



# Losses in the Field: An Opportunity Ripe for Harvesting

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## About BSR

BSR works with its global network of nearly 300 member companies to build a just and sustainable world. From its offices in Asia, Europe, and North and South America, BSR develops sustainable business strategies and solutions through consulting, research, and cross-sector collaboration. Visit [www.bsr.org](http://www.bsr.org) for more information about BSR's more than 20 years of leadership in sustainability.

This report was written by Nate Springer, with contributions from Ryan Flaherty and Kai Robertson.

For more information, contact Ryan Flaherty ([rflaherty@bsr.org](mailto:rflaherty@bsr.org)) or Kai Robertson ([kr Robertson@bsr.org](mailto:kr Robertson@bsr.org)).

## Introduction

Around the world, food is lost or wasted at every stage in the continuum from farm to fork, as outlined in BSR's brief, *Waste Not, Want Not: An Overview of Food Waste*.<sup>1</sup> Based on studies by the Food and Agriculture Organization of the United Nations (FAO), this loss amounts to about 1.3 billion metric tons per year, or roughly, one-third of food produced for human consumption.<sup>2</sup> While much attention has focused on increasing productivity as the primary solution to feeding nine billion people by 2050, an important part of the solution must also be reducing the inefficiencies that create such huge losses in our food system.

This brief describes the importance of addressing food waste at the agricultural production and post-harvest stages of the value chain—referred to in this article as “food loss”—and identifies a range of solutions for companies to consider.

Reducing these pre- and post-harvest losses provides a win-win opportunity. For society, using more of the food we already produce can provide additional nutrition to feed those in need and eases the pressure on increasingly constrained land, energy, and water resources. For companies, the benefits include revenue opportunities through new markets or products, cost savings through improved supply chain efficiency, and contributions to meeting corporate goals related to food security and resource use. Some estimate savings in the millions of acres and hundreds of billions of dollars.

In this report, BSR recommends companies take three steps to address food loss and realize triple-bottom-line benefits:

- » **Understand the issues in your value chain.** Companies will benefit from connecting with suppliers and other partners along their own value chain to identify and analyze the different causes of food loss and specific opportunities.
- » **Deploy targeted, local solutions.** Numerous cost effective solutions exist to reduce sources of loss identified in the value chain. To be effective, however, they need to match the local context.
- » **Collaborate to identify solutions.** A growing number of partnerships are developing that share risk and generate mutual benefit. The type of possible partners ranges widely—from suppliers to agriculture extension resources, as well as local governments, civil society, and providers of infrastructure and distribution solutions.

<sup>1</sup> Business for Social Responsibility, “Waste Not, Want Not: An Overview of Food Waste,” March 2011, [www.bsr.org](http://www.bsr.org).

<sup>2</sup> Food and Agriculture Organization of the United Nations, *Global Food Losses and Food Waste: Extent, Causes, and Prevention*, January 2011.

## Summary Assessment of Upstream Food Loss

Upstream food loss occurs for a wide range of reasons. These include overplanting, labor shortages, lack of storage infrastructure, low market prices, and restricted access to markets because of disorganized supply chains. While detailed food loss data are still missing in many regions around the globe, there is enough information available to show that food loss is a problem that needs to be addressed. Companies can use existing information to target the challenge, prioritize where to focus additional research and resources, and take action that helps meet corporate efficiency targets and sustainability goals.

Based on existing data, BSR has observed the following:

- » **Companies must research the problem to take action.** The causes of food loss vary by region, crop, and supply chain. Large losses found in developed and developing countries often emerge from different causes. Companies must understand their own supply chains and then investigate locally to prioritize action, select metrics, and track benefits.
- » **Upstream loss is a global challenge.** Developed and developing countries both have high rates of food loss in certain crops. Each year, tens of millions of tons of crops are lost in the field or post-harvest in every region across the globe. Companies are therefore likely to find opportunities to reduce loss in every region.
- » **Emerging markets offer big opportunities.** While loss is global, emerging markets offer particular promise. Companies are seeking innovative solutions to food security, land use, and economic development in regions such as Southeast Asia, Africa, and Latin America. Reducing food loss can be a cost-effective way to address these issues.

