Global Farm Loss Tool Guidance 2.0:

FRUITS, VEGETABLES AND TREE CROPS

Acknowledgements

The GFLT and the accompanying guidance have been developed in collaboration and with the support of numerous individuals and organizations. It builds on previous work by leading members of the Food Loss and Waste community including WRAP's Grower Guidance, WWF-US' SISC Food Loss Metric calculator and Dr. Lisa K. Johnson's measurement guidance and is guided by the *Food Loss and Waste Accounting and Reporting Standard*.

Disclaimer:

The GFLT is provided free of charge without any warranties as to its quality, accuracy or suitability for your purposes. The individuals and organizations which participated in the development of the GFLT accept no liability or responsibility for the accuracy of the data or outputs of the GFLT, or for any decisions or actions taken directly or indirectly as a result of using it.

Contents

1 Introduction

3 Overview

3 Scope

5 Definitions

7 Planning for Measurement

- *7 About In-Field Sampling*
- *7 In-Field Sampling*

9 Measuring In-Field Loss

- *9 In Field Sampling*
- *10 In Field Direct Weighing*
- *10 Planning for Measurement of Further Stages (Post-Harvest Losses)*

11 Recording and Uploading Data

13 Variable Inputs

14 Calculations

- *14 In-Field Losses*
- *15 Further Stage Losses*

16 Accounting for a Change in Moisture Content

17 Greenhouse Gas and Water Impacts and Intensity Reduction

- *17 GHG and Water Intensity Reduction*

19 Frequently Asked Questions

Introduction

The Global Farm Loss Tool (GFLT) 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 buyers with useful data on where and why loss is occurring within the boundaries of a single farm's operation. The GFLT measures loss at the field level in addition to other stages that may exist under a single operation and before the product leaves the farm gate such as packinghouse/ processing facility, and storage. The GFLT also has the potential to track destinations for loss, drivers for loss, moisture content loss, environmental impacts and the financial opportunity that could be realized by returning to the field to harvest surplus. By measuring loss, it is possible for:

1. Buyers to identity surplus channel opportunities to more fully utilize the harvest and reduce impacts in their supply chain.
2. Growers to identify adjustment opportunities to improve operational efficiencies.

Grower Benefits

Growers can use the GFLT 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, the GFLT can be embedded into existing systems for collecting farm data such as annual yield, acres planted, etc. Growers also have the option within the GFLT, to track the causes of loss. Tracking the causes of loss allows growers to use the GFLT as an effective on-farm management tool for reducing crop loss over time. The baseline measurement generated through the GFLT 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.

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 GFLT 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, the GFLT will provide growers, and buyers with information that can inform future planting and management decisions.

Buyer Benefits

Buyers can use the GFLT to initiate supplier measurement for a commodity of focus to inform future surplus channels into the business, environmental impact reductions and an overall better understanding of where and how much loss is occurring in the supply chain. Measuring surpluses can help to identify adjustment opportunities to improve operational efficiencies in sourcing strategies. 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.

