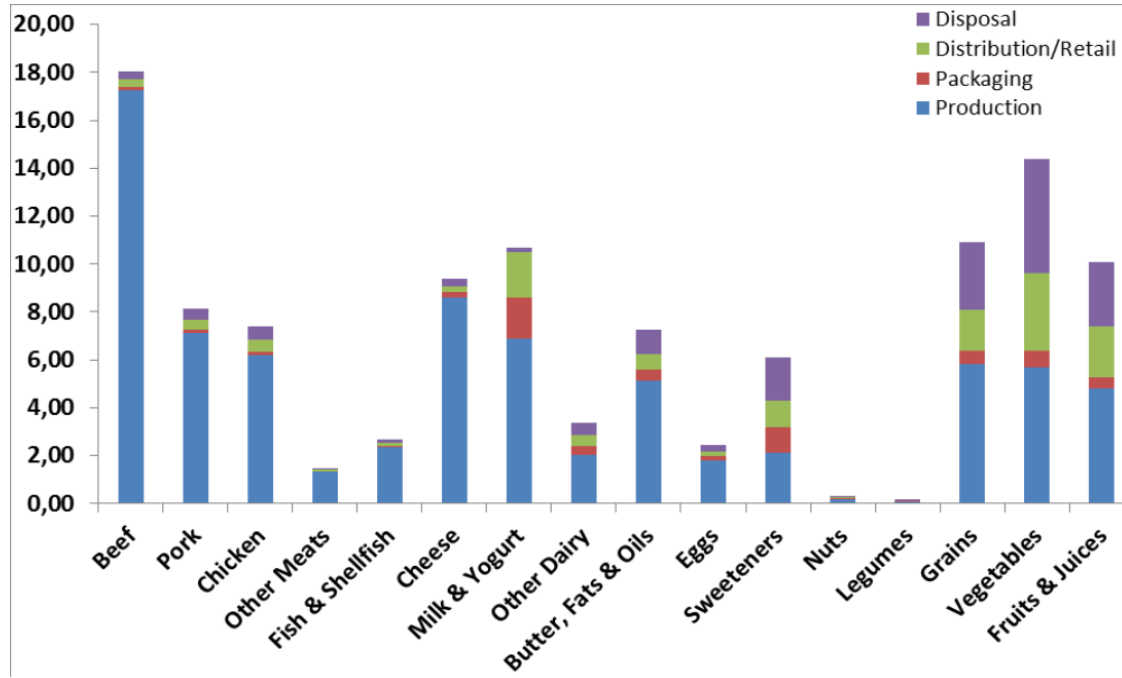


Greenhouse gas emissions from production, marketing, disposal

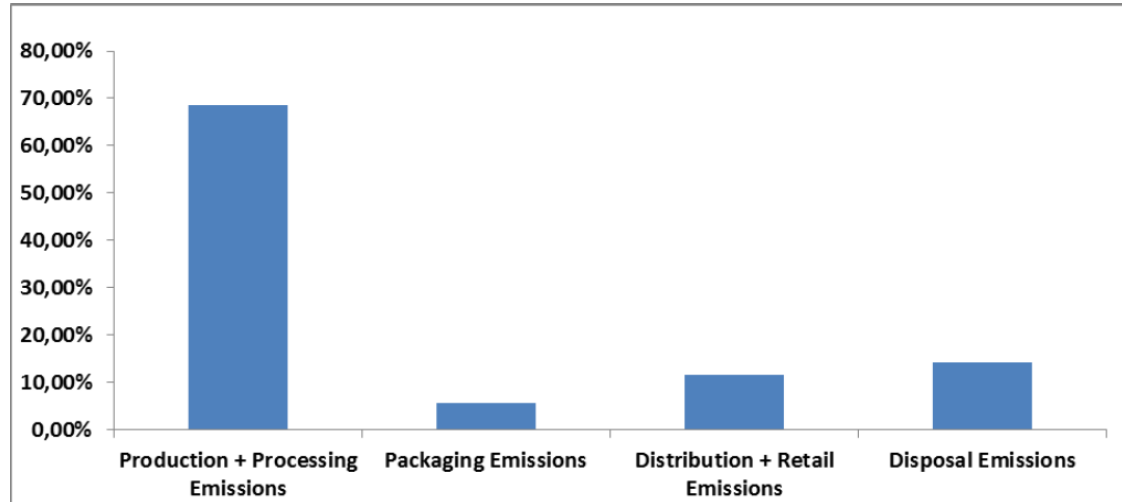
Greenhouse gas and climate change

Kumar Venkat / Int. J. Food System Dynamics 2 (4), 2011, 431-446

US national GHG emission from avoidable food waste in 2009 (MMT CO2e/year)



Components of US national GHG emissions from avoidable food waste in 2009



These emissions are equivalent to **2% of net US GHG emissions for 2009** based on the national emissions inventory published in the US Environment Protection Agency (EPA, 2011)

