STEWARDSHIP INDEX FOR SPECIALTY CROPS

FOOD LOSS METRIC GUIDE

INTRODUCTION

The Food Loss Metric is intended for growers to track and report the amount of food grown to the point of maturity but not used; in other words: crops that were “ready for harvest” but did not enter the supply chain for human consumption. Understanding this amount of product ‘loss,’ such as product left in the field or culled out at a processing facility or packinghouse, will provide growers and associated buyers with useful data on where and why loss is occurring within the boundaries of a single farm’s operation. The Food Loss Metric Calculator measures loss at each operational unit under a grower’s control which may include fields, packinghouse/processing facility, storage, and transport between each link. This Metric Calculator also has the potential to track destinations for loss, drivers for loss, moisture content loss, and the financial opportunity that could be realized by returning to the field to harvest surplus. By measuring loss, it is possible for growers to identify adjustment opportunities to improve operational efficiencies.

Grower Benefits

Growers can use this tool to simply track and manage or, if they choose report on farm loss and surplus. As surplus and loss on farm may change year to year, and field to field, this tool can be embedded into existing systems for collecting farm data such as annual yield, acres planted, etc.

Growers also have the option within this Metric Calculator, to track the causes of loss. Tracking the causes of loss allows growers to use the Metric Calculator as an effective on-farm management tool for reducing crop loss over time. The baseline measurement generated through this tool can be used by farmers to track current losses on farm, understand the potential for surplus recovery, assist in building an industry average, and track management decisions that could lead to reductions in future losses.

A final component of this tool calculates the economic potential of returning to the field to harvest what is left behind under four different scenarios (described below).

As industry data collected increases, farmers may also be able to benchmark themselves against regional averages allowing them to quantify their opportunity compared to their peer group. The Metric Calculator attempts to tie the quantified losses to specific reasons—i.e., weather or pest damage, unfulfilled contracts, and market specifications to name a few. Therefore, this metric will provide growers, and buyers with information that can inform future planting and management decisions. Measuring surpluses can help to identify adjustment opportunities to improve operational efficiencies. Identifying why food is not sold provides an opportunity to optimize the use of other resources and inputs, i.e., water, chemicals, labor, and fuel. In addition, new secondary market opportunities could be created for less than perfect food. For example, the quality of produce lost may be suitable for a variety of secondary markets such as value-added processing channels or food service channels that do not require such strict cosmetic standards.

METRIC GUIDE OVERVIEW

The sections below are designed to logically walk through the metric calculation process, so please read each step of the Metric Calculator in the order it is listed. The metric scope captured in **Figure 1** outlines the areas on-farm where measurable food surplus and loss may exist and will be captured through this metric. The **Definitions** section explains the terms that are used throughout the Metric Calculator. The **Metric Inputs** section explains the variables that will be used to complete the calculations within the SISC calculator. For each proposed input, the variables, potential challenges, and possible uncertainties that may arise from recording measurements, have been described. For quantitative components of the calculator, data inputs can be recorded in volume (i.e., containers) or weight, so long as the volume (or container) unit is consistent throughout the Metric Calculator. In addition to the quantitative inputs, the Metric Calculator asks for the qualitative reasons for the loss so that the final output can portray what is being underutilized on-farm and why, as accurately as possible. To conform to the internationally recognized Food Loss and Waste Standard (FLW Standard), the Metric Calculator also asks for final destinations of all underutilized crop. The Metric Calculator allows for the input of the same crop measurements over the course of three years as that has been determined to be the smallest time interval over which you can start to get a reliable average loss for that crop.

! *Please note that the logical order on the calculator does not imply that the same product harvested in-field needs to be tracked all the way to the processing or storage stages. You can obtain the calculations for each tab in the calculator at different times. Pilots indicated that the time to conduct the Food Loss Metric exercise took upward of two hours the first time, but much less time thereafter.*

METRIC SCOPE

The Food Loss Metric Calculator includes on-farm operations only. These will differ by grower based on their unique operation. The Metric Calculator is intended for crops for which the primary market is human consumption. Crops that are produced for animals, animal feed, or material goods that are not directly consumed by humans, should not be included in the Metric Calculator. Activities that are not part of the farm's direct on-farm operations should also not be included in the Metric Calculator. For example, if a grower does not operate their own packinghouse, then the loss measurement would exclude the packinghouse calculations. The operations covered by the Metric Calculator include the following stages in a grower's supply chain where food loss may occur:

- **IN-FIELD** product left in the field once it is mature enough for harvest either after a field has been harvested or from a field that has been walked-by. Losses of a crop during planting or maturation (i.e., weather or pest damage before harvest time) are considered outside of scope.
- **TRANSPORTATION** from the field to the next operational stage on farm. (e.g., moving produce from field to packinghouse)
- **PACKINGHOUSE** harvested product graded out or damaged during grading and sorting within the on-farm packinghouse.
- **PROCESSING** any product lost during pre-processing or processing on the farm before the product is sent to market. By-products such as shells are not considered loss.
- **STORAGE** product lost in storage facilities on farm.
- **REJECTION** product that is returned to the farm.