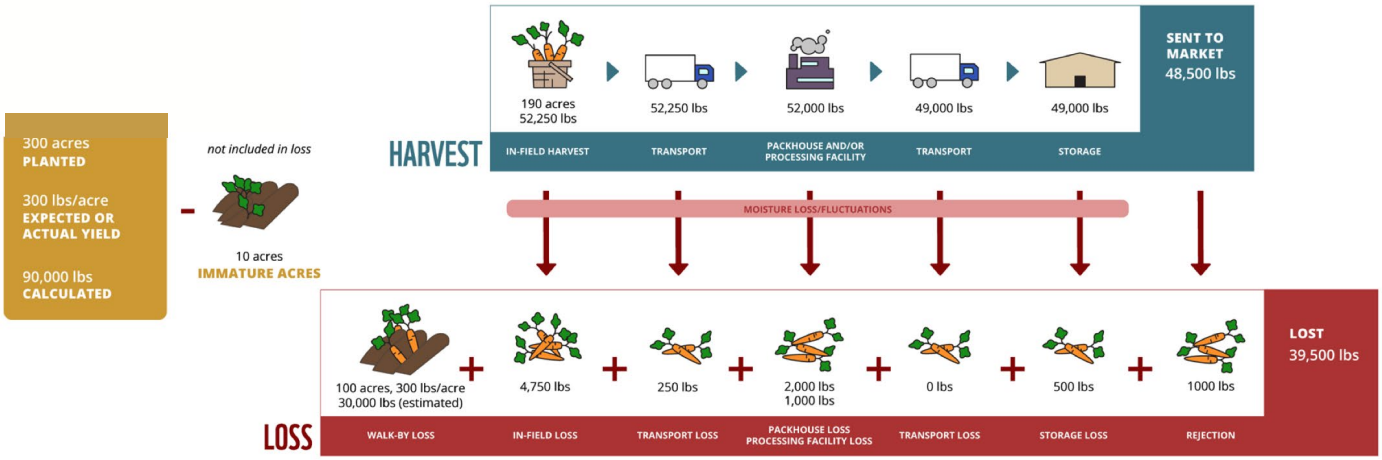
Overview

The sections below are designed to logically walk through the GFLT's calculation process. The metric scope captured in Figure 1 outlines the areas on-farm where measurable food surplus and loss may exist and will be captured in the GFLT. The Definitions section explains the terms that are used throughout the GFLT. The Variable Inputs section explains the variables that are used to complete the calculations within the GFLT. For each proposed input, the variables, potential challenges, and possible uncertainties that may arise from recording measurements, have been described. To conform to the internationally recognized Food Loss and Waste Accounting and Reporting Standard (FLW Accounting and Reporting Standard), the GFLT also asks for final destinations of all underutilized crop.

Scope

The GFLT includes on-farm operations only. These will differ by grower based on their unique operation. The GFLT 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 GFLT. Activities that are not part of the farm's direct on-farm operations should also not be included in the GFLT. 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 GFLT 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.
- **OTHER STAGES** product left behind at any other stages under a growers operation such as:
    - **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.



GRAPHIC © WWF-US / KATARINA JIN

Figure 1. Areas where on farm loss may occur

This guide will help farm businesses to plan for and undertake measurements, as well as assist in entering data into the GFLT so that opportunities become visible, improving the volume of saleable produce and profitability. Figure 2 outlines the process for collecting and reporting data.

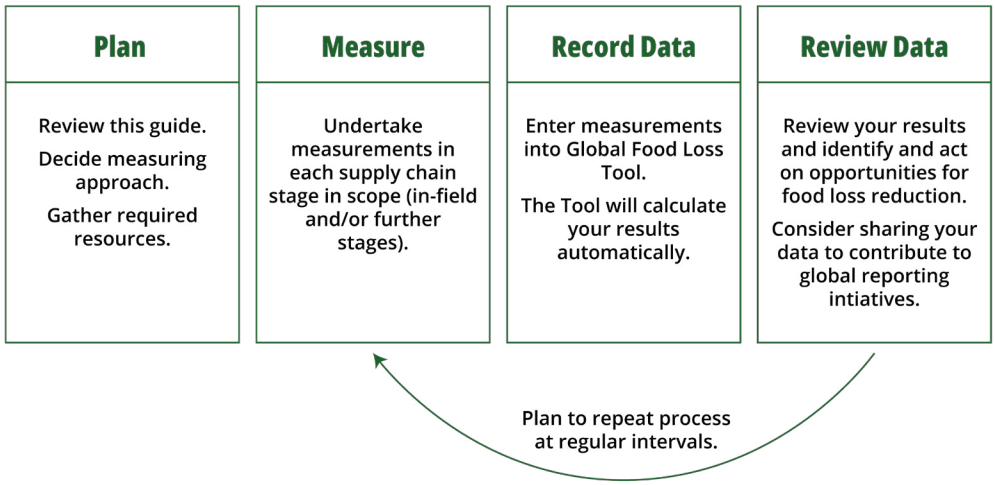


Figure 2. Measuring and reporting food loss on farms process

Definitions

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 – crop 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, over-mature, 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. In the GFLT, 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.

