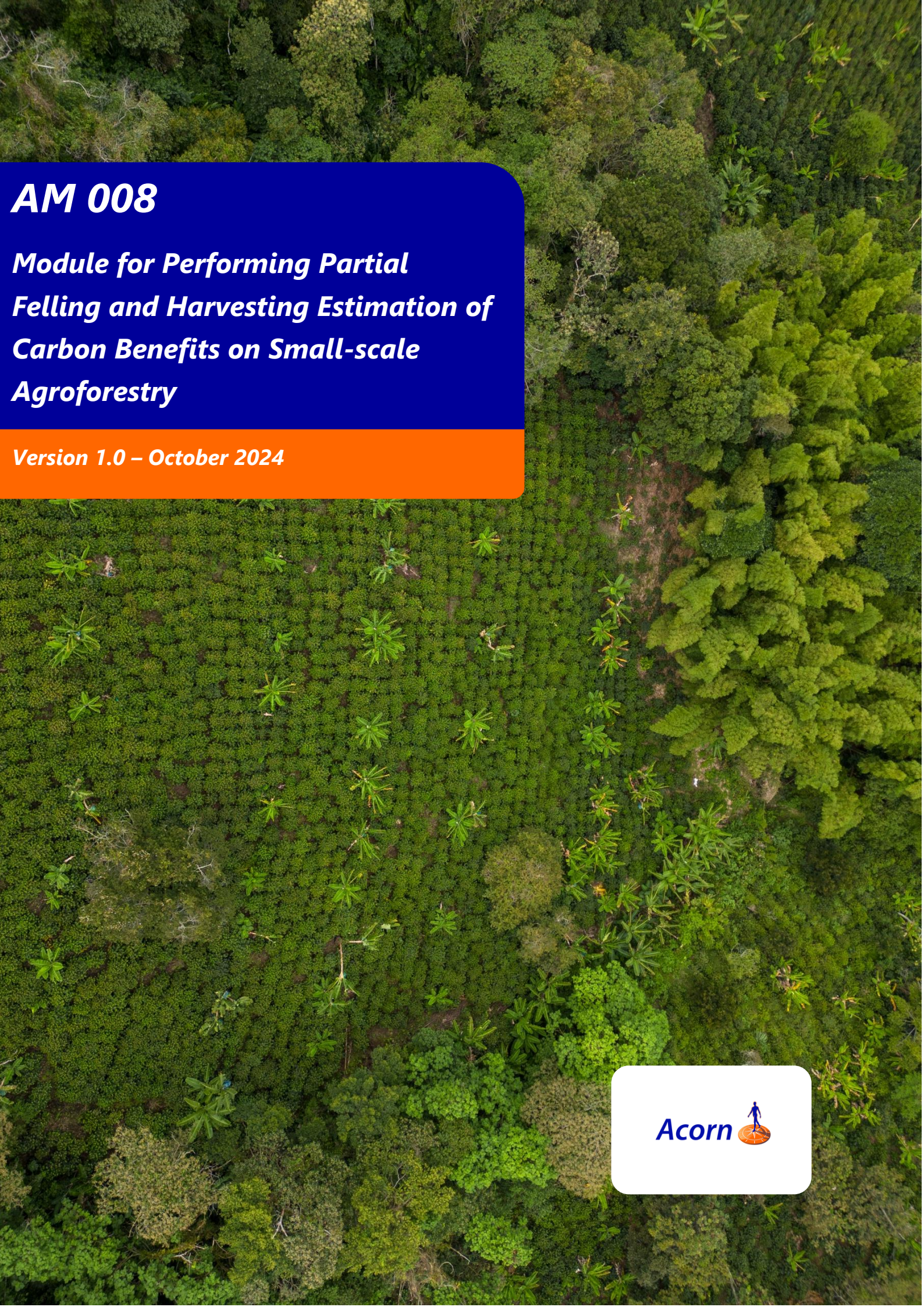

# AM 008

## Module for Performing Partial Felling and Harvesting Estimation of Carbon Benefits on Small-scale Agroforestry

Version 1.0 – October 2024

Acorn

# Contents

# 1 Summary

This Module for *Performing Partial Felling and Harvesting Estimations of Carbon Benefits on Small-scale Agroforestry v1.0* outlines the applicability conditions and procedures for implementation at *Harvesting Design* level within a project. It details the processes of partial felling and harvesting within *Acorn projects*, emphasizing the importance of maintaining carbon recovery times and modeling the *Carbon Cycles*. The Module also specifies the criteria for classifying projects to include either partial felling or harvesting activities and provides guidelines for calculation and capping Aboveground Biomass. Regular re-assessment and monitoring are required to align with the project design(s) and achieve long-term project ambitions.

# 2 Sources

This module supports the following methodology:

- **AM-001** Methodology for Quantifying Carbon Benefits from Small-scale Agroforestry v2.0
- **AM-007** Module for Performing Uncertainty Estimation of Carbon Benefits on Small-scale Agroforestry v1.0

# 3 Definitions

Definitions used in this module follow the latest version of the Acorn Glossary available on the Acorn website.

# 4 Applicability Conditions

For this module, the applicability conditions of the Acorn Methodology **AM-001 v2.0** should be met. The method described in this module is applicable at a *agroforestry design level*.

# 5 Procedures

## 5.1 Partial felling

*Partial felling* concerns the activity of removing *biomass* as part of the *Acorn project intervention* after the establishment of the *agroforestry* system, resulting in a *carbon recovery time* to pre-felling levels within 5 years. *Partial felling* is typically implemented to leave the best-performing and desired trees standing and to reduce competition for resources. *Partial felling* is often referred to as "thinning". Thinning or *partial felling* systems (single tree or group selection) are excluded from the *harvesting* procedure under Section 5.2.

Project activities are considered "*partial felling*" if the *carbon recovery time* to pre-thinning *biomass* levels is shorter than or equal to 5 years (Cardinael, R. et al., 2020, Bhardwaj et al. 2024). Different levels of thinning are allowed, depending on the *Agroforestry Design* and projected *Carbon Cycle*.

For each *Acorn project* with *partial felling*, the time necessary after each felling to recover *biomass* should be within 5 years. To determine whether this is the case, the modeling of estimated *Carbon Cycle* should be done based on the *Agroforestry Design*. *Local Partners* are required to include felling levels per tree species, indicating the % of trees removed compared to tree planting density. Furthermore, the growth modeling should be done for each tree species, taking into account the tree species characteristics, tree phenology, environmental conditions, and management practices such as pruning, thinning and felling.

The *Agroforestry Design* is used as an input to model the *Carbon Cycle* over the *Acorn Project Period*. For determining the LTA, a 50 year period is used as default value. The growth models to estimate tree and *biomass* growth should be based on best available scientific insights, either done through recognized (agro)forestry tree carbon estimation tools or models (e.g. Farm Tree Tool, Cool Farm Tool), allometric equations, photosynthetic efficiency models (including multiscale models) or other equations such as the Michaelis-Menten equation and the Beer-Lambert law.

To determine whether a *Carbon Cycle* of an *Agroforestry Design* has a *biomass* drop longer than 5 years, the total amount *biomass* from trees established through the *Acorn project intervention* is calculated. If a drop in the total *biomass* is predicted that is not recovered within 5 years, an *Agroforestry Design* is classified as a *harvesting design*.

*Local Partners*, with support of Acorn, are required to re-assess at least every 10 years that general felling practices remain within those foreseen within the formulated *Agroforestry Design*. *Local Partners*, with support of Acorn, are required to realize monