Estimating Post-Harvest
Food Losses: Developing a Consistent Global Estimation Framework

Jaspreet Aulakh, Anita Regmi, Joan Fulton, and Corinne Alexander

INTRODUCTION

The United Nations predicts that 1.3 billion tons of food is lost globally every year (Gustavsson et. al, 2011). Food losses in Europe and Ameri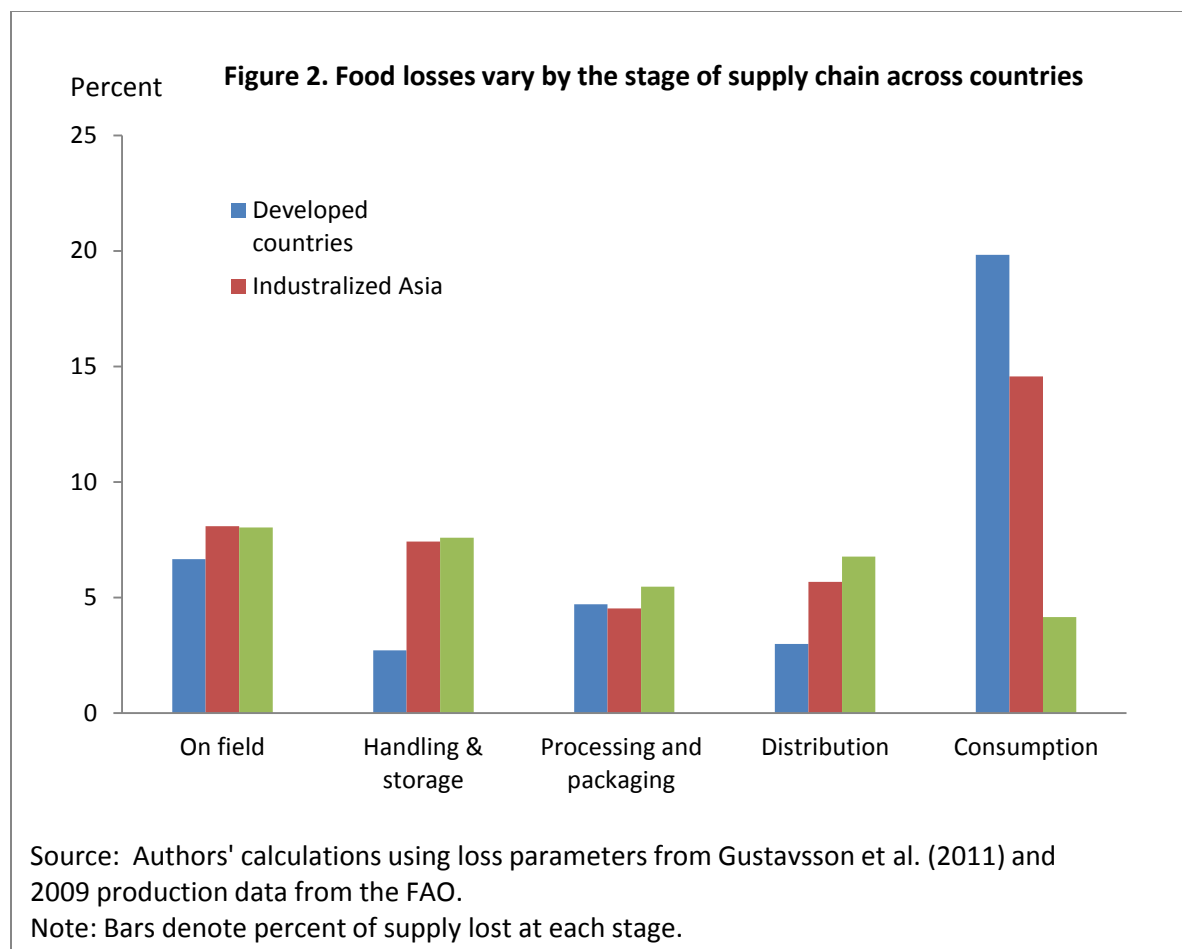ca range from 280-300 kgs/year, and are about 120-170 kgs/year in Sub-Saharan Africa and South/Southeast Asia (Gustavasson et. al., 2011). With the current world population expected to reach 10.5 billion by 2050, this food loss, if managed and prevented, can feed future generations.

