



## Waste and Spoilage in the Food Chain

Decision Intelligence Document  
May 2013

# Problem Statement and Key Messages

***Food waste and loss is a large and increasingly urgent problem and is particularly acute in developing countries where food loss reduces income by at least 15% (according to the FAO) for 470 million smallholder farmers and downstream value chain actors, most of whom are part of the 1.2 billion people who are food insecure.***

## Key Messages

1. This Search was initially anchored in the Revalue Ecosystems Issue Area, but as a result of our analysis, we see a much stronger linkage to Secure Livelihoods. The most direct impact on the poor comes from the effect of food loss on the livelihoods and income of producers in developing countries for whom the loss and degradation of food leads to reduced volumes and prices at the point of sale.
2. The world population will reach 9 billion by 2050, and with 2 billion more mouths to feed, if food loss is not reduced, food production will need to increase in developing countries by an estimated 70% and require investment of \$83 billion per year to meet the demand. Cutting food wastage in half would yield enough food to feed 1 billion people, or enough for half of the projected population growth.
3. Ecological impact of food wastage is primarily driven by the intensity of agricultural practices in the developed world and the fact that consumer waste includes all the compounded resources used at every previous step in the value chain. However, developed country waste has a less clear link to impact on the poor and vulnerable than developing countries. Furthermore, developed world waste is a less dynamic space because the problem is distributed across many consumers and it is difficult to change their behaviors.
4. The Search findings indicate sub-Saharan Africa is the global region with the greatest momentum towards addressing food loss. Several African governments have named improved agriculture as a national priority for economic growth. Furthermore, emerging private sector interest is reflected in multinational corporations increasing their food sourcing from smallholders.
5. Food loss is gaining traction among policymakers, the private sector, and development agencies as a critical issue, and there is potential to shift the dialogue from the historical donor and government focus on increasing farm production towards increasing the efficiency of the food value chain as a whole.
6. The potential scale of impact of an initiative in Execution is likely to be several million, particularly in Africa, where there is a critical mass of individuals who are both farm-dependent and food insecure.

Term	Definition
<b>Types of Impact</b>	
<b>Food Security<sup>1</sup></b>	Physical and economic access to food that meets people's dietary needs. This document uses food inadequacy, a daily calorie intake below FAO recommended levels, as the primary indicator of food security. An estimated 1.2 billion people are food insecure.
<b>Ecosystem Impact</b>	Although there are many measures of ecosystem impact, this document uses measures of land use (in hectares) and water consumption as proxies for natural resource use. Other specific impacts are discussed where relevant.
<b>Economic Impact</b>	Increases in the incomes of farmers or agricultural workers or decreases in the price of food for people who are poor and vulnerable.
<b>Poor</b>	People currently earning less than \$2 per day, equivalent, at purchasing power parity.
<b>Vulnerable<sup>2</sup></b>	People at risk of falling into poverty in the near future.
<b>Loss and Waste</b>	
<b>Food Loss<sup>3</sup></b>	The decrease in edible food mass at production, postharvest, processing, and distribution in value chains directed to human consumption.
<b>Food Waste<sup>3</sup></b>	Food fit for human consumption being discarded at the retail or consumer level.
<b>Food Wastage<sup>3</sup></b>	Encompasses “food loss” and “food waste.”

Note: Calculation of 1.2 billion people comes from FAO food inadequacy indicators listing 22.5% of developing country population as food inadequate multiplied by 2011 population data provided by the World Bank World Development Indicators. Sources: (1) WHO website; (2) World Bank, “Measuring Vulnerability,” 2013; (3) FAO “Global food losses and food waste”; All other definitions are based upon literature review and Merriam-Webster and are intended to establish a common understanding of key terms going forward.

Term	Definition
<b>Loss Across the Value Chain</b>	
<b>Agricultural Production Loss<sup>1</sup></b>	Spilled or damaged agricultural output during harvest, sorting, and handling.
<b>Postharvest Handling and Storage Losses<sup>1</sup></b>	Losses due to spillage and degradation during handling, storage, and transportation off the farm.
<b>Processing Losses<sup>1</sup></b>	Losses due to spillage and degradation during industrial or domestic processing, including crops sorted out or lost during process interruptions.
<b>Distribution Losses<sup>1</sup></b>	Losses experienced while in the market system, e.g., in wholesale markets, supermarkets, retailers, and wet markets.
<b>Consumption Waste<sup>1</sup></b>	Waste incurred at the household level, typically due to discards.
<b>Types of Loss</b>	
<b>Degradation/Deterioration</b>	Decrease in volume, edibility, and nutritional value over time, as foods lose their original color, flavor, odor, and consistency.
<b>Discards</b>	Food intentionally thrown out by any actor along the value chain.
<b>Spoilage</b>	The decay of food due to yeasts, molds, or bacteria, which makes it unsuitable for consumption.
<b>Types of Crops</b>	
<b>Durables</b>	Cereals (excluding beer), which include: wheat, rice (milled), barley, maize, rye, oats, millet, sorghum, other cereals.
<b>Perishables</b>	1) Roots and tubers (i.e., potatoes, sweet potatoes, cassava, yams, other roots). 2) Fruit and vegetables.

***This Search primarily focuses on crop food losses in developing countries, which directly affect poor or vulnerable people. As a secondary focus, this Search includes a high-level discussion about U.S. food waste, which is primarily an ecosystem footprint problem.***

	Primary Focus	Secondary Focus (in Appendix)	Out of Focus
What geographies were covered?	<ul style="list-style-type: none"> <li>Developing country food loss and its impact on poor and vulnerable populations</li> </ul>	<ul style="list-style-type: none"> <li>Consumption waste in the United States and its impact on the ecological footprint of waste</li> </ul>	<ul style="list-style-type: none"> <li>Other developed countries (other than the U.S.)</li> </ul>
How far upstream in the value chain did we focus?	<ul style="list-style-type: none"> <li>Food wastage from the harvest period onward (e.g., poor harvesting technology causing food loss during harvest through food loss due to consumer discarding of spoiled food)</li> </ul>		<ul style="list-style-type: none"> <li>Effects on yield before the harvest period (e.g., insufficient irrigation stunting yield)</li> </ul>
What types of wastage were included?	<ul style="list-style-type: none"> <li>Wastage from food meant for human consumption, from the harvest period onward</li> <li>Embedded natural resources in wasted food (e.g., the water and land that has been wasted in producing food that is never consumed)</li> </ul>		<ul style="list-style-type: none"> <li>Agricultural processing byproduct (e.g., peels and seeds of fruit discarded during the juicing process)</li> <li>Non-food resource waste due to efficiency of processing (e.g., efficiency of energy use in milling)</li> </ul>
What categories of food were covered?	<ul style="list-style-type: none"> <li>Grains, fruits, vegetables, tubers, pulses, and dairy products produced for human consumption</li> </ul>	<ul style="list-style-type: none"> <li>Ecological footprint of livestock (and crops grown for feed) produced for human consumption</li> </ul>	<ul style="list-style-type: none"> <li>Aquaculture</li> </ul>

# Executive Summary (Developing World Context)

## Problem Assessment

- Food waste and loss is a large and increasingly urgent problem and is particularly acute in developing countries where food loss reduces income by at least 15% for 470 million smallholder farmers and downstream value chain actors, most of whom are part of the 1.2 billion people who are food insecure.
- In developing countries, 90% of wastage is from food loss within the value chain. It directly impacts poor producers through foregone income and impacts poor consumers through reduced food availability, increased prices, and decreased nutritional content.
- The primary source of loss is within crop foods, not meat and fish. Together, crop foods (e.g., grains, fruits, vegetables, tubers, pulses) and dairy comprise 92% of developing world losses. Although meat and fish have comparable rates of loss to other crops, they are a small part of the overall problem because they have relatively low production and consumption.
- The root causes of food loss are interlinked and complex, but the primary drivers include: lack of training and local services to build skills in handling, packaging, and storage; insufficient postharvest storage facilities or on-farm storage technologies; and poor market access that leads to spoilage before product is sold.

## Dynamism Assessment

- The most dynamic activities in the space that are addressing food loss and creating new livelihood opportunities include: i) market-based models for low-cost, distributed storage, preservation, and processing technologies that are creating accessible solutions for food loss; ii) the expansion of large commercial food companies' operations in emerging markets that are bringing technology, infrastructure, and management discipline to reduce losses; and iii) investments in agro-processing solutions that are reducing food loss and directly creating off-farm jobs.

## Landscape Assessment

- Food loss and waste receives relatively little donor capital addressed directly to the issue. U.S. philanthropic funding from 2008-2012 directed towards reducing wastage in developing countries amounted to only \$14 million, approximately 5% of the \$260 million directed towards agricultural productivity. Funding for postharvest loss research is about 5% of total agriculture research.

## Impact Assessment

- A preliminary estimate of a scenario for impact suggests that an investment of \$100 million could improve the incomes of 1 to 4 million farmers and value chain actors (plus their families) whose livelihoods are dependent on smallholder farming.

## Problem Assessment

- Ecological impact of food wastage is primarily driven by the intensity of agricultural practices in the developed world and the fact that consumer waste includes all the compounded resources used at every previous step in the value chain, so as a secondary priority, the appendix of this Search includes a high-level discussion of food waste in the United States. However, developed country waste has a less clear link to impact on the poor and vulnerable.
- Food wastage depletes water, land, and fertilizer and contributes to landfill and global warming. Thirty five percent (35%) of agricultural water resources in North America and Oceania are used to produce food that is unconsumed.
- Food waste in developed countries is driven by consumer and retailer behavior. Demanding aesthetic standards, strict food company contracts, large portion sizes, and promotion-driven sales lead to overproduction that is discarded.
- Meat accounts for only 7% of total food wastage in the United States, but uses land less efficiently than crops due to the need to grow feed and have grazing pastures. Cereals have a disproportionate impact on wasted water because of extensive irrigation.

## Dynamism Assessment

- The most dynamic activities that are addressing the problem of food waste in the United States include: i) media attention and consumer campaigns that have raised consumer awareness of the food waste issue and which may lead to changes in consumer behavior over time; ii) policies that are requiring food waste to be recycled or composted that can reduce the amount that ends up in landfill; and iii) food companies that are changing the way they manage food waste in order to reduce the amount they discard.
- However, changing food policies that drive waste nationally, as well as changing retailer, and consumer behavior is very difficult. Overall, there is less momentum towards solving the U.S. food waste problem than the food loss issue in developing countries, and there is no evidence of tipping points approaching.

## Landscape Assessment

- Current interventions in U.S. food waste focus on: i) redistributing excess food to food banks, ii) raising consumer awareness in order to change behaviors, and iii) investing in packaging solutions that better preserve food for retailers and consumers.

## Impact Assessment

- Due to the dispersed nature of food waste across many consumers, it is difficult to have a significant impact. For example, an initiative that could get 1 million consumers to reduce waste by 25% would reduce ecological impacts on water, land, fertilizer, and landfill in the United States by less than 0.05%.



# What is the scale and scope of the problem? Why is the problem pressing?

## Scale: Why It Is Important

**In developing countries, food loss is a large and increasingly urgent problem that affects producers and consumers by reducing income by at least 15% (according to the FAO) for 470 million smallholder farmers and downstream value chain actors, most of whom are part of the 1.2 billion people who are food insecure.**

- **Producers:** Production and postharvest loss constitutes 320 million metric tons of food (17% of total production) and associated income for the 470 million smallholder farmers in developing countries. Grain wastage in sub-Saharan Africa alone is worth \$4 billion per year.
- **Consumers:** Many producers are part of the 1.2 billion people who are food insecure, and food loss indirectly exacerbates the problem by contributing to price volatility. Food price increases starting in 2008 left an additional 200 million people hungry, bringing the total to nearly 1 billion people worldwide.

**Food wastage leads to the use of natural resources for unconsumed food, particularly in developed countries.**

- One quarter of global freshwater consumption is used producing food that is never eaten.
- Ecosystem impact of food waste and loss is primarily driven by intensity of agriculture practices in the developed world.

**The world population will reach 9 billion by 2050, and with 2 billion more mouths to feed, if food loss is not reduced, food production will need to increase by an estimated 70% and require investment of \$83 billion per year to meet the demand.**

- Reducing wastage by half would yield enough food to feed 1 billion people, half of the additional mouths expected by 2050.
- Although some wastage is inevitable, a scenario in which the lowest wastage percentages achieved in any region are applied to all other regions in the world suggests that a 50% reduction is achievable.

## Scope: Global Relevance

**Among crop foods, perishables (i.e., fruits, vegetables, roots, and tubers) have the largest loss in both relative and absolute terms and loss is an especially notable problem in sub-Saharan Africa (particularly Nigeria, Ghana, and Ethiopia), which has the highest per capita losses of any crop in any developing region.**

- Root and tuber loss is comparatively important to diets in sub-Saharan Africa, which loses twice as many kilograms per person per year as in South and Southeast Asia.
- The only hotspot with more per capita losses than roots and tubers in Africa (110 kg per capita) is the loss of vegetables in Industrialized Asia (115 kg per capita).

**Across developing countries, cereals in South and Southeast Asia (particularly India, Indonesia, and Vietnam) have large losses in absolute terms due to scale of production, but are low as a percentage of production.**

- Loss of cereals in South and Southeast Asia account for almost 8% of total global food losses and are the largest concentration of loss in any crop in any developing country.
- However, only 20% of cereal production in South and Southeast Asia is lost, compared to 51% of fruits and vegetables in the same region.

**The food loss problem has been getting worse over time.**

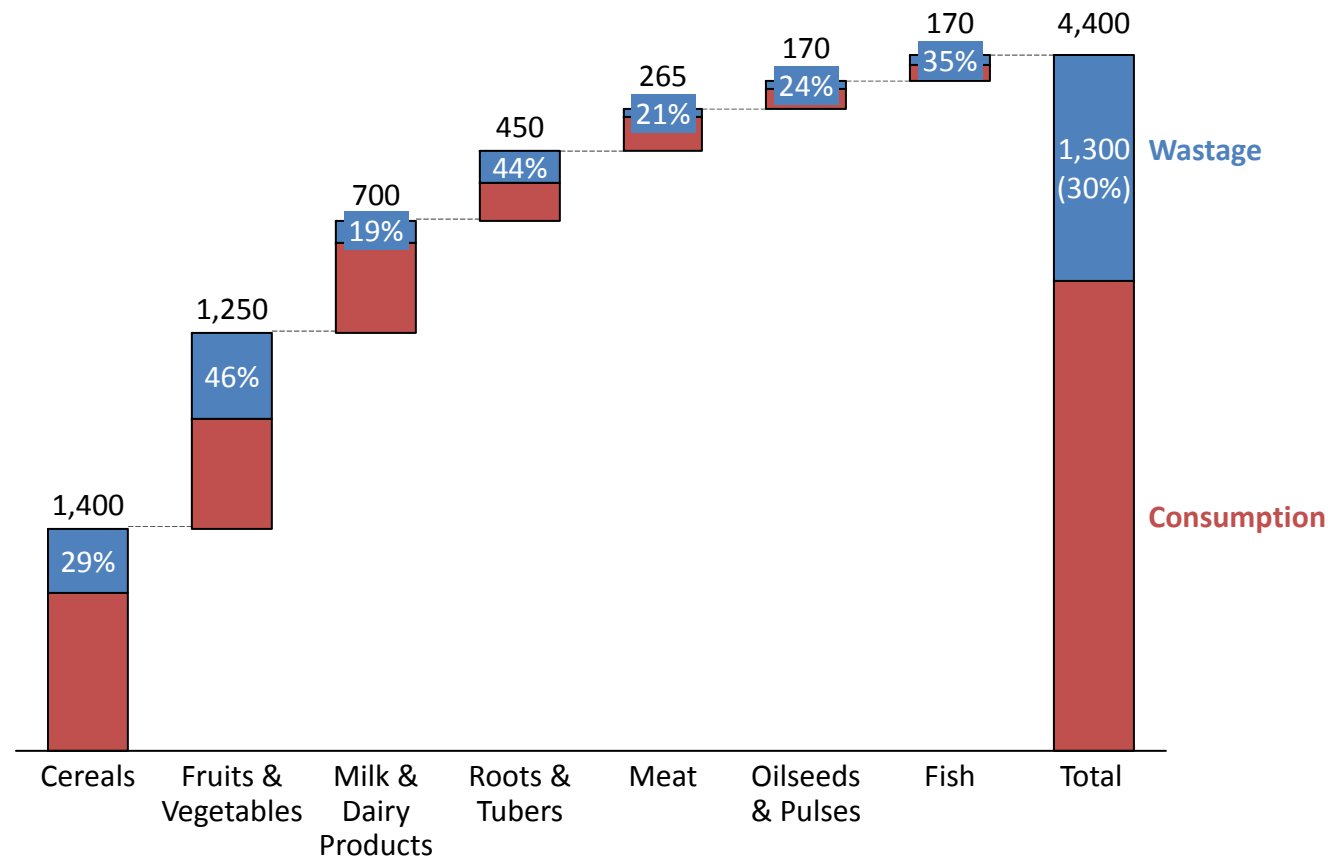
- Although lack of comprehensive time-series data makes it difficult to know conclusively, loss of rice in Southeast Asia has increased from about 14% in 1994 to an average of 20% in 2007, which suggests the problem is getting worse.



# What is the scale and scope of the problem?

## Wastage is a Global Problem, with Roughly One Third of Food Produced for Human Consumption Lost from Farm to Fork

Global Food Production by Crop Category (million metric tons, % of category total)\*



**Fruits and vegetables contribute the most wastage despite being the second-largest category by production volume.**

- Cereals production is 12% larger than fruits and vegetables production, but contributes 400 million metric tons wastage worldwide compared to fruits' 575 million metric tons.
- Fruits and vegetables have the largest opportunity for improvement.