Combined attention to hunger and environment warrants sustained attention to loss and waste, not episodic preoccupation then neglect

The “want not” and “warm not” agendas complement each other

- The combination of food security and environmental management should underpin action

Action requires multiple interventions:

- Good measurement: how much, how, where
- Increased investment in multi-purpose infrastructure
- Increased investment in agricultural research, particularly climate smart technologies
- Targeted assistance to the poor and hungry
- Innovation in the retail and hospitality sectors
- Price incentives—taxes and subsidies—to reduce loss and waste and encourage adoption of climate smart agriculture
- Awareness and behavior change by producers and consumers

What are the current methods?

PFWL estimation methodologies

Macro approach

DATA & METHODS

Data: National or regional aggregated statistics

Methods:

- Mass- and energy balances: comparison of raw material input and produced output

PROS

- Cheap and straightforward implementation
- Representative for large region and good comparability

CONS

- High requirements on data quantity, quality and standardized collection methodologies
- Not representative for specific regional units
- No distinction between:
 - VC stages where loss occurs
 - Natural and unnatural loss
 - Edible and non-edible loss

PFWL estimation methodologies

Micro approach

DATA & METHODS

Data: data on a sample of value chain actors, often collected ad-hoc

Methods:

- Questionnaires and interviews
- Food loss and waste diary
- Direct measurement, through weighing or volume assessment
- Scanning

PROS

- Commodity, climatic zone and context specific
- Detailed, fully relevant and VC stage specific data
- Insights into causes and prevention possibilities

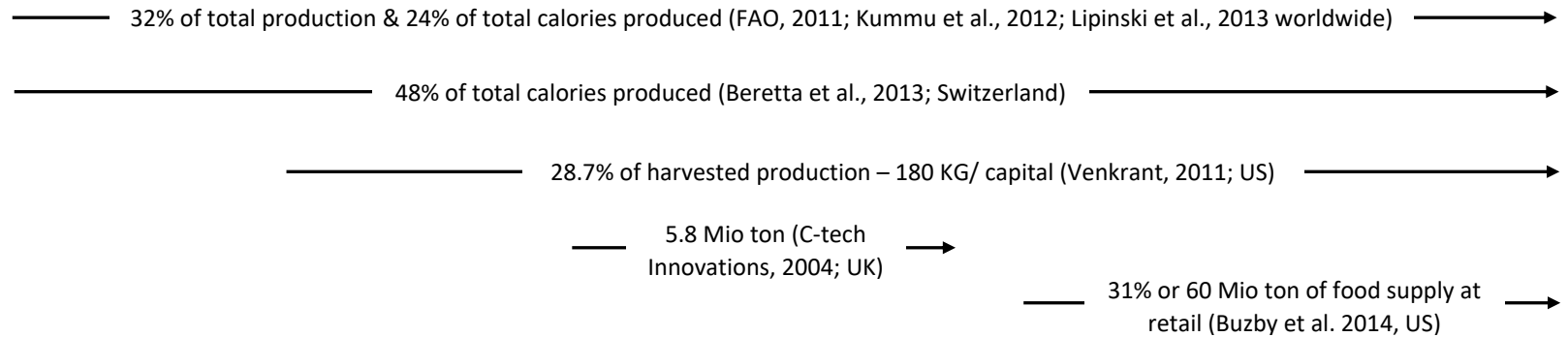
CONS

- Costly and time consuming
- Representativeness highly sensitive to sampling choices
- Sensitive to the estimation timing
- Estimates are often not comparable, and cannot be generalized
- Same estimation method can often not be applied to all VC stages