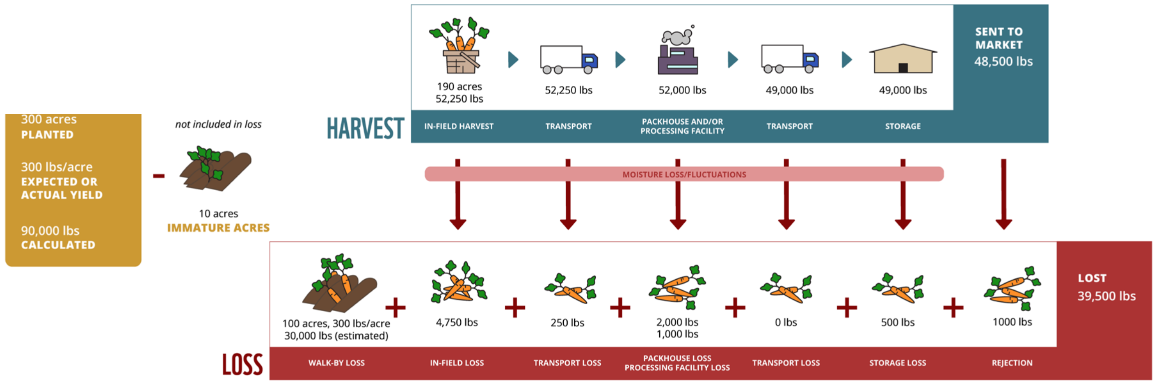

FIGURE 1 Areas where on-farm loss may occur

DEFINITIONS

Below are the definitions of terms used throughout the Metric Calculator. Familiarization with these terms will help with efficiently completing the Metric Calculator.

EDIBLE, NOT MARKETABLE (REFERRED TO GOING FORWARD AS "EDIBLE") Crop that does not meet buyers' current quality specifications but is still considered edible for human consumption.

> Example: Unharvested crop that is left in-field for one or more of the following reasons: misshapen, too small, or too large, cosmetic inefficiency, not enough or too costly labor.

IMMATURE LOSS Product left in a field that was ready for harvest but was never harvested.

> Example: crop/field left unharvested due to low market values, unfulfilled contracts, weather or pest damage, post-maturity, and/or lack of labor force.

INEDIBLE, PARTS[1] Components associated with a food that, in a particular food supply chain, are not intended to be consumed by humans.

> Example: The pit of a peach. For the Metric Calculator, inedible parts are assumed to be included in the final calculation unless a farmer changes this default setting.

INEDIBLE, PRODUCT[2] Crop that is damaged, diseased, showing signs of decay, or over mature.

> Example: Crop that at the time of measurement is no longer able to be sent to market because it is showing signs of decay and therefore is no longer food safe.

IN-FIELD HARVEST, LOSS Crop left in a harvested field that was missed by harvesters or equipment or left in field due to quality specifications.

> Example: Crop that was missed by picker or completely passed over by a picker due to cosmetic damage or other issues related to quality standards. If a crop has been gleaned after the market harvest, the amount that is gleaned is not considered loss, but should be tracked to understand the potential opportunity remaining in field that may be an economic loss.

1 Food Loss and Waste Standard
2 Johnson et al. "Estimating on-farm food loss at the field level: A methodology and applied case study on a North Carolina farm, Resources, Conservation and Recycling".

MARKETABLE[3] Crop that meets buyers' current quality specifications.

Example: Harvested crop that corresponds to the quality standards set forth by USDA's grading standards, and buyer specifications.

MOISTURE LOSS Changes in moisture content between each point in a grower's operation (e.g. between field to processing facility). The extent of loss from evaporation or other means, such as cutting of the physical surface, is determined by various factors including the product's variety, weather (e.g., rain at harvest), as well as storage duration. The intrinsic water weight of a product may go up (when humidity rises) or down (when drying occurs).

Note: The calculator does not automatically account for a change in the crop's moisture content. If a grower knows the moisture content at any step, they can input it as an optional field. The calculator will then look at the initial and final moisture content to determine how much of the change in weight is due to a loss of physical product versus due to a change in the product's moisture content.

PACKINGHOUSE LOSS Product lost or culled out during packing. A packinghouse is defined as any operation that takes product from the field and prepares it for shipment without adding any additional "value" to the product.

Example: Product that is culled or sorted out in the process of being packed due to pest damage, ripeness, or other quality issues.

PROCESSING LOSS Product within the processing facility that is sorted, culled out, or discarded from raw materials (i.e., trimming losses). A processing facility is defined as any operation that adds value to the product such as a slicing and packaging operation.

