MEASURING FOOD LOSSES

Session 1:
Conceptual framework and definitions
Objectives of the presentation

• Introduce the concept used in food loss measurement, such as harvest and post-harvest food loss

• Inform the audience about the benefits of conducting an assessment of harvest and post-harvest food loss
Outline

• Introduction

• Concepts and definition

• Identifying loss « hot spots »

• Example of other loss assessments
Introduction

- Strong request from sub-Saharan countries at the AFCAS (2011)
- Malabo Declaration of African Union countries in 2014
- Lack of availability and quality of post-harvest loss data

Solutions to methodological challenges need to be provided. Examples:

- **Scope**: where does post-harvest start and end? Are we measuring quantitative, qualitative, nutritional losses?
- **High level of expertise** needed to assess damage
- **Multiple dimensions of post-harvest loss**: commodities, technology, value chain, actors, ..
- **Statistical approach**: sampling vs. case studies / value chain
- **Cost-effectiveness**
Introduction

• Post-harvest and food loss assessments PHFLA
  ➢ Enable relevant and efficient rapid data collection, processing and dissemination of food loss statistics

• Important!!! Practitioners in different countries need to have a clear understanding of what constitutes PHFLA

• Conceptual framework is based on a literature review and experience gathered in various countries

• Primary purpose: systematically and cost-effectively provide an objective picture of the grain loss situation
  ➢ in the country (or in specific areas)
  ➢ at a specific time, so that timely and appropriate actions can be taken by government and the international community for decision making (loss prevention, mitigation, etc.)
Introduction

• Post-harvest food losses (PHFL) in the literature

• Food loss and Waste (FLW) from the World Resources Institute

• Loss ≠ Waste
Introduction

Losses → Food security

• **Food availability** = food produced, food brought through market mechanisms, food held by traders and in government reserves, and food supplied by the government and/or aid agencies **linked to losses**
Introduction
“By 2030, halve per capita global food waste at the retail and consumer levels and reduce food Loss along production and supply chains, including post-harvest Loss.”
Introduction: motivation for using a value chain analysis approach

• Proper agricultural value chain analysis (VCA) should be conducted prior to the main assessment

  ➢ identify major participants in the supply chain

  ➢ fully decompose the system and its current status (subsystems, cost structures, spatial, seasonal dimensions)

  ➢ better identify actors and processes in the chain where most losses are likely to occur

• The relevant agents to be included during the assessment interviews are identified bearing in mind the many reasons for storing grain and the different roles they play along the supply chain
1
Concepts and definitions
1.1. Concepts and definitions: main concepts

• **Grain:**
  - Cereals and pulses; it includes cereals on the head, ear or cob, and after threshing or shelling, and pulses both shelled and in pod

• **Food:**
  - Commodities that people normally eat: the weight of wholesome edible material, measured on a moisture-free basis that would normally be consumed by humans
  - Inedible portions of the crop, such as stalks, hulls and leaves, are not food. Crops for consumption by animals are not considered food

• **Harvest:**
  - Refers to the deliberate act of separating the food material from the site of immediate growth or production, for instance reaping of cereals, picking of fruits, lifting fish from water, etc.
1.1. Concepts and definitions: Main concepts

• **Post-harvest:**
  - Period after separation from the site of immediate growth or production

• **Post-production**
  - Comprises harvest and post-harvest operations

• **Loss/Food Loss:**
  - The measurable decrease of food produce which may be quantitative or qualitative
  - Any change in the availability of food and in the edibility, wholesomeness or quality of food that reduces its value to humans
  - Food grain losses may either be characterized as direct, indirect, quantitative, qualitative and economic
1.1. Concepts and definitions: Main concepts

- **Food damage:**
  - Refers to the superficial evidence of deterioration, for example, holed or broken grains, from which loss may result

- **Grain loss (quantitative):**
  - Loss in weight of food grain that would have been eaten had it remained in the food chain

- **Direct food loss:**
  - Disappearance of food by spillage or consumption attributed to insects, rodents, birds, moulds, fungi, etc.
1.1. Concepts and definitions: Main concepts

• **Indirect loss:**
  - Loss caused by a lowering of quality, leading to its rejection as food
  - **Quality loss** is an indirect loss, as nutritional losses