Figure 1. Food losses vary by commodity across countries

Source: Authors' calculations using loss parameters from Gustavsson et al. (2011) and 2009 production data from the FAO.
Note: Bars denote percent of production lost for the respective commodity.
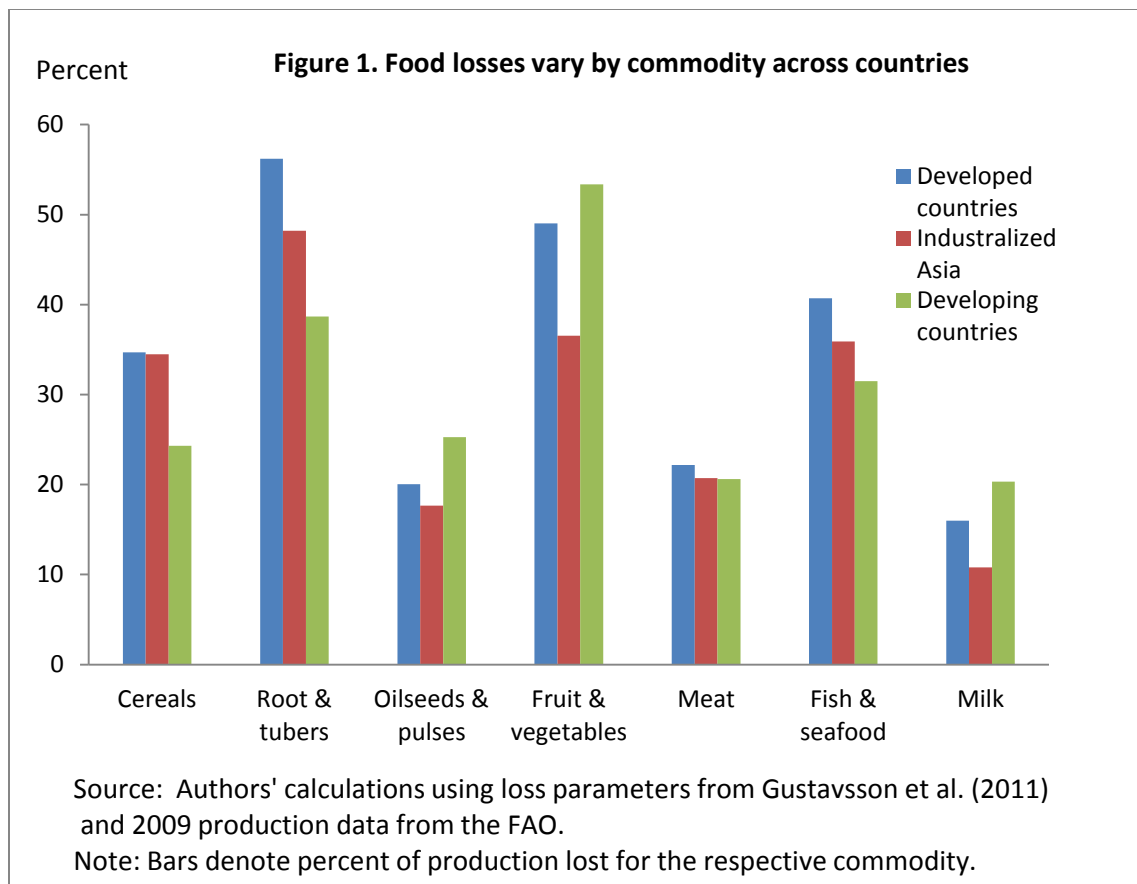
Perishables, such as fruit and vegetables, undergo the greatest proportion of post-harvest losses in developing countries. These losses are likely a reflection of the underdeveloped nature of the farm-to-retail supply chain. In contrast, food losses are relatively high across many commodities for developed countries.