Example: product that is culled or sorted out in the process of being processed due to pest damage, ripeness, or other quality issues.

REJECTED LOSS Product that returns to the farm because it was turned away from buyer or processor.

Example: Crop that overripens in transport or has too many quality issues and no longer meets buyer specifications may then be sent back to place of origin.

STORAGE LOSS Product lost within the storage facility

Example: Product that is culled or sorted after it has been in storage

TRANSPORT LOSS Product that makes it out of the field but is discarded upon arrival to packinghouse, processing facility, storage facility, or its intended destination due to damage in transportation.

Example: Product arrives from field to processing facility but was harvested a bit too ripe and therefore began to decay or was damaged in transport and culled out before it is processed or packaged.

WALK-BY LOSS Product that was planted and raised to the point of maturity but was never harvested.

Example: Product was planted and raised to the point of maturity in preparation for specific contractual agreements, or to make sure contracts were met in case of weather or pest damage but ended up not being needed and was therefore "walked-by".

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3 Johnson et al. "Estimating on-farm food loss at the field level: A methodology and applied case study on a North Carolina farm, Resources, Conservation and Recycling".

METRIC INPUTS

Below you will find definitions and justifications for the inputs needed to calculate loss results.

Variable: **ACRES PLANTED**

Definition Total amount (in acres) of field(s) put into production for the specific crop being measured (this would be the same number reported to USDA NASS, if you have reported in the past). If rows are intercropped (i.e., bean planted under orchard trees) only include acres for the crop of interest.

Justification By understanding the total amount of acreage put into production, the Metric Calculator can use additional variables to calculate acres that are not harvested, and the qualitative responses can be used to determine the cause of those unharvested fields, which may include contracts that are not fulfilled.

Anticipated challenges Actual planted acreage may not always be measured accurately, particularly when planting multiple varieties in a field side by side. Reporting parcel size rather than actual planted acreage may include row ends and driving aisles and therefore lead to inaccuracy. Some variation is to be expected.

Possible uncertainty Reporting biases or inconsistencies in planting records may contribute to differences between the planted acres inputted and the actual number of planted acres.

Variable: **ACRES HARVESTED**

Definition Total amount (in acres) of field(s) for the crop being measured that are harvested

Justification By understanding the total acres harvested, the Metric Calculator can calculate walk-by losses using the difference between acres planted, immature acres, and acres harvested.

Anticipated challenges Minimal challenges are anticipated.

Possible uncertainty If small plots of land within an acre are not harvested due to localized pest or animal presence the number reported could be overestimated.

Variable: **IMMATURE ACRES**

Definition Total amount (in acres) of the field(s), or parts of a field, that were planted for the chosen crop but did not reach maturity, for example due to pest or weather damage, or irregular field conditions. This bucket could also include fields that are abandoned, not because of damage, but due to price expectations that it will not be worth investing additional resources into to grow a crop to maturity.

Justification The number of acres that did not reach maturity need to be removed from the total acres planted since they are considered loss before harvest, which is outside of the scope of the metric. If the farmer is already removing these acres from the planted acres, then this variable can be excluded.

Anticipated challenges Accurately capturing this number may be challenging if it is not often reported or recorded. This will likely be an average by growers.

Possible uncertainty This number will likely be an estimate by growers, which will introduce moderate uncertainty into the final number of walk-by losses.

Variable: **YIELD PER ACRE**

Definition Total harvested yield per planted acre

Justification Knowing how much of the crop was harvested is necessary to understand how much is left in-field as well as how much is lost during all future activities included grading, packing, transportation, and/or storage.

Anticipated challenges Limited challenges are anticipated since this is likely the metric that is most consistently and reliably tracked by growers.

Possible uncertainty For handpicked harvests, this number is what workers can be compensated against and would therefore have limited uncertainty. Uncertainty would be introduced when converting to pounds, the amount in cartons or boxes if the average weight is used. For mechanical harvests, this number may have less uncertainty since it could go across a scale as buyers sometimes purchase by tons.

Variable: **TOTAL HARVESTED YIELD (CALCULATED)**

Definition Total harvest in pounds.

Justification Knowing how much of the crop was harvested is necessary to understand how much is left in-field as well as how much is lost during all future activities included grading, packing, transportation, and/or storage.

Anticipated challenges Limited challenges are anticipated since this is likely the metric that is most consistently and reliably tracked by growers.

Possible uncertainty For handpicked harvests, this number is what workers can be compensated against and would therefore have limited uncertainty. Uncertainty would be introduced when converting to pounds, the amount in cartons or boxes if the average weight is used. For mechanical harvests, this number may have less uncertainty since it could go across a scale as buyers sometimes purchase by tons.

Variable: **QUANTITY RECEIVED AT PACKINGHOUSE**

Definition Pounds or containers of harvested crop that are received at the packinghouse facility.