**Meat and fish are a small share of total wastage (~8%) but are expected to grow as incomes increase.**

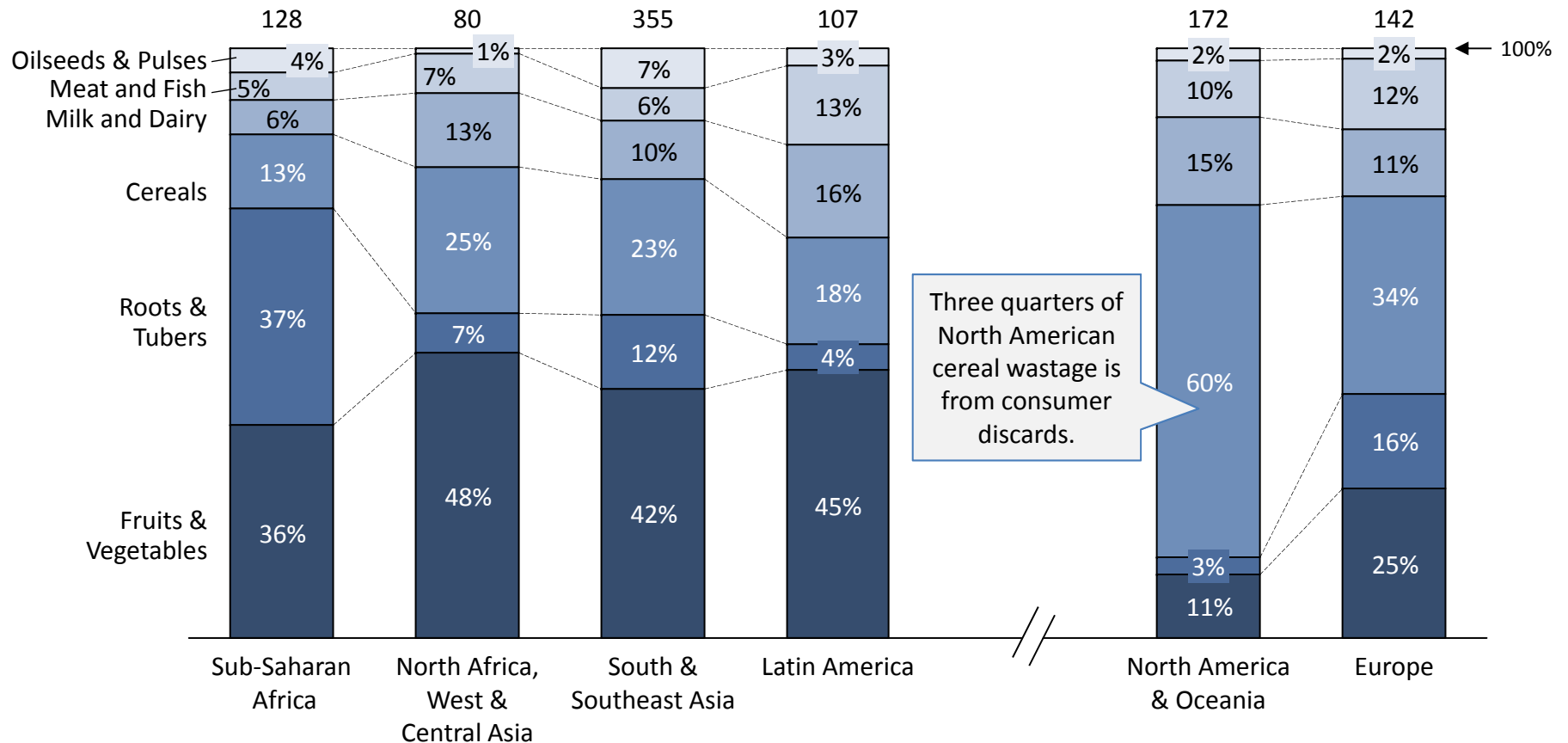
**Roots and tubers contribute a large relative share of waste, but small absolute amount.**

- Root and tuber wastage, at 200 million metric tons, is half of that within cereals.

# What is the scale and scope of the problem?

## Amount of Wastage by Region and Type of Food, Millions of Metric Tons

**From a crop perspective, fruits and vegetables have the largest losses across developing geographies, accounting for 42% of developing country loss and waste worldwide. In sub-Saharan Africa, roots and tubers are also a significant source of loss.**



# What is the impact on the lives of poor or vulnerable people?

## Impact on Poor or Vulnerable People is Driven by Developing Country Food Loss

**VULNERABLE PRODUCERS – Food loss leads directly to lower effective yields, increases exposure to price volatility, and decreases productivity for smallholder farmers.**

- **Decreased Sales:** Food loss during the harvesting period directly decreases saleable volumes by at least 15% for the 470 million smallholder farmers and their families and affects the 290 million people working downstream in the agriculture industry.
- **Price Volatility:** Food loss and the inability to store food decreases farmers' ability to manage fluctuating agriculture prices. Developing countries are expected to continue facing more volatile prices than other countries, increasing pressure on the vulnerable.
- **Long-term Productivity:** Tackling food loss would increase effective yields without having to use agriculture practices that deplete long-term productivity of land.

**POOR CONSUMERS – Most vulnerable producers are also part of the 25% of households in the developing world that are food insecure and face vulnerability due to food loss.**

- **Food Availability:** More than half of fruits and vegetables and nearly one quarter of cereals are lost, which decreases food availability for the 1.2 billion people facing food inadequacy in Africa, Asia, and Latin America.
- **Food Price:** Spending studies indicate that consumers in low income countries spend 40-50% of their incremental income on food. Food loss therefore affects poverty of the consumer base through higher real food prices. Over the long term, the sustained increase in food supply brings more people out of poverty than the income increases to farmers.
- **Nutrition:** Food loss affects fruits, vegetables, roots and tubers most directly, removing potential dietary diversity that is good for human health. Improper storage can also accelerate crops' nutritional degradation before reaching consumers.
- **Health Risk:** Improperly stored grain can create aflatoxin and other mycotoxins, which are avoidable but can be deadly, causing 25,000 to 150,000 cases of liver cancer per year.

**WOMEN AND CHILDREN – Women are disadvantaged in agriculture and would receive outsized gains from reducing food loss.**

- **Gender Equity in Production:** Despite making up half of the farming work force, women own less land (e.g., only 25% of farmland in Tanzania) and smaller plots (e.g., half the average plot size in Benin) as compared to men. Beyond the farm gate, they also face decreased access to transportation, barriers to membership in cooperatives, and time constraints that prevent them from finding the highest prices for their produce. Although data is not available, it is likely that women experience larger losses than men.
- **Nutritional Deficiency:** Additional availability of fruits and vegetables may help decrease the incidence of stunting, which affects 180 million children worldwide and can lower lifetime earnings by up to 22%.

***Food loss affects poor or vulnerable populations in the developing world, but is not a primary source of negative ecosystem impacts.***

# What are the root causes at play? What systems failures are causing or exacerbating the problem?

*Of the root causes listed, the majority of food loss in developing countries is due to a lack of training and local services to build skills, poor postharvest techniques and facilities, and inadequate market access, each of which vary by degree across regions and crops.*

**System Failures:** Underlying constraints that exacerbate vulnerability in developing countries

<p><b>Political System</b></p> <p>Poor road and market infrastructure is a key source of loss across the developing world, and the government is the only actor that can address this issue.</p>	<p><b>Policy System</b></p> <p>Policies create distortions in markets, particularly through price floors, which can lead to overproduction of crops beyond what the market demands, increasing wastage.</p>	<p><b>Economic System</b></p> <p>Negative economic, social, and ecosystem externalities embedded within farming practices are not accounted for in the price of products, causing wastage to be undervalued.</p>	<p><b>Cultural Norms</b></p> <p>Access to markets, services, networks, inputs, training, and finance is key to reducing food loss, but cultural norms can exclude some people based on gender or ethnicity.</p>
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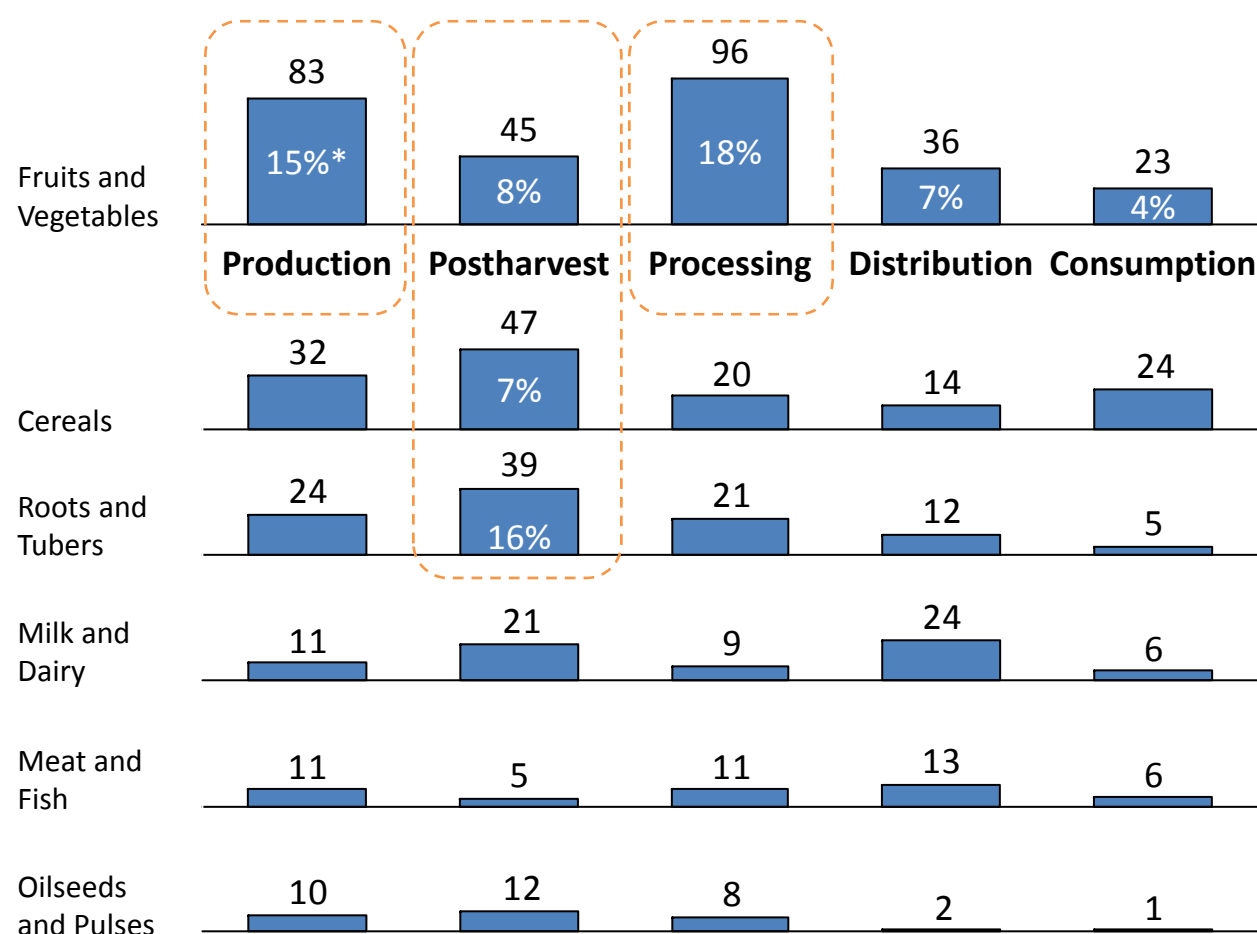
**Root Causes:** Main drivers that directly contribute to vulnerability in developing countries

<p><b>Weak Infrastructure</b></p> <p>Poor storage and processing facilities, bad roads, nonexistent cold chains, and lack of electricity for chilling and processing all contribute to loss across the value chain.</p>	<p><b>Poor Human and Financial Capital</b></p> <p>Lack of training and services to build skills (e.g., handling, packaging, and storage) inhibits best practices. Limited financing prevents investment.</p>	<p><b>Limited Access to Markets</b></p> <p>Rural farmers travel long distances or face cultural barriers that limit their ability to deliver product to market before it spoils.</p>
<p><b>Strict Industry Requirements</b></p> <p>Overly stringent aesthetic requirements lead to excessive trimming and discards. Contractual obligations with minimum required volumes lead to overproduction that rots or is discarded.</p>	<p><b>Lack of Technology and Information</b></p> <p>Poor or outdated technology does not sufficiently preserve and protect food. Lack of timely market and weather information leads to poor production and harvesting decisions.</p>	<p><b>Limited Access to Services</b></p> <p>Food loss is exacerbated by insufficient or inaccessible value chain services (e.g., storage, packaging, transport, and processing).</p>

# What are the root causes at play?

Amount of wastage in developing countries, millions of metric tons and as % of production<sup>1</sup>

*The largest sources of loss in developing countries are in fruits and vegetables and the postharvest storage of cereals, roots, and tubers.*



## Primary Root Causes

### Fruits and Vegetables:

- Production: 15%\* is lost through manual harvest, bad weather during the harvest season, and premature harvest due to cash constraints.
- Postharvest: 8% is lost, mainly due to bruising or damage from improper packaging or handling, lack of cold storage in warm and humid climates, and seasonality that yields surpluses.
- Processing: 18% is lost due to high seasonality and poor storage, together lowering incentives to build processing capacity that meets total demand.

### Cereals:

- Postharvest: 7% is lost due to improper storage, attributable to poor hygiene, pest infestation or bumper harvests beyond capacity.

### Roots and Tubers:

- Postharvest: 16% is lost, mainly due to lack of cold storage in warm climates and distance to market.

\*Note: Percentages listed are share of total category production in developing countries.

# What are the prevailing perspectives on this problem?

***Research and interventions in developing countries have largely focused on technology-based approaches, but donors have more recently taken a wider market-based approach. In developed countries, donors have focused on consumer advocacy to change behaviors.***

## Technology-Based Approach

**“It’s important to develop technologies and techniques to reduce postharvest losses that are appropriate to the needs of local communities.”**  
The technology-based approach seeks technological solutions to specific food loss problems at single points in the value chain. For example, this may include on-farm storage in hermetically sealed bags, fruit and vegetable refrigeration through solar-powered coolers, and mobile drying systems for grain.

## Market-Based Approach

**“The transition to market-driven systems with greater reliance on the private sector necessitates that postharvest loss interventions be embedded in the context of value chains.”**  
Recent donor activity has focused on improving the efficiency of the value chain as a whole, rather than on single points. The market-based approach recognizes the importance of having sufficient capability, capacity, and incentives along the entire value chain in order to reduce losses.

## Awareness Approach

**“Simple actions by consumers and food retailers can dramatically cut the 1.3 billion ton of food lost or wasted each year.”**  
The awareness approach suggests that by changing consumer behavior, food loss and waste can be reduced. In developed countries, most waste is driven by consumers and food companies catering to consumer tastes, thus changes in consumer behavior are the most promising solution. This is the approach currently being taken by the SAVE FOOD campaign.

***One or more of these approaches can be emphasized depending on the context, but some combination of these approaches is likely required to effectively address food wastage.***



# What has and has not worked?

***Failed past interventions focused on promoting imported technologies and raising awareness, while more recent approaches have attempted to strengthen value chain linkages.***

	What Has Not Worked	What Has Worked
Efforts to Improve Technology Adoption to Prevent Loss	<ul style="list-style-type: none"> <li>• <b>Pushing new technology onto specific user groups without tailoring it to local conditions and economics has consistently failed.</b> In the 1970s, aid agencies donated technologies for reducing specific types of loss. These technologies failed to scale due to lack of economic incentives for adoption, poor cultural fit, incorrect assessment of the root causes of loss, and short project timelines.<sup>1,2</sup> Poor design persists today, as Kenya’s National Cereals Produce Board sees 50% utilization of its 1 million tons of storage capacity due to poor locations and trust concerns.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Locally tailored and commercially viable technologies can be successful.</b> Over 6 million metal silos have been distributed to smallholder farmers for grain storage in Central America, made successful by local manufacturing capacity, a partial subsidy and government promotion.</li> <li>• <b>Adoption of labor-saving technologies has occurred in Asia, where rural wages have recently risen.</b> These include small-scale rice dryers and rice threshers, which reduce loss in both the storage and processing stages.</li> </ul>
Efforts to Improve Farmer Links to Markets	<ul style="list-style-type: none"> <li>• <b>Warehouse receipt systems for grains can be politically contentious and, therefore, difficult to scale up.</b> Public warehousing has not scaled quickly in east Africa due to repeated political interference in times of food insecurity, which distort incentives for private banks, borrowers, and collateral managers to cooperate.</li> <li>• <b>Interventions can be culturally inappropriate.</b> Farmers accustomed to individually storing grain on-farm resisted government collective storage in Uganda out of concern for grain security.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Functioning downstream markets create incentives for reducing food waste.</b> Lesiolo Grain Handlers has been financially profitable and thus sustainable because it is a commercially-driven organization that is not owned by the government. The World Food Programme began procuring food from smallholder farmers in 2008, contracting 260,000 tons through commodity exchanges, warehouse receipts, grain fairs, and direct contracts that reached 42,000 farmers.</li> </ul>
Efforts to Improve Awareness of Food Loss	<ul style="list-style-type: none"> <li>• <b>Multilateral agencies failed to make postharvest loss a major global issue when real food prices were declining.</b> Following the food crisis in the 1970s, the UN prioritized reducing staple crop postharvest losses. The initiatives created, FAO’s Prevention and Food Loss Program and the Global Postharvest Forum, faltered as real food prices began to decline and the issue lost urgency.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Major donors have elevated the importance of food loss because real food prices are high, volatile, and expected to remain so in the future.</b> FAO’s SAVE FOOD Initiative, USAID’s Feed The Future, and the Government of China have launched food loss reduction initiatives, that are elevating the issue as an urgent problem for sustainable food security that ultimately trumps food price fluctuation.</li> </ul>

## 2) Dynamism Assessment

### Purpose

The Dynamism Assessment aims to identify the primary opportunities that could be catalyzed to address the problem. It also aims to identify emerging issues and future trends that could influence these opportunities, and the potential risks or uncertainties that could inhibit transformative change.

### Key Findings

- Sub-Saharan Africa is the most dynamic region because governments increasingly view growth in the agricultural sector as a national strategic priority for economic growth. Since the 2003 Maputo declaration, many African governments have been moving towards (or exceeding) their commitment to allocate at least 10% of their national budgets to agriculture.
- The most dynamic activities in the space that are addressing food loss and creating new livelihood opportunities include: i) market-based models for low-cost, distributed storage, preservation, and processing technologies that are creating accessible solutions for food loss; ii) the expansion of large commercial food companies' operations in emerging markets that are bringing technology, infrastructure, and management discipline to reduce losses; and iii) investments in agro-processing solutions that are reducing food loss and directly creating off-farm jobs.
- Potential tipping points that could catalyze large-scale positive change include: i) affordable new technologies becoming more widespread and available, and ii) widespread adoption of standards among food companies for sustainable engagement of smallholder farmers.
- The growth and direction of these dynamic activities will be shaped by changing demographics, climate change, national government strategies, and the increasing maturity of the agriculture sector.

# What forces are creating windows of opportunity?

## Forces Contributing to Dynamism

- **Donor Agencies.** Official development assistance (ODA) for agriculture as a share of total ODA has been increasing for the last decade. The G8 New Alliance for Food Security and Nutrition, USAID's Feed the Future initiative, and the E.U.'s policy framework on Enhancing Maternal and Child Nutrition, reflect ongoing attention to agriculture and food security. Meanwhile, the FAO has raised 10% of its target \$52 million for a five-year, multi-donor initiative on reducing food loss.
- **National Governments.** African governments increasingly view growth in the agricultural sector as a national strategic priority for economic growth. In the 2003 Maputo declaration, African governments committed to allocate at least 10% of their national budgets to agriculture. Although only 8 countries have met the target, at least 40% have been moving closer in recent years.
- **Regional Corridors.** Trade corridors such as the Common Market for Eastern and Southern Africa (COMESA) are opening up markets and creating more regional demand for export of raw and processed agricultural products.
- **Research Institutions.** Research institutions have been developing new agricultural technologies to meet donors' shifting priorities. In 2011, ADM presented a five-year, \$10 million gift to the University of Illinois to found the ADM Institute for the Prevention of Postharvest Loss.
- **Emerging Middle Class.** Emergence of the middle class is increasing consumers' purchasing power, shifting diets toward higher intensity products, and moving more people to cities.
- **Food Companies.** Walmart, ADM, Cargill, and other food companies have been entering emerging markets in pursuit of growth in both commodity sourcing and sales.
- **Impact Investors.** Investors with a mix of social and financial goals have been increasingly looking at agriculture in developing countries. A 2010 study found more than \$4 billion in 31 funds focused on agriculture, primarily in sub-Saharan Africa, and the number has been increasing.