• **Nutritional loss:**
  - It is the loss in terms of nutritional value (nutrient loss, for example) to the human population concerned
  - Example: weight loss during storage, excluding loss of moisture content, is an incomplete measure of food loss: indeed, the nutrient loss may be consistently larger due to selective feeding by pests, targeting the most nutritious parts of grains
1.1. Concepts and definitions: Main concepts

• *Post-production losses*
  - Comprise harvest and post-harvest losses

• *Economic losses*
  - Is the value of the losses in terms of money
  - Can be easily calculated if information on prices are available
1.1. Concepts and definitions: Main concepts

• Three general periods identified for losses of crop product:
  
  ➢ *Pre-harvest losses*: occur before the harvest begins and may be the result of attacks by insects, mites, rodents, birds, weeds or diseases afflicting crops
  
  ➢ *Harvest losses*: occur during harvesting and may be the result of shattering, mechanical damage, and shedding of the grain from the ears to the ground
  
  ➢ *Post-harvest losses*: as defined before
1.2. Concepts and definitions: Important parameters

- **Losses** are expressed on a moisture-free basis.

- Normally post-harvest loss assessments are mostly made on the basis of **dry-matter variations**, with almost **no attention paid to nutritional or financial losses** in most FAO approaches.
1.2. Concepts and definitions: Important parameters

• **Moisture content (mc):**
  - Defined as the quantity of free water in a given material
  - Loss of moisture during grain drying is not considered food loss

• Decimal ratio or percentage is used to define moisture content:
  - **Wet basis (wb).** This is the ratio of the weight of water to the total weight of dry matter and water, and is most commonly used in agriculture (by default)
  - **Dry basis (db).** This is the ratio of the weight of water to the dry-matter weight

\[ mc.wb = \frac{mc.db}{1 + mc.db} \]
1.2. Concepts and definitions: Important parameters

• Two major ways to present weight losses:
  ➢ Absolute loss, the actual weight of grain
  ➢ Relative loss, given as a percentage or proportion

• The denominator can be either the quantity harvested or the quantity handled during the last operation
  ➢ With the quantity harvested, percentage can be added up
1.3. Concepts and definitions: Causes of losses

- Attack by insects, mites, birds, rodents (biological/microbiological)

- Deterioration by fungi and bacteria (biological/microbiological)

- Environmental and climatic factors

- Processes of initial or primary processing, handling and storage (mechanical/technical/biochemical/chemical)

- Processes of harvesting, transportation, conveying, drying, threshing, shelling, etc. (mechanical/technical/socio-economic)
Identifying loss “hot spots”
2.1. Agricultural supply/Value chain

- Objectives:
  - Which links of the value-chain display the highest losses?
  - What should be the focus of measurement efforts/policy measures?

- First step: Perform value chain analysis of the relevant crops or commodities

- Value Chain: full range of activities that are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services); delivery to final customers; and final disposal after use (Kaplinsky and Morris, 2002)

- Agricultural value chain: comprises the input supply, production, post-harvest, storage, processing, marketing and distribution, food service and consumption functions along the “farm-to-fork” continuum for a given product
2.1. Agricultural supply/Value chain

• **Second step**: Define what is going to be measured, how and according to which scope/coverage it will be measured.

• **For PHFLA:**
  
  ➢ Weight loss of specific crops handled by the value chain actors, from farmers to consumers, at a given time, expressed in percentages of production

  ➢ Losses can be broken down along various dimensions: processes/activities, technologies, factors causing/impacting losses, etc.
2.1. Agricultural supply/Value chain

- A simplified food supply chain
2.1. Agricultural supply/Value chain

- A simplified food supply chain

**Figure: Simplified Value-Chain (VC) and Food Supply Chain Analysis (FSC)**
2.1. Agricultural supply/Value chain

• Sources of information for the supply chain situation analysis:
  - Existing supply chain or industry analyses
  - Broader country agricultural development or trade studies
  - Investment climate studies
  - Agricultural strategy documents
  - National and international databases
  - National poverty assessments
  - General country economic development studies
2.1. Agricultural supply/Value chain

• Key decisions should be taken before starting the value chain analysis:
  
  ➢ Which sub-sectors, products or commodities?
  