Justification Some product could be lost from field to packinghouse, so the pounds entering the facility can be used to calculate this potential loss pathway. It also serves to enable the Metric Calculator to subsequently capture what is lost within the packinghouse.

Anticipated challenges This may not be a standard metric captured when produce is offloaded at a facility and would require extra work to obtain this input.

Possible uncertainty If this input is not a number normally captured it may contribute to estimates being used in place of more accurate measurements.

Variable: **QUANTITY LEAVING PACKINGHOUSE**

Definition Pounds or containers of specified crop that are loaded onto trucks going to a storage or processing facility on farm or leaving the farm.

Justification Understanding how much product was loaded onto a truck at the packinghouse to be sent to storage or to market allows for comparison between what is coming into the packinghouse and what is leaving the packinghouse.

Anticipated challenges This variable will likely be accurate since it will be used to fulfill orders further up the supply chain.

Possible uncertainty Minimal.

Variable: **QUANTITY RECEIVED AT PROCESSING FACILITY**

Definition Pounds or containers of specified crop that are loaded onto trucks going to a processing facility. Depending on where this stage falls this may be the same number as the pounds harvested or the pounds leaving the packinghouse.

Justification Understanding how much product was loaded onto a truck coming into a processing facility, allows for comparison between what is coming into the processing facility and what is leaving the processing facility.

Anticipated challenges This variable may not currently be a value that is tracked on farm therefore may rely on numbers coming from other phases not considering possible losses between stages.

Possible uncertainty Minimal.

Variable: **QUANTITY LEAVING PROCESSING FACILITY**

Definition Pounds or containers of specified crop that are loaded onto trucks from the processing facility going to a storage facility on farm or leaving the farm.

Justification Understanding how much product was loaded onto a truck at the processing facility to be sent to storage or to market allows for comparison with what is coming into the processing facility.

Anticipated challenges This variable could be challenging to capture since it should only include the produce item of interest and therefore a facility with a mixed waste stream (i.e., waste from making bagged salads) could make segregating one item's waste a challenge.

Possible uncertainty Minimal.

Variable: **QUANTITY RECEIVED AT STORAGE**

Definition Pounds or containers of the specified crop of interest that are stored over the course of one growing season.

Justification Collecting this variable allows for comparison between the amount leaving the packinghouse with the amount entering storage to understand if there is any loss from transport to the storage facility.

Anticipated challenges If this is not a standard metric captured on-farm, collecting an additional data point could be challenging.

Possible uncertainty Assuming this number is used to fill upstream orders, limited uncertainty should exist. If a change in the crop's moisture content is not accounted for, loss could be over- (or under-) reported as some may be the result of lost (or increased) moisture while in storage.

Variable: **QUANTITY LEAVING STORAGE**

Definition Pounds or containers of the specified crop of interest leaving the storage facility for the packinghouse or for market within the same growing season as the quantity entering storage.

Justification Collecting this variable allows for comparison with the amount entering storage to understand if there is any loss during storage.

Anticipated challenges If this is not a standard metric captured on-farm asking for an additional data point could be challenging.

Possible uncertainty Assuming this number is used to fill upstream orders, limited uncertainty should exist. Since a change in the crop's moisture content is not accounted for at this time, loss could be over (or under) reported as some may be the result of lost (or increased) moisture while in storage.

Variable: **INPUT COSTS/LB. (OPTIONAL)**

Definition All of the costs associated with bringing a crop to the point of sale, e.g., cost of labor to pick, cost of labor to pack, cost of packaging unit, cost of labor to sort, inspection charges, etc.

Justification Collecting this variable allows the calculator to estimate the economic opportunity for returning to the field to harvest any surplus crop that was left behind.

Anticipated challenges Difficult to accurately capture all inputs.

Possible uncertainty Missing inputs that were used to raise the crop to point of maturity for harvest.

Variable: **WHOLESALE PRICE FOR MARKETABLE PRODUCT (OPTIONAL)**

Definition Average or actual market price for the crop during the harvest year

Justification: Collecting this variable allows the calculator to estimate the economic opportunity for returning to the field to harvest any surplus crop that was left behind. This can be used to perform a sensitivity analysis to understand what the price per pound needs to be in order to return to the field.

Anticipated challenges This number should be easy to obtain by the grower

Possible uncertainty If using an average instead of the actual market price for the day or week could impact the accuracy of the opportunity calculation.

Variable: **AVERAGE WEIGHT OF PACKED CONTAINERS**

Definition The average weight of a fully packed container used to handle and transport the crop of interest excluding the weight of the package itself.

Justification Since crops are not always measured in pounds at every stage on farm, the calculator allows farmers the option to input crops entering various stages in either pounds or containers. This variable is then used to convert any inputs in boxes to pounds.

Anticipated challenges If multiple types of containers are used at different stages the calculator cannot currently accommodate fully packed weights of different containers and assumes one type of container flows through the entire system.