## Areas of Dynamism

### Technology Distribution

**Models:** Market-based models for low cost, distributed storage, preservation, and processing technologies are creating accessible solutions to food loss.

**Retail Revolution:** Large commercial food companies are expanding in emerging markets (particularly Africa and India) and bringing technology, infrastructure, and management discipline that reduces losses in the value chain.

**Agro-processing:** Agro-processing solutions that can reduce food loss and create off-farm jobs are increasingly adapted to crops in the developing world.

# What are the primary opportunities that could address this problem?

***Within the areas of Dynamism, there are opportunities for donors to have impact by supporting innovative financing, coordinating standards with the public and private sector, assessing business cases, and creating public-private partnerships.***

## Technology Distribution

*Market-based models for low-cost, distributed storage, preservation and processing technologies are creating accessible solutions to food loss.*

- **Design:** Research and create new technology solutions (Researchers).
- **Pilot:** Test solutions in actual value chains and evaluate economic feasibility (Donors).
- **Financing:** Incentivize investments and finance the purchasing of technologies (Donors and Impact Investors).
- **Manufacturing and Distribution:** Establish local manufacturing and distribution of the technology (Government and Private Sector).
- **Marketing and Extension:** Promote technology and provide training on proper use (Government and Private Sector).
- **Monitoring and Reporting:** Assess progress and results in order to correct failures and scale-up successes (Donors and Researchers).

## Retail Revolution

*Large commercial food companies are expanding in emerging markets and bringing technology, infrastructure, and management discipline that reduces loss.*

- **Standards:** Develop labor, safety, quality, and inclusive sourcing standards for retailers (Retailers, Government, and Donors).
- **Infrastructure:** Build roads and cold chain to connect retail outlets with farmers (Government and Retailers).
- **Aggregation:** Organize farmers into producer groups that can deliver to retailers (Donors and Retailers).
- **Value Chain Coordination:** Improve efficiency of actors along the value chain to ensure reliable delivery of product (Donors and Retailers).
- **Value Chain Financing:** Develop finance products that leverage retailer relationships as collateral (Banks and Impact Investors).
- **Technical Assistance:** Build capability of farmers to meet requirements of retailers (Donors and Retailers).

## Agro-processing

*Agro-processing solutions that can reduce food loss and create off-farm jobs are increasingly adapted to crops in the developing world.*

- **Business Case:** Assess specific processing opportunities supported by availability of raw input and local or regional demand for output (Donors and Government).
- **Public-Private Partnership:** Organize stakeholders to create PPP's (Donors).
- **Capital Financing:** Provide public or private financing for construction of facilities (Government and Investors).
- **Management:** Establish operational management (Private Sector).
- **Labor:** Support skill training for workers (Donors and Private Sector).
- **Technical Assistance:** Build capacity of farmers to meet standards required by processing centers (Government and Donors).
- **Monitoring and Reporting:** Assess progress and results (Donors).

Highlighted initiatives reflect the most dynamic opportunities where a donor could generate impact.

# How do we know that these opportunities are gaining traction?

## Areas of Dynamism

### Technology Distribution

**Models:** Market-based models for low-cost, distributed storage, preservation and processing technologies are creating accessible solutions to food loss.

**Retail Revolution:** Large commercial food companies are expanding in emerging markets and bringing technology, infrastructure, and management discipline that reduces losses in the value chain.

**Agro-processing:** Agro-processing solutions that can reduce food loss and create off-farm jobs are increasingly adapted to crops in the developing world.

## Evidence of Movement

- **Incentives for Investment:** In 2011, G20 donors announced support for prize mechanisms to incentivize and reward public and private sector investment in agriculture. This \$100 million global, multi-donor initiative includes on-farm storage as one of its three pilots.
- **Value Chain Financing:** Impact driven smallholder agricultural lenders, such as Root Capital, are finding innovative ways to provide capital to farmer organizations by using value chain relationships and purchase contracts as collateral. In October 2012, USAID announced a five year credit enhancement to allow Root to disburse \$50 million to more than one million farmers to help reduce postharvest losses and process foods for local markets.

- **Establishing Standards:** Food companies have been creating “pre-competitive” alliances to collaborate outside of the core business by establishing standards for smallholder farmer engagement, sharing best practices, and pooling resources to build capacity (e.g., the Sustainable Agriculture Initiative). Companies consistently express a desire for more alliances that are specific to particular crops and geographies.

- **Developing the Business Case:** The African Agribusiness and Agro-industries Development Initiative (3ADI) is a multi-donor framework to promote agribusiness by identifying value chain constraints to agro-processing, postharvest handling, supply chain management, and trade promotion. One of the goals is that by 2020, at least half of Africa’s food products sold are in processed form.
- **Public-private Partnerships:** Although examples of public-private partnerships for agro-processing are limited, there are some emerging successes, such as Uganda Grain Traders Ltd., a company formed by 16 trading companies to coordinate processing, storage, and quality control. Kenya and Ghana have had success with public-private partnerships for cold storage.

## Potential Tipping Point

**Affordable new technologies become more widespread and available.**

**Widespread adoption of standards among food companies for sustainable engagement of smallholder farmers.**

**Investment and growth agro-processing companies through public-private partnerships.**

# What potential tipping points are emerging?

	Description	What would have to happen to reach this tipping point?
<b>Positive Potential Tipping Points</b> (Actions & events that could catalyze large-scale positive change)	<ul style="list-style-type: none"> <li>• <b>Affordable new technologies become more widespread and available.</b> Appropriate technologies can reduce some types of losses from 20% down to 1% if those technologies can be scaled. A key barrier is access to finance and affordability of technologies.</li> </ul>	<ul style="list-style-type: none"> <li>• Adoption and growth of value chain financing models.</li> <li>• Growth and penetration in commercial sale and use of loss-averting technologies among smallholder farmers and value chain actors.</li> </ul>
	<ul style="list-style-type: none"> <li>• <b>Widespread adoption of standards among food companies leads to reduced waste by smallholder farmers.</b> Shareholders, consumers, and policy makers can help shape the standards and working relationships that will define the norms for how food companies expand in a sustainable and inclusive manner.</li> </ul>	<ul style="list-style-type: none"> <li>• Bold, quantifiable, and time-bound commitments to smallholder sourcing by major food companies.</li> <li>• Pre-competitive alliances among major food companies.</li> <li>• Development and adoption of smallholder engagement standards by food companies.</li> </ul>
<b>Negative Potential Tipping Points</b> (Thresholds beyond which there is no going back)	<ul style="list-style-type: none"> <li>• <b>Demanding industry standards make food discards more widespread in developing countries.</b> The flip side of increasing food company penetration in developing countries is that, without improvements in farmer practices or food company standards, there could be added pressure to increase discards due to aesthetic requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• Changes in industry standards in developing countries that could exclude smallholder farmers due to aesthetic requirements.</li> <li>• Changes in consumer preferences among the emerging middle class in developing countries that put pressure on food companies to tighten aesthetic requirements.</li> </ul>
<b>Too Early to Tell</b>	<p><i>These could potentially be tipping points (positive or negative) but will require further monitoring to define and size:</i></p> <ul style="list-style-type: none"> <li>• <b>Investment and growth of agro-processing companies through public-private partnerships.</b> Public-private partnerships for agro-processing are still relatively untested, and the few that exist are too new for impact evaluations, but there may be an emerging opportunity to support their expansion for the benefit of smallholder farmers.</li> </ul>	



# What are emerging issues and future trends that could influence these opportunities?

*The growth and direction of the dynamic activities will be shaped by changing demographics, climate change, the increasing development of agriculture, and national government strategies.*

## Changing Demographics

Growth in food demand will track the growth of the young labor force, urbanization, and the middle class, whose purchasing power will shift the average diet.

- **Youth Boom:** 32 million youth in Africa will enter the labor force each year, reaching an economically active population of 1.6 billion people by 2050.
- **Rapid Urbanization:** One third of global migration to cities will happen in Africa, where nearly 60% of the continent's population will live by 2050.
- **Higher Value Diets:** GDP per capita in sub-Saharan Africa is expected to rise threefold, from \$1,700 in 2010 to \$4,800-5,500 by 2050, steadily shifting toward higher quality and more diverse foods. The retail sector, including food, typically expands moderately once GDP per capita reaches \$750, and rapidly once it exceeds \$3,000.

## Climate Change

Climate change will cause higher yield volatility and cause more frequent and forceful droughts and floods, elevating the importance of food loss prevention to sustain existing supplies.

- **Yield Decreases:** Climate change is likely to negatively impact southern Africa in particular. Its maize, wheat, and sugarcane, along with western Africa yams and groundnut, are at risk of median yield decreases between 5% and 28%. Significant uncertainty remains when forecasting the impacts of climate change on specific crop-region pairs.
- **More Droughts and Floods:** Scientists project with moderate confidence that droughts and floods will increase across Africa, with particular risk in coastal areas.

## Increasing Development of Agriculture Sector

Multinational and regional agribusiness investment is accelerating farm privatization, where plantation farms' production plateaus will eventually shift sourcing toward smallholder farmers.

- **Smallholder Sourcing:** Companies are expected to expand their sourcing from smallholder farmers in developing countries, particularly as their traditional sources reach production plateaus. Global companies SABMiller, Walmart, Tesco, Olam, ADM, and Export Trading Group, and regional players such as Nakumatt and Reliance Retail, are beginning to engage in this via off-take agreements.
- **Demand for Value Chain Development:** African urban food demand is expected to rise fourfold through 2030, to a value of \$400 billion, requiring matching supply chain improvements in sourcing, storage, processing, distribution, and retail.

## National Government Strategies

Food loss reduction depends on government attitudes toward agricultural trade and investment in roads, markets, and cold chain infrastructure.

- **Improving National Trade Policies:** Maize protectionism is dropping in sub-Saharan Africa, recently halving in aggregate since 2008.
- **Regional Trade Commitments:** Momentum is increasing for a Continental Free Trade Area connecting three of Africa's major trade unions (COMESA, EAC, SADC) that could increase regional trade by nearly \$35 billion through 2022.
- **Regional Agricultural Commitments:** The New Partnership for Africa's Development's (NEPAD) Comprehensive Africa Agriculture Development Program (CAADP) is an Africa-led initiative to improve food security and nutrition and boost productivity by 6% per year.

# What are potential risks or uncertainties?

***Interventions in this space are subject to a range of factors that could derail or diminish impact, including unintended pricing fluctuations, limited data availability, and unknown policy responses.***

Risks	<b>PRICE RISK</b>	<ul style="list-style-type: none"> <li>A significant increase in market volumes could lead to a reduction in farm gate prices. However, in developing countries 60-80 percent of the price goes to commission agents. Linking farmers directly to markets and retailers to cut out middlemen might lead to higher prices for farmers and lower prices for consumers, which would be a win-win for both parties.</li> </ul>
	<b>EMPLOYMENT DESTRUCTION</b>	<ul style="list-style-type: none"> <li>Increasing private sector investment from foreign companies or use of new technologies risks putting small local actors out of business, potentially having a negative impact on small traders and distributors in the value chain.</li> </ul>
	<b>RAPID SMALLHOLDER FARMER AGGREGATION</b>	<ul style="list-style-type: none"> <li>Rapid aggregation of smallholder farmers into plantation farms could make targeted smallholder interventions irrelevant.</li> </ul>
Uncertainties	<b>LIMITED DATA AVAILABILITY</b>	<ul style="list-style-type: none"> <li>Measuring food loss is critical to deciding where to intervene, but data is severely lacking. A study by AGRA found that 90% of the data on losses across 11 staple crops in Africa was missing. Until there are robust measurement systems across crops, it will be hard for donors and the private sector to efficiently allocate investment.</li> </ul>
	<b>PROTECTIONIST AND DISTORTIONARY POLICIES</b>	<ul style="list-style-type: none"> <li>Government interference in food markets distorts market prices of food, lowering incentives to invest in agricultural supply chains and agro-processing while inhibiting regional trade. Government responses cannot always be anticipated, but can be mitigated by engaging governments as stakeholders.</li> </ul>
	<b>UNCERTAIN ECOSYSTEM RESILIENCY</b>	<ul style="list-style-type: none"> <li>One quarter of global farmland is already heavily degraded, which climate change is expected to worsen while simultaneously increasing vulnerable farmers' production risk.</li> </ul>
	<b>TECHNOLOGY BREAKTHROUGHS</b>	<ul style="list-style-type: none"> <li>Engineered seeds could create breakthroughs for crops in developing countries that would increase yields and result in lower pressure to reduce food losses. However, the pace of technological change in agriculture suggests that a combination of better seeds and reduced losses will both be needed to meet projected demand for food from a growing population.</li> </ul>

### Purpose

The Landscape Assessment aims to identify the key players and opinion leaders in the field, what organizations are doing innovative work, who provides funding, and the gaps in funding.

### Key Findings

- Food loss and waste receives relatively little donor capital specifically dedicated to addressing the issue. U.S. philanthropic funding from 2008-2012 directed towards reducing wastage in developing countries amounted to only \$14 million, approximately 5% of the \$260 million directed towards agricultural productivity. Funding for postharvest loss research is about 5% of total agriculture research.
- Relatively few donors have taken a commercial and market-based approach to addressing food loss. Instead, they have traditionally focused on disseminating technological solutions and supporting value chain efficiency without a specific food loss focus.
- The most dynamic activities are in sub-Saharan Africa. Not only is Africa the source of the most pronounced per capita food losses, but it is also where most key players and thought leaders have focused their initiatives.
- The food value chain spans a diverse set of players ranging from small farmers and traders up to large wholesale markets and food service companies (e.g., ADM, Cargill, Walmart).
- There is a white space opportunity to support the development of distribution models for on-farm technologies and develop market-based private sector linkages to reduce food loss.

# Who are the key players and opinion leaders in the field?

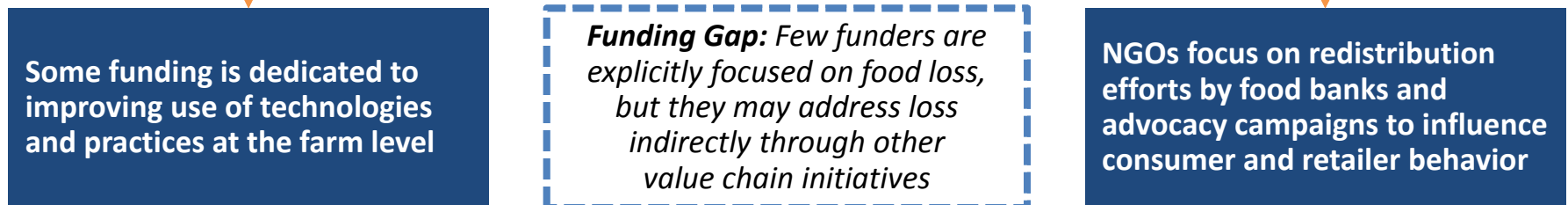
*The food value chain spans a diverse set of players ranging from small farmers and traders, up to large wholesale markets and food service companies.*



## Actors Along the Global Food Value Chain



## Areas of Philanthropic Emphasis



*Most philanthropic efforts do not focus solely on reducing food wastage, but rather aim to increase agricultural productivity across the value chain, which may indirectly contribute to reductions of wastage.*

## Who are the key players and opinion leaders in the field?

***Public agencies and NGOs have been focused on food loss for some time; the private sector and research institutions are increasingly taking a critical lens to the problem.***

### Public Agencies

Multilateral and bilateral agencies such as the FAO, CGIAR, the World Bank, USAID, and GIZ conduct field research, manage advocacy campaigns, and execute or facilitate key interventions that span technology- and market-based approaches. In 2011, FAO launched the “Save Food Initiative,” for which it aims to fundraise \$52 million from various donors.

### International and Local NGOs

Organizations such as the International Fertilizer Development Centre (IFDC), AGRA, and the Postharvest Project are implementing waste reduction-focused programs, adopting a technology-based approach by testing storage methods or processing machinery. Meanwhile, NGOs in the United States are tackling consumption waste predominantly through awareness campaigns and local redistribution programs (e.g., food bank services).

### National Governments

While governments have historically focused on increasing agricultural production, some African countries, including Kenya and Tanzania, have begun to emphasize the issue of postharvest loss, and appointed officials to address the problem from a market perspective. Several regional networks and governing bodies (e.g., Comprehensive Africa Agriculture Development Programme, New Partnership for Africa’s Development) are involved in strengthening agricultural supply chains.

### Research Institutions

Departments at various U.S. research institutions (e.g., ADM Institute at Illinois and UC Davis) provide foundational knowledge on postharvest loss and wastage reduction techniques. Agricultural research departments across Africa and Asia house research subsidiaries that study food loss by crop type (e.g., International Rice Research Institute, Stellenbosch University). However, postharvest loss only attracts about 5% of all funding for agricultural research globally.

### Private Sector

Companies such as DuPont, General Mills, ADM, and Walmart are partnering with NGOs to implement solutions that reduce food loss. Private sector networks such as the Global Cold Chain Alliance and East Africa Grain Council contribute to infrastructure or market-based improvements while various social enterprises (e.g., GrainPro, DADTCO) test promising and commercially sustainable technological interventions.

## What organizations are doing innovative and / or high-impact work?

***Although we identified over 70 existing interventions in the space, less than a dozen organizations are doing highly innovative and impactful work that is directly focused on the issue of food loss. A sample is included below.\****



**Food and Agriculture Organization of the United Nations (Global):** With an overarching mission of achieving food security, FAO has implemented numerous interventions globally to reduce postharvest loss (PHL), mainly through capacity building, technical assistance, and the establishment of innovative institutional mechanisms (e.g., warehouse receipt systems and revolving funds). FAO produces global and regional research on food wastage, measuring both the ecosystem impact and socioeconomic consequences of wastage, then formulates solutions and proposes enabling policies built on this evidence base. In 2011, FAO launched the “Save Food Initiative,” for which it aims to fundraise \$52 million. This effort spans awareness raising, collaboration and coordination of global programs, policy and strategy development, field studies, and investment in global programs and projects.