  ➢ Which method and which approach to use (World Bank, UNIDO, etc.)?

• Important!!! Statisticians should work closely with agricultural economists/agrononomists as they are specialists on the subject matter
2.1. Agricultural supply/Value chain

• What are the purposes of the VC analysis?

➢ Better understand the connections between actors and processes in a value/supply chain

➢ Demonstrate interdependency between actors and processes in the value chain

• What should be taken into account during the analysis?

➢ The targeting of the entities to be surveyed: households, farms, intermediaries, mills, government institutions, etc.

➢ The identification of the type of stocks: food security stocks, speculative stocks, operative stocks, etc.
2.1. Agricultural supply/Value chain

Questions to help in designing the study:

- What are the different (core) processing steps in the value chain?
- Who are the actors involved in these processes and what do they actually do?
- What are the flows and stocks of the crops or commodities in the value chain?
- What is the volume of products, and the number of actors?
- Where do the crops or commodities originate from and where do they go?
- What types of relationships and linkages exist?
- What types of (business) services are feeding into the chain?
- What are the loss points in the chain by crop, actor and level or process?
- What are the estimated loss value along the chain?
2.2. Different stages for loss assessment

• **Harvesting losses (farmer):**
  - Manual harvesting process includes cutting the crop, gathering, bundling and stacking
  - The same operations may be done mechanically by a harvester
2.2. Different stages for loss assessment

- **Threshing or shelling (farmer):**
  - Grains are beaten to separate them from the husk (threshing, case of rice) or from the plant to which they are attached (shelling, case of maize)
  - The process may be performed manually or mechanically using threshers or shellers
2.2. Different stages for loss assessment

• Cleaning or winnowing (farmer):
  ➢ The process consists of cleaning the grain by blowing away the chaff from it.
  ➢ In so doing, losses occur because of a certain amount of the edible grain passing into chaff.
  ➢ The cleaning operation may be done manually or mechanically.
2.2. Different stages for loss assessment

- **Drying: two mains ways in which losses occur (farmer)**
  - When crops like paddy, pearl-millet or sorghum, is spread out on the road or in the yard in open air, some may be eaten by birds, rodents, insect pests, etc.
  - In case of inadequate drying, fungal damage to grain may ensue
2.2. Different stages for loss assessment

- **Storage (farmer, middleman, processor, wholesaler, retailer, supplier):**
  - Storage requirements vary depending on the nature of the crop: durables (cereal grains and pulses), semi-durables (roots and tubers) or perishable (fruits and vegetables)
  - Deterioration of stored produce may be caused by agents, such as microorganisms (fungi, bacteria and yeasts), insects and mites, rodents, birds, and metabolic activity
2.2. Different stages for loss assessment

- Transport (farmer, middleman, processor, wholesaler, retailer, supplier):
  - **On-farm:** Harvested crop may need to be transported from the field to the farm threshing floor, and from there to the farm storage area, and finally from the storage area to the collecting points.
  - **Off-farm:** from those markets to local shops or storages or over long distances to distant or foreign markets by train, trucks, ships or other modes of transport.
2.2. Different stages for loss assessment

• Processing (processor, retailer):

  ➢ Food grains go through different types of processing before being finally consumed (dehusking the paddy rice, for example).
  
  ➢ A key parameter in the efficiency of milling is measured by recovery in terms of whole grain, broken and brown grains.
  
  ➢ Most of the time losses are better defined in relation to a base standard type of rice mill.

• Packaging/Handling/Distribution (processor, retailer):

  ➢ Because of the reduction in weight or rejection because of spoilage, etc.
  
  ➢ May occur at different stages: from farm to storage, from storage to market, at different points of marketing channels, at whole or retail trade levels.
Example of other loss assessments and value chains
3.1. Example of other loss assessments and value chains

• FAO 4S method:

➢ **Screening**: preliminary screening of food losses, based solely on secondary data and expert consultations

➢ **Survey**: undertake a survey on food loss assessment using questionnaires per type of actors. No physical measurement

➢ **Sampling**: load tracking and sampling assessment for physical measurement

➢ **Synthesis**: solution finding with the identification of the causes of losses and proposal of solutions to reduce them
3.1. Example of other loss assessments and value chains

