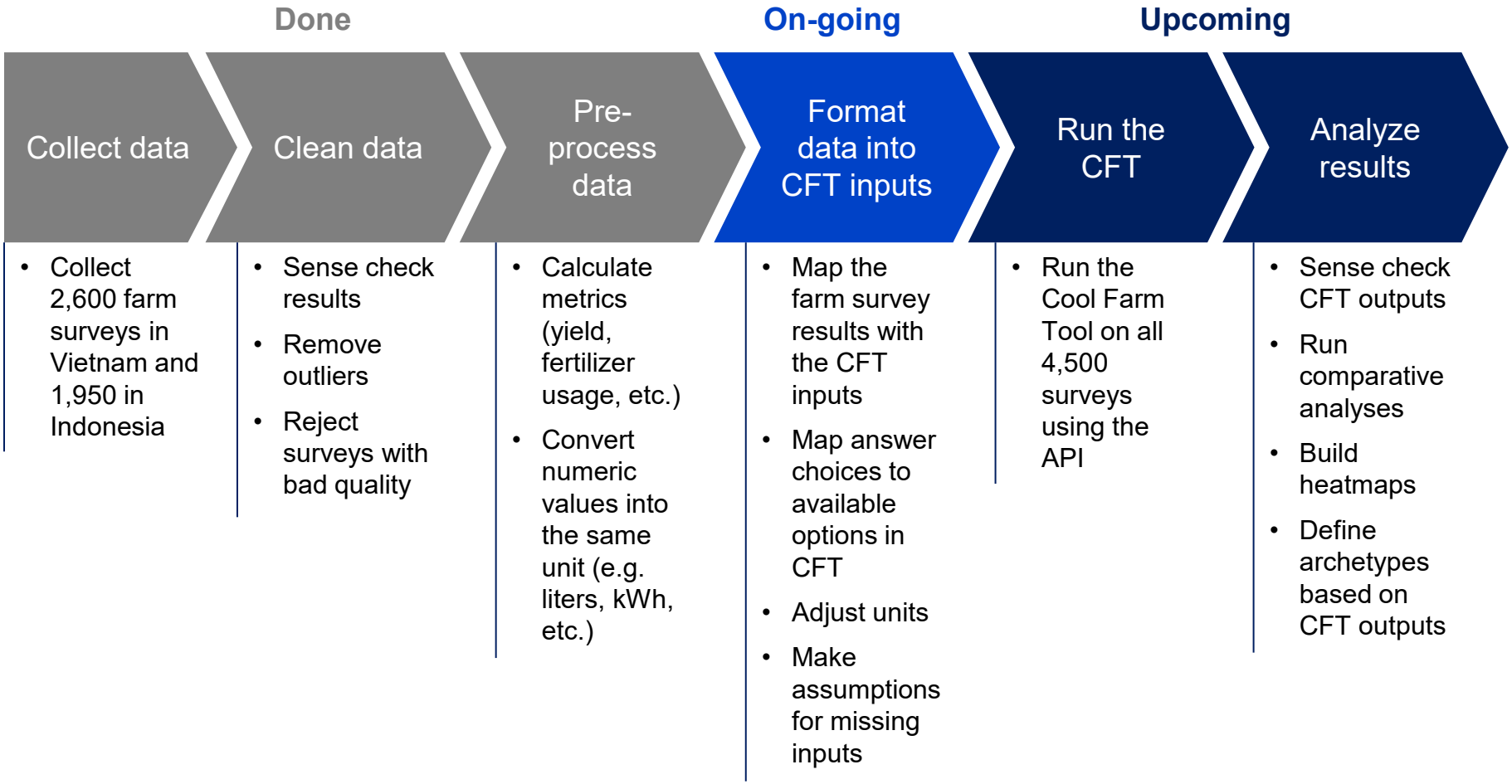
Enveritas

Application of Cool Farm Tool on farm survey data – model assumptions

Final version with decisions made during the technical meeting on 14 Feb 2023

Current status



The Cool Farm Tool components

Farm characteristics	• Country • Climate • **Temperatures**
Crop characteristics	• Production volume • Area • **Soil organic matter** • **Residue**
Pesticides & herbicides	• Type • **% active ingredient** • **Application rate**
Irrigation	• **Method** • **Allocation** • Water volume • **Power source**
Fertilizers	• **Type** • **Origin** • **Application rate** • Application method • **Inhibitor**
Wastewater	• Production (quantity) • Oxygen demand • **Treatment type**
Direct energy	• Category • **Source** • **Usage (quantity)**
Land management	• **Type of land changed** • **Years ago** • **Area of expansion** • **Forest: ecological zone** • **Forest: age** • Cover crops: years change • **Cover crops: area of expansion / clearing**
Transport	• **Mode** • **Weight carried** • Distance
Tree biomass	• **Intercropped tree type** • **Shade tree type** • Density last year • **Size last year** • **Size this year** • **Change in number of trees**
Co-products	• **For intercropped trees, food crops, coffee husks: % of green coffee value**

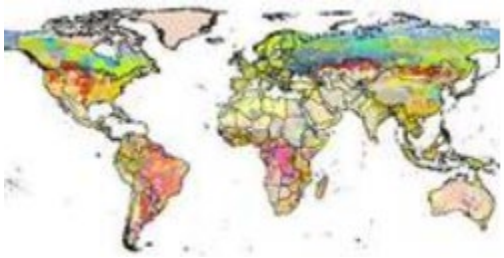
Farm characteristics

Temperatures

- Average yearly temperatures: **23.21°C** in Vietnam, **22.59°C** in Indonesia
  - Source: ECMWF
    - Validated by Geotree (Enveritas originally used another source)

Crop characteristics (1/2)

Soil organic matter



- Soil texture: **clay**
  - Source: FAO's Harmonized World Soil Dataset
  - Validated by Geotree (Soilgrids classifies as “Clay Loam”)
- Organic matter default value (for farmers who don’t know): **1.72 to 5.16**
  - Assumption: soil type = Acrisols
  - Validated by Geotree:
    - Soilgrids 250: Vietnam = SOC (1.86-2.42) %, Indonesia = SOC (2.73-7.73) %
    - “The values for Vietnam are in the range in the literature study in Kontum province, Vietnam (Le et al., 2021)”
- pH default value (for farmers who don’t know): **< 5.5**