**DuPont (Global):** DuPont Food Security is collaborating with USAID to reduce maize postharvest loss in Ethiopia through increased use of hybrid maize seed, improved seed distribution, and postharvest storage. This collaboration aims to help more than 30,000 smallholder maize farmers increase their productivity by up to 50% and reduce postharvest loss by up to 20%. DuPont supported Global 4-H in launching agricultural leadership institutes in five African countries to engage and train youth about agriculture. In addition, DuPont’s Global Food Security Index, launched with the Economist Intelligence Unit in 2012, continuously measures the risks and factors driving food security. The index tracks affordability (e.g., access to farmer financing), availability (e.g., agricultural infrastructure), and quality and safety (e.g., micronutrient availability).



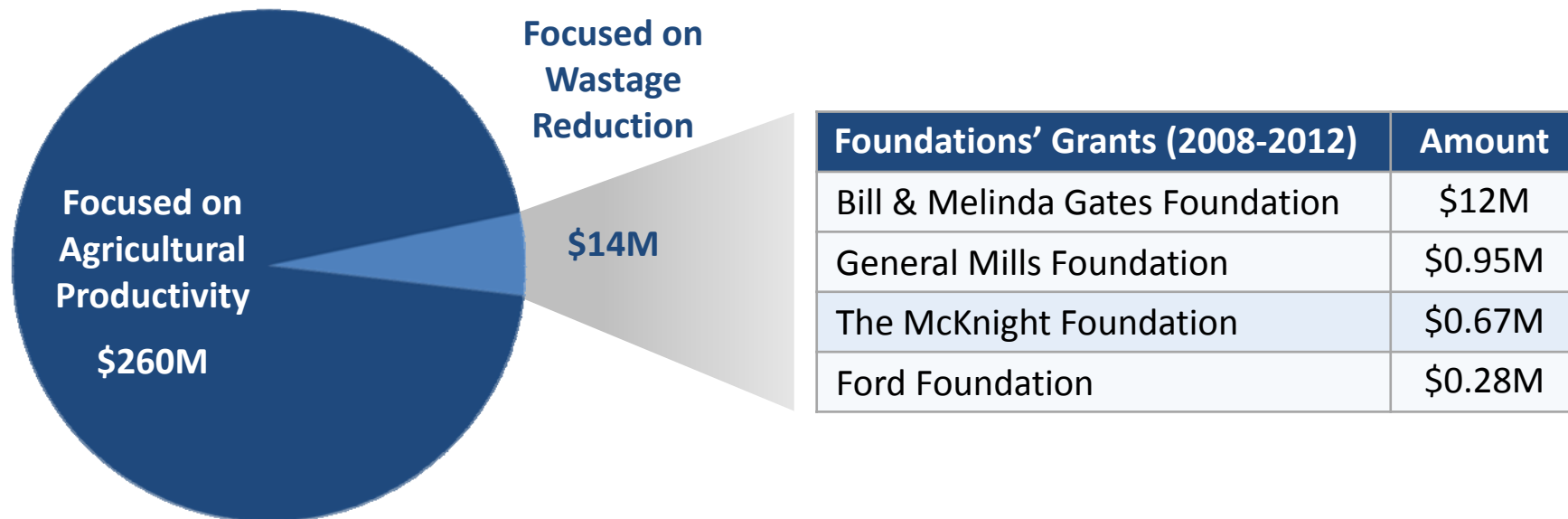
**GrainPro, Inc. (Global):** Founded in 1992, GrainPro is a social enterprise dedicated to providing safe, cost-effective solar drying and airtight storage products to over 80 countries. GrainPro aims to improve the quality of life by reducing world hunger, protecting public health, increasing small farmers’ incomes, and improving the environment. Hermetic storage of the kind provided by GrainPro’s products reduces losses without chemicals or refrigeration from up to 25% to less than 1% per year. In 2010, GrainPro fulfilled a \$7 million USAID subcontract for its hermetic storage and solar dryer systems to small Afghan farmers. It has also sold its products to the World Food Program for use in Guatemala, the Philippines, Burundi, and Kenya.



# Who is providing funding in this space?

## U.S. Philanthropic Funding Landscape: Key Observations

***U.S. philanthropic funding explicitly directed towards reducing wastage in developing countries from 2008-2012 amounts to only \$14 million, approximately 5% of the ~\$260 million directed towards agricultural productivity.***

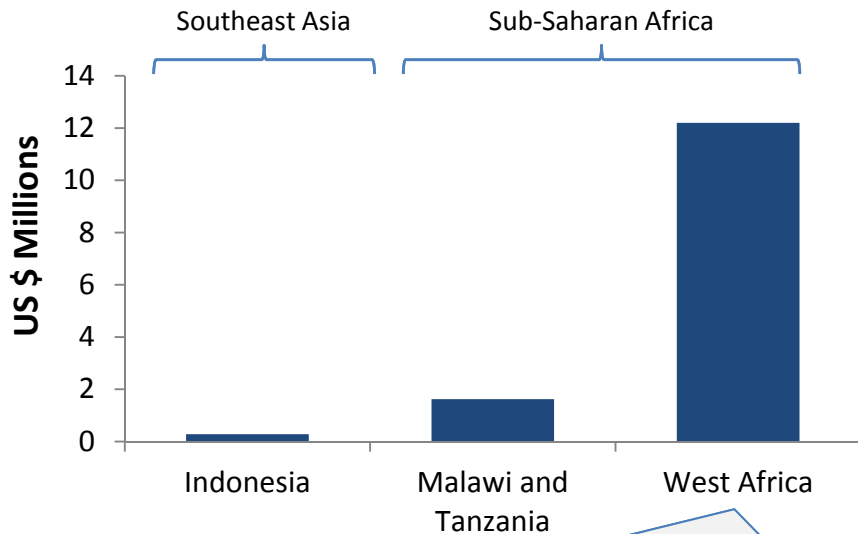


Note: Funding for initiatives that “focused on wastage reduction” is defined as project descriptions that either include the terms “postharvest” and “waste” or “loss” or are carrying out activities that directly lead to postharvest loss reduction. “Focused on agricultural productivity” indicates grants that include the terms “agricultural productivity” or “agricultural value chains” in their descriptions. Source: Foundation Center.

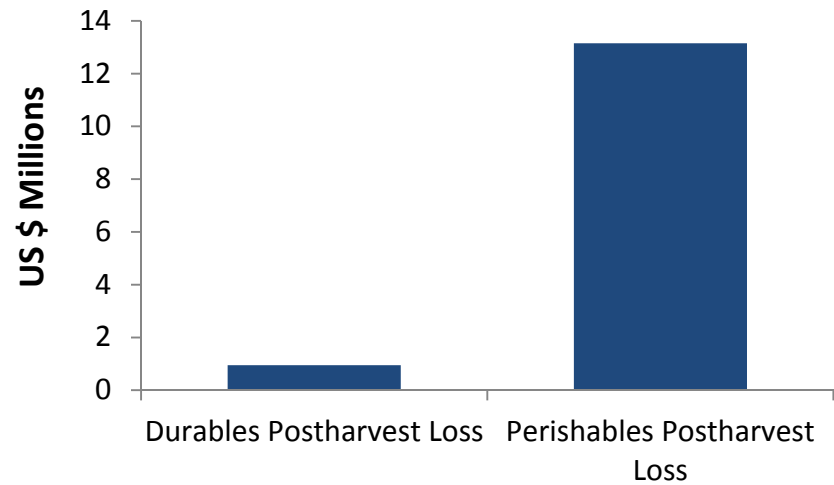
# How is funding distributed across sub-themes? What are potential gaps in current funding?

## U.S. Philanthropic Funding Landscape: Distribution of Funding

U.S. Philanthropic Funding by Target Region



U.S. Philanthropic Funding by Food Type



The Bill & Melinda Gates Foundation gave a 5-year \$12.2 million grant to the International Institute of Tropical Agriculture to support Nigerian and Ghanaian yam farmers.

***U.S. philanthropic funding targeting wastage reduction is currently concentrated in one project in West Africa.***

## How are funding trends expected to change over time?

***Funders are taking a series of different approaches depending on their respective capabilities and mission.***

### Developing and Scaling-up On-farm Technologies and Practices

Donors and research institutes have been creating, piloting, and scaling technologies (e.g., drying machines and hermetically sealed bags) to address specific types of food loss. They increasingly focus on market-based solutions to address the failings of previous interventions that were not sustainable without donor money.

### Investment in Postharvest Infrastructure and Market Linkages

Large multilateral donors (e.g., FAO, Africa Development Bank) have been investing in postharvest infrastructure. The trend is supported by increasing private sector investment in supply chain infrastructure, particularly as large retailers and traders expand into emerging markets (e.g., Reliance Retail's fruit supply chain in India).

### Investment in Measurement of Sources of Loss

A few donors are supporting food loss measurement systems (e.g., the African Postharvest Losses Information System and the DuPont Global Food Security Index). Sources consistently cite the lack of data on food loss as a key problem because until the problem can be accurately measured, it is hard to focus investments.

### Advocating for Consumer Awareness

Donors seeking to reduce the large amount of waste on the retail and consumer end of the value chain have launched awareness campaigns in order to create consumer demand for reductions in discards by supermarkets, distributors, hotels, restaurants, and households (e.g., Feeding the 5000 and Think Eat Save).

## Coverage Drivers

- Major reports and conferences hosted by global organizations such as the UN Food & Agriculture Organization, other UN agencies, G8 summits, World Bank and leading NGOs drove media coverage.
- Media coverage was driven by debate or adoption of government policies designed to improve food security. There was little media coverage of what multinational food companies are doing to reduce waste and spoilage.
- Global media coverage of food shortages is driven by climate/disaster events, such as drought, rather than infrastructure or supply-chain issues.

## Gap Analysis

- Coverage lacks an in-depth conversation about how food loss contributes to food scarcity in developing countries. It also fails to discuss simple solutions – not currently brought to scale – that could prevent insects, disease or temperature changes from spoiling food.
- There was little media attention on the role of multinational food companies in addressing some of the infrastructure challenges to prevent both food waste and food spoilage.

## Volume, Geography and Tone

- Media outlets in Africa, China, India, Brazil, Indonesia, Mexico and the United States were most active in coverage.
- More than 500 relevant articles were reviewed from English-language global media and native-language media in selected markets.
- Social conversation is weak, with less than 1,000 mentions over the past 12 months. Online dialogue is led by journalists, agribusiness groups and environmental NGOs.
- Tone is neutral, and focused more on reporting published reports rather than proposing solutions.

## Highlights from Coverage

- Coverage focused on the presentation of statistics and research showing that while developed country food waste is primarily at the consumer level, developing country food loss and waste are mainly connected to financial, managerial and technical limitations in harvesting techniques, storage and cooling facilities in difficult climatic conditions, infrastructure, packaging and marketing systems.
- Food waste is most prominent in the coverage. Food waste issues primarily focus on developed countries and reference household waste and retail/institutional/hospitality industry waste. Food spoilage coverage gains much less attention in developing countries and tends to reference supply chain issues (such as storage, transportation, and refrigeration).
- Coverage focuses on the insufficient attention given to the problem of current global food supply chain losses in spite of the fact that low-cost solutions to address infrastructure, storage and transportation issues are largely available, with coverage providing examples of small-scale success stories in developing countries.
- The extent of the problem – described as one-third of the world’s food is wasted – focuses on African, Asia and Latin American countries where reduction in food losses could have an immediate and significant impact on livelihoods in low-income countries.

## White Space Recommendation

Food loss (spoilage) receives less media visibility than food waste. Food loss is associated with developing world issues within the food supply chain (such as storage, refrigeration and transportation), while food waste is discussed in terms of developed countries that throw out already-processed foods. This suggests media and the general public could benefit from education and awareness about the distinction between food waste and spoilage and potential solutions and environmental, public health and economic benefits to addressing the issue.

### Purpose

The Impact Assessment presents an early view of the impact potential in this space, outlining how we think change could happen based on the dynamism assessment and using scenarios to illustrate different impact ranges.

### Key Findings

- While choices determining impact pathways would be made in Development, the following scenarios build on our assessment of dynamic activities to illustrate the potential scale of impact. These scenarios include a focus on improving the livelihoods and income of producers, or enhancing the food security of consumers. Many farmers and value chain actors are also part of the food insecure segment, so the scenarios illustrate how a program could be designed to support both producers and consumers.
- The illustrative scenarios for impact assume a \$100 million investment over 10 years with an impact goal of *improving the livelihoods, economic opportunities, and food security for poor and vulnerable people in the production, postharvest, and processing stages of the agricultural value chain.*
- Preliminary visions of scale include the following:
  - Directly improve the incomes of 1 to 4 million farmers and value chain actors (plus their families) whose livelihoods are directly and indirectly dependent on smallholder farming.
  - Broadly improve the food and nutrition security of 8 to 40 million individuals who are food inadequate by lowering market food prices and increasing availability of food.

# How We Think Change Could Happen

## Areas of Dynamism That Could be Catalyzed Towards High-level Outcomes

On-farm technologies are becoming cheaper and improving in quality.

Innovative financing mechanisms (e.g., value chain finance) are improving the ability of farmers to purchase technologies.

Supermarkets are expanding in emerging markets, bringing improved infrastructure and supply chain management.

Food companies are increasingly sourcing from smallholder farmers to expand their supply.

Increasing investment in agri-business (particularly in Africa) is supporting the growth of agro-processing companies.

Increasing regional trade is opening up pathways for export of processed agriculture products.

## High-level Outcomes That Would be Required to Achieve the Impact Goal

Improved ability to purchase and use distributed storage, preservation, and processing technologies.

Improved linkages between food companies and smallholder farmers.

Increased agro-processing capacity in the value chain.

## Potential Impact Goal

Improve the livelihoods, economic opportunities, and food security for poor and vulnerable people in the production, postharvest, and processing stages of the agricultural value chain.

***An initiative could increase the volume and quality of saleable crops and have the potential to create additional farm income and new employment opportunities, while improving food security.***



***These scenarios present selected choices around which a potential development strategy could be designed.***

## ***Scenario 1: Producers' Livelihoods<sup>1</sup> and Income***

### **Characteristics of the Segment**

- Solutions to food loss that focus on value-add services, like storage or agro-processing, can greatly increase the volume of saleable produce and have the potential to create additional farm income and new employment opportunities.
- Africa has the largest shares of population whose livelihoods depend on agriculture, and recent government and donor commitments suggest it is more dynamic than Asia.

### **Toolkit of Interventions or Activities**

- Innovate financing schemes to increase farmers' access to value chain finance and microfinance to enable purchase and use of improved storage, preservation, and processing technologies.
- Scale promising models that are low-cost and can be brought to scale, such as technologies for on-farm storage, packaging, and processing.

## ***Scenario 2: Consumers' Food Security***

### **Characteristics of the Segment**

- Solutions to food loss can indirectly address under-nourishment for consumers by making more edible food available and reducing the prices in the market.
- Countries in sub-Saharan Africa have undernourishment rates much higher than those in developing Asia, reaching nearly 50% in Ethiopia, the Democratic Republic of Congo, Tanzania, and Mozambique.

### **Toolkit of Interventions or Activities**

- Collaborate across sectors and integrate agendas, including alliances and collaboration between food companies, governments, and smallholder farmers to change policies and practices and leverage public and private sector funding.
- Create investment opportunities through public-private partnerships, particularly in agro-processing, cold chain, and warehousing.

***Many farmers and value chain actors are also part of the food insecure segment, so an initiative could be designed to address both producers and consumers.***

1) "Livelihoods" in this case is defined as having the means to secure the necessities of life.

## Affected Populations

### Livelihoods and Income Scenario

- Smallholder farmers (direct): 470 million farmers in developing countries.
- Value chain actors (indirect): the 290 million whose livelihoods are made in processing or value addition.
- The 2.8 billion people dependent on smallholder farmers and 1.7 billion people dependent on downstream workers, assuming households of six people.

### Food Security Scenario

- 1.2 billion people in developing countries who are food inadequate partially or wholly dependent on purchasing food.
- 180 million children affected by stunting and are especially vulnerable to malnutrition.

## Possible Solution Spaces

Support financing and commercial distribution of on-farm storage and preservation technologies.

Support small-scale agro-processing opportunities in order to create end-markets for crops and generate off-farm income.

Collaborate across sectors and integrate agendas, including alliances and collaboration between food companies, governments, and smallholder farmers to change policies and practices and leverage public and private sector funding.

## Vision of Scale

**Directly improve the incomes of approximately 1 – 4 million farmers** (plus their families). This estimate assumes an implementation cost of \$25 to \$100 per farmer reached (based on benchmarks of existing similar initiatives).

**Directly create off-farm income opportunities for approximately 1 – 4 million farmers and value chain actors** (plus their families). This estimate uses the same benchmarks as above due to the similarity of the two solution spaces.

**Broadly improve the food and nutrition security of 8 – 40 million individuals** who are food inadequate. The low estimate assumes 10% of the population is reached in five of the most food insecure countries in Africa, and the high estimate assumes 50% of the population is reached.