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.

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".

3 Ibid.

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.*

Potential Additional Stages:

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.*

Planning for Measurement

ABOUT IN-FIELD SAMPLING

There is no obligation to follow any particular methodology to collect your data for the Global Farm Loss Tool, but you may wish to follow the recommended process below for accuracy. Once the harvest is complete and to populate the tool, an assessment can be done of the crop left in the field. A recommended process for sampling in-field loss is below although there is no obligation to follow this process in order to enter data into the GFLT. Please also include an assessment of whole blocks or fields that do not get harvested (e.g., ploughed in / walk-by).

IN-FIELD SAMPLING

1. **ASSIGN ROLES:** Consider who will be responsible for undertaking the measurements and decide when to involve them in the planning process.

2. **DECIDE WHICH CROP(S) YOU WILL MEASURE:** If measuring multiple crops, it is best practice to assess each crop separately. Where relevant, decide whether to measure all or only some varieties.

3. **DECIDE MEASURING AND SAMPLING TIMEFRAMES:** Decide what time frame is relevant for the crop(s) being measured. Normally this would be a whole season, for example, the 2021 season. If the crop is harvested multiple times throughout the season, decide whether to take measurements several times throughout the season instead of waiting until the last harvest is complete.

4. **DECIDE SAMPLING AREA/REGION:** Decide whether measurement will occur across all areas where the crop is grown (i.e., across multiple blocks, fields, or farms) or only some. If the latter, decide which crop(s) are the most representative of your total area. The area/region will depend on specific circumstances including climate zones, soil types, and other factors which would affect the representativeness of the sampling strategy.

5. **DECIDE SAMPLING STRATEGY FOR MEASURING AFTER THE HARVESTING TEAM HAVE FINISHED:**

    A. In-field measurements should be taken immediately after harvest, so decide when that will be.

    B. Take measurements in at least three sampling areas across any field/block. This is done to consider differences in field conditions and harvesting techniques used by farm personnel. Taken together, the samples areas should be representative of the field/block as a whole.

6. **GATHER EQUIPMENT:** In advance, gather any equipment that will be needed to undertake the in-field measurements. This includes:

   A. Measuring tape,
   B. Flags/cones (at least 2) to mark out the sampling areas
   C. Bags, or containers (at least three) to collect crops and keep the samples separate
   D. Scales (for either weighing in field, or weighing in subsequent location),
   E. The Tool Field Worksheet and pencil/pen to keep track of measurements, and
   F. Harvesting tools (e.g., knife, gloves).
   G. Other useful equipment can include safety clothing, a field map, and a camera (photographing what is collected helps with interpreting and sharing the results).

7. **PRINT FIELD WORKSHEET (OPTIONAL):** Download or print off the Field Worksheet to help you record the in-field measurements.

** Time Required: Previous experience suggests that following the approach outlined for in-field sampling takes two people about an hour to sample three rows and a further 1–1½ hours to sort and weigh the sample by the three categories and input the data.*

Measuring In-Field Loss

This section outlines a recommended step-by-step process of how to sample and collect the appropriate input data to use the Global Farm Loss Tool. For the in-field stage, data can be collected through either sampling or direct weighing.

IN FIELD SAMPLING

STEP 1: Identify three rows (or other areas) representative of the field.

STEP 2: Go into the field, mark the rows to be sampled (or selected number of trees to measure around), and harvest all crop not picked (or dug up). For each row (or other area being sampled):

- Measure the length of row or area from which to remove (e.g., pull off, dig up) all the remaining product. For many crops, a length of 50 feet/15 meters is robust enough. Select a relevant length for your sampling to be representative. For tree crops, a recommendation is to measure a 10-foot by 10-foot plot under at least 3 representative trees.
- Mark the beginning and end of the row or area with a flag/cone or any marker that helps the measurer determine the sample area.
- Keep track of the width of the area sampled (e.g., row spacing) as this data will be important for extrapolating the sampled area to the entire field.
- Harvest each row or tree, harvesting all the product left on the plant (or rejected and in the furrow, or still underground), no matter the reason or condition. 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. Put samples from each row in a separate container. If you decide to also measure product that has dropped on the ground please indicate so in the GFLT and keep this data separate (see FAQ for further guidance).