### SOURCES OF FOOD LOSS

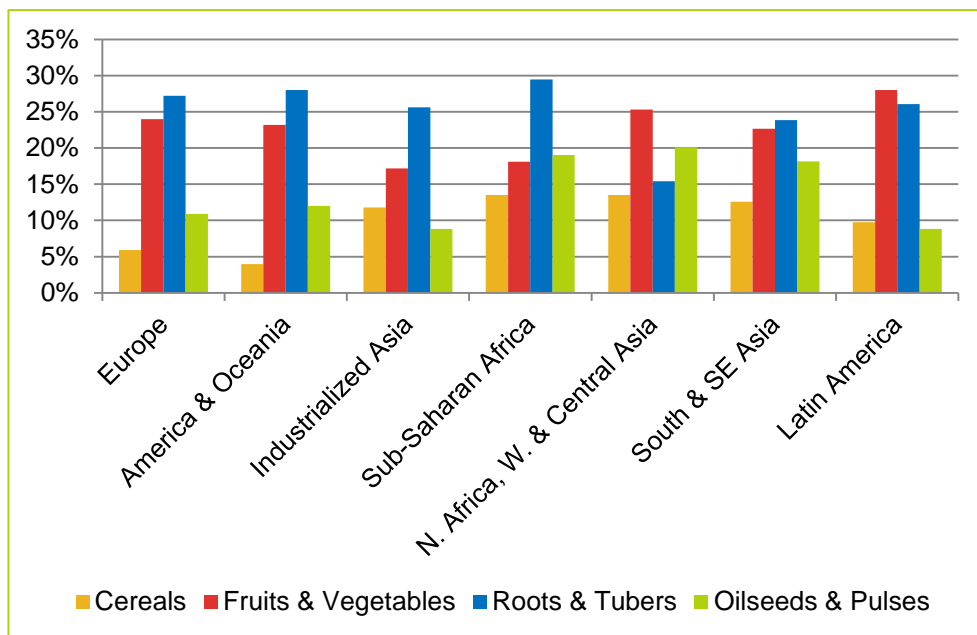
The data analyzed in this report draw from FAO food loss research on cereals, fruits and vegetables, roots and tubers, and oilseeds and pulses.<sup>3</sup> Please see the Appendix for methodology and assumptions with the FAO data.

The fruits and vegetables category and roots and tubers category lead in *proportion* of losses globally, with 20-30 percent lost across most regions. We highlight that even in developed regions, which often have more efficient production and transportation techniques, losses are as high as 28 percent for roots and tubers (See Chart 1 on the next page and Table 2 in the Appendix).

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<sup>3</sup> FAO.

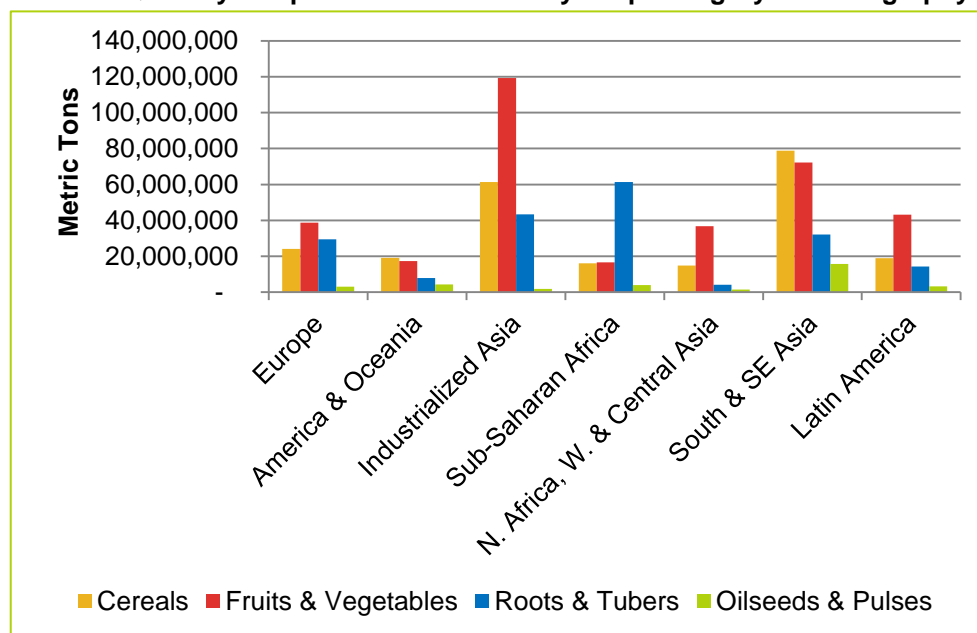
**Chart 1: Proportion of Upstream Food Loss by Crop Category and Geography**



Source: FAO 2011

However, when analyzing total *volume* of upstream loss instead of percentage, different crop categories emerge as significant. While production of cereals is fairly efficient, the sheer volume produced globally places cereals second in total quantity lost. In South, Southeast, and industrialized Asia, for example, a relatively small 11-12 percent loss amounts to an estimated 140 million metric tons of cereals wasted in these two regions annually at the upstream stage.

**Chart 2: Quantity of Upstream Food Loss by Crop Category and Geography**



Source: BSR analysis of FAOSTAT

Some sources of loss are explained later in this brief, but it is clear that the first action companies can take to address upstream food loss is to perform more research individually and in collaboration with public-sector and industry partners to answer questions relevant to their particular supply chain. Based on the FAO data, for example:

- » Why do some regions, like Europe and the United States, have higher loss rate among fruits and vegetables and roots and tubers than industrialized Asia and sub-Saharan Africa?
- » Why has Latin America been so successful in keeping loss in oilseeds and pulses low, while losses in fruits and vegetables are so high?
- » Why are losses so high in developed countries, where more efficient production and transport techniques are common?
- » Could methods that have resulted in reduced losses in cereals in developed countries apply to other crops and/or regions?

In the United States, the non-profit Natural Resources Defense Council (NRDC) undertook a targeted survey of crop shrink, interviewing large commercial vegetable and fruit growers and packers/shippers in Central California. While the sample size was small, results indicated that key drivers of food loss in the United States include overplanting, variable market prices, and labor shortages. Companies that have this type of information about their own supply chains can apply relevant solutions that are specific to their needs.<sup>4</sup>

### **FOOD LOSS: A TRIPLE-BOTTOM-LINE OPPORTUNITY**

Better use of food that the world already produces can help reduce the pressure to convert land for agricultural production. The FAO has estimated that food production (net of food used for biofuels) must increase by 70 percent to meet global food demand in 2050.<sup>5</sup> At the same time, the consulting firm McKinsey estimates that 65 million hectares could be saved by reducing food waste in the value chain (excluding consumer food waste) by 2030.<sup>6</sup>

Given that agriculture relies on the planet's natural resources, increased utilization of the crops currently grown represents a significant opportunity to make the best use of water, energy, and land. Crop production is estimated to contribute up to 14 percent of all greenhouse gas emissions in the world, including a disproportionately high amount of gases that have higher climate change impacts than carbon dioxide, such as methane and nitrous oxide.<sup>7</sup> With respect to water, losses in the food value chain account for an estimated 12-15 percent of global water use.<sup>8</sup>

In light of these factors, McKinsey's *Resource Revolution* rates food wasted across the entire food value chain as the third-largest opportunity to increase resource productivity and estimates the value of these gains at a whopping US\$252 billion.<sup>9</sup>

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<sup>4</sup> Milepost Consulting, *Left-Out: An Investigation of the Causes and Quantities of Crop Shrink*, commissioned by the Natural Resources Defense Council, December 2012.

<sup>5</sup> FAO, *How to Feed the World in 2050*, September 2009.

<sup>6</sup> McKinsey Global Institute, *Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs*, November 2011.