  - Assumption: soil type = Acrisols (acidic soils)
- Moisture level (moist / dry): **moist**
  - Tropical climate
- Soil drainage (good / poor) : **good**
  - CFT definition from the UI: *“Soils which are often saturated or show surface water, should be classified 'Poor'. This would usually include clay soils with restricted or no drainage. For other cases enter 'Good’.”*

Crop characteristics (2/2)

Residue

- Volume of residue from husks: **90% of volume of green bean produced**
  - An Overview of the potential use for coffee husks: *"The green coffee bean constitutes only 50–55% of the dry matter of the ripe cherry"*
  - Utilisation of waste for coffee production: *"About 0.18 tons of husks are released from 1 ton of fresh coffee fruits, producing around 150 to 200 kg of commercial green coffee"*
  - Coffee processing residues as a soil potassium amendment: *"The green coffee bean constitutes only 50–55% of the dry matter of the ripe cherry"*
  - Feedback from Yara: Agree to the assumption of husk residue = 100% green bean produced. However, this is fresh matter husk residue, which has a dry matter content of about 90%
  - "Husk" here accounts for the entire coffee bean's dry matter excluding the green bean.
- Volume of residue from leaf litter: **35.6% of volume of green bean produced**
  - Suggested by CFT
  - Feedback from technical call: will be considered as "residue"
  - Feedback from technical call: compost will be excluded here and included in the emissions from organic fertilizers, to avoid double counting
- If the farmer does not know their "husk disposal method": defaulting to **"Removed; left untreated in heaps or pits"**
  - If "husk disposal method" is empty, it means the farmer sold non-hulled coffee. Hence, coffee residue is managed at the mill level. The most likely outcome for the husk is "left untreated in heaps or pits"
- When several husk disposal methods are selected by the farmer, we only **select the one with the largest emission factor**
  - Originally set as "lowest emission factor" by Enveritas, but changed following consensus during technical call