## Intervention Benchmarks

Name of Intervention	Description	Number of People Reached	Quantification of Impact	Cost per Farmer	Farmers for \$100M
<b>Cowpea Storage Project (Purdue University)</b>	Researchers partnered with the Gates Foundation to develop and sell improved bags for cowpeas, spending \$11.4M in five years from 2007-2011.	1 million bags sold since 2007, out of a projected 1.7 million goal for West and Central Africa.	Expecting annual income increases of \$150 per farmer.	<b>\$7</b>	<b>14 million</b>
<b>Poverty Reduction and Women's Empowerment Project (UNDP)</b>	\$19M over four years (2008-2011) was used to establish 600 rural agro-enterprises in Burkina Faso, Mali and Senegal.	Goal was to directly impact 0.9 million people in rural areas through improving off-farm livelihoods.	One shea butter processor increased her income from \$55 to \$220 per year.	<b>\$21</b>	<b>4.7 million</b>
<b>Yam Improvement for Income and Food Security in West Africa (IITA, AGRA)</b>	\$12M from the Gates Foundation will engage the International Institute for Tropical Agriculture to improve yam varieties and lower postharvest losses.	Goal is to reach 200,000 yam farmers in Ghana and Nigeria.	Overall yam income is expected to double.	<b>\$60</b>	<b>1.7 million</b>
<b>Hybrid Seed and Postharvest Storage Program (USAID, Ethiopia, DuPont)</b>	\$3M from DuPont over three years (2013-2015) will distribute improved seeds and increase access to improved postharvest storage.	Goal is to reach 32,000 maize farmers in Ethiopia.	Yields are expected to rise by up to 50% and losses decrease by 20%.	<b>\$97</b>	<b>1.0 million</b>
<b>Rwanda Postharvest Handling &amp; Storage Project (CARANA, ACDI/VOCA)</b>	USAID is spending \$8.6M on a five-year program to support farmers' acquisition of storage and processing equipment, training in postharvest handling, and access to finance.	Supported 37,500 farmers in acquiring storage and processing technology; trained 40,000 farmers in postharvest handling.	Unmeasured.	<b>\$111</b>	<b>0.9 million</b>

***Cost per farmer varies based on the type of intervention and required amount of contact with farmers and cooperatives, suggesting a midrange of \$25 – 100 is reasonable.***

# Waste and Spoilage in the Food Chain

## Appendix

Content in the Appendix	Slide Number	Summary of Content
Developed Country Food Waste	40-44	<ul style="list-style-type: none"> <li>• Describes the water, land, and fertilizer, carbon, and landfill impacts of wastage in the developed world and globally</li> <li>• Profiles potential sources of dynamism, current interventions, and potential impacts for an Initiative in Execution</li> </ul>
Supplementary Questions and Responses	46-47	<ul style="list-style-type: none"> <li>• Argues for and against taking food loss as the primary entry point to improve ecosystems and improve the lives of poor and vulnerable populations</li> <li>• Addresses additional questions from the Executive Team, including unintentional consequences of wastage reduction, links to nutrition and food quantity consumed, and the effects on downstream employment</li> </ul>
Illustrative Causal Chains	48	<ul style="list-style-type: none"> <li>• Demonstrates how decreasing food wastage positively impacts ecosystems, producers, and consumers</li> </ul>
Gender Dynamics	49-50	<ul style="list-style-type: none"> <li>• Highlights key facts on women's role in agriculture and the nutritional benefits of improving food availability in households</li> </ul>
Covariance of Risk and Price Effects	51	<ul style="list-style-type: none"> <li>• Explains how agricultural risk's covariance causes many banks to limit their ag. lending</li> <li>• Reviews a key study in India showing how increasing food availability is a powerful way to bring large numbers of people out of poverty</li> </ul>
Scale and Scope of the Problem	52-53	<ul style="list-style-type: none"> <li>• Shows relative amounts of loss and waste and of food insecurity around the world</li> </ul>
Sources and Root Causes of Wastage	54-57	<ul style="list-style-type: none"> <li>• Traces where along the value chain durables, perishables, and dairy are lost in developing countries and the United States</li> </ul>
Technology Distribution Learnings	58-60	<ul style="list-style-type: none"> <li>• Draws lessons about what has and has not worked from a literature review on attempts to develop and market loss prevention technologies to farmers in developing countries</li> </ul>

Content in the Appendix	Slide Number	Summary of Content
Warehousing Learnings	61-62	<ul style="list-style-type: none"> <li>Draws lessons about what has and has not worked from warehouse receipt and collective storage programs in developing countries</li> </ul>
Additional Landscape Detail	63-66	<ul style="list-style-type: none"> <li>Shows what agencies have engaged in food loss prevention efforts using technology, a market-based approach, research, and policy/advocacy</li> <li>Describes select initiatives by donors, institutes, NGOs, and private companies</li> </ul>
ODA Funding Sources and Uses	67	<ul style="list-style-type: none"> <li>Shows agricultural Official Development Assistance by region and sub-sector from 2007-2011</li> </ul>
Profile of Potential Target Populations	68	<ul style="list-style-type: none"> <li>Compares the share of the population involved in agriculture and share of population undernourished in fourteen key countries in Sub-Saharan Africa and developing Asia</li> </ul>
Select Annotated Bibliography	69-70	<ul style="list-style-type: none"> <li>Summarizes lessons from key sources consulted during the Search</li> </ul>
Key Sources	71	<ul style="list-style-type: none"> <li>Lists the most informative reports and research papers found during the Search</li> </ul>



## Impact on Ecosystems Is Driven by Developed Country Food Waste

**Ecological impact of food wastage is primarily driven by the intensity of agricultural practices in the developed world and the fact that consumer waste includes all the compounded resources used at every previous step in the value chain. The average consumer throws out 240 pounds of food per year.**

- **Water, land and fertilizer overuse:** Ecosystem impacts of food wastage are greater in areas where production is more resource intensive, and over half of these impacts are addressable across the developed world. 35% of agricultural water resources in North America and Oceania are used to produce food that is unconsumed, twice the rate of South and Southeast Asia. Globally, land used to produce unconsumed food almost equals the total cropland in Africa, while adoption of best practices could reduce this amount by the size of Southeast Asia. Lost and wasted food uses one in every four pounds of fertilizer, with farm runoff in the United States creating a dead zone in the Gulf of Mexico the size of Connecticut and Rhode Island combined.
- **Landfill and emissions:** In the United States alone, the 34 million metric tons of food waste is one seventh of landfill mass and emits methane as damaging as adding 4 million cars to the road. A life-cycle analysis of both global food loss and food waste estimates the combined impact as equivalent to nearly 650 million cars.
- **Carbon emissions:** The carbon footprint of wastage is greatest at the consumption end of the value chain, comprising one fifth of volume but two fifths of carbon impacts, because consumer-generated waste includes all the resources that have been used at every previous step. Thus the per capita carbon footprint of wastage in North America and Oceania is 4.5x that of sub-Saharan Africa.

## Root Causes: Main drivers that directly contribute to ecosystem impact in developed countries

### Consumer Preferences

Consumers purchase fruits and vegetables that are cosmetically perfect, leaving produce that is not standard on the shelf for retailers to discard.

### Food Company Practices

Food companies can cancel purchase contracts with distributors on short notice, forcing production without a guaranteed buyer.

Distributors and wholesalers will reject produce that does not fit high cosmetic standards, denying large amounts of edible food a retail channel.

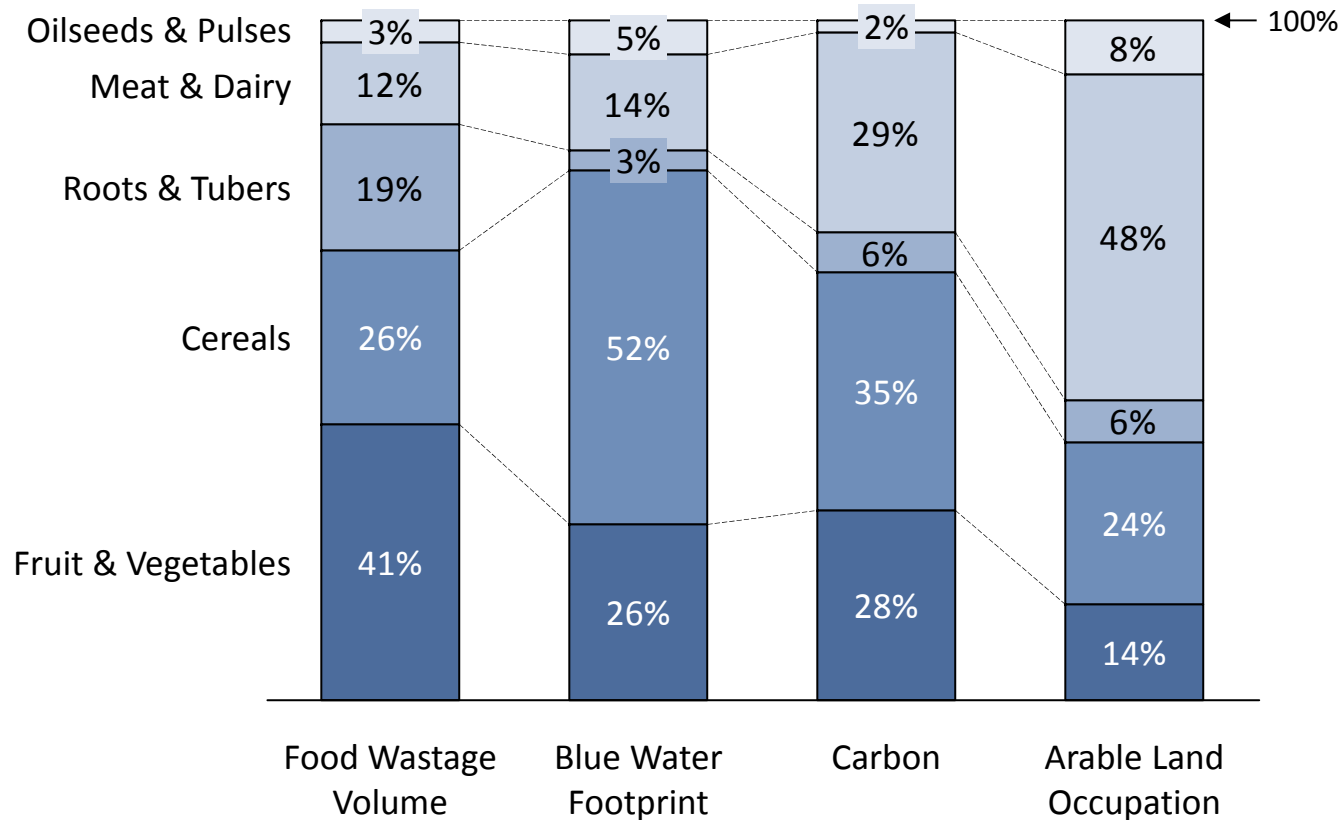
### Consumer Behavior

Large portion size in the United States and sale-driven purchases in grocery stores lead to large amounts of consumption-level waste.

***Developed country food waste has clear ecosystem impacts, but the link to the livelihoods and food security of poor families is less clear.***

## Ecological impact of global food waste, % of total

**Meat accounts for only 12% of total food waste, but contributes 2.5 times as much to the carbon footprint and 4 times as much to arable land occupation caused by waste.**



- Water usage by cereals is high due to widespread irrigation in the United States and rice flood irrigation in Asia
- Meat and dairy's carbon impacts are outside due to methane emitted from ruminant digestion and fertilizer emission from poultry feed
- Meat and dairy use 200M hectares of arable land and an additional 900M hectares of non-arable land not included in this chart

Notes: Blue water footprint is the total volume of ground or surface water that is used directly or indirectly to produce the product. Carbon footprint is calculated as total GHG equivalents from a life cycle assessment, including emissions during agricultural phase of on-farm energy use, CH<sub>4</sub> and N<sub>2</sub>O from soils and livestock. It does not include land use change, which would increase total emissions by 20-40%. Land occupation describes the surface of land necessary to produce foodstuff, i.e. fields for crops and grasslands areas specifically the surfaces occupied by the food that was grown/produced but uneaten because of waste. For livestock, land occupation accounts for the arable agricultural surfaces occupied to produce animal feed and/or surfaces used for grazing, per tonne of animal product. Fish are not included due to the difficulty of accounting for the water and land footprints of fishing.

## Areas of Dynamism

**Consumer Activism:** Media attention and consumer campaigns have raised consumer awareness of the food waste issue and may lead to changes in consumer behavior over time.

**Policy Reform:** Policies that require food waste to be recycled or composted can reduce the amount that ends up in landfill.

**Private Sector Practices:** Food companies can change the way they manage food waste in order to reduce the amount they discard.

## Evidence of Movement

- **Media attention and awareness campaigns:** The number of newspaper mentions of “food waste” has increased by 50% since 2008 (to 6,000 mentions in 2012), suggesting increasing public awareness. Meanwhile, FAO’s *Think.Eat.Save. Reduce Your Footprint* campaign launched in 2011 specifically targets food wasted by consumers, retailers, and the hospitality industry.
- **Freeganism:** “Freeganism” is the practice of finding and eating food that has been discarded as a response to food waste. The practice has limited followers, but is a popular news story.
- **Municipal composting:** ~100 cities in the US now have composting programs, which directly addresses the environmental effects of consumer food waste. However, despite these efforts, only 34% of total waste is recycled and only 1% of total waste is composted.
- **Waste reduction:** The U.S. Environmental Protection Agency’s Food Recovery Challenge encourages companies to reduce the amount of food waste they produce in order to cut costs and reduce environmental impact. 192 participating organizations have signed up for the Challenge, including food companies, sports stadiums, and universities. New York City’s Mayor Bloomberg recently announced more than 100 restaurants in the city have pledged to reduce food waste by 50%.
- **Food bank donations:** The Food Donation Connection claims that in 2011, 250 businesses donated 35 million pounds of food from 14,000 restaurants. A few of the restaurants included Pizza Hut, KFC, Taco Bell, Long John Silver’s, A&W, Olive Garden, and Red Lobster.

## Potential Tipping Point

Despite increasing awareness of the problem, there is little evidence that any of these Dynamic Opportunities are leading to a Tipping Point.

## Approaches to reducing food waste in developed countries

Categories of Interventions	Current Interventions	
<p><b>Food Redistribution</b></p>	<p>In high income countries, many efforts are aimed at saving and redistributing potential food waste from retailers and restaurants to those in need via food banks, pantries, community centers, shelters, and direct transport to consumers.</p>	<ul style="list-style-type: none"> <li>• <b>U.S.A. – Zero Percent:</b> This social enterprise aims to help every restaurant in the US achieve zero waste by offering an online platform for restaurants to post donations of surplus edible food. The system alerts local soup kitchens and shelters until a volunteer is found to pick up the donation.</li> </ul>
<p><b>Awareness Raising</b></p>	<p>Since most waste in developed countries is driven by consumers and food companies catering to consumer tastes, changing consumer behavior and preferences via awareness raising campaigns is a promising solution.</p>	<ul style="list-style-type: none"> <li>• <b>Global – “Think.Eat.Save” campaign:</b> This global campaign seeks to catalyze action by producers and consumers by raising awareness, providing information and resources, facilitating the exchange of ideas, solutions, and projects, and inspiring new actors to join the movement.</li> </ul>
<p><b>Technical Solutions</b></p>	<p>Technical solutions, from the processing to consumption stages, aim to address the immediate causes of disposal of edible food. For instance, studies offer best practices and packaging solutions to minimize wastage, helping enable retailers and consumers alike to help reduce food waste.</p>	<ul style="list-style-type: none"> <li>• <b>United Kingdom – “Helping Consumers Reduce Food Waste – A Retail Survey 2011”:</b> This study by the British Waste and Resources Action Program (WRAP) concludes that packaging can help reduce food waste by selling food in smaller portions and resealable packages.</li> </ul>

***Developed country wastage reduction interventions most often target changes in retailer and consumer behaviors.***

# Developed Country Food Waste – Impact

Target: Wasted ecological resources	Description: Who or What are We Talking About?	Potential Goal for an Initiative in Execution (range)*
<p><b>Wasted freshwater</b></p>	<ul style="list-style-type: none"> <li>• 15 cubic kilometers of water, roughly the entire water usage of Ecuador in one year.</li> </ul>	<p>Decrease annual water waste by <b>2 - 5 million cubic meters</b>, less than 0.05% of annual US water waste</p>
<p><b>Wasted land and fertilizer</b></p>	<ul style="list-style-type: none"> <li>• Nearly one third of cropland used for food production in the US, roughly the size of Oklahoma.</li> <li>• 3.3 million metric tonnes of fertilizer, the weight of nearly 1.8 million cars.</li> </ul>	<p>Decrease annual land waste by <b>2,000 - 6,000 hectares</b>, less than 0.05% of annual US land waste</p> <p>Decrease annual fertilizer waste by <b>400 - 1,000 metric tonnes</b>, less than 0.05% of annual US fertilizer waste</p>
<p><b>Contribution to landfill and carbon emissions</b></p>	<ul style="list-style-type: none"> <li>• One in every seven pounds of material sent to landfills in the U.S., or 34 million metric tonnes of food waste.</li> <li>• 280 million metric tonnes of carbon-equivalent, or the equivalent emissions of Thailand</li> </ul>	<p>Decrease annual food waste headed to landfills by <b>5,000 - 12,000 metric tonnes</b>, less than 0.05% of annual US fertilizer waste</p> <p>Decrease annual emissions by <b>40,000 - 100,000 metric tonnes</b> of CO<sub>2</sub>-equivalent, less than 0.05% of annual US carbon emissions</p>

***It would be difficult to have impact in the developed world because the ecosystem problems are dispersed across such a large number of consumers whose behaviors are hard to change.***

Note: Ecosystem impacts calculated based on Kummu et al's per capita estimations of the impacts of wastage in the United States and Oceania, which are 42 m<sup>3</sup>/yr water, 498 m<sup>2</sup>/yr land, and 9.3 kg/yr fertilizer. Landfill estimate of 108.3 kg/cap/yr obtained from BSR "Waste Not Want Not: An Overview of Food Waste," 2011. Carbon-equivalent estimate of 900 kg/cap/yr obtained from FAO's "Food Wastage Footprint," 2013. U.S. citizens are estimated to lose 8% of production in distribution and 38% in consumer waste. Reductions of 10% (low) and 25% (high) result in reducing this wastage to 35-41% from 46%. That reduction is multiplied by per capita ecosystem impacts to calculate the goal for an Initiative in Execution.