<sup>7</sup> United Kingdom Government Office for Science, *The Future of Food and Farming: Challenges and Choices for Global Sustainability*, January 2011.

<sup>8</sup> Kumm, M., de Moel, H., Porkka, M., Siebert, S., Varis, O., Ward, P.J. "Lost Food, Wasted Resources: Global Food Supply Chain Losses and Their Impacts on Freshwater, Cropland, and Fertiliser Use," *Science of the Total Environment*, November 2012.

<sup>9</sup> McKinsey.

## Investing in Solutions

While the opportunity is large, a range of challenges exists. The following chart illustrates many of the most significant causes of upstream food loss, paired with some of the potential solutions we highlight in the following pages.

**Table 1: Partial List of Causes of and Potential Solutions to Food Loss**

| Stage in Food Value Chain | Example Causes  | Example Solutions  |
|---------------------------|---|--|
| Production                | <b>Practice-Based</b> <ul style="list-style-type: none"> <li>• Pest/disease/weather damage</li> <li>• Improper handling</li> <li>• Premature harvest</li> </ul>   | <ul style="list-style-type: none"> <li>• Precision agriculture</li> <li>• Integrated pest management</li> <li>• Pest- and weather-resistant crops</li> <li>• Training and agriculture extension</li> <li>• Crop diversification</li> </ul> |
|                           | <b>Market-Based</b> <ul style="list-style-type: none"> <li>• Culling/selective harvesting/grading</li> <li>• Labor shortage</li> <li>• Low market prices</li> <li>• Oversupply/overplanting</li> </ul>  | <ul style="list-style-type: none"> <li>• Contractual modifications</li> <li>• Concurrent picking</li> <li>• New markets for off-spec/less-than-perfect products</li> <li>• Policies that support donations</li> </ul>                      |
| Post-harvest              | <b>Practice-Based</b> <ul style="list-style-type: none"> <li>• Anticipatory packing</li> <li>• Improper handling</li> <li>• Pest/contamination in storage</li> <li>• Natural drying</li> <li>• Spillage</li> <li>• Spoilage or bruising in transport</li> </ul> | <ul style="list-style-type: none"> <li>• Investments in storage and transport solutions and infrastructure</li> <li>• Training and agriculture extension</li> </ul>  |
|                           | <b>Market-Based</b> <ul style="list-style-type: none"> <li>• Processing requirements</li> <li>• Quality standards</li> </ul>  | <ul style="list-style-type: none"> <li>• Contractual modifications</li> <li>• New markets for edible damaged product</li> <li>• Food donations</li> </ul>  |

Source: BSR research and analysis.

Solutions to food loss are proliferating and range from companies making low-cost capital investments, to considering the unintended impacts of their buying specifications. While some solutions are within a company's immediate sphere of influence, such as engaging with suppliers, other approaches require partnerships to overcome more complex challenges. The side bar and text below provide examples and greater detail on some of these solutions. FAO's Food Loss and Waste Database has additional examples:

<http://www.fao.org/nr/sustainability/food-loss-and-waste/database/en/>

### INVESTMENTS IN LOCAL RESEARCH

Even though the extent of losses is global, the solutions must be locally driven. For example, a study commissioned by the ADM Institute of Post-Harvest Loss at the University of Illinois at Urbana-Champaign found that even across the same crop (black lentils) and in the same country (India), there were distinct variations

### **Capital Investment**

Pilot projects in India and China documented by the Water Resources Group 2030 show that basic postharvest treatment and transport improvements with fruits, vegetables, and other high-value crops could reduce losses by as much as 20 percent. Low-cost techniques such as washing, curing, and fungicide applications could reduce loss by 2.5 percent in India, while better on-site and in-transit storage could reduce losses as much as 20 percent in India and 10 percent in China at the postharvest stage.\*

in post-harvest loss rates across different states.<sup>10</sup> It is clear that best practices to address food loss must be based on an area's specific needs and challenges.