Figure 2. Food losses vary by the stage of supply chain across countries

Source: Authors' calculations using loss parameters from Gustavsson et al. (2011) and 2009 production data from the FAO.
Note: Bars denote percent of supply lost at each stage.

Food losses in developed countries occur primarily at the consumer level, although some losses occur on the fields or at other stages of the supply chain. Field losses occur because of farmers' decisions to forgo harvesting due to tough market standards. Losses in developing countries, in contrast, occur mostly during the field-to-market stages, with the smallest share of losses occuring at the consumer level. Premature harvesting, poor storage facilities, lack of infrastructure, lack of processing facilities, and inadequate market facilities cause high food losses in developing countries along the entire Food Supply Chain (FSC).

Poor post-harvest food loss (PHL) estimates affect the quality of food availability data. Food security assessments and other analyses, which consider projections of future food needs, rely on food balance-sheet information. Food availability in food balance sheets is generally calculated as:

Food availability for human consumption = Total supply – [PHL + feed and industrial use]

OBJECTIVE

The objective of this study is to develop a consistent and comprehensive framework for estimating PHL. This framework will help to develop econometric models to estimate PHL for selected countries and commodities. The ultimate goal of the project is to improve global food balance-sheet data via better estimates of PHL.

CONCEPTUAL FRAMEWORK FOR ESTIMATING POST-HARVEST FOOD LOSSES

Figure 3. Conceptual framework for estimating post-harvest food losses
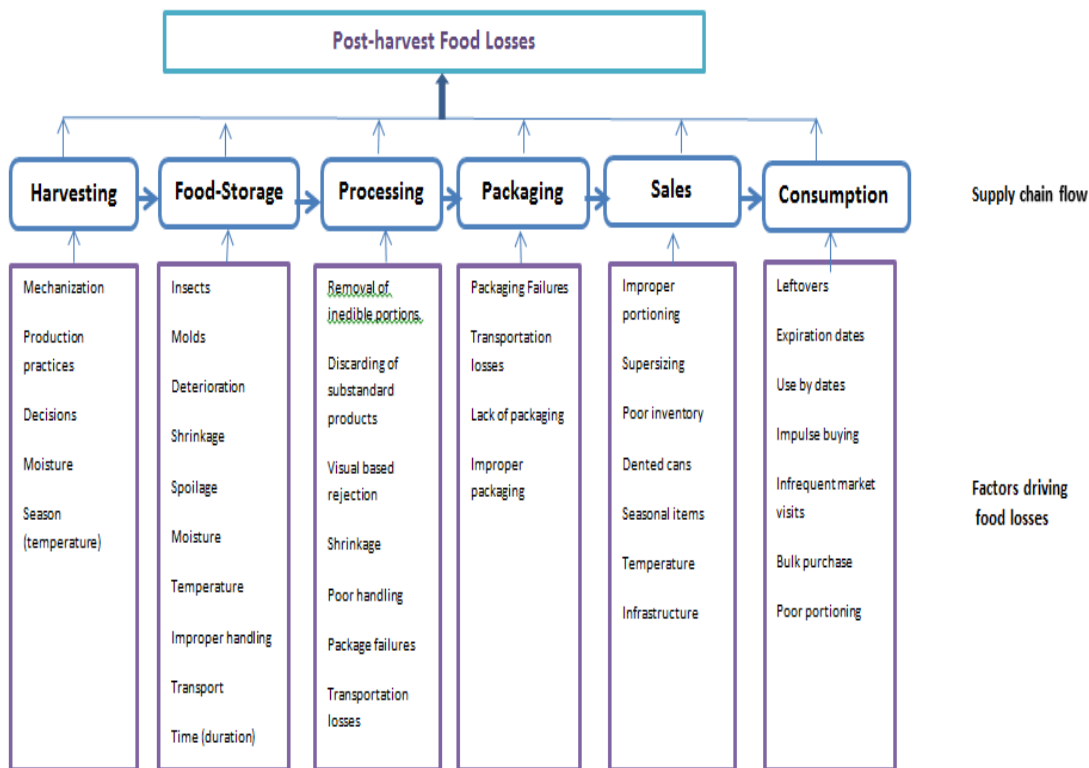
Food travels along the value chain from harvest to consumption. Losses occur at each stage along the chain and contribute to total PHL. The loss at each stage is driven by different factors, examples of which are described in figure 3. The relative importance of a particular stage or factor toward contributing to total PHL will vary across countries and commodities. For example, estimating losses for a sophisticated, vertically integrated supply chain will likely require consideration of fewer factors than for a less integrated supply chain where the commodity undergoes several transactions before reaching the retail outlet. Therefore, while the conceptual framework is the same, the actual econometric model used for PHL will vary.