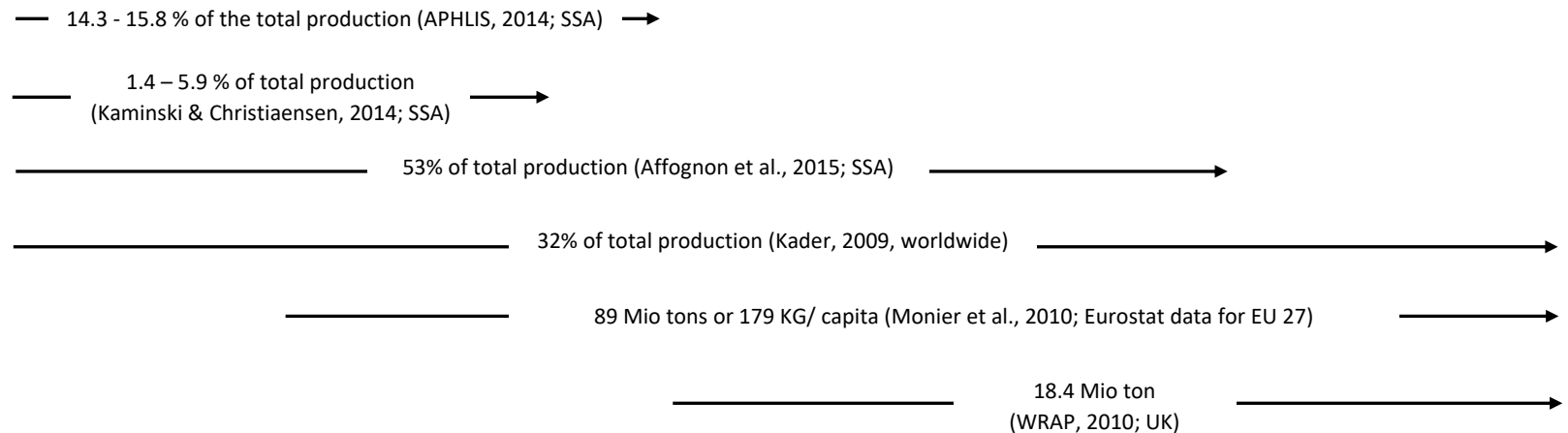
Estimation of PFWL

Production — Post - Production — Processing — Distribution — Consumption →

Macro Approach



Micro Approach



All loss and waste is reported per year

What is the problem?

What are we measuring?

Confusion in the definition

quantity *versus* quality

Weight, caloric, nutritional and/ or economic loss

Inclusion/ exclusion of different
loss dimensions

In percentage of total, harvested or potential
production

natural *versus*
unnatural

edible *versus* inedible

real loss *versus* re-use

Avoidable, possibly avoidable and unavoidable

What are we measuring? Quantity vs quality

‘The decrease in mass of food’

versus

‘The decrease of quality attributes of food linked to a degradation of the product (nutrition, micro-nutrient, aspect...)

What are we measuring?

Weight, caloric, nutritional and/ or economic loss

Weight: Decreased food mass

Caloric loss: food loss in terms of calories (in the calculation of FLW

it gives a greater “weight” to food loss of energy-dense foods)

Nutritional loss: food quantity might be preserved as expressed in mass, but this does not necessarily means that proteins quality and nutrients are equally preserved.

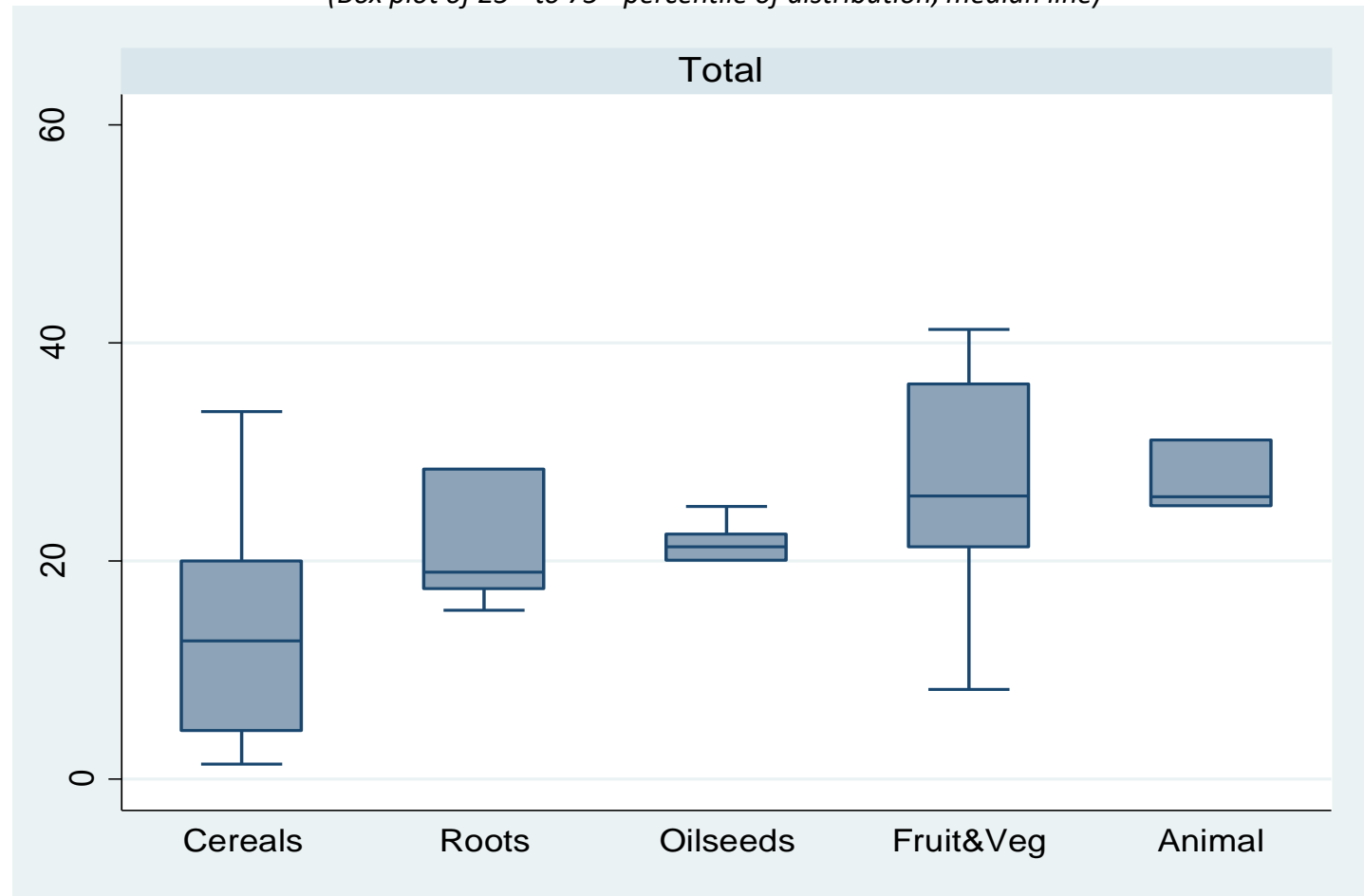
Economic loss: foregone income opportunity of producers or middlemen, due to decreased mass or quality