Pesticides & herbicides

Active ingredient

- Farmers know the brand of chemical used, but don't know the % of active ingredient: we did some external research and could find the % active ingredient values for most chemicals: **available here**
  - 15/442 chemicals in Indonesia missing
  - 72/387 chemicals in Vietnam missing
- For missing active ingredient data, we resort to default values based on country averages: **20%** in Vietnam, **30%** in Indonesia
- Feedback from technical call: we will not differentiate the active ingredients as not enough information is available and the impact would be minimal

Application rate

- Null values are replaced with country averages for herbicide / pesticide, i.e.:
  - Indonesia:
    - > Pesticides: **10.3 kg / ha**
    - > Herbicides: **12.9 kg / ha**
  - Vietnam:
    - > Pesticides: **6.1 kg / ha**
    - > Herbicides: **5.3 kg / ha**
      - Feedback from technical call: although glyphosate is banned in Vietnam, other herbicides such as glufosinate are used – the value of 5.3 kg / ha was not considered to be excessive

Irrigation

Method

- Hose & pump system does not exist as an option in CFT: **use "direct energy" component with average energy usage values**, as suggested by the CFT
  - CFT comment: *"Since the Cool Farm Tool does not have information on the energy use of a "hose and pump" system, I recommend estimating the energy use in irrigation outside of the Cool Farm Tool. The best way is a direct estimate of the amount of diesel consumed and/or kWh used, and fill these values out in section 4.1. If you use 4.1 and do not need the tool to help with energy use estimation, you could leave all of the irrigation questions unanswered. If considering this comment, you still want to use the Cool Farm Tool to assist with the estimation of energy use in irrigation, I agree that "flooding" may be the closest."*
- If the farmer answers "none of the above" to the irrigation system question: use **"rain gun"**
  - Sprinkler irrigation (assimilated to rain gun in the CFT) is the most frequent in Vietnam after hose and pump, which is not an option in the CFT

Allocation

- Share of plot irrigated: assuming **100%**
  - Validated by Geotree

Power source

- If farmer uses both electricity and another source: defaulting to the **most emitting source** (most often diesel)
- CFT suggests choosing the dominant source of energy, but we don't have that information. *"if both diesel and electricity are used, choose the dominant source of energy."*
  - Clarification following 4C's question: this is only applicable to farmers who selected two sources, which represents less than 1% of the dataset
  - Originally set as "electricity" by Enveritas, but changed following consensus during technical call
- If farmer responds "Other" to the energy source question: defaulting to **diesel** (most emitting source
  - Originally set as "electricity" by Enveritas (most common source in Vietnam), but changed following consensus during technical call
- If energy source is solar: **0 emission assumed**

Fertilizers (1/3)

Fertilizer types

Inorganic fertilizers

- KNO3 (Potassium Nitrate) is not available in CFT: using **Calcium Nitrate** as a proxy
  - Originally set as “Potassium chloride (60% K2O)” by Enveritas, but changed following feedback from Yara
- Ammophos (Ammonium Phosphate Sulphate) is not available in CFT: using **ammonium sulphate (21% N)** as a proxy
- The survey has a common option for “SP (Super Phosphate) / TSP (Triple Super Phosphate)”: mapping to **“Super phosphate - 21% P2O5”**
- If farmer selected “Other” or “NPK (other)” as a fertilizer type: defaulting to most common values in country, i.e. **NPK 15-15-15** in Indonesia and **NPK 16-16-8** in Vietnam
- For custom NPK fertilizers, the N component can be “ammonium-N” or “nitrate-N” or “Urea-N”: using **“Urea-N”**
  - Originally set as 50% “ammonium-N”, 50% “nitrate-N” by Enveritas, but changed following feedback from Yara: “The local blends in Vietnam and Indonesia typically contain urea or AS as N source. Nitrate is not common as N component in local products. The production footprint of local urea and ammonium is significantly lower than that of non-European nitrate. We could try to confirm this “expert assumption” by local fertilizer statistics if needed.”