Possible uncertainty A fully packed container should be easy to weigh, however, that weight could vary so there is likely some uncertainty when choosing to enter the crop in containers instead of pounds.

Variable: **REJECTION**

Definition Any crop that was harvested and sent to its intended market but returned to the farmer because it was found to be unmarketable once it reached its next or final destination (i.e., distribution center, retail outlet).

Justification Rejected crop means that the crop did not make it to its intended market and is therefore still considered to be loss unless it is able to be processed on-farm into an alternative product and sold to an alternative buyer.

Anticipated challenges Difficult to attribute to the same cycle of harvested crop measured in-field to complete other parts of the calculator. May skew the results.

Variable: **MOISTURE CONTENT (INITIAL MOISTURE CONTENT AND FINAL MOISTURE CONTENT)**

Definition The change in weight due to a change in the moisture content percentage in the crop at each stage. The moisture content is typically expressed as a percentage of the total weight of the product, including the water.

Justification A change in a crop's moisture content can impact the weights reported at each stage and therefore if not considered, the physical product losses can be over- (or under-) estimated. By taking this into account, this calculator would provide a more accurate measure of physical product loss.

Anticipated challenges This is not a standard measurement for horticultural crops and therefore may not be captured at each stage along the way. In addition, in some cases, the change in a crop's moisture content is not significant enough to impact the calculation of actual product losses.

Variable: **TRANSPORTATION**

Definition Pounds or containers of product lost between each operational stage, for example from field to processing facility or processing facility to packinghouse.

Justification Collecting this variable allows for insight on whether any product is being lost during transportation, for example from falling off of trucks.

Anticipated Challenges This may not be a standard metric captured when produce is being moved between operational stages so the Metric Calculator attempts to calculate this based on differences between each stage. Any inaccuracies at various stages will lead to inaccuracy in transport loss.

CALCULATIONS

Below are the proposed calculations that will run in the background of the calculator using the above input variables.

! Note that you do not need to understand these calculations in order to use the Metric Calculator on your farm. They are included here to provide background information for how the metric functions.

To make this section easier to interpret, please find an example below each equation and refer to **Figure 1** that attempts to capture the losses at each stage of farm production.

WALK-BY LOSSES =

(Acres planted – Acres harvested – Immature acres) x Yield per acre

Example (120 planted acres – 115 harvested acres – 3 immature acres) x 483 lb./acre =

966 lbs. of loss walked-by

IN-FIELD HARVEST LOSSES

Calculating the size of your sample row:

[Field/Block size x 43,560 Sq.ft/acre x .001 (or .1%)] / Row Spacing Feet / 3 Sample Rows = sample row size

Example Block 1 is 40 acres

40 acres x 43,560 x .001 = 1742.40 sq. ft	This is the total field sample
1742.40 sq. ft / 10 ft (row spacing) = 174.24	This is the total length of sample
174.24 / 3 (rows) = 58.08	This is the sample length for each row, assuming 3 rows.

Sample 3 rows @ 58 ft. long each

Steps for Worksheet Completion:

1. Figure out how many rows and what length you will be sampling (see calculation above).
2. For accuracy, you can use 0.1% of the field/block area as a rule.
3. Note the row spacing and the acreage in the field. Gather measurement tools (worksheet and scale)
4. Mark rows randomly in the field, or selected number of trees to measure around (Fifty feet works well with fruiting crops; 25 feet or less can be used if sampling speed is more critical than the accuracy of the estimate.)
5. Harvest rows
6. Sort samples into categories listed on worksheet (Marketable, Edible not marketable, Inedible)
7. Weigh and record samples in each category

For tree crops, please measure a 10-foot by 10-foot plot under at least 3 representative trees.

More detailed information on how to collect the sample and how the in-field loss is calculated can be found in **Appendix A** and video tutorials for crops harvested a single time can be found **here** and crops harvested multiple times **here**.

LOSS DURING TRANSPORT TO PACKINGHOUSE/PROCESSING FACILITY =

(Total mass harvested – Quantity received at packinghouse/processing facility)

Example 52,250 lbs. – 52,000 lbs. received at packinghouse =

250 lbs. of loss during transport to packinghouse

LOSS AT PACKINGHOUSE =

(Quantity received at packinghouse – Quantity leaving packinghouse)

Example 52,000 lbs. received at packinghouse – 50,000 lbs. leaving packinghouse =

2,000 lbs. of loss at packinghouse

LOSS AT PROCESSING FACILITY =

(Quantity received at processing facility – Quantity leaving processing facility)

Example 50,000 lbs. received at processing facility – 49,000 lbs. leaving processing facility =

1,000 lbs. of loss at processing facility

LOSS DURING TRANSPORT TO STORAGE =

(Quantity leaving packinghouse or processing facility – Pounds entering storage)

Example 49,000 lbs. leaving processing facility – 49,000 lbs. entering storage =

0 lbs. of loss during transport to storage

LOSS IN STORAGE =

(Quantity entering storage – Quantity leaving storage)