Diagnosis: How much?

Literature review shows wide variation

Percent of reported postharvest losses by commodity

(Box plot of 25th to 75th percentile of distribution, median line)

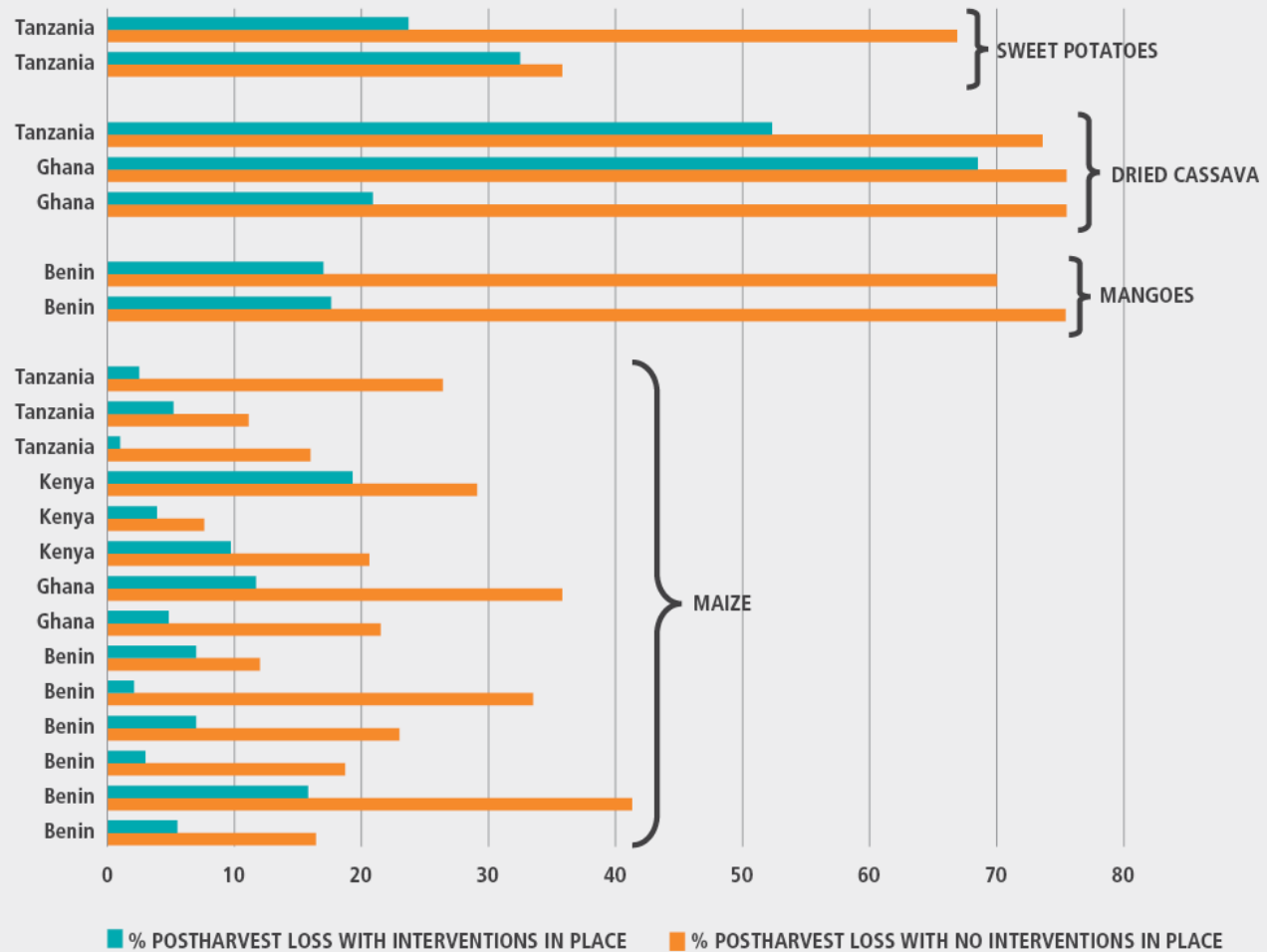


Range of post-harvest losses by commodity

Commodity	Country	Author	% PHL - Maximum (no interventio n in place)	Weights (wi)	% PHL - Minimum (with interventions in place)
Maize	Benin	Borgemeister et al. (1998)	16.40	0.09	5.50
	Benin	Meikle et al. (1998)	41.30	0.10	15.80
	Benin	Schneider et al. (2004)	18.70	0.18	3.00
	Benin	Meikle et al. (2002)	23.00	0.08	7.00
	Benin	Affognon et al. (2000)	33.50	0.04	2.10
	Benin	Adda, Borgemeister, Biliwa, and Aboe (1997)	12.00	0.44	7.00
	Ghana	Compton & Sherrington (1999)	21.50	0.05	4.80
	Ghana	Ofosu (1987)	35.90	0.06	11.70
	Kenya	Mutambuki and Ngatia (2012)	20.60	0.02	9.70