PHOTOS © WWF-US / ALEX NICHOLS-VINUEZA

STEP 3: Determine what qualifies as marketable, edible/not marketable, and spoiled for your operation.

STEP 4: For each row (or other area), sort samples collected into separate containers according to each of these 3 categories: marketable; edible (not marketable) and spoiled. This will help to determine the value of potentially saleable product.

STEP 5: Weigh the sampled product as sorted by the 3 categories, keeping data from each row separate. When recording the weight, remember to subtract container weight.

STEP 6: Try and utilize the samples (e.g. give away edible food).

IN FIELD DIRECT WEIGHING

If all the crops eventually left in the field or lost have been harvested and weighed, a total amount can be entered into the GFLT. With this method, categorize the loss into the three categories: marketable; edible (but not marketable) and spoiled as explained above.

PLANNING FOR MEASUREMENT OF FURTHER STAGES (POST-HARVEST LOSSES)

There are two approaches to measure the losses from any relevant further stages (e.g., packhouse, storage, processing):

1. **MASS BALANCE:** weigh the crop received at the further stage, quantity received, and weigh the crop again when leaving the stage, quantity leaving.

2. **DIRECT WEIGHING:** a total weight of everything left/discarded/tossed at the relevant stage.

Recording and Uploading Data

This section outlines how to enter your data into the GFLT.

STEP 0: Begin by Signing Up on the home page and select whether you are a grower or an aggregator. Growers are the users out in the field, on farm, measuring loss, whereas aggregators are often suppliers or buyers who are interested in reviewing the loss data being submitted by growers.

After signing in, enter basic information about the farm, including the name, location, and your preferred units of measurement (which will auto-default based on your location, but which you can override at any point).

Navigation Tips:

If the data field has the word 'optional' next to it, you do NOT need to enter data.

There are '?' across the GFLT that provide helper text and definitions when you hover over.

When filling out an Entry, you can save your progress as you go through the GFLT and monitor your progress using the blue bar at the top right of the screen. You can save a draft of the data without submitting it by clicking "save draft" on the left side of the screen.

STEP 1: Create a New Entry

Click the New Entry button on the My Entries page of the GFLT. Next, fill out the Entry Name, Crop Type, and Crop Variety. Each entry only represents one crop type. When filling out your Entry Name, be sure to choose a name that will help you find the entry later. Once you are done, click 'Create'.

STEP 2: Fill in your Harvest Data

The Harvest Data is the general information about your entire farm for the crop you are studying. The information you are required to enter includes the Harvest end date, the Total Area Harvested for which the sample was taken (not just the sample size), the Total Yield, and the Average Yield. The Average Yield will auto-populate by dividing your total yield by the Total Area Harvested. Click 'Next' at the bottom right corner.

STEP 3: Fill in the In-Field Data

For In-Field Data, you have two options:

- Use an Area Sampling Method
    - Area Sampling information will be used to estimate the amount of crop not harvested based on field size, weight of samples and harvest yield.
- Use a Direct Weighing Method
    - Weighing total loss would involve weighing all the unharvested crop after finishing harvest of the field. This approach assumes that you are weighing all the crop that was not harvested/rejected and left in the field.

When a selection has been made, click Next.

- If using an Area Sampling Approach
    - For the Area Sampling Approach, either sample the entire farm, or sample subsections of the farm where there may be different agricultural practices being utilized or external factors that affect yield differently. The sample is only of the harvested area for which you entered the total size, and total yield of in the previous page. If you are measuring a subsection of the farm, write the total size of that subsection in the “Sample Area Size/Block” section of the page. Otherwise, this field will auto-populate with the size of the entire farm for the crop type that was entered on the Harvest Data page.
    - The section on the Total Area Yield will auto-populate the Yield of the entire farm. This number can be overridden.
    - Please enter the sample data weights that were collected in the field in the three randomly selected areas into the table.
    - If samples equal 0, please enter a 0 and don’t leave blank.
    - At the bottom of the page, describe any uncertainly in your samples. This is optional.
    - Lastly, populate the ‘Destinations for Loss’ and ‘Reasons for Loss’. Reasons for Loss in optional.