As another example, a flagship R&D program of The African Ministerial Council on Science and Technology (AMCOST) is promoting research to identify, develop and promote diffusion of relevant or appropriate technologies to reduce post-harvest food loss among root and tuber crops in particular. It is undertaking an inventory of current technologies and practices for reducing post-harvest food loss, promoting the exchange of information on appropriate technologies, stimulating new research and technological innovation, and encouraging multidisciplinary networks of research and technicians to work on specific food technology development initiatives.

### **BASIC CAPITAL INVESTMENTS**

Capital investments that address specific causes of food loss can provide readily available solutions that are often low cost. Post-harvest transport and storage stages of the upstream food value chain are especially ripe for these interventions. For example, sealed storage drums are low-capital-investment solutions to reduce losses—and have already been deployed successfully in pilot cases by the FAO in Afghanistan and elsewhere.<sup>11</sup> The FAO also notes that low-cost improvements to trucks reduce losses and damage from transport.<sup>12</sup>

The FAO handbook on preventing post-harvest food loss describes many more proven basic capital investments that reduce loss.<sup>13</sup>

### **TECHNOLOGY-ENABLERS**

Basic and cutting-edge agriculture tools are available to address food loss. The U.K. Government Office for Science, for example, suggests that simple low-cost technologies such as mini combine harvesters, grain-drying equipment, and mechanical rice threshers offer high potential to reduce food loss.

A suite of new technology-enabled tools is also available. Precision agriculture techniques use technology, such as geographical information systems, remote sensors, and online databases or weather modeling that provides farmers with better data on crop growth, yield projections, and market prices to harvest at optimal times and levels. In addition, information technology applications that enable better monitoring and management of inputs allow companies to track inefficiencies starting in the field.

Producers are also able to reduce losses from weather and other natural risks through the increased availability of crop varieties that are resistant to pests, spoilage, drought, or flooding.<sup>14</sup> Integrated pest management also reduces food loss by combining practice-based approaches, such as scouting for pests, with advanced technologies and production systems, such as the use of natural pest predators.

Further steps can be taken at the transport level. Global shipping company Maersk introduced a new technology to improve freshness and reduce loss in transit. The company's new StarCare™ system creates a controlled atmosphere

\* The 2030 Water Resources Group, *Charting Our Water Future*, 2009.

<sup>10</sup> MART, "Mapping the Production System and the Supply Chain and Study the Crop Losses of Black Gram," August 2012

<sup>11</sup> United Kingdom Government Office for Science.

<sup>12</sup> FAO, *Prevention of Postharvest Food Losses: Fruits, Vegetables, and Root Crops: A Training Manual*, 1989.

<sup>13</sup> The report can be found at: <http://www.fao.org/docrep/T0073E/T0073E00.htm>

<sup>14</sup> United Kingdom Government Office for Science, *The Future of Food and Farming: Challenges and choices for global sustainability*, January 2011.

### **Contractual Modifications**

A major global food retailer discovered that a significant portion of one supplier's harvest was left in the field due to the retailer's grading specifications. Together, they created an additional specification that gave the producer a market for more of the crop and ability to sell under the second standard, reducing the large amount of crop that wasn't being harvested.

### **New Markets**

A project of Professor Andrea Segrè at the University of Bologna, Italy, Last Minute Market provides a platform to distribute unsold edible food or produce left in the field to charities or people in need. The program is based on collaboration with a range of stakeholders, from large retailers to universities and municipalities.

### **Concurrent Picking**

The California Farm to Family program pays producers to pick food for food banks that would otherwise be left in fields. Called "concurrent picking," the program pays the cost of labor and transport of edible food that does not meet grading specifications. According to NRDC, the program provided 120 million pounds to food banks last year at a lower cost than buying from the market.

to lower the rate at which bananas and avocados ripen and decompose. It keeps produce fresh for up to 50 days, with the potential to massively reduce waste en route to sales markets.

### **CAPACITY BUILDING**

An increasing number of companies are finding ways to enhance the capabilities of their suppliers. The steps a company would take to help suppliers reduce pre- and post-harvest losses mirror those taken to address other production-related issues. One of the first steps is to understand the needs and realities of the producers including how, why, and by whom decisions are being made.