Question	Argument For	Argument Against
<p>What is the argument both for and against taking <b>food loss as the primary entry point</b> (as opposed to access to markets) to move the needle on the problem?</p>	<ul style="list-style-type: none"> <li>• <b>Relatively low dependency on other actors.</b> Specific loss-reducing technologies (e.g., on-farm storage and mobile processing units) can be implemented as stand-alone initiatives whereas market and infrastructure improvements are dependent on governments and other value chain actors.</li> <li>• <b>Relatively high feasibility.</b> Increases in production and market access require investments that take decades to implement, whereas reductions in loss can be implemented and scaled more immediately.</li> <li>• <b>Shift the dialogue from production.</b> A food loss lens emphasizes efficiency of the value chain as a whole, which helps shift the dialogue from the historical donor and government focus on increasing farm production as the primary solution. In a Feed the Future webinar on postharvest loss, a USAID expert said, “We have failed to break away from the wonder of the Green Revolution and front-end productivity gains.”</li> <li>• <b>Gaining momentum.</b> Donors (e.g., USAID’s Feed the Future initiative) are increasingly making postharvest loss reduction a central theme, but it is not yet a crowded space.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Other agriculture interventions may indirectly address some food loss.</b> Improving market access and strengthening infrastructure will inherently reduce some (but not all) food loss.</li> <li>• <b>A food loss focus could run the risk of addressing symptoms and not root causes.</b> The root causes of food loss are multi-dimensional, involving infrastructure, market access, training services, processing services, storage facilities, farmer practices, access to finance, and industry norms. Donors may find it more productive to focus on these specific root causes rather than trying to address food loss as a whole.</li> <li>• <b>Lack of granular loss data complicates the decision on where to intervene.</b> Pinpointing fast-growing end markets that would benefit from farmer access to market initiatives may be easier than selecting specific loss interventions.</li> </ul>
<p>What is the argument for and against entering this space for its <b>potential for ecological impact</b>?</p>	<ul style="list-style-type: none"> <li>• <b>Agriculture is one of the largest causes of environmental degradation worldwide.</b> Food wastage accounts for 10% of global greenhouse gasses, depletes a quarter of global freshwater, and uses the equivalent of all of the cropland in Africa to produce food that is not consumed.</li> <li>• <b>Food loss and waste involves many dimensions of environmental impact,</b> including excessive use of land, water, and fertilizer, increases in carbon emissions, and contributions to landfill. Thus, focusing on food waste reduction can address multiple environmental issues at once.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Primarily a developed world problem.</b> Ecological impact is primarily driven by the intensity of agriculture practices and embedded resources of consumer waste in the developed world, so addressing the problem requires a different intervention focus than addressing food loss and its impact on poor and vulnerable populations in developing countries.</li> <li>• <b>Difficult to have impact.</b> An intervention to address intensity of developed world agriculture or consumer driven waste means trying to reform the US farm bill or trying to change consumer behavior, both of which are monumental tasks.</li> <li>• <b>Low dynamism.</b> There is currently little reason to believe that consumer behavior or US farm policy are dynamic. Despite increasing awareness of the problem, there has been little movement.</li> </ul>



Question	Response
<p>What are some of the potential (negative) unintended consequences of reducing food loss?</p>	<ul style="list-style-type: none"> <li>• <b>Drop in farm gate prices.</b> A significant increase in market volumes could lead to a reduction in farm gate prices. However, in developing countries, consumers pay three to four times the farm gate price for fresh produce (compared to one and a half to two times in developed countries) and 60-80 percent of the price goes to commission agents. A price drop due to reduction in losses is likely to disproportionately impact middlemen. Linking farmers directly to markets and retailers to cut out middlemen is likely to lead to higher prices for farmers and lower prices for consumers, which is a win-win for both parties.<sup>1</sup></li> <li>• <b>Job loss.</b> Commercialization of food chains could put small local traders and other value chain actors out of business. However, this is unlikely to be a significant concern within the time horizon of a Rockefeller Foundation initiative and could be counterbalanced by additional salaried jobs in agribusiness.</li> <li>• <b>Adoption of developed world practices</b> in developing countries could increase the consumer driven food waste problem even as the food loss problem dissipates.</li> <li>• <b>Government distortions.</b> Interventions that attempt to manage markets and reduce losses could spur additional distortion of food markets, possibly stifling price declines for crops and thus harming consumers.</li> </ul>
<p>What amount of food loss reenters the food production system as feed or fertilizer?</p>	<ul style="list-style-type: none"> <li>• <b>Currently unknown.</b> Although the amount of food loss that reenters the production system as feed or fertilizer is unknown, approximately 45% of global cereal production is not intended for human consumption, but rather is grown explicitly for animal feed and biofuels.<sup>2</sup> There may be an opportunity to repurpose additional human food loss as animal feed. The FAO is currently soliciting a consultant to create a brief for its 2014 High Level Panel of Experts on food wastage, of which one question is “actual uses of food loss and waste as feed for livestock and feedstock for energy production.”</li> </ul>
<p>If there is less food waste, will people eat it?</p>	<ul style="list-style-type: none"> <li>• <b>Low income families spend earnings on food.</b> USDA price elasticity data suggests that the poorer the country, the more likely people are to spend their incremental dollar of income on food, particularly cereals, fruits and vegetables. In sub-Saharan Africa, approximately 45 cents of each incremental dollar of income is spent on food (rather than housing, recreation, etc.).</li> <li>• <b>Higher yield is linked to lower poverty.</b> Datt &amp; Ravallion’s fifty-year longitudinal poverty study in India suggests that increasing yields lowers overall market food prices for all consumers, which effectively gives them more income and reduces poverty.</li> </ul>
<p>Can you make the nutritional impact argument more clear?</p>	<ul style="list-style-type: none"> <li>• <b>Increased availability of more diverse foods leads to a balanced diet.</b> Fruits, vegetables, roots, and tubers (i.e., perishables) are an important part of a diet that is balanced with grains. Due to the relative abundance and durability of grains, poor households tend to consume more of them. Greater availability of perishables (particularly at lower consumer prices) would allow families to have a more diverse and nutritious diet.</li> <li>• <b>Reducing qualitative loss can increase nutritional value of crops.</b> There is less research available on “qualitative” degradation of nutritional quality than on “quantitative” volume losses, but it is clear that better storage and preservation can reduce degradation of foods and improve their nutritional quality.</li> </ul>

Source: (1) IFPRI, “Global Food Policy Report,” 2012

(2) Note that the 45% of production used for animal feed or biofuels is incremental above other references to “production of edible food mass” referenced throughout this Search. The FAO’s calculations of food waste and loss do not include production that is originally intended for livestock feed or energy production.

### Question

### Response

How much food loss is attributable to incentivized overproduction?

- **Currently unknown but primarily driven by developed world practices.** In 2002, industrialized countries in the OECD spent \$300 billion on crop price support, production payments, and other farm programs. These subsidies in the developed world lead to overproduction that floods markets with surplus crops sold below the cost of production. Much of this overproduction ends up as waste, though actual volumes of waste due to subsidy are unknown.

What is the impact on livelihoods for other actors in the value chain such as food processors?

- **Reducing loss benefits food processors** because they will have higher volumes to process and sell. However, this assumes that both the processor and the end market have sufficient absorptive capacity for the increased volumes.
- **Promoting off-farm services (e.g., storage facilities and processing centers) would create additional small enterprise or wage labor jobs.**

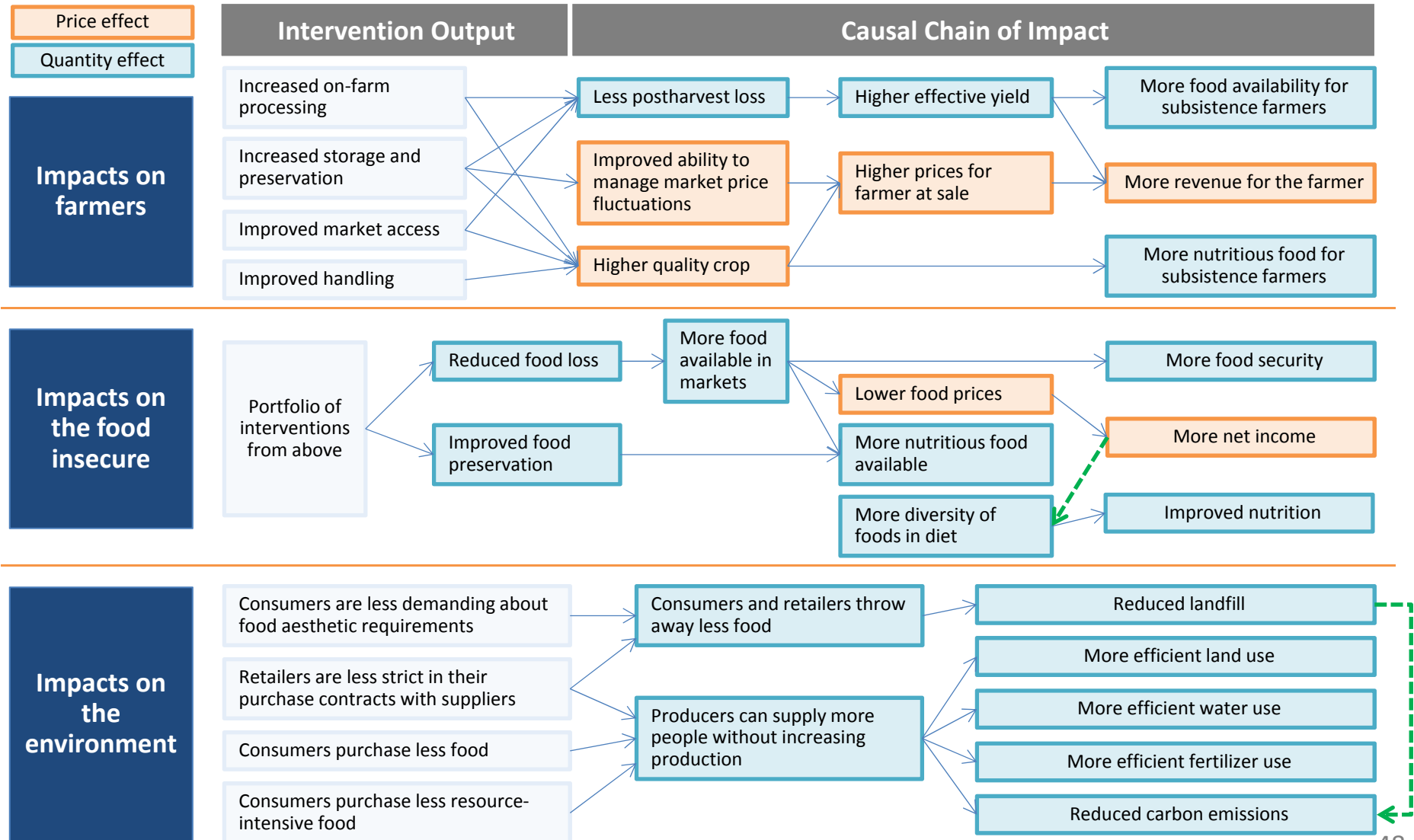
Is reduction of food loss likely to have a greater measurable impact on livelihoods than on the environment? If so, are there other entry points in the food system that you believe could have much greater impact on livelihoods?

- **In developing countries, food loss reduction will have a greater measurable impact on livelihoods than the environment** because farming is a core contributor to income, but is less resource intensive than developed countries. Environmental impact is primarily driven by the intensity of agriculture practices and embedded resources of consumer waste in the developed world. Food loss in the developing world is a dynamic opportunity with potential for a donor to have a pronounced impact, which is why this Search recommends focusing on food loss instead of food waste.
- **The relative cost/benefit of food loss interventions is difficult to assess due to lack of information.** An interviewee at APHLIS said that, “Donors are still missing clear information on what is really feasible and convenient to do.” The need for reliable cost/benefit information in order to make informed donor investments was re-iterated as a top priority in an interview with Steven Sonka, the Director of the ADM Institute for Prevention of Postharvest Loss at the University of Illinois.
- **Assessing impact of other entry points in the food system is difficult.** Agriculture is a very complex sector. Donors have many schools of thought that include influencing government and trade policies, promoting agribusiness, expanding training services, creating access to finance, and organizing producer organizations, among many others. The question of where best to intervene depends on the respective goals and capabilities of the implementing organization and the market dynamics of particular regions or crops. Food loss is an interesting lens because it is a critical problem that crosses many areas of the agriculture sector, so it encourages a multidimensional approach to solutions.

Is there a risk that private sector actors will push out smallholders?

- **Most smallholders are already excluded from commercial supply chains.** Instances of commercial farms pushing smallholders off their land are fairly rare, although there have been high profile “land grabs” that have been highly politically contentious. Most private sector actors would prefer to avoid the negative reputation risk of a land grab. In the past, smallholders have been largely irrelevant to private sector actors, but there is increasing recognition that they are an important source of supply for large food companies, especially as large plantations reach production plateaus. An initiative that engages the private sector constructively can help ensure that smallholders are integrated into supply chains in a manner that is mutually beneficial rather than exploitive.

*What is the causal chain that would have a positive impact on the environment? On the farmer? On the food insecure?*



***Women are central to agriculture in the developing world and will directly benefit from the boosted income and resiliency caused by decreasing food losses.***

## Importance of Women in the Value Chain

- In sub-Saharan Africa, 90% of processing and 80% of food storage is conducted by women, suggesting that interventions to reduce food loss must deliberately be tailored to and engage women.
- Depending on the country and crop, women can contribute 50-90% of agricultural labor and receive only 10-30% of the resulting income, making loss reduction particularly important for increasing the amount of income controlled by women.

## Gender Disparities in Access and Decision Making

- Women do not participate as actively as men in agricultural leadership initiatives and are limited by their socio-cultural role in the household.
- Despite making up half of the farming work force, women own less land, e.g. 25% of farmland in Tanzania, and smaller plots, e.g. half the average plot size in Benin as compared to men.

## Benefits of Engaging Women


- Women are central to household health, as they have been shown to reinvest more of their income back into food and nutrition for their children than men.
- Improving maternal nutrition can directly increase birth weight, the primary determinant of early child health.

## Examples of Engaged Women

- In Kenya, women's participation in farmer field schools increased crop production by over 80%, while the same program more than doubled female farmer income in Tanzania and Uganda.
- In India, when women belonged to a forest protection committee, control of illicit grazing increased 24% and regeneration of allotted forest increased 28%.

***Women's additional nutritional needs during pregnancy and lactation are significant and include a 14-25% increase in energy, 24-62% increase in protein, and more than doubling micronutrient intake.***

Women's nutritional requirements <sup>1</sup>			
	Baseline	Additional requirements	
	Ages 20-59	Pregnant	Lactating
Total energy (kcal)	1990	285	500
<b>Macronutrients</b>			
Protein (g)	29 <sup>2</sup>	7.1	18.9
<b>Micronutrients</b>			
Vitamin A (µg RE)	500	100	350
Vitamin D (µg)	2.5	7.5	7.5
Vitamin B1/thiamine (mg)	0.8	0.1	0.2
Vitamin B2/riboflavin (mg)	1.4	0.1	0.3
Niacin (mg)	11.5	1.1	2.7
Folic acid (µg)	170	250	100
Vitamin B12 (µg)	1.0	0.4	0.3
Ascorbic acid (mg)	30	20	20
Calcium (g)	0.4-0.5 <sup>2</sup>	0.6-0.7	0.6-0.7
Iron: low 5-9% (mg)	32	60-120	17
Iodine (µg)	150	50	50



Access to nutritional food is particularly important during pregnancy and lactation, both for the health of the mother and the health of the child

### Agricultural Risk

**Agriculture faces production, ecological, market and regulatory risks that other industries do not.<sup>1</sup>**

- Business risk is common to all organizations, and includes health, personal accident risk, and macroeconomic risk.
- Production risk includes weather conditions, pests, diseases and technological change.
- Ecological risk includes production, climate change, and natural resource management.
- Market risks include output and input price variability.
- Regulatory and institutional risk includes shifting agriculture policies, food safety and environmental regulation.

**Covariant market risk affects entire groups of farmers, who transmit that risk to all downstream members of the food supply chain.<sup>2</sup>**

- Natural disasters can systemically affect large groups of farmers, temporarily changing the production in entire regions and causing significant changes in food prices and effective yields that hurt poor and vulnerable producers and consumers.
- Downstream industries also share that systemic risk, because there are no substitutes for primary crop production.

**Banks in many developing countries are often unwilling to increase their agricultural lending due to the high covariance of risk along the food supply chain.<sup>3</sup>**

- In Nigeria, banks lend 4% of their portfolio to agriculture, a much smaller figure than the 60% of its population that works in agriculture and related industries.<sup>4,5</sup>

### Price Elasticity

**Figure 1.4 Price and wage effects dominated the long-run elasticity of rural poverty to cereal yields in India, 1958–94**



Source: Datt and Ravallion 1998a.  
Note: The direct income effect includes that from higher yields and employment.

**Food price reduction is a powerful lever for bringing large numbers of people out of poverty.<sup>6,7</sup>**

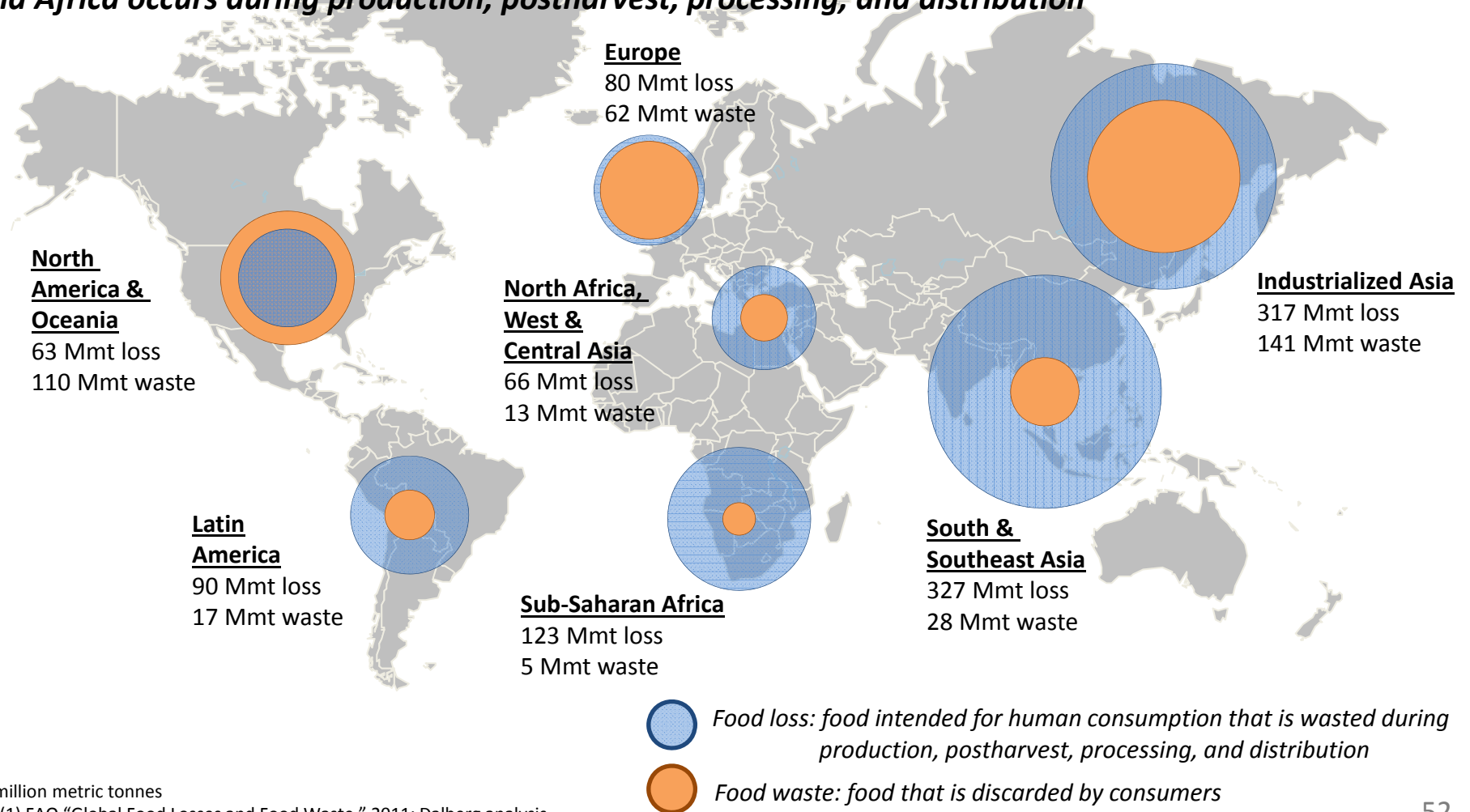
- When effective yields increase, due to either reductions in losses or increases in production, farmers' increased direct income helps alleviate poverty. This short-term effect benefits farming households.
- In the long run, the sustained increase in food supply that lowers real prices benefits a far larger number of people, helping to bring the entire consumer base out of poverty.
- Measurement and evaluation programs are likely to only capture short run income increases and undervalue the long run consumer effects.

***Reducing food prices is central to addressing the needs of poor and vulnerable consumers, but finance remains difficult to access domestically due to the co-variant risk profile of farming and the food supply chain.***



## Food waste and food loss around the world, millions of metric tons<sup>1</sup>

*Unlike consumer driven waste in the developed world, over 90% of all wastage in developing Asia and Africa occurs during production, postharvest, processing, and distribution*



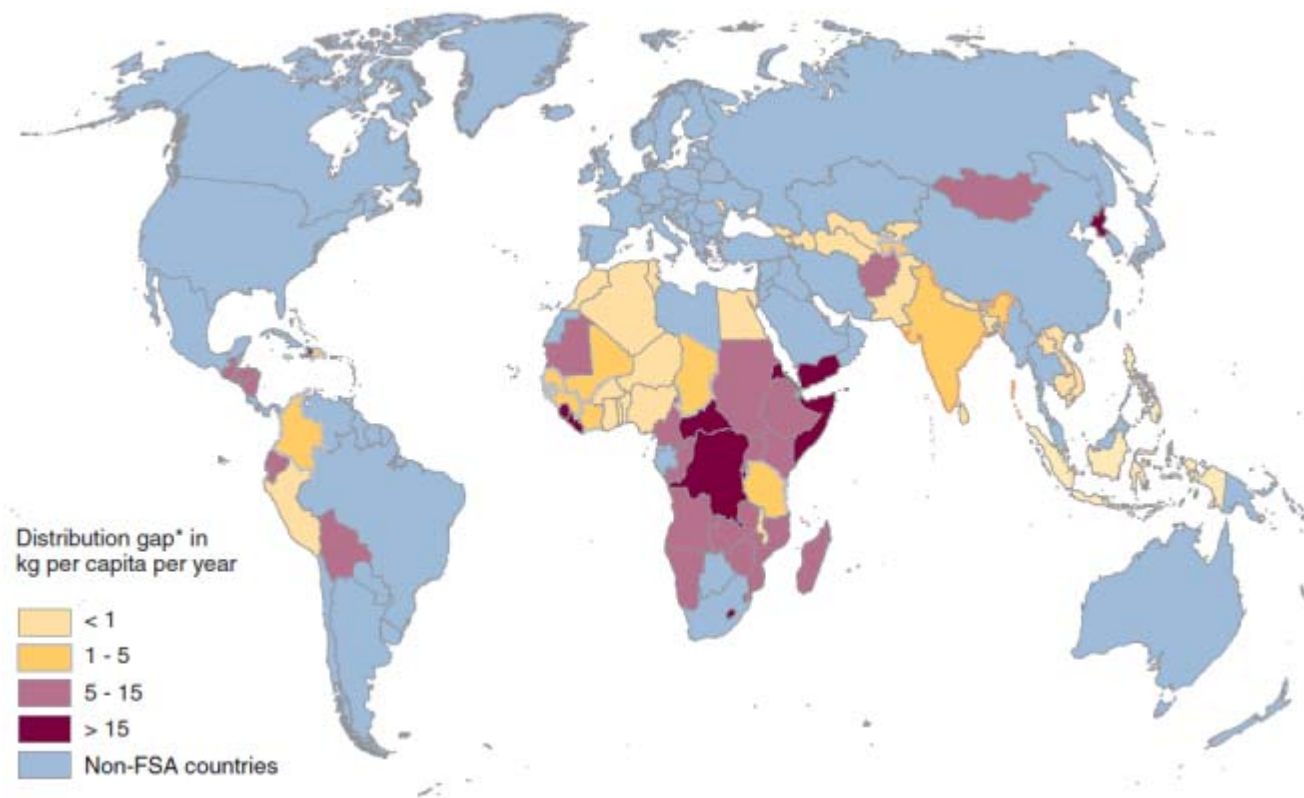
Mmt = million metric tonnes

Source: (1) FAO "Global Food Losses and Food Waste," 2011; Dalberg analysis



**Food wastage is a pressing issue because food insecurity affects populations in Asia and Africa, and the problem is expected to grow over the next decade**

## Intensity of food insecurity in lower income countries, 2012<sup>1</sup>



***Food insecurity is currently concentrated in sub-Saharan Africa and developing Asia***

- SSA has 24% of the population but 44% of the number of food-insecure people in studied countries
- Asia has 66% of the population and 50% of food-insecure people

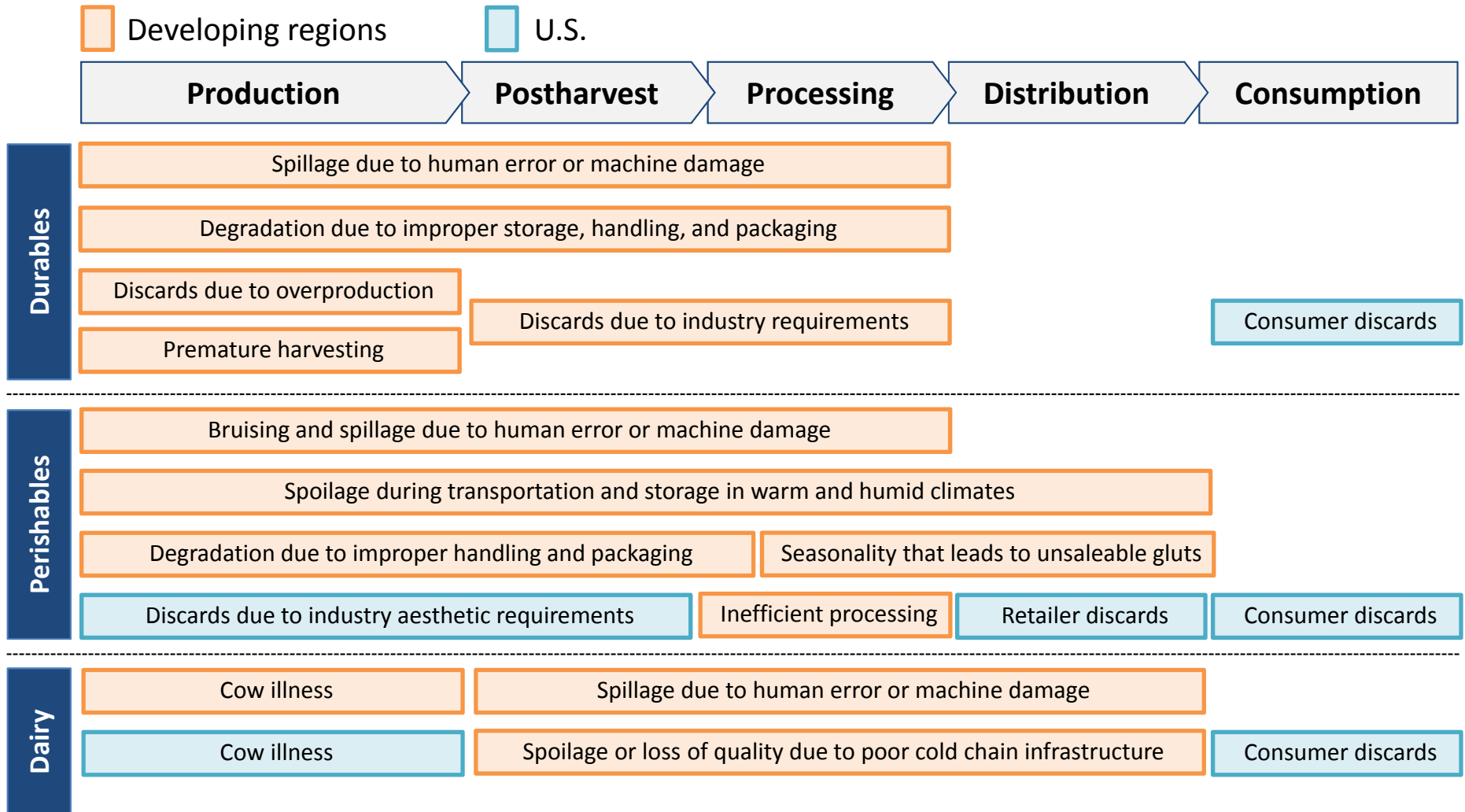
***The number of food insecure people will remain roughly constant through 2022***

- SSA will experience a 15% increase, to 411 million food-insecure people over the decade, slower than its 28% population growth
- In Asia, most countries expect a steady, slow improvement in food security

\*The difference between projected food availability and the food needed to increase consumption in food-deficit income groups within individual countries to meet the recommended nutritional target.

Source: (1) Figure and explanation from USDA International Food Security Assessment 2012-2022

# Appendix Primary Sources of Wastage by Food Type











Durables













Perishables



Dairy

Sources of wastage	Food type most affected	Root Causes
Spillage due to human error or machine damage		<ul style="list-style-type: none"> <li>Poor or outdated technology (financing gap)</li> <li>Inadequate training and education in relevant skills and best practices</li> <li>Inefficient facilities, processes, or systems (e.g., during threshing or picking)</li> </ul>
Degradation due to improper storage, handling, and packaging		<ul style="list-style-type: none"> <li>Lack of access to modern storage products (due to financing gaps)</li> <li>Weak infrastructure (e.g., access to electric grid, timely access to market)</li> <li>Deficit in knowledge of or training in best practices and spoilage prevention</li> <li>Weak preventive measures against adverse weather (climate change), pest attacks, contaminated water</li> </ul>
Bruising and spillage due to human or machine error		<ul style="list-style-type: none"> <li>Lack of training in handling and transportation practices</li> <li>Weak transportation and distribution infrastructure</li> <li>End market is difficult to access or processing plant is not within close proximity</li> </ul>
Spoilage in warm and humid climates		<ul style="list-style-type: none"> <li>Weak infrastructure for roads and distribution networks</li> <li>Poor temperature control in storage facilities</li> </ul>
Cow illness		<ul style="list-style-type: none"> <li>Poor handling practices that increase stress and vulnerability to infection</li> <li>Lack of consistent routines and new technology that maximize hygiene and prevent contamination on the farm (e.g., cattle housing and grazing management techniques)</li> </ul>
Discards due to overproduction		<ul style="list-style-type: none"> <li>Intentional overproduction to ensure production of the contracted amount</li> <li>Lack of timely or direct access to secondary markets to sell surplus</li> <li>Lack timely and excellent market and weather intelligence on which to base their production and harvesting decisions</li> </ul>

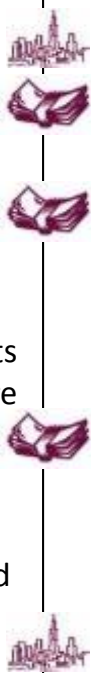


Sources of wastage	Food type most affected	Root Causes
Premature/inefficient harvesting		<ul style="list-style-type: none"> <li>Farmers attempt to meet market demand, and lack supplier power, flexibility, and/or inventory to meet unexpected demand</li> <li>Economically insecure (e.g., need for immediate cash)</li> </ul>
Discards due to industry aesthetic requirements	 	<ul style="list-style-type: none"> <li>Overly stringent industry requirements (e.g., aesthetics)</li> <li>Consumer preferences, real or perceived; cultural norms and standards</li> </ul>
Seasonality that leads to unsaleable gluts		<ul style="list-style-type: none"> <li>Poor market intelligence, options, and flexibility on part of farmer</li> <li>Lack of supplier power and additional channels for sale</li> </ul>
Spoilage or loss of quality due to poor cold chain infrastructure		<ul style="list-style-type: none"> <li>Infrastructure weakness (e.g., poor road systems prolong exposure time)</li> <li>Financing gaps prevent acquisition of cold chain technology</li> <li>Inadequate training</li> </ul>
Inefficient processing leads to excessive discards		<ul style="list-style-type: none"> <li>Inefficient processes due to financing and knowledge gaps, and/or weak infrastructure</li> <li>Inadequate training and education of workers leads to unnecessary discards</li> <li>Excessive trimming or cutting; imperfect industry standards</li> </ul>
Retailer discards		<ul style="list-style-type: none"> <li>Consumer preferences and norms</li> <li>Business strategies</li> </ul>
Consumer discards	  	<ul style="list-style-type: none"> <li>Consumer preferences for fresh food</li> <li>Food spoilage from poor packaging, handling, or storage</li> </ul>

## Example – Tomatoes in Nigeria

Production			Postharvest			Processing			Distribution	
Input Availability	Knowledge	Finance	Farmer Organization	Storage	Finance	Product Availability	Installed Capacity	Finance	Demand	Finance
Yellow	Yellow	Orange	Yellow	Orange	Yellow	White	Red	Red	White	White

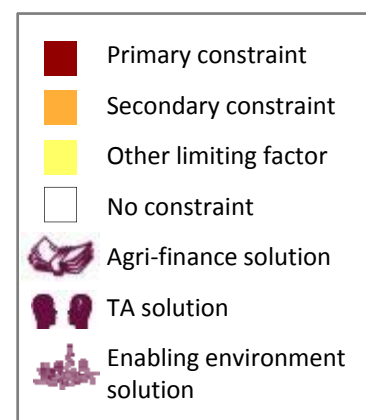
- High quality inputs (fertilizer especially) are unaffordable for many, resulting in low yields
- Credit is largely unavailable, and prohibitively expensive even when accessible
- Farmers have no markets for their produce and are forced to sell crop to traders at low prices before tomatoes rot
- Supply of improved seed varieties is low given small market size



- Cold storage does not exist, so farmers are forced to sell produce to traders at harvest when price is lowest
- Low levels of farmer cooperatives limit capacity to engage in postharvest activities like transport and storage due to capital requirements
- Transport and handling results in postharvest losses of up to 50% of total production



- Processors are not operational



## Technology Distribution Models

### What Has Not Worked

- Attempting to scale up processing among **farmers who are not organized** into associations or cooperatives.
- Local manufacturing of technologies that require **specialized input materials**, which may face import duties.
- Silo and other relatively **expensive on-farm technologies** marketed in the absence of donor subsidy or financing.
- Storage technology in the **absence of training** on proper pre-storage crop preparation, usually drying.
- **Developing technologies without jointly developing the business model** that will be used to scale them up. Business models include consumer education and training as well as rolling out repair and maintenance services.

### What Has Worked

- Farm-gate **processing into secondary materials** suitable for industrial use.
- Processor group or **community-based agro-processing**, particularly for cassava, yam, plantain and oil palm. Pooling farmers' produce together improves their ability to get financing to acquire the processing asset.
- **Farmer-to-farmer technology transfer.**
- **Local manufacturing** of technologies using locally sourced, rather than imported, materials.
- Marketing and selling **technologies inexpensive enough for farmers to test** them without switching entire processes or crops, such as bags.

## Technology Distribution Models

### Types of Technology

- **On-farm storage** aims to prevent immediate postharvest losses on the farm and allow farmers to delay selling some produce until later in the season when prices are higher.
  - **Bags or silos** can protect crops from weather and pest damage.
  - **Evaporative fridges** made from local materials can cool produce to extend its freshness.
- **On-farm processing** can create secondary products that have a longer shelf life than raw crops, while also increasing the value captured by the farmer.
  - **Solar dryers** replace open-air drying, which is labor-intensive and leaves fruits and vegetables susceptible to weather and pests. They can be used in areas without electricity access to produce export-grade produce.
- **Packaging.** Fresh fruits and vegetables offer many opportunities for improved packaging to reduce loss.
  - **Postharvest.** Anti-microbial packaging, microflute technology, and adoption of automated processes to replace handpicking.
  - **Distribution.** Plastic and collapsible metal crates, slip sheets and stretch wrapping.
  - **Processing.** Leak and tear-resistant packaging, hermetic seals.

### Example

- **Sierra Leone – Edlyn Steam Dryer:** Developed in Sierra Leone, this technology dries grated cassava pulp for processing into High Quality Cassava Flour. It is created for rural communities and requires no electricity, instead using biofuels worth around \$5 USD per day.
- **United States – Lawrence Livermore Institute for Globally Transformative Technologies (LIGTT):** The LIGTT lab is developing an ultra low-energy refrigerator that could drastically lower the cost of cold chain development.

***Though a range of loss prevention technologies at various price points and for various crops already exist, low-cost cold storage remains elusive and farmers lack information about which solutions best suit their needs.***



## Technology Distribution Models

### Lessons Learned from 20 Years of the PostCosecha Metal Silo Programs in Latin America, reaching 300,000 families

- **Start with a concentrated push in one region and plan for slow expansion.** Farmers are very risk-averse and it takes time for them to evaluate and adopt new technologies. The PostCosecha program has lasted for over two decades and transfers silos through many different partnering organizations in different communities.
- **Blend subsidized and unsubsidized sales.** Though subsidies are key to reaching the poorest farmers, having a portion of unsubsidized sales allows the company to evaluate farmers' willingness to buy and understand how much value is being delivered.
- **Design the technology to meet the appropriate price point.** Consider using local materials and training local artists to manufacture the product, which creates additional off-farm employment.
- **Ensure the government is one of many local partners.** Involving the government will help prevent tariffs on the technology and, in combination with reputable local partners, may provide additional marketing and consumer education support. In the long term once a functioning market is created these partnerships become less critical.

***Technologies that aim to change farmers' behavior take a long time, and are more successful when a broad coalition of stakeholders jointly pushes for adoption.***

### Example

- **Kenya & Malawi – Effective Grain Storage Project, Swiss Agency for Development and Cooperation & CIMMYT<sup>2</sup>:** To decrease grain losses from the maize weevil and larger grain borer, which amount to 10-20% within three months and 50% within six, the SDC funded metal silo manufacturing to replace traditional mud hut storage. Local artisans were trained to manufacture and sell the products, while aid organizations are providing low-interest loans. Local fabrication allowed the artisans to size the silos for both individual and community use.

## Warehousing Programs

### What Has Not Worked

- Warehouse receipt systems for grains can be politically contentious and therefore difficult to scale up. Public warehousing has not scaled quickly in east Africa due to repeated **political interference** in times of food insecurity, which distort incentives for private banks, borrowers, and collateral managers to cooperate.
- Collective storage can be **culturally inappropriate**. Farmers accustomed to individually storing grain on-farm resisted government collective storage in Uganda out of concern for grain security.
- Warehouse receipts in **countries without developed financial markets** and governments that do not interfere with food prices are not trusted, so farmers cannot use their records as collateral to access input finance.

### What Has Worked

- Functioning **downstream markets in which warehouses can sell grain** create incentives for private sector involvement. Lesiolo Grain Handlers has been financially profitable and thus sustainable because it is a commercially driven organization that is not owned by the government.
- **Purchase guarantees** promote warehousing. The World Food Programme began procuring food from smallholder farmers in 2008, contracting 260,000 tons through commodity exchanges, warehouse receipts, grain fairs, and direct contracts that reached 42,000 farmers.

## Warehousing Programs

### How Warehousing Works

- **Warehouse receipt programs** issue farmers receipts for grain deposits into a central commercial warehouse. These receipts can be transferred and are redeemable for the entire deposited quantity of grain, making the operator responsible for losses. Receipts are useful collateral records for farmers, who can take them to banks to secure financing for the following season.
  - **Public warehousing** is open to any farmer and set up by the government to enhance the value chain. Its usefulness depends largely on banks' willingness to extend loans to grain producers.
  - **Private warehousing** is usually used for high-value export crops rather than grains. It is relatively developed in South Africa, but is used more by medium-sized farmers than by smallholders.
  - **Farmer-focused warehousing** involves groups of producers collectively financing storage for their own produce, either through microfinancing or via a cooperative. This approach has been used in Mali, Niger, Togo, and Tanzania.
- **Warehousing requires standards setting and quality control**, as crops must be of the same grade to be pooled together from multiple farmers.