Variable Inputs

TOTAL AREA HARVESTED – The size of the area harvested for which the sample will be taken from

IMMATURE – Area planned but due to weather or pest damage during the growing season, never reached maturity. This variable will not count towards the farm's total loss but can be useful in identifying causes/trends for pre-harvest loss.

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

TOTAL HARVEST – Total amount of product harvested if the field that is sampled from.

CURRENT MARKET PRICE AND % OF TOTAL HARVEST FOR GRADE 1 – Price per unit of first grade product and the rate of the total harvest that went into that grade.

CURRENT MARKET PRICE AND % OF TOTAL HARVEST FOR GRADE 2/B – Price per unit of second grade product and the rate of the total harvest that went into that grade.

IN FIELD SAMPLE DATA – (See In Field Sampling below)

MASS BALANCE – The change in weight from what was incoming to what was outgoing at one of the further stages.

DIRECT WEIGHING – A direct weight (not a sample of the total) of the product left behind in the field, or the product sorted/packed out at further stages or discarded at any other additional areas of the operation.

MOISTURE CONTENT (INITIAL MOISTURE CONTENT AND FINAL MOISTURE CONTENT) – The change in weight due to a change in the moisture content percentage in the crop at each of the further stages. The moisture content is typically expressed as a percentage of the total weight of the product, including water.

Calculations

Please note that the Global Farm Loss Tool performs all of the calculations below automatically. These calculations are provided to explain the methodology and to help you check your work.

IN-FIELD LOSSES

For the in-field harvest total loss numbers, the GFLT uses different approaches depending on measurement type.

1. **DIRECT WEIGHING:** The Total Losses in Marketable, Edible and Spoiled that are collected and weighted as a whole and not sampled. May be viable for smallholder farmers

2. **AREA SAMPLING:** The Total Loss at this stage is estimated by adding together the total loss in the samples and comparing this total to the size of the rows sampled to find the average loss per acre or hectare. Then, the average loss per acre / hectare is multiplied by the total Sample Area Size (which in many cases is the farm's Total Area Harvested), to give an estimate of the Total Loss on farm.

Formula for calculating the estimated In-Field Area Sampling Total Loss, with Lbs and Acres:

$$\frac{\text{((Sample 1 Loss in lbs + Sample 2 Loss in lbs + Sample 3 Loss in lbs + ...)}}{\text{Sample Size in Acres) x Harvested Area}} \text{ + Walk-by Losses}$$

Formula for Walk-by Losses:

(Walk-by acres) x Yield per acre

EXAMPLE

3 walk-by acres x 1500 lbs./acre = 4500 lbs. of loss walked-by

((7 lbs. of Loss in Sample 1, 6 lbs. of loss in Sample 2 + 5 lbs. of loss in Sample 3) / 0.0138 acres sampled) x 10 acres of harvested area + 4500 lbs. of walk-by =

13,043.48 lbs. lost in harvested area + 4500 lbs. of walk-by = 17,543.48 lbs. of loss on farm

Calculating Acres Sampled	
Number of Rows Sampled	3
Height and Width of Samples	4 ft x 50 ft = 200 sq feet
Conversion to Acres (square feet in a sample x number of samples) / 43560	(200 sq feet x 3 samples) / 43560 = 0.01378

FURTHER STAGE LOSSES

The Global Farm Loss Tool allows loss measurement in Other Farm Stages both through Direct Weighing in which the Total Losses in Marketable, Edible and Spoiled that are collected and weighted as a whole and not sampled, or through the Mass Balance approach in which the loss is calculated by subtracting the quantity that enters and exits that stage. Below are examples of the mass balance approach.

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

Total Loss =

In-field losses (including walk-by) +

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

Loss at packinghouse (and/or processing facility) +

Loss at any Other Farm Stages

EXAMPLE

17,543.48 lbs. in-field loss + 250 lbs. loss during transport to packing house + 2,000 lbs. loss at packing house = 19,793.48 lbs. total loss

Accounting for a Change in Moisture Content

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.