Example 49,000 lbs. received in storage – 48,500 lbs. leaving storage =

500 lbs. of loss in storage

TOTAL LOSS =

Walk-by losses +

In-field harvest losses +

Loss during transport to packinghouse (and/or processing facility) +

Loss at packinghouse (and/or processing facility) +

Loss during transport to storage +

Loss in storage +

Rejections

Example

966 lbs. walk by loss +

4,750 lbs. in-field harvest loss +

250 lbs. loss during transport to packing house +

1,000 lbs. lost a processing facility +

2,000 lbs. loss at packing house +

0 lbs. loss during transport to storage +

500 lbs. loss in storage +

1,000 lbs. rejected =

10,466 lbs. total loss

ACCOUNTING FOR A CHANGE IN MOISTURE CONTENT (OPTIONAL)

A change in moisture content can occur at any stage: on farm, in the field after harvest, in the packinghouse and processing facility, and—more substantially—in long-term storage. The calculation below is based on a mass balance quantification approach. It uses the initial moisture content and final moisture content of a crop to yield an estimated final weight of the physical product loss, adjusted for the change in weight due to moisture fluctuation.[4]

TOTAL LOSS ADJUSTED FOR MOISTURE FLUCTUATIONS (POUNDS)

This is the weight of crop loss, adjusted for a change in moisture content. The formula used is:

(recorded initial weight * (1-initial moisture content %)/(1-final moisture content %)) – recorded final weight

Example

1,000 lbs. received by packinghouse (recorded initial weight)

25% initial moisture content

14% final moisture content

800 lbs leaving packinghouse (recorded final weight)

Calculations

1,000 lbs. recorded initial weight * (1-25%) / (1-14%) = 872 lbs. estimated final weight adjusted for the moisture loss but if there were zero crop loss

Subtracting the 800 lbs leaving the packinghouse from the 872 lbs estimate (after accounting for a change in moisture content) = 72 lbs of Total Loss (Product excluding Moisture Change)

Note: 1000 lbs – 872 lbs = 128 lbs of moisture loss (due to a change in the moisture content)

The "Total Loss (pounds), not adjusted for moisture fluctuations" would equal 200 lbs (128 lbs of moisture loss plus 72 lbs of actual physical loss). Keep in mind that this figure would overstate the amount of actual physical product loss generated. It is best practice to report Total Loss (Product excluding Moisture Change).

4 Of note: the formula used assumes that the moisture content of the product leaving the supply chain (i.e., the crop loss) is the same as that which stays in the supply chain at the end of the activity (i.e., the moisture content of the crop loss equals "final moisture content "). If the moisture content of the crop loss is different, you can use the FLW Protocol's Moisture Content Calculator (downloadable at **www.flwprotocol.org**) to make an adjustment.

OPPORTUNITY (OPTIONAL)

By inputting the cost of labor to pick, sort, and pack, and other associated costs for harvesting a product, in addition to the cost per pound for the marketable product and cost per pound for product sold to the food bank or other secondary market channel, we can estimate the per-acre profitability of harvesting and selling recovered product under 4 different scenarios:

1. **PACKED IN BINS AT 50% WHOLESALE PRICE**, when marketable and edible product are offered for sale in secondary market channels, paying growers 50% of the value of USDA No. 1 grade products.
2. **FIELD PACKED, SOLD IN BINS AT PRICE INPUT INTO CALCULATOR FOR FOOD BANK/SECONDARY MARKET**, when marketable and edible product is offered for sale to food banks or other secondary markets.
3. **PACKED IN CARTONS FOR WHOLESALE, EDIBLE PRODUCT PACKED IN BINS AT 50% WHOLESALE PRICE**, when marketable product is offered at full, wholesale price and edible products is offered at 50% of the value of USDA No. 1 grade products for edible.
4. **MARKETABLE PRODUCT PACKED IN CARTONS, EDIBLE PRODUCT PACKED IN BINS**, when marketable product is offered at full, wholesale price and edible product is offered for sale at food banks or other secondary market channels at price input into calculator.

Note: There may be other channels (i.e., direct to restaurants or food service) that your farm is able to utilize for surplus and underutilized produce left in-field.

QUALITATIVE INPUTS (OPTIONAL)

To better understand the reasons for loss and the destination of the underutilized crop of interest, we have included these optional questions. Understanding the reasons for food loss can help growers more effectively use the Metric Calculator as an on-farm management tool.

Reasons crop was not harvested

Please choose all that apply and estimate the number of acres (or pounds of a crop) that fall into each category based on the total number of unharvested materials reported in the calculator.

