SISC 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 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 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, to track the causes of loss. Tracking the causes of loss allows growers to use this metric as an effective on-farm management tool for reducing crop loss over time. The baseline measurement generated through this metric 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. This metric 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 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. 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. In addition to the quantitative inputs, the metric 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 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 took upward of two hours the first time, but much less time thereafter.*

**Metric Scope**

This food loss metric includes on-farm operations only. These will differ by grower based on their unique operation. The metric 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 this metric. Activities that are not part of the farm’s direct on-farm operations should also not be included in the metric. 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 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., on-farm grading and 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.
**Definitions**

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

**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 this metric, 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

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\(^1\) 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”.
is not considered loss, but should be tracked to understand the potential opportunity remaining in field that may be an economic loss.

**Marketable** 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 overripen 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.

**Metric Inputs**

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

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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”.
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 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 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 this 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: 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 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:** Pounds of by-product leaving processing facility (e.g. shells)

• Definition: Pounds of inedible by-product (e.g., shells from nuts) discarded from the crop that are not meant for human consumption.

• Justification: Collecting this variable is necessary to compute the accurate amount of loss occurring in the processing facility, and each stage afterwards under the grower’s operation.

• Anticipated challenges: If this is not a standard metric captured in a processing facility, collecting an additional data point could be challenging.

• Possible uncertainty: Since the weight of by-products may not be a standard metric tracked by facilities, there could be some associated uncertainty with attempting to estimate the number if direct measurement is not possible.

**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**

• 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.
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 this metric 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**

\[(\text{Acres planted} - \text{Acres harvested} - \text{Immature acres}) \times \text{Yield per acre}\]

*Example:*

\[(120 \text{ planted acres} - 115 \text{ harvested acres} - 3 \text{ immature acres}) \times 483 \text{ lb./acre}\]

= 966 lbs. of loss walked-by

**In-Field Harvest Losses**

Measuring in-field loss is the most accurate way to calculate this number. Please follow these steps:

1. Note the row spacing and the acreage in the field. Gather measurement tools (worksheet and scale)
2. 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.)
3. Harvest rows or trees
4. Sort samples into categories listed on worksheet
5. 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: [https://www.youtube.com/watch?v=Nb-nUubV16Y&feature=youtu.be](https://www.youtube.com/watch?v=Nb-nUubV16Y&feature=youtu.be) and crops harvested multiple times here: [https://www.youtube.com/watch?v=K9dE9EavUSg&feature=youtu.be](https://www.youtube.com/watch?v=K9dE9EavUSg&feature=youtu.be).

**Loss during transport to packinghouse/processing Facility**

\[(\text{Total mass harvested} - \text{Quantity received at packinghouse/processing facility})\]

*Example: 52,250 lbs. – 52,000 lbs. received at packinghouse*

= 250 lbs. of loss during transport to packinghouse

**Loss at packinghouse**

4 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”.
(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

Processing loss for crops with by-product (e.g. shells from tree nuts)

[(Quantity received at processing facility – Quantity leaving processing facility excluding by-product loss) – By-product loss]

Example: 50,000 lbs. received at processing facility – 45,000 lbs. leaving processing facility - 4,000 lbs. by-product leaving processing facility

= 1,000 lbs. of loss for crops

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

Moisture Content Change (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 a change in moisture content.\(^5\)

Total Loss (Product excluding Moisture Change) (pounds). This is the weight of crop loss, adjusted for a change in moisture content. The formula used = (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:

\[
1,000 \text{ lbs. recorded initial weight} \times (1-25\%) \div (1-14\%) = 872 \text{ lbs. estimated final weight adjusted for the moisture loss but if there were zero crop loss}
\]

Subtracting the 800 lbs leaving the packinghouse from the 872 lbs estimate (after accounting for a change in moisture content) = \text{ 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 (Product + Moisture) (pounds)” 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).

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.

\(^5\) 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.
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 this metric 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:**

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.

• **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.
• **Animal feed:** diverting material originally intended for human consumption in its current form to feed animals.

• **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.

• **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.

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following suggestions have been listed for further research and accommodation into version 2.0 of the Food Loss metric.

• 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.

• Including 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

1. 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. This metric attempts to calculate loss in field to minimize bias and improve accuracy in the reported results.

2. 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 this metric 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 www.FLWProtocol.org.
Appendix A

Measuring the Available Marketable Crop

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:

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

Solve for the unknown:

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

\[
\left(\frac{43,560}{900}\right) \times (100) = x
\]

\[
4,840 \text{ lbs.} = x
\]

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:

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

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.