METHODOLOGY

Table 1. Factors affecting post-harvest losses at critical stages of the food supply chain.

Critical stages of food supply chain (Si)	Factors affecting postharvest losses (PHL) (Xj)								
	Moisture	Weather	Pests/disease	Infrastructure	Size of operation	Level of mechanization	Quality of management	Operator characteristics	Access to capital
Harvesting	X	X	X		X	X	X	X	X
Food storage	X	X	X	X	X	X	X	X	X
Processing	X	X	X	X	X	X	X	X	X
Packaging				X	X	X	X	X	X
Sales				X	X		X	X	X

Source: United Nations, FAO,1980 and authors.
Note: Food waste at the consumer level will not be covererd in this study.

Total PHL = Sum of PHL at each stage of the food supply chain:

$$Total\ PHL = \sum S_i = \sum f(X_j),$$

where 'Si' stands for the losses in each critical stage of FSC; 'X$_j$' stands for the factors affecting losses at each step, and 'i' represents critical stages from harvesting to sales.

For purposes of this study, we focus on the segment of the supply chain which covers harvesting through sales (and exclude food losses at the consumer stage). For qualitative factors, such as the quality of management or infrastructure, indicies will be developed to allow their incorporation into the model (Basavaraja et al., 2007). Other factors, such as the size of the operation, can directly enter the model as scalar variables. Controlled experimental surveys will be developed to calculate losses at each stage, and these losses will be regressed using different factors as variables. The estimated parameters can be used to project future losses.

NEXT STEPS

As a follow-up to this work, and using the methodology discussed, we will build econometric models for selected commodities and countries to estimate the losses.

DEFINITIONS

Post-harvest food loss (PHL) is food lost along the supply chain from harvest until consumption (or other end uses). PHL can occur due to food waste or inadvertent food losses along the way.

- *Food waste* is the loss of edible food due to human action or inaction, such as not consuming food before its expiration date or throwing away wilted produce.

- *Food loss* is the inadvertent loss in food quantity because of the infrastructure and management limitations of a given food value chain. Food losses can be the result of a quantitative loss or a qualitative loss.

Quantitative food loss

Qualitative food loss

Food waste

Total Food Loss

Quantitative loss of food implies a reduction in the available quantity as a result of:

- Infestation by pests at harvest or storage,
- Physical loss during handling, or
- Reduction in quantity because of changes in temperature, moisture content, or chemical composition.

Qualitative loss of food results in changes which lower its economic or nutrient value, often requiring that it be discarded (i.e., resulting in quantitative loss). This can occur due to:

- Spoilage due to pests or diseases,
- Physical or chemical changes due to a lack of climate-controlled storage and handling facilities,
- Food contaminated with nonfood material, or
- Adverse taste, texture, or other changes due to improper processing.

ACKNOWLEDGEMENT

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Jaspreet Aulakh, ERS-USDA/Purdue University (jaulakh@ers.usda.gov)
Anita Regmi, ERS-USDA (aregmi@ers.usda.gov)
Joan R. Fulton, Purdue University (fultonj@purdue.edu)
Corinne Alexander, Purdue University (cealexan@purdue.edu)