Formula for the Total Loss Adjusted for Moisture Content:

Arrival Weight x ((1-Initial Moisture) / (1-Final Moisture)) - Exit Weight

EXAMPLE

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

25% initial moisture content

14% final moisture content

800 lbs leaving packinghouse (recorded exit weight)

Calculation: 1000 arrival weight x ((1-25%)/(1-14%)) - 800 Exit Weight = ***72 lbs of loss***

*Explanation: 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).

Greenhouse Gas and Water Impacts and Intensity Reduction

Associated Impacts

The GFLT uses calculations from the sources listed below to estimate the greenhouse gas emissions or water use per kilogram of a crop in a specific country or region. When possible, it relies on country- and crop-specific data; if those are unavailable, it expands to regional values, crop-type averages, or global estimates. To generate the GHG and water-use values shown on the dashboard, it multiplies the per-kilogram intensity by the total loss in kilograms.

In collaboration with Wageningen University, impact calculation data sets are based off estimates from the following sources:

FAOSTAT accessed 2025-01-06

For Rice and Cereals excl. rice

Average for 2020, 2021 and 2022

Mekonnen, M.M. and Hoekstra, A.Y. (2010) The green, blue and grey water footprint of crops and derived crop products, Value of Water Research Report Series No. 47, Appendix II, UNESCO-IHE, Delft, the Netherlands. http://www.waterfootprint.org/Reports/Report47-WaterFootprintCrops-Vol1.pdf

Petersson, T., L, Secondi, A. Magnani, M. Antonelli, K. Dembska, R. Valentini, A. Varotto, S. Castaldi: A multilevel carbon and water footprint dataset of food commodities. Sci Data 8, 127 (2021). https://doi-org.ezproxy.library.wur.nl/10.1038/s41597-021-00909-8 (accessed 19 April 2023)

Porter, S.D.; Reay, D.S.; Higgins, P.; Bomberg, E. A half-century of production-phase greenhouse gas emissions from food loss & waste in the global food supply chain. Sci. Total Environ. 2016, 571, 721-729

GHG AND WATER INTENSITY REDUCTION

To estimate the reduction in GHG and water intensity, the GFLT compares the amount of on-farm loss before an intervention with the loss after the intervention. The percentage change shown reflects the difference between the GHG intensity before the intervention and the intensity after the intervention. An example of the calculations is provided below.

EXAMPLE

Water Intensity Factor	**133 L/kg for strawberries in the US**
Total Amount Harvested	**4000 kg**
Total Loss	**1000 kg**
Total Food Produced on the farm	**4000kg + 1000kg = 5000 kg**
Total Loss saved after interventions	**300kg**

Pre-intervention Water Intensity:

(Water Intensity Factor x Total Food Produced) / (Total Harvested)

EXAMPLE

(133 Water Intensity Factor x 5000 kg of food produced on farm) / (4000 kg Total Harvest amount) = 166.25 Liters / kg

Post-intervention Water Intensity:

(Water Intensity Factor x Total Food Produced) / (Total Harvested + Total Loss saved after intervention)

EXAMPLE

(133 Water Intensity Factor x 5000 kg of food produced on farm) / (4000 kg Total Harvested amount + 300 kg of loss saved after intervention) = 154.65 Liters / kg

Water Intensity Reduction:

(Post-Intervention Water Intensity – Pre-Intervention Water Intensity) / (Pre-Intervention Water Intensity)

EXAMPLE

(154.65 - 166.25) /166.25 = **-6.98%**

Frequently Asked Questions

ABOUT THE SCOPE OF THE GFLT

How can growers use the GFLT to connect with buyers?

Growers that measure what is left unharvested in the field and at further stages say it brings them new opportunities to identify innovation and profit. It also provides evidence and confidence for conversations with buyers and others.[4]

For growers, supplying customers that are reporting on food loss and waste reduction goals (SDG Target 12.3), data from the GFLT can be used to automatically generate the requested reports. This information can also incentivize them to support efforts to reduce food loss on farms and therefore improve grower's food loss and waste, and scope 3 emissions figures.