Mars, PepsiCo, Starbucks, and Walmart are among the companies that use a mix of procurement incentives, financial resources, direct training, and technological assistance to work with growers willing to increase the quality, reliability, and quantity of their production. Most efforts to date have focused on improving productivity; however, reducing losses can provide equally attractive gains.

### **CONTRACTUAL MODIFICATIONS**

Existing contractual arrangements can be a cause of food loss because they often result in producers overplanting or leaving edible crops in the field. When faced with strict contractual volume requirements, farmers overplant to hedge against pest and weather uncertainty. Farmers may also decide to leave edible crops in the field due to rigorous quantity and quality standards stipulated in contracts and an unfavorable return on investment to take those products to market elsewhere.

Adjustments to contractual arrangements could reverse these obstructive incentives. Doing so requires longer-term relationships between buyers and producers, as well as additional customer flexibility around supply timing and product specifications.

### **NEW MARKETS**

New revenue can be generated by creating or tapping into alternative markets such as food banks, farmer's markets, and online exchanges. This provides an outlet for items that don't meet buyer's traditional specifications. A related option is creating new products – such as a farmer who created pre-cut carrots when his carrots didn't meet supermarket specifications. Developing countries producing agricultural goods mainly for export may find similar opportunities to sell remaining products in local markets.

A growing number of new ventures are filling the distribution gap by connecting growers with excess food to those in need. Food Cowboy is one example, aiming to use location-based technology to direct unsellable yet edible fruits and vegetables to charities, from any point in the food value chain within the United States.

Some producers try to cut their waste through donations to food banks. For example, Del Monte Foods Co. recently donated more than two million pounds of bananas and cantaloupes to Ventura Food Share. Millions more pounds are rescued from the plow blade by gleaning groups that deliver "second harvest" crops to food banks for distribution to local meal and pantry programs. In California, Hidden Harvest hires low-income farm workers to glean locally grown food. Ag Against Hunger is yet another effort, which collects surplus crops from local growers and shippers to distribute to food banks and charities. Obstacles remain, including a need for more volunteers and liability concerns from farmers worried that gleaners might be injured in their fields.

### **Partnership on Surplus Crop Recovery**

General Mills was the catalyst in bringing together key partners for a project with Hunger-Free Minnesota that distributed 600,000 pounds of sweet corn oversupply to families in 10 states during the 2012 harvest season. The project converted potential waste to 465,000 meals. Seneca Foods harvested the sweet corn and provided logistics support, Cargill provided equipment and repacking support, SuperValu contributed its trucks, and two local food banks stored and distributed the corn. The companies plan to repeat the program in 2013.\*

### **Partnership on Infrastructure**

The Better Life Alliance is a partnership among Community Markets for Conservation (COMACO), Cargill, General Mills, Norway, USAID, the Wildlife Conservation Society, and Zambia designed to better the lives of poor rural farmers. Support includes helping producers increase sales and reduce losses through infrastructure investments such as a US\$700,000 wild-food processing plant recently opened in Zambia that provides producers with a central distributor for their crops.

## **PUBLIC-PRIVATE AND INDUSTRY PARTNERSHIPS**

Public-private and intra-industry collaborations may present the most promising large-scale opportunities to reduce food loss. Gluts, product-safety scares, and other conditions leading to oversupply and low prices will continue to introduce losses in the food supply chain. Government and industry must play a collaborative role in addressing causes and offering protection for uncontrollable circumstances.

Companies can be important drivers of public-sector solutions. More comprehensive data collection on production levels and losses by region and crop are examples of public-sector contributions to address food loss. Companies can play a role by advising government on where to collect data, then providing access to the value chain for data collection so that data are meaningful and actionable.

Another set of collaborations involves new relationships among government, non-profit organizations, and business. California joined Arizona, Colorado, and Oregon in passing a bill that allows growers to receive a tax credit for donations of excess produce to state food banks.<sup>15</sup> By reducing or sharing the cost barriers for companies to better use excess supply, governments can catalyze significant reductions in food loss.

The Southern Agricultural Growth Corridor of Tanzania is a public-private partnership among the Government of Tanzania, global companies like Unilever and Diageo, and other partners. This development initiative was launched in 2010 to boost food security, exports, and incomes in the region. The program links clusters of agricultural farming and services businesses to ports through upgraded transport infrastructure that will slash post-harvest food losses.

## **Conclusion**

Many companies and organizations are leading the way to understand and reduce food loss. The examples highlighted in this report demonstrate some of the steps and gains that are possible. Although these are laudable initial actions, there is much left to be done.

Small reductions can have a big impact toward achieving business objectives and sustainability goals. However, creating large-scale impact will require a strategic, collaborative approach. That is why BSR recommends that companies first understand the problem, then launch targeted, locally relevant solutions and collaborate with partners.

Leading companies understand that addressing waste is a significant opportunity and recognize that change takes time and investment. By investing in solutions that reduce food loss, companies can generate returns on the triple bottom line: producing more food with same amount of natural resources, improving livelihoods of farmers and their communities, and generating new revenue streams.

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\* Read more: <http://www.blog.generalmills.com/2012/09/the-great-corn-rescue/>  
<sup>15</sup> NDRC.



## Appendix

### Methodology and Assumptions with FAO Data

- » The FAO made assumptions about rates of loss in geographies where data were incomplete.
- » The FAO data include only crops that enter the chain destined for human consumption (e.g. not crops produced for animal feed, biofuels, etc.).
- » BSR combined two separate FAO data sets with slightly different regional categorizations (FAO Statistical Yearbook 2010 and Global Food Losses and Food Waste) to estimate the total volume of loss by region.
- » Quantities of food lost are measured in metric tons (1 metric ton = 2,206.4 pounds).

**Table 2: Agriculture Production and Post-Harvest Losses**

*As a percentage of total food that enters value chain*

|                                   | Cereals | Fruits & Vegetables | Roots & Tubers | Oilseeds & Pulses |
|-----------------------------------|---------|---------------------|----------------|-------------------|
| Europe                            | 6%      | 24%                 | 27%            | 11%               |
| America & Oceania                 | 4%      | 23%                 | 28%            | 12%               |
| Industrialized Asia               | 12%     | 17%                 | 26%            | 9%                |
| Sub-Saharan Africa                | 14%     | 18%                 | 30%            | 19%               |
| North Africa, West & Central Asia | 14%     | 25%                 | 15%            | 20%               |
| South & SE Asia                   | 13%     | 23%                 | 24%            | 18%               |
| Latin America                     | 10%     | 28%                 | 26%            | 9%                |

Source: BSR analysis of Global Food Losses and Food Waste, FAO, 2011.

**Table 3: Agriculture Production and Post-Harvest Losses**

*Metric tons of food lost by crop category*

|                                   | Cereals    | Fruits & Vegetables | Roots & Tubers | Oilseeds & Pulses |
|-----------------------------------|------------|---------------------|----------------|-------------------|
| Europe                            | 24,116,175 | 38,715,435          | 29,432,964     | 3,014,636         |
| America & Oceania                 | 19,072,062 | 17,359,941          | 7,795,047      | 4,331,426         |
| Industrialized Asia               | 61,400,115 | 119,253,453         | 43,357,401     | 1,838,294         |
| Sub-Saharan Africa                | 16,142,723 | 16,606,528          | 61,421,159     | 3,959,362         |
| North Africa, West & Central Asia | 14,779,527 | 36,719,933          | 4,060,110      | 1,390,210         |
| South & SE Asia                   | 78,797,719 | 72,182,400          | 32,162,896     | 15,757,611        |
| Latin America                     | 18,861,072 | 43,162,430          | 14,337,280     | 3,187,207         |

Source: BSR best estimate based on available FAOSTAT Food and Agriculture Commodities Production 2010 data.