In-field loss options

- Not marketable; Crop was out of contract specifications due to one or more of the following:
  - Crop was too small, too large, misshapen or had other cosmetic abnormalities
  - Crop was too ripe for transport journey
  - Crop suffered from disease, pest damage or weather damage after it was ready to harvest
- Marketable but not profitable: Contract buyer chose not to harvest/take/sell crop due to low market demand
- Insufficient labor: Marketable but not harvestable
- Food safety concerns (i.e., animal exclusion zones)
- Environmental factors: Harvest conditions were not ideal
- Inedible: Crop rotted
- Other: please specify (i.e., COVID Pandemic)

Post-harvest loss options

- Culled: Inedible
- Culled: Quality standards
- Culled: Damage
- Food safety concerns
- Lack of buyer
- Insufficient storage/transport
- Other: please specify (i.e., COVID Pandemic)

Destinations of Unsold Crop[5]

Please choose all that apply for the crop harvested and provide a percent estimate of the specified crop that went to each destination, if known. Crop by-products, such as almond hulls or the outer leaves of lettuce, should be captured separately from the crop itself. In the final calculator, this optional question will be asked after each stage in case different options apply for different loss points.

- **ANIMAL FEED** Diverting material originally intended for human consumption in its current form to feed animals.
- **BIO-BASED MATERIALS/BIOCHEMICAL PROCESSING** Converting material into industrial products. Examples include creating fibers for packaging material; creating bioplastics (e.g., polylactic acid); making "traditional" materials such as leather or feathers (e.g., for pillows); and rendering fat, oil, or grease into a raw material to make products such as soaps, biodiesel, or cosmetics. "Biochemical processing" does not refer to anaerobic digestion or production of bioethanol through fermentation.

5 Food Loss and Waste Accounting and Reporting Standard. ***Version 1.0. Food Loss and Waste Protocol.*** Table 6.1, pp.40

- **CODIGESTION/ANAEROBIC DIGESTION** Breaking down material via bacteria in the absence of oxygen. This process generates biogas and nutrient-rich matter. Codigestion refers to the simultaneous anaerobic digestion of food loss and waste and other organic material in one digester.
- **COMPOSTING/AEROBIC DIGESTION** Breaking down material via bacteria in oxygen-rich environments. Composting refers to the production of organic material that can be used as a soil amendment.
- **CONTROLLED COMBUSTION** Sending material to a facility that is specifically designed for combustion in a controlled manner, which may include some form of energy recovery.
- **LAND APPLICATION** Spreading, spraying, injecting, or incorporating organic material into or onto the land.
- **LANDFILL** Sending organic material to an area of land or an excavated site that is specifically designed and built to receive waste.
- **NOT HARVESTED/PLOWED-IN** Leaving crops that were ready for harvest in the field or tilling them into the soil.
- **REDISTRIBUTED TO PEOPLE THROUGH ALTERNATIVE MARKETS** (E.g., donation, gleaning, food that is repurposed or redistributed at less than market value)
    - This is not considered food loss and should be removed from calculator if this was originally reported as loss.
    - Please report the pounds of crop donated. Although this portion of the harvest still ends with human consumption, it is an economic loss so is important to understand.
- **REFUSE/DISCARDS/LITTER** Abandoning material on land. This includes open dumps, open burns, and dumping of culls back on an abandoned field, but not tilling it back into the soil.

METRIC DASHBOARD AND VISUAL DASHBOARD

Congratulations! You have completed the Food Loss Metric Calculator! The metric dashboard and visual dashboard provide you with your food loss metrics. It is highly encouraged to conduct year-to-year measurement so you can benchmark your losses and understand where there is opportunity to reduce loss and maximize utilization of what's planted.

Metric Dashboard

The following metrics can be viewed in the metric dashboard tab:

- Walk-by loss
- Marketable, in-field loss
- Edible not marketable, in-field loss
- Inedible in-field loss
- Transport loss
- Packinghouse loss
- Processing loss
- Storage loss
- Rejected loss

Each of these metrics can be seen as total loss per acre harvested, total loss on farm, total loss per acre adjusted for a change in moisture content, and total loss on farm adjusted for a change in moisture content. Additionally, you can view your total utilization of crop as a percentage, and the drivers and destinations for loss at each operational stage.

Visual Dashboard

The visual dashboard provides a deeper insight of your food loss metrics to better illustrate the areas of opportunity for increased product utilization.

VERSION 2.0

The Metric Technical Advisory Committee and the Coordinating Council keeps an on-going list of suggestions that are added as the landscape for the metric changes and evolves to accommodate into future versions. The following suggestions have been listed for further research and accommodation into version 2.0 of the Food Loss Metric Calculator.

- On the 'Opportunity' tab, account for the possibility of growers selling surplus produce to other alternative markets besides food banks. Farmers may have existing outlets for surplus produce besides food banks such as alternative processing, "ugly" produce, CSA (Community Sustained Agriculture) boxes or gleaned by volunteer organizations. These other options could be added to the "Opportunity" calculations.
- Include a methodology for estimating waste in the processing facility when multiple crops are processed together (i.e., bagged salad mixes) and therefore the waste stream is not segregated by crop.
- Research whether "Bio-material/processing" is ever used as a destination for horticultural crops.