	Kenya	Komen, Mutoko, Wanyama, Rono, and Mose (2006)	7.60	0.01	3.90
	Kenya	Mutambuki and Ngatia (2006)	29.10	0.41	19.30
	Tanzania	Makundi et al. (2010)	16.00	0.44	1.00
	Tanzania	Golob and Hodges (1982)	11.10	0.01	5.20
	Tanzania	Golob and Boag (1985)	26.40	0.00	2.50
Mango	Benin	Vayssie`res, Korie, and Ayegnon (2009)	75.40	0.01	17.60
	Benin	Vayssie`res, Korie, Coulibaly, Temple, and Boueyi (2008)	70.00	0.00	17.00
Dried cassava	Ghana	Chijindu, Boateng, Ayertey, Cudjoe, and Okonkwo (2008)	75.50	0.19	20.90
	Ghana	Isah, Ayertey, Ukeh, and Umoetok (2012)	75.50	0.03	68.50
	Tanzania	Hodges, Meik, & Denton 1985	73.60	0.00	52.30
Sweet potato	Tanzania	Rees et al. (2003)	35.80	0.01	32.50
	Tanzania	Tomlins et al. (2007)	66.90	0.00	23.70

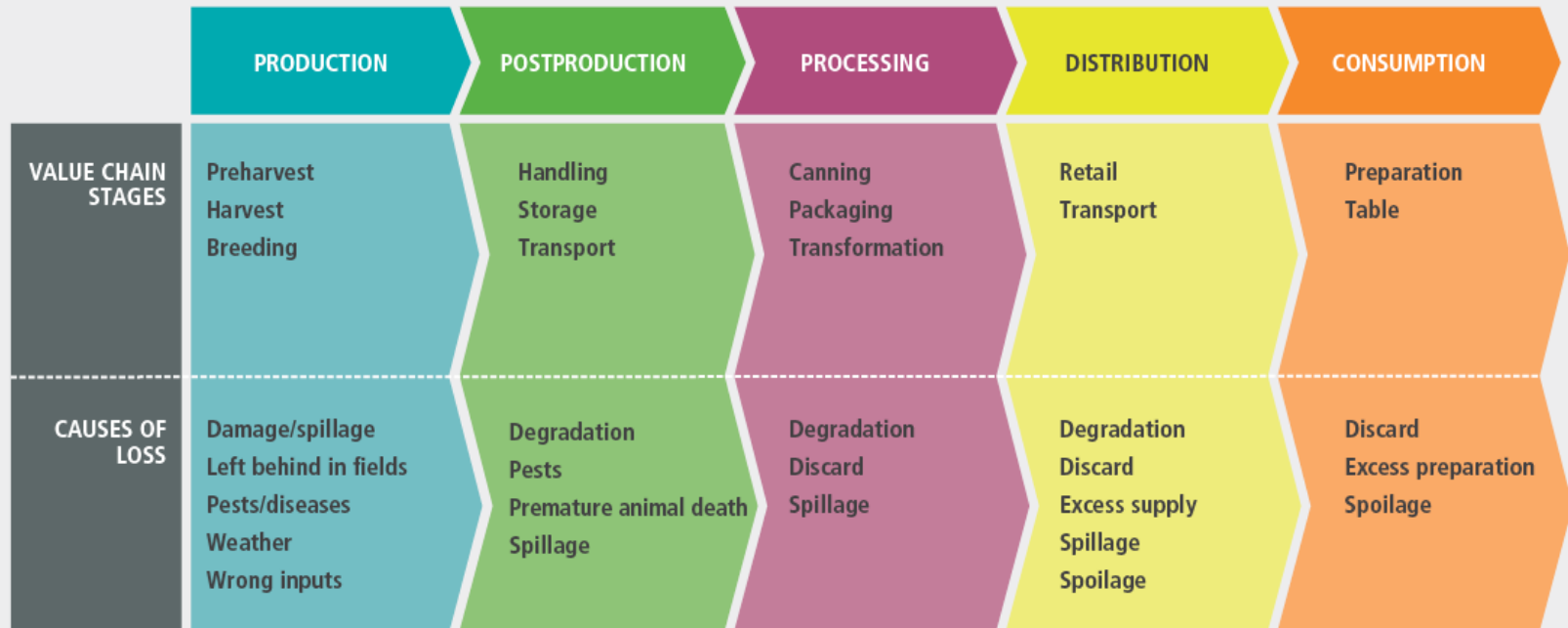
Source: Affognon et.al. (2014).