Fertilizers (2/3)

Fertilizer types

Organic fertilizers

- "Compost" can be mapped to three options in CFT: "fully aerated production", "non-fully aerated production", "zero emissions". We selected **"non-fully aerated production"**
  - Feedback from technical call: compost selected under the residue management section will have 0 emission to avoid double counting – emissions will be taken into account here, as organic fertilizer
- "Microbial fertilizer" is not available in CFT: considered as **0 emission** as per CFT feedback
  - Clarification following question from 4C: microbial fertilizers = biofertilizers. They will be included in a next iteration of the CFT; in the meantime, the CFT team recommended to assign them 0 emission.
- If farmer doesn't know what animal produced the digestate / manure / slurry: defaulting to most common values in country, i.e. **Cattle** in Indonesia and Vietnam
  - Feedback from technical call: although "goats" were suggested for Indonesia, they are not included in the list of options from the CFT
- If farmer selected more than one animal for digestate / manure / slurry: using the **first one selected by the enumerator** (CFT does not allow the user to have several types of animals)
- If farmer selected "Other" or "None of the above" as a fertilizer type: defaulting to most common values in country, i.e. **Cattle Manure (0.6% N)** in Indonesia and Vietnam

Fertilizers (3/3)

Application volumes

- Only two farmers in Vietnam did not provide a fertilizer application volume: defaulting to country average, i.e. **796 kg / ha** (inorganic) and **5,686 kg / ha** (organic). There were no such cases in Indonesia.
  - Clarification following comment from Yara: these replacement values only applies to farmers who reported using fertilizers but whose reported volumes were outliers. There are only 2 cases in Vietnam, and none in Indonesia
  - Suggestion to replace with 2 tons / ha: consensus to keep the country average of 796 (this does not have any visible impact on the results anyway as it just concerns two farms)

Inhibitors

- The wide majority of farmers do not know whether inhibitors were used: defaulting to **"None"**

Origin

- If farmer does not know where the fertilizer was produced: defaulting to most common values in country, i.e. **Southeast Asia** in Indonesia and Vietnam
- Feedback from Yara: "In Vietnam the N (urea/AS) mainly stems from Vietnam/SE-Asia or China. The split can be derived from local experts or statistics. The fertilizer production emission factor for Chinese N products is significantly higher than for SE-Asia."
- Decision taken by Core Committee: we will rely on farmer-reported data for this project, which is "Southeast Asia" in 95% of cases, and will use Yara's upcoming feedback in the final report to provide further context

Wastewater

Treatment type

- If farmer answers “poured on the ground”, “pour into a waterbody”, or “I don’t know”: mapping to **“Discharge in an unspecified aquatic environment”** (IPCC tier 1)
- Feedback from technical call: this component will remain negligible, hence Sphera’s approach to exclude it will have very minimal impact on the results
- Comment from 4C: “Empty or “I don’t know” cells: This could be a major point for different results as we normally don’t fill up empty cells but calculate only with the data available from other farms. If we have to take the same approach we would need to receive the completed dataset from Enveritas with the “replacements”
  - Feedback from technical call: we need to keep survey data that has empty or “I don’t know” values, in order to keep a sufficient sample size. Hence the need to fill those values. We will send a completed dataset with filled values
- Feedback from technical call following Nestlé’s comment: only wet processing occurring at farm level will be considered. This only includes a handful of farms from both origins, so will eventually be negligible.