• APHLIS (African Post Harvest Losses Information System):

<table>
<thead>
<tr>
<th>Harvesting</th>
<th>Transport to farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platform drying</td>
<td>Farm Storage</td>
</tr>
<tr>
<td>Threshing and Shelling</td>
<td>Transport to market</td>
</tr>
<tr>
<td>Winnowing</td>
<td>Market storage</td>
</tr>
</tbody>
</table>
3.1. Example of other loss assessments and value chains

**APHLIS:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvesting or field drying</td>
<td>4 – 8 %</td>
</tr>
<tr>
<td>Transport to homestead</td>
<td>2 – 4 %</td>
</tr>
<tr>
<td>Drying</td>
<td>1 – 2 %</td>
</tr>
<tr>
<td>Threshing or shelling</td>
<td>1 – 3 %</td>
</tr>
<tr>
<td>Winnowing</td>
<td>1 – 3 %</td>
</tr>
<tr>
<td>Farm storage</td>
<td>2 – 5 %</td>
</tr>
<tr>
<td>Transport to the market</td>
<td>1 – 2 %</td>
</tr>
<tr>
<td>Market storage</td>
<td>2 – 4 %</td>
</tr>
<tr>
<td>Cumulative loss from production</td>
<td>10 – 23 %</td>
</tr>
</tbody>
</table>

Postharvest losses for cereals grains (Source: APHLIS website, [http://www.aphlis.net](http://www.aphlis.net))
3.1. Example of other loss assessments and value chains

**APHLIS:**

<table>
<thead>
<tr>
<th>Stages</th>
<th>Loss figure</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5</td>
<td>Egyir I.S. - 2011</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>Boxall R.A. - 1998</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>Vervroegen D. - 1990</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Singano C. - 2008</td>
<td></td>
</tr>
<tr>
<td>6.5</td>
<td>Singano C. - 2008</td>
<td></td>
</tr>
<tr>
<td>6.9</td>
<td>Singano C. - 2008</td>
<td></td>
</tr>
<tr>
<td>9.9</td>
<td>Singano C. - 2008</td>
<td></td>
</tr>
<tr>
<td>9.9</td>
<td>Grolleaud M. - 1997</td>
<td></td>
</tr>
<tr>
<td>5.8</td>
<td>Mvumi B.M. - 1995</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>Odogola W.R. - 1991</td>
<td></td>
</tr>
<tr>
<td>Harvesting/field drying</td>
<td>6.4</td>
<td>Lars-Ove Jonsson - 1987</td>
</tr>
<tr>
<td>Platform drying</td>
<td>4.0</td>
<td>Odogola W.R. - 1991</td>
</tr>
</tbody>
</table>

Postharvest losses for cereals grains (Source: APHLIS website, [http://www.aphlis.net](http://www.aphlis.net))
3.1. Example of other loss assessments and value chains

• APHLIS:

- **Peer-reviewed literature**
  - Systematically reviewed
  - Source of APHLIS loss figures

- **PHL profiles**
  - Combine loss figures per:
    - crop
    - climate type
    - value-chain step
  - Reference underlying literature

- **Seasonal Factors**
  - Crop production data
  - Environmental conditions affecting loss (e.g. weather, pest incidence)
  - Postharvest activities (e.g. % marketed, % stored, storage duration)

- **Expert Network**
  - Covers 28 African countries
  - Provides seasonal factors
  - Represents APHLIS

**Loss estimates**
- Weight loss data for 38 African countries
- 9 cereal crops: wheat, maize, rice, sorghum, barley, rye, oats, millet, fonio, teff
- Available for 2003-2016
- The APHLIS project will:
  - expand number of crops
  - provide financial loss estimates
  - provide nutritional loss estimates

**Find APHLIS data and research at [www.aphlis.net](http://www.aphlis.net)**
3.2. Example of other loss assessments and value chains

• WRI (World Resource Institute):

<table>
<thead>
<tr>
<th>Production</th>
<th>Distribution and market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling and storage</td>
<td>Consumption</td>
</tr>
<tr>
<td>Processing and packaging</td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

• Really important to have clear definitions and concepts

• Scope should be very well defined at the beginning of the study

• A value chain analysis may be conducted to identify the loss hot spots
References

Thank You