LINK TO RELATED PROGRAMS

Cool Farm Tool

The information collected here should align with what is being recommended by the **Cool Farm Tool**. However, in the event that growers do not have direct measurements to input, the Cool Farm Tool asks for estimations of what was not harvested. The Metric Calculator attempts to calculate loss in-field to minimize bias and improve accuracy in the reported results.

Food Loss and Waste Accounting and Reporting Standard and the Food Waste Atlas

The **Food Waste Atlas**, developed by WRI and WRAP, is the first online tool for gathering global food loss and waste data in one place. A producer completing the Metric Calculator may choose to also report their data in the Atlas, which is also in conformance with the "Food Loss and Waste Accounting and Reporting Standard" (FLWS). This helps to standardize food loss and waste numbers to make it easier to track food loss and waste in a consistent manner, benchmark performances, identify 'hotspots', and support the delivery of SDG 12.3. The FLWS provides a common language and standardized framework for describing what has been quantified and how. More details can be found at **FLWProtocol.org**.

APPENDIX A

Measuring the Available Marketable Crop[6]

1 Note the row spacing and the acreage in the field directly in the calculator This information is critical for calculating potential yield with this method. In addition, gather flags, a measuring tape, harvest containers, and a weighing scale. This is all the equipment you will need.

2 For the sample area, mark three sample rows or the three representative trees. Flags can be used for marking, but other techniques would also work. The sample row locations in the field should be randomly chosen in areas of the field that seem representative of field conditions. Sections of rows should be marked A, B, and C, for example, to a known length. Fifty feet works well with fruiting crops; 25 feet or less can be used if sampling speed is more critical than the accuracy of the estimate. Depending on the crop, one person should be able to make this assessment in 3 hours or less. Three rows are ideal for sampling in order to account for differences in field conditions and harvesting techniques used by farm personnel.

3 Harvest each row or under each tree. To accurately analyze what quality remains in the field, collect all of the remaining vegetables, fruits, or nuts in the marked row lengths or on each tree into any suitable harvest container. Even diseased, decayed, overly mature, sun-scalded, or damaged vegetables, fruits, or nuts that remain attached to the plant should be harvested for this measurement; that information will be important for calculations. In determining what portion of the remaining crop is edible or marketable, collect all sizes, even if they are considered immature. This will determine how much of the remaining crop was damaged by disease or is inedible for another reason. Do not collect vegetables, fruits, or nuts that have fallen to the ground and are no longer attached to the plant.

4 Sort the collected samples from each row into three main categories: marketable, edible, and unmarketable. These three categories will provide an overview of the potential remaining in the field and indicate whether it is traditionally marketable or simply edible, which could be marketed to an alternative buyer. Marketability is unique to every grower, based on their buyers' specifications, which can be different from published U.S. Department of Agriculture standards.

5 Weigh each sample category by considering the tare weight of the container. Ensure the scale you are using is accurately balanced and zeroed, then record the weights. Data should be recorded in pounds for each of the three categories from each row A, B, and C. Total the marketable, edible, and inedible categories.

6 Calculate the potential within each category. The calculation finds the area sampled first and then finds estimates of available volumes in the field for each of the three categories.

Calculate available product in the field

Determine how much of the field you sampled. Multiply the number of rows by the length of the rows and by the row spacing. Sampling three 50-foot rows spaced 6 feet apart looks like this:

$$3 \times 50 \times 6 = 900 \text{ square feet in the sample}$$

Total the weight of marketable produce found in the sample area. Set up a ratio with x serving as the unknown amount of marketable produce per acre. If 100 pounds were found in 900 square feet, and because an acre contains 43,560 square feet, the calculation looks like this:

$$\frac{(100\text{ lb})}{(900\text{ sq ft})} = \frac{(x\text{ lb})}{(43{,}560\text{ sq ft})}$$

6 Johnson, L. 2018. How to Determine the Potential to Increase Vegetable Yield through Estimating and Reducing Field Losses. NC State Extension.

Solve for the unknown:

$$(43{,}560 \text{ sq. ft}) (100 \text{ lb.}) = (900 \text{ sq. ft}) (x)$$

$$\frac{(43{,}560) * (100)}{(900 \text{ sq ft})} = x$$

$$4{,}840 \text{ lbs.} = x$$

The amount of marketable produce in one acre of this field is 4,840 pounds. Multiply by the number of acres to determine the remaining harvest potential in this field. In a 15-acre field, the calculation looks like this:

$$(15 \text{ acres}) * (4{,}840 \text{ lb./acre}) = 72{,}600 \text{ lbs. remaining}$$

Divide by the number of pounds in a box to determine how many boxes are potentially available. Repeat this calculation to estimate how much produce of edible quality is in the field if a buyer should be available.