Can the GFLT be used in any part of the world?

Yes, the GFLT is designed for global use. Among other customizable features, it allows users to select the relevant unit (e.g., pounds, kilograms). Moreover, the sampling methods and calculations are suitable for global application.

Can the GFLT be used by any size of farm operations?

Yes, this metric tool can be used to measure food loss in operations of any size. Tracking loss in-field can be done in fields less as small as one acre. Vertically integrated operations can use the GFLT as well since the GFLT offers options to track losses not just in-field but also in further farm-level stages (e.g., in packing, processing, storage).

Can the Global Farm Loss Tool be used for all crops?

The GFLT can be used to measure losses in all specialty crops, including fruit, vegetable, and tree crops. The GFLT builds on the SISC food loss metric calculator and WRAP Roadmap Grower Guidance Field-Record Sheet which were originally designed for measurement of vegetable crops.

Can the GFLT be used for greenhouse or controlled environment agriculture operation?

The Food Loss Tool can be adapted for use in a greenhouse or controlled environment operations. Note: Careful thought should be given to the area calculations.

4 Growers' Perspective on Measuring Fresh Produce Left in the Field: A Summary Business Case, 2021

What "on-farm" stages can the GFLT be used for?

The GFLT is designed for measuring in-field losses and those subsequent stages that are part of a particular farming operation. We recognize that there are many types of farming operations. The GFLT is not intended for use with stages (such as a packhouse) if it is not on-farm. If a packhouse that is on farm services an area larger than what's being supplied by the farm, the GFLT may be helpful.

Is the GFLT for hand- or machine-harvested crops?

Any and all harvest methods are suitable for measurement using the GFLT.

Can the GFLT be used to sample more than one field?

Yes, the GFLT allows for measurements for multiple fields to be inputted with results for all fields available separately and aggregated.

Are photos required?

It is not required to take photos however it is encouraged as best practice in order to accurately record your methodology and criteria used to sort your crop into the 3 categories of marketable, edible/not marketable, and spoiled.

ABOUT IN-FIELD MEASUREMENT

How long will it take to measure product left in-field?

Sampling and data collection in the field takes about 1 hour for two people (on average). This includes time to gather the equipment and 15 - 20 minutes per row to harvest the samples. Sorting and weighing by the three categories, inputting the data takes approximately 1 – 1½ hours.

What equipment is needed to sample in-field?

In order to take samples in the field and weigh them (as opposed to estimating based on what's seen) staff will need (at a minimum): a long measuring tape, flags or another marker to mark out sample area, harvest containers, and a scale. Printing out the Global Farm Loss Tool Field Worksheet for the metric tool is a useful option.

When should the measurement be done in-field?

It is recommended that measurement is undertaken immediately after harvesting has been completed ideally after the same harvest interval that has been used throughout the season. For example, if broccoli were harvested every four days, then four days after the final harvest would be ideal. For products that are the continuously harvested and sorted out in field such as strawberries, samples should be taken at peak productivity for the crop.

What criteria is used to determine what is marketable, edible but not marketable, and spoiled?

Sorting what's left in the field by quality provides important insights. The suggestion is to sort by marketable, edible but not marketable, and spoiled. Marketability is unique to every grower based on its buyer's specifications. Criteria to make this determination include size, shape, defects, maturity, color, insect/disease evidence, and decay. The most subjective decision is about what's still potentially edible but not marketable. This would be product that could be eaten but falls outside of marketable range. Growers may also find it provides useful insights to create more than one category for the 'edible not marketable" product. As an example, for fresh tomatoes that are still safe for human consumption but not marketable, one subcategory may be 'the right size but too mature' for the buyer (i.e., red) or slightly blemished, while a second category may be too small but the right maturity (i.e., green).

Should dropped product be measured as well?