Range of post-harvest losses by commodity



What we need to know?

Food loss and waste across the value chain



Remedies

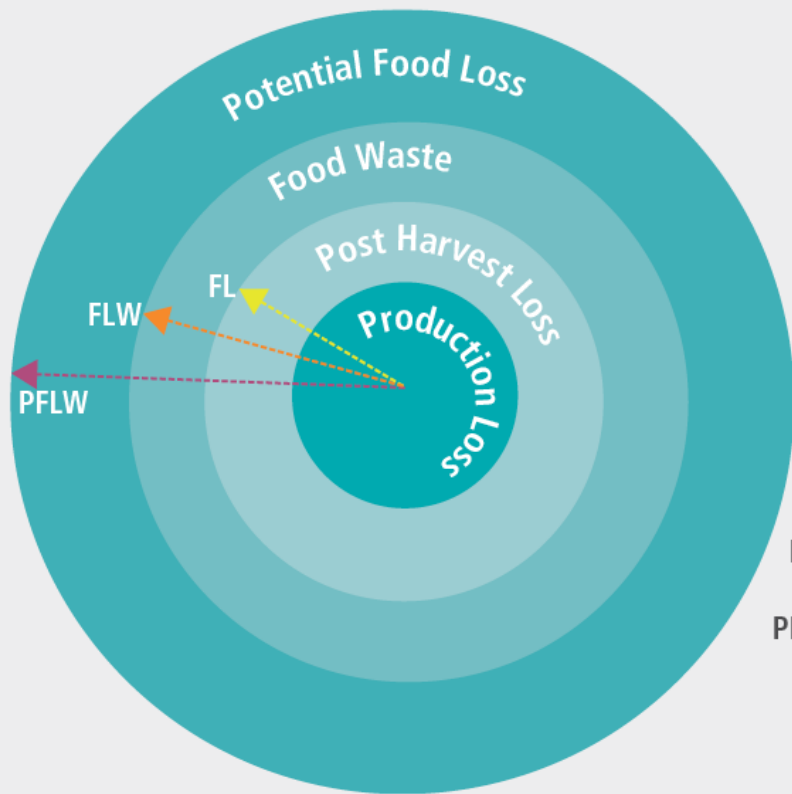


Food losses in the Nigerian cassava value chain

VALUE CHAIN STAGES	INPUT-SUPPLY	ON-FARM PRODUCTION	POSTHARVEST HANDLING	PRIMARY PROCESSING	MARKETING	CONSUMPTION
PRODUCTS	Cassava Tubers		Gari, Chips, Starch, Flour		Food Products	
CAUSES OF LOSS	Farm 8.5%		Gari Processing 14.8%	Starch Factory 11.8%	Gari Market 9.5%	
	HARVEST 5% STORAGE/SPOILAGE 1.6% SIZE/SMALL 1.9%		FRESH TUBERS 12.1% Transport 2.2% Too woody 4.1% Too small 5.8%	PROCESSING 5.5% STORAGE 6.3%	TRANSPORT 2.5% STORAGE 7% Moisture 4.5% Rodents 2.5%	
			GARI LOSS 2.7% Processing 1.6% Storage/spoilage 1.1%			

Bringing economics to the concept of
Loss and waste across the value
chain?

Not only accounting, but also opportunity cost



FL → FOOD LOSS: Unintentional reductions in food quantity or quality before consumption, including postharvest losses.