### Example

- **Zambia – ZACA Ltd:** A private national network of warehouses was set up with ZACA as the inspecting and regulating agency in 2003. Within one year national storage capacity rose by a factor of thirteen, to 105,000 tons, led by commercial farmers then slowly adopted by smallholders. Storage is profitable for farmers because maize prices are highly seasonal.
- **Uganda – Uganda Commodity Exchange:** Receipts from any of three licensed warehouse operators can secure a 60% loan through the Housing Finance Bank. The system is expanding as WFP has begun purchasing receipts.

***Warehouse receipts are suitable for cereal storage in countries with comparatively developed financial markets and low government intervention distorting food prices.***



Technology-based approach










































































Market-based approach



Research



Policy/Advocacy

Interventions		Africa	South & Southeast Asia	Latin America & Caribbean	U.S.
Public Agencies	UN Food and Agriculture Organization	  	  	  	   
	EU Commission (e.g., Joint Research Centre)	  			
	World Food Programme	 			
	USAID	  	  	  	   
	German Bilateral Aid (e.g., Federal Office, GIZ)	 			
	African Development Bank	  			
NGOs	CARE USA	  			
	International Fertilizer Development Center				
	Alliance for a Green Revolution in Africa	  			
Private Sector Research	ADM Institute, University of Illinois	 	 	 	
	Postharvest Technology Center, UC Davis	 			 
Private Sector	DuPont	  	  	  	  
	GrainPro, Inc.				
	DADTCO <sup>1</sup>				

***While many interventions take a technology-based approach, few are addressing the market as a whole.***

Geographic regions imply area where majority of an organization's work and/or funding occurs. <sup>1</sup>Dutch Agricultural Development & Trading Company BV. Icons by Douglas Cavendish, from The Noun Project.

## Multilateral Agencies

### Select Examples



The United Nations World Food Programme (WFP)'s Purchase for Progress Pilot program aims to test innovative ways to buy staple foods while reducing smallholder farmers' postharvest losses by introducing new procurement practices, such as competitive tenders for purchases from local traders and direct contracting with smallholders, in 21 pilot countries, 15 of which are in sub-Saharan Africa. In addition, WFP provides training in procurement and grain storage in partnership with FAO and international NGOs.



The African Development Bank conducts an ongoing screening of AfDB agricultural portfolio to ensure the inclusion of postharvest loss (PHL) activities, and prepares a Framework Paper for Continental Program on PHL reduction based on a rapid country needs assessment. Initial findings suggest that isolated investments do not work, and actors need to analyze the full value chain analyses and address PHL via support to farmer organizations, capacity building, and infrastructure development.

## Bilateral Agencies

### Select Examples



USAID's Feed the Future program is dedicated to bolstering agricultural development through an array of interventions (e.g., the Global Agriculture and Food Security Program). In Rwanda, USAID is partnering with the World Food Program to develop new market opportunities for maize and bean producers by facilitating improvements in postharvest handling to reduce losses. Feed the Future has thus far helped 1.8 million food producers adopt improved technologies or management practices that can lead to more resilient crops, reduced loss, higher yields, and increased incomes.



The German Federal Office for Agriculture and Food (BLE), in coordination with the EU Commission Joint Research Centre, funds and supervises the African Postharvest Losses Information System (APHLIS), which provides relevant, on-the-ground quantitative information on postharvest losses in 38 African countries, and helps decision-makers choose the appropriate initiatives for postharvest loss reduction. APHLIS publishes its data as interactive maps or tables, with a breakdown of loss calculation, data source, and quality.

## NGOs

### Select Examples



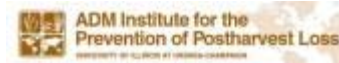
Alliance for a Green Revolution in Africa (AGRA) is an Africa based organization working in partnership with governments, agricultural research organizations, farmers, private sector, civil society and other rural development stakeholders to significantly and sustainably improve the productivity and incomes of resource poor farmers. Recently, AGRA has refocused the attention on the issue of postharvest loss, calling on African governments to take bold action to curb such losses.



CARE USA aims to increase food security for 15,000 people in Malawi through the Postharvest Loss Reduction and Small-Scale Irrigation Enhancement Project (PHASE), focusing on women- and child-headed households. One of PHASE's key objectives is to disseminate information on appropriate technologies for grain harvest and postharvest loss reduction for smallholder farmers to increase household food security. The PHASE project has received grants totaling \$950,000 from the General Mills Foundation from 2009 to 2011. CARE's initiatives have been successful in increasing adoption of loss reduction technologies and production levels of traditional staple food and cash crops.

## Research Institutes

### Select Examples



The Archer Daniel Midlands Institute works with smallholder farmers in the developing world to preserve millions metric tons of grains and oilseeds that would otherwise be lost to pests, disease, and mishandling. The Institute also serves as an international information and technology hub for evaluating, creating and disseminating economically viable technologies, practices, and systems that reduce postharvest loss in staple crops.



The International Rice Research Institute (IRRI) is an independent research and training organization that helps rice farmers improve the yield and quality of their rice in an environmentally sustainable way. IRRI works with public and private partners on national agricultural research and training and knowledge transfer within extension systems. IRRI contributes to rice postharvest loss reduction through pursuing its mission of reducing poverty, ensuring sustainable and stable rice production, and improving the nutrition and health of rice consumers and farmers.



## Corporate Initiatives

### Select Examples



Reliance Retail India is investing in its cold chain infrastructure to reduce the transport time of fruits and vegetables, and in the process, contributing to the commercialization of domestic retail chains. Its goal is to grow 5-6x in 3-4 years and source from a million domestic farmers. Its fresh fruit division, Reliance Fresh, along with other retail chains such as Subhiksha and Adani, are offering better and competitive prices to farmers. As of 2012, Reliance Retail operates about 1,300 stores across multiple formats in 86 cities, covering six million square feet.



The Dutch Agricultural Development & Trading Company BV (DADTCO) has developed an innovative processing technology, an Autonomous Mobile Processing Unit, which processes fresh cassava on or near the farm, thus avoiding any spoilage that may result from the lengthy transport to a central processing plant. DADTCO forms public private partnerships with a wide range of stakeholders – including local government and multilateral organizations – to provide cassava farmers with training, input supplies, mechanization, etc. Having piloted this initiative successfully in the Taraba State of Nigeria, DADTCO plans to roll out its AMPUs program to other Nigerian states.

## Corporate Networks

### Select Examples



Global Cold Chain Alliance (GCCA) serves as a platform for communication, networking, and education for each link of the cold chain. Its members operate refrigerated warehouse facilities, factories, ports, and transportation hubs globally. Recently, GCCA is expanding into cold storage construction, participating in postharvest loss reduction dialogue, and collaborating with research institutes to implement postharvest loss reduction programs.



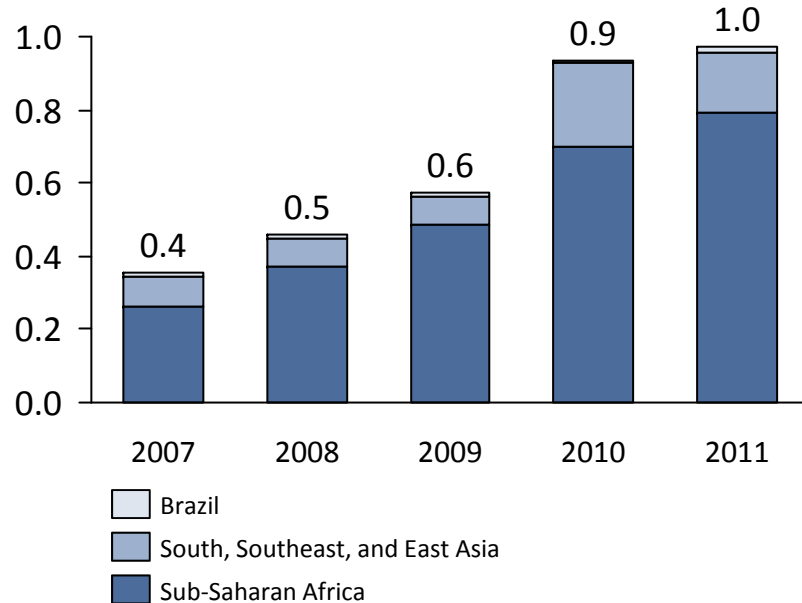
The East Africa Grain Council (EAGC) is a membership-based organization that brings together players along the grain value chain. EAGC promotes structured trading systems that enhance food security through regional trade. With a presence in nine countries in the greater Eastern Africa region, the Council brings together producers, traders, millers, and processors. EAGC is currently training Rwandan farmers in post harvest management and partnering with the Agricultural Transformation Agency in Ethiopia to improve various market access tools, such as structured trading platforms, warehouse receipt systems, the agricultural intelligence network, and postharvest handling and management training.



## Official Development Assistance (ODA) Funding Landscape<sup>1</sup>

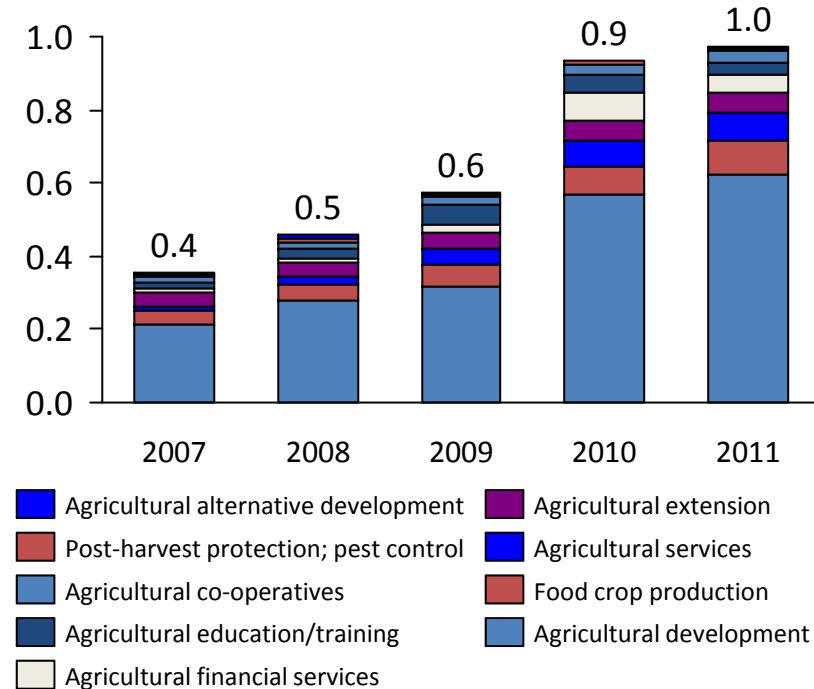
### ODA funding by region

US \$ Billions



### ODA funding by sub-sector

US \$ Billions

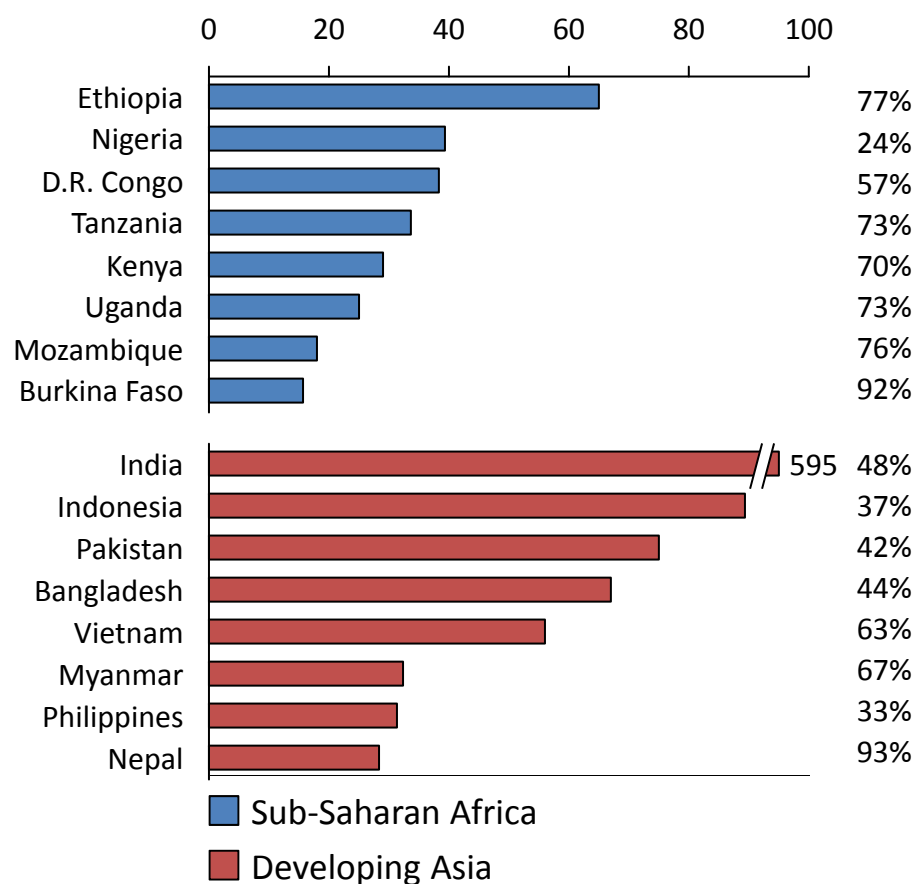


***ODA for sectors relating to agriculture development is mainly concentrated in sub-Saharan Africa and focused on general agricultural development aid.***

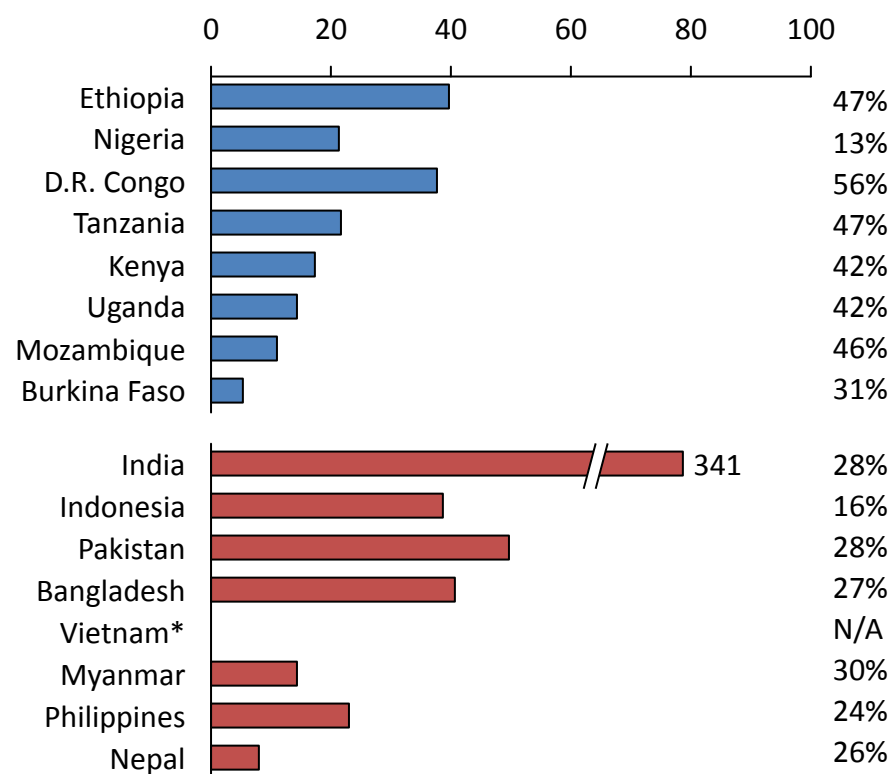
Notes: Includes funding for agricultural development, food crop production, agricultural alternative development, agricultural extension, agricultural education/training, agricultural services, plant and post-harvest protection and pest control, agricultural financial services, and agricultural cooperatives from all OECD-reporting donors.

Sources: (1) OECD Creditor Reporting System

## Agricultural Population<sup>1</sup> (million, and % of total)



## Undernourished Population<sup>1</sup> (million, and % of total)



***While Asia has larger absolute numbers of people working in agriculture and people undernourished, sub-Saharan Africa has a higher average shares of both.***

\*Data not available for Vietnam.

Source: (1) FAOSTAT; note that agricultural population includes all people working in farming, forestry, fishing, and hunting, and their dependents.

### Selections from annotated bibliography

Source Title	Author (or Publishing Organization)	Date Published	Summary/ Highlights
<b><i>Report: Missing Food: The Case of Postharvest Grain Losses in sub-Saharan Africa</i></b>	World Bank	2011	<ul style="list-style-type: none"> <li>• Details causes of cereals loss in the developing world, with a focus on technologies that can help increase incomes and food security</li> </ul>
<b><i>Research Paper: Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertilizer use</i></b>	Kummu et al.	2012	<ul style="list-style-type: none"> <li>• Estimates the ecosystem damage of the resources wasted to grow food that is not consumed</li> <li>• Highlights what loss would look like if all regions were to adopt global best practices</li> </ul>
<b><i>Research Paper: Global Food Losses and Food Waste</i></b>	UN Food and Agriculture Organization	2011	<ul style="list-style-type: none"> <li>• Estimates the amount of food loss and food waste by crop category in seven regions worldwide</li> </ul>
<b><i>Report: The State of Food and Agriculture 2012: Investing in Agriculture for a Better Future</i></b>	UN Food and Agriculture Organization	2012	<ul style="list-style-type: none"> <li>• Describes the role of investment in fulfilling global food needs, with a focus on how farmers can accumulate capital</li> <li>• Outlines how governments could best channel public and private resources to farmers</li> </ul>

### Selections from annotated bibliography

Source Title	Author (or Publishing Organization)	Date Published	Summary/ Highlights
<i>Report: Growing Africa: Unlocking the Potential of Agribusiness</i>	World Bank	2013	<ul style="list-style-type: none"> <li>• Reviews the state of agribusiness today and describes how the sector is expected to grow to \$1 trillion in sub-Saharan Africa by 2030</li> <li>• Details specific value chain constraints in combinations of countries and crops</li> </ul>
<i>Report: Wasted: How America is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill</i>	Dana Gunders, National Resources Defense Council	2012	<ul style="list-style-type: none"> <li>• Details the causes and potential responses to food wastage in the United States, with suggested actions by businesses, government and consumers</li> </ul>
<i>Report: Agriculture for Development</i>	World Bank	2008	<ul style="list-style-type: none"> <li>• Reviews the available literature about reducing poverty through agriculture</li> <li>• Links increases in food availability with long term, broad based poverty reduction</li> </ul>

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