Direct energy (1/2)

Source

- If farmer answers “None of the above” to the energy source question: **0 emissions** assumed
  - Feedback from technical call following 4C’s comment: if farmer selects “none of the above” although the list of options is very long, it means the energy source is not one of the most commonly emitting ones. Hence, it is fair to assume it has 0 emission (most likely: renewable source or no energy source at all)
- If energy source is unavailable: using **country’s most frequent source for that activity**, i.e.:
  - Indonesia:
    > Pulping: **diesel**
    > Hulling: **petrol**
    > Drying (rotating): **petrol**
    > Drying (heating): **diesel**
    > Other: **petrol**
  - Vietnam:
    > Pulping: **diesel**
    > Hulling: **diesel**
    > Drying (rotating): **diesel**
    > Drying (heating): **biomass**
    > Other: **petrol**

Direct energy (2/2)

Usage (quantity)

- If data is unavailable: using **country averages per activity / energy source**, i.e.:
  - Indonesia:
    > Pulping: diesel = **11.5 L**, petrol = **26.1 L** , electricity = **0 kWh** (no data)
    > Hulling: diesel = **9.4 L**, petrol = **10.8 L**
    > Drying (rotating): diesel = **50 L**, petrol = **21.4 L**, electricity = **0 kWh** (no data)
    > Drying (heating): diesel = **8 L**
    > Other: electricity = **14 kWh**, petrol = **20.5 L**, oil = **0 L** (no data), biodiesel = **0 L** (no data)
  - Vietnam:
    > Pulping: diesel = **11.5 L**, petrol = **26.1 L**, electricity = **0 kWh** (no data)
    > Hulling: diesel = **19.8 L**, petrol = **15.5 L**, electricity = **84.8 kWh**
    > Drying (rotating): diesel = **50 L**, petrol = **21.4 L**, electricity = **0 kWh** (no data)
    > Drying (heating): diesel = **8 L**, biomass = **3,633 kg**, electricity = **200 kWh**, fuel wood = **1,500 kg**
    > Other: electricity = **56.2 kWh**, petrol = **44.4 L**, diesel = **22.1 L**
- Feedback from technical call following Sphera's comment: values represent total energy usage over an entire year. It needs to be divided by green bean production.

Land management (1/2)

Type of land changed

- If farmer does not know what the land type was before coffee was grown: defaulting to **forest**
  - Feedback from technical call: those cases remain rare, and it is better to remain conservative and consider “forest”. Enveritas will not use remote sensing for this.
- The CFT only allows 1 land type: if the land had different uses including forest, defaulting to **100% forest**
- If farmer reported “natural vegetation” or “land was fallow” as land type: mapping to **“grass”**

Years ago

- If the farmer does not know when the land was cleared: defaulting to country averages, i.e. year **2018** in Indonesia and **2015** in Vietnam

Area of expansion

- Share of farm expanded is calculated as such: **average between [area expanded / plot area] and [number of trees added / number of trees on plot]**
- If farmer does not know what share of the farm was expanded: defaulting to **10% of the current plot area**
  - Validated by Geotree: “The literature says that this is a reasonable value. Mulia et al., (2021) study on Vietnam states 10% of existing agroecosystems (including Robusta based) are considered suitable for production.”

Land management (2/2)

Ecological zone

- **Tropical rain forest** in Indonesia and **Tropical moist deciduous forest** in Vietnam
  - Source: FAO's global ecological zones
    - Validated by Geotree: "Seems correct. https://data.apps.fao.org/map/catalog/srv/api/records/2fb209d0-fd34-4e5e-a3d8-a13c241eb61b/attachments/ecozones2010_1.jpg"

Forest age

- No data was collected on the age of the forest cleared: defaulting to **100 years old**

Cover crops – area of expansion / clearing

- The answer options for the share of the farm covered with cover crops are in categories, but the CFT requires numerical values. The mapping applied is the following: {"Less than 20%": **10%**, "21-40%": **30%**, "41-60%": **50%**, "61-80%": **70%**, "More than 80%": **90%**}