FLW → FOOD LOSS + FOOD WASTE: Deliberately discarded food that is fit for human consumption

PFLW → FOOD LOSS + FOOD WASTE + POTENTIAL FOOD LOSS: Crops lost before harvest to pests and disease or left in the field, crops lost due to poor harvesting techniques or sharp price drops, or food that was not produced because of a lack of appropriate agricultural inputs

Methodology proposed

Losses Across the value chain

- Huge variance on results and methods, they can vary considerably depending on the crop, local factors and the statistical methodology employed.
- However, even within the same commodities and countries, different studies provide substantially different estimates. Kader (2009). The estimates for PHLs range between 12% and 35%. In the case of cauliflowers in India, estimates of PHLs ranged between 13% and 35%. Similarly, he documents previous estimates of 10-15% and 22.7%-61.6% for cabbage in China
- Same problem with PHLs estimates calculated by the African Postharvest Losses Information System (APHLIS)
- Not appropriate systematic sampling to be able to extrapolate results
- Extremely complex to do a meta-analysis with current studies
- There is a need to have a common methodology, appropriate sampling and homogenous instruments to collect data
- Not enough information to identify technologies that can be used if the assessment of the losses along the value chain is not clear

Our proposal

- Develop a methodology to measure PHLs at the different stages of the chain value that can be applied across crops and regions.
- Our analysis will be limited to the analysis of the PHLs from farmers, middlemen, wholesale buyers, and processors as in developing countries PHLs in retail seems to be less important (in comparison to PHLs in the farmer to retail phase).
- We will collect information through representative surveys among farmers, middlemen, wholesale buyers, and processors. These surveys will allow us to characterize the storage and handling practices for each of these agents and estimate the quantities, quality and prices of the production as it travels through the value chain.
- The methodology takes into account the presence of multiple agents across the value chain, which complicates attribution of any potential loss to a specific node in the value chain.
- In addition, the methodology distinguishes PHLs that are due physical quantities from those due to quality and value.
- To gauge the usefulness of the methodology and the magnitude of PHLs across regions and crops, we propose studies in Africa, Asia, and Latin America for: cash crops; fruits, vegetables, and legumes; staple crops; and livestock products.

Steps

Step 1 – Literature Review

- Literature review of current studies on measuring post-harvest losses
 - Differentiating methods
 - Differentiating commodities
 - Differentiating regions
 - Understanding the market conditions in each of the regions
 - Identifying inconsistencies in methods

Step 2 – Classification of commodities and regions

- Based on Literature review we need to identify key commodities:
 - Cash crops (coffee, tea, sugar cane)
 - Fruits and vegetables
 - Staple crops (maize, rice, cassava, sorghum)
- Identify regions and market conditions
- Develop an appropriate sampling framework for 1 or 2 case studies by commodity and type of region

Step 3 – Develop a methodology to measure losses

- Commodity specific and context specific
- Identify needed sampling within the value chain
- Identify quantitative instrument that can be used and validated at a small pilot level
- Identify a qualitative component that will help understanding the reasons
- Implement methodology and validate results in field

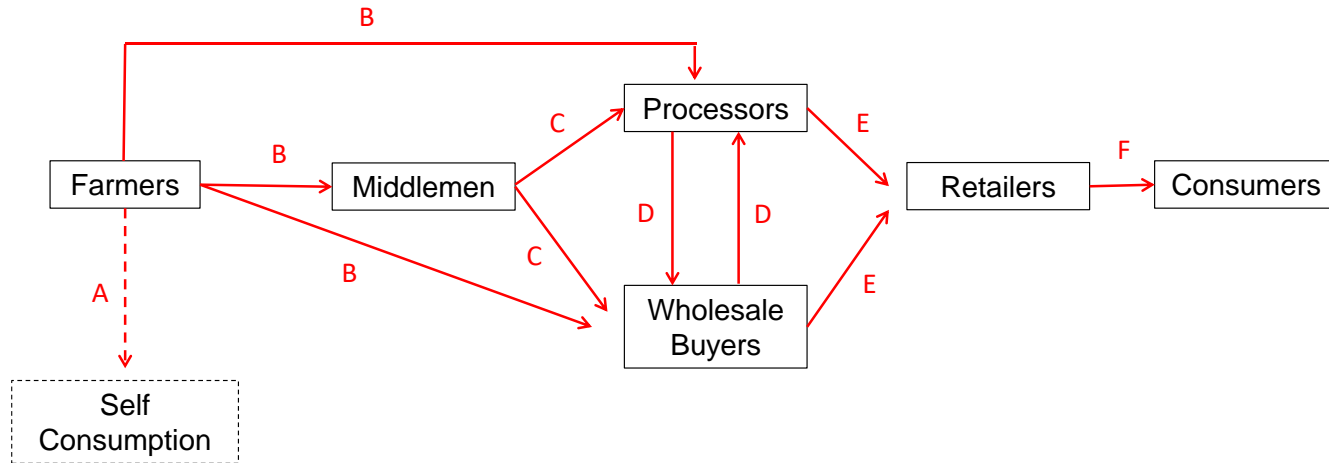
Step 4- Test some solutions

- Once we have consistent methods
- Identify key bottlenecks
- List potential solutions
- Test in the field solutions and use the tool to assess impact of solutions over losses
- Do a cost benefit analysis

Step 5- Linking results to modelling

- Given our sampling framework our results could be directly link to models
- Inputs on cost benefit ratios and productivity changes
- Modelers can simulate different scenarios based on different technologies.