If harvesting by hand, typically no. However, if you want information on the amount left on the ground for other reasons (e.g., shattered during harvest), or as a result of equipment deficiencies (if mechanical harvest), that could also be valuable but identifying the category of this loss (by marketable, edible/not marketable, or spoiled) may not be feasible.

How do you sample product that grows underground?

For root vegetables and tubers, a rule of thumb is to dig through the sampling area to a depth of 15cm / 6 inches to gather the crop remaining beneath the soil surface.

How would the GFLT extrapolate across perennial crops (e.g., apples) in different growth stages?

For example: small, young trees have less fruit to begin with per hectare, with likely less fruit left behind as well. The GFLT allows for narrative to be included about potential sources of uncertainty, which is where a user may need to make a note about this type of situation. The extrapolation is driven by the size of the field and current yield. If the crops in different growth stages are grouped in a distinct part of the field, a separate submission could be created for the different blocks (with the size and yield adjusted accordingly).

Should I include crops not suitable for harvest due to crop failures caused by things like weather, pest, or disease?

No. If the crop is not ready for harvest (i.e., has not yet met harvest parameters or specifications) but is damaged due to weather, pest, or disease then this should not be included. Practical guidance on how to decide whether a crop is damaged before or after it became ready to harvest is included in the 'grower record' and reporting template (see Appendix).

Should I include unharvested material that is part of the plant? For example, celery where outer leaves are left in the field, or the outer leaves of lettuce be treated (trimmed after harvesting)?

If these are ready to harvest (i.e., at a stage where they would normally be harvested) then this material should ideally be included in your measurement. However, since these may be considered 'inedible parts' – i.e., not intended for human consumption in your supply chain – if you do decide to exclude them, indicate so in the GFLT with a description about what was not measured.

ABOUT VARIOUS GROWING SCENARIOS

What about where the product is mixed with mud and stones—e.g., potatoes?

In this case the potatoes (food) would be measured but the mud and stones are not part of the product and therefore should be excluded. It is recognized that these may be mixed together. As such, the weight of the crop may be an estimate if that is more practical, but the calculations used should be included in the inventory narrative section.

Some unharvested vegetables are left in the field and livestock can graze and eat the crop—should this be classified as animal feed?

The proportion of the unharvested crop that has been eaten by animals through grazing should be classified as animal feed. If a significant amount of the crop remains in the field, then this should be classified as 'not harvested.' Recording the amount of the crop that is eaten by animals in the field (if significant) is valuable to get a full picture and help businesses make better informed decisions about how to optimize performance against financial and sustainability targets.

Some unharvested vegetables are left in the field and gleaning is employed (e.g., volunteers and charities come onto the farm and pick the crops)—should this be classified as redistribution of surplus food?

The proportion of the unharvested crop that has been gleaned should be classified as redistribution for human consumption and reported separately. Recording the amount of the crop that is gleaned (if significant) is valuable to get a full picture and help businesses make better informed decisions about how to optimize performance against financial and sustainability targets.

Regrowth is harvested on some crops (e.g., rocket, mushrooms) and the number of re- cuts can vary. Sometimes waste can increase if you persist with an 'old' crop or, in some cases, it could be higher if you re-crop—how would a grower account for this?

Where this is common practice, both scenarios would be in scope. The guidelines are to start measuring when a crop is deemed as 'ready for harvest' which could vary in this situation or be repeated in the case of a crop that is harvested multiple times due to re-growth.

How should the sampling be undertaken for crops that produce continuously (e.g., have multiple cuts such as strawberries)?

For crops that produce continuously and are harvested multiple times a week, data will be extrapolated from samples taken in any given week, from the beginning to the end of the harvest period. Over time, by sampling at various points across the growing season, the GFLT will help growers to calculate an average loss and track and monitor how their loss levels fluctuate.

together possible

Cover photo © WWF-US / Alex Nichols-Vinueza

© 1986 Panda symbol WWF – World Wide Fund for Nature (Formerly World Wildlife Fund) ® "WWF" is a WWF Registered Trademark. WWF, Avenue du Mont-Blanc, 1196 Gland, Switzerland. Tel. +41 22 364 9111. Fax. +41 22 364 0332.