Transport

Mode

- Motorbike is used by the wide majority of farmers but is not available as an option in the CFT: mapping to **light goods vehicle**
  - Sphera will use the same assumption

Weight carried

- Some farmers could not estimate the weight carried over the entire year: defaulting to **country averages for each vehicle type**:

- Vietnam:
  - > Inbound transportation of inputs:
    - Light goods vehicle: **2100 kg**
    - Heavy goods vehicle: **3500 kg**
  - > Outbound transportation of coffee:
    - Light goods vehicle: **4550 kg**
    - Heavy goods vehicle: **7000 kg**
- Indonesia:
  - > Inbound transportation of inputs:
    - Light goods vehicle: **1000 kg**
    - Heavy goods vehicle: **600 kg** (only one case)
  - > Outbound transportation of coffee:
    - Light goods vehicle: **1500 kg**
    - Heavy goods vehicle: **2000 kg**
- Feedback from technical call following comment from 4C: Farmers were asked about all trips they made to buy inputs from shops. Although the transportation of inputs from the production factory to the shop might not be taken into account in CFT's emissions factors, those are deemed negligible by 4C.

Biomass

Tree type

- Our survey results include the actual tree types present on the plot, for both intercropped trees and shade trees. However, CFT includes a restricted list of tree categories. The mapping applied is the following:
  - All shade trees: **"Shade"**
  - All intercropped trees in Vietnam: **"Tropical Moist "**
  - All intercropped trees in Indonesia: **"Tropical Wet Hardwood"**
- As per CFT recommendation, **coffee trees themselves are excluded from the biomass stock calculations**
  - CFT: *"If an area of land has been in coffee and will remain in coffee there is no significant change in carbon change over longer timeframes. This question of what carbon is and is not to be factored in to an assessment is a hot topic and one we're tackling in more depth with the new perennials module, currently in development. There are certain situations in which this could and/or should be included but for simplicity and given that you don't have diameter data, I would say, no."*
- Similarly, as per CFT recommendation, **food trees are excluded from the biomass stock calculations**

Size (tree diameter) last year and this year

- Last year's diameter of trees is not available in the dataset: we are using **year-on-year tree growth assumptions** (available here) to estimate this dimension
- Some collected tree diameters were removed from the dataset as outliers: replaced them with country averages per tree type
  - CFT: *"For the older trees - if there is any way to estimate how much the diameter might have increased over the course of the year, and enter this set of trees separate from the new trees, that could also work."*
- Newly planted trees should not have the same tree diameter as existing ones: defaulting to **1 cm** for "size last year" and "size this year", as per CFT response
  - CFT: *"perhaps you could enter the new trees separately from the old trees. Diameter could be small - 1 cm diameter or less - and wouldn't change from last year (when they didn't exist) to this year. The number of new trees would be entered"*

Co-products

Name

- Products included as “co-products” (if sold): **intercropped trees**, **intercropped food crops**, **coffee husks**

Percentage of green coffee value

- The value of each co-product is assessed using its **financial value, based on the sales**. Any non-sold product produced on the farm (e.g. for household consumption) is not considered as a co-product.
  - Based on CFT feedback
- CFT does not allow any product to go beyond 100% of the coffee value: capping each product at **100% of the coffee value**
- If coffee revenue is not available for a farmer (e.g. outlier values): defaulting to **0% of co-products**
- Feedback from Sphera: “We would suggest to report results without allocation and include allocation as a scenario or agreeing on a fixed allocation ratio (e.g. 80/20 looks like a reasonable estimate from a first review of data excluding outliers). Else, this introduces a lot of uncertainty in our view as allocation has a large and linear (direct) impact on results. Note that assuming same revenue for co-products as for coffee means that only 50% of overall impacts will be allocated to coffee.”
- Feedback from technical call: some data points were not cleaned – Enveritas will send a revised / clean version. We will also calculate the results for 2 scenarios:
  - 100% coffee, no co-product
  - Using financial share of co-products as reported by the farmer