Agricultural Value Chain in Developing Countries



- We plan to begin the data collection from the last (processors and wholesale buyers) to the first stage (farmers).
- The processor / wholesale buyer surveys will capture information about their trading patterns (purchased and sold quantities), locations where they purchase the agricultural products, and whether they additionally process crops (and if there are any losses due to processing). Importantly, we will collect information about their prices, their testing strategies, and how they assess the quality of the agricultural production
- Subsequently, we will collect data on the middlemen. We will collect similar information about their trading patterns, processing activities, prices paid to farmers, quality verification strategies (and product characteristics that determine price premiums or reductions)
- Finally, we will collect data from farmers. Data on farmers' production will allow us to estimate the share and describe the characteristics of the harvest placed in storage; their storage practices; the share and characteristics of the production that they consumed; and their product preparation activities.

Analysis

- Construct estimates of losses across the value chain by backward induction:
- Second, we would be able to quantify the value of losses and capture differences in quality throughout the value chain. To do so, we can take the differences in attributes (i.e. size, color, approximate moisture content, etc.) in the agricultural products that each agent buys or sells.
- In this spirit, we can estimate the value of the losses between processors / wholesale buyers and middlemen with three pieces of information.

The way forward

The way forward

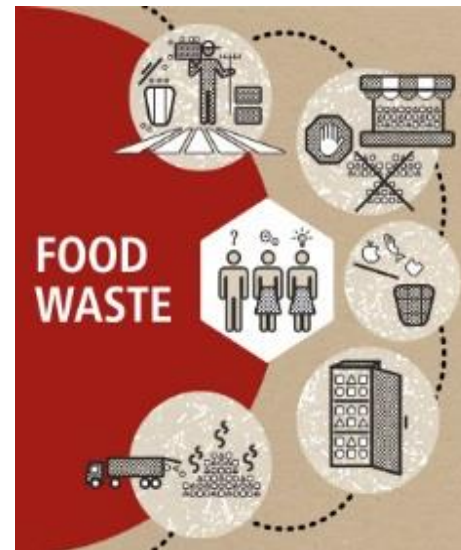
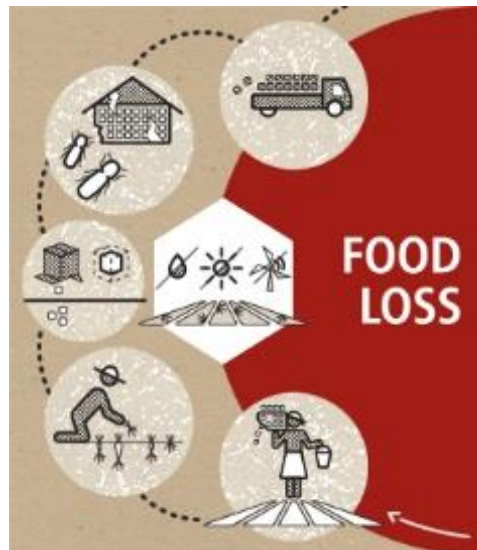
- Reducing Potential Food Loss and Waste (PFLW) can contribute to food security and sustainability and reach the SDGs, especially SDG 12
- Concrete targets at regional and country levels are needed
- Addressing PFLW requires a common understanding of the concept
- We need a better measurement and better understanding of the causes and market failures that contribute to them
- Micro-, meso- and macro-level causes need to be addressed

The way forward

- For smallholders, the public sector can address some of the market failures such as access to infrastructure and storage facilities
- The private sector also has a role to play, particularly when reducing PFLW can generate profits
- For developed countries, the focus should be on waste
- For developing countries, the focus should be on food loss and potential food loss; they should also leapfrog in policies to reduce waste

Technical Platform on the Measurement and Reduction of Food Loss and Waste

The G20 agriculture ministers highlighted the extent of food loss and waste (FLW) as "a global problem of enormous economic, environmental and societal significance" and encouraged all G20 members to strengthen their collective efforts to reduce FLW.



Sources:

IFPRI

2016 Global Food Policy Report

https://www.dropbox.com/s/oc0cn50o120fa4y/BK_GFPR_2016_embargoed_w.pdf?dl=0

FAO & IFPRI

Technical Platform on the Measurement
and Reduction of Food Loss and Waste

<http://www.fao.org/platform-food-loss-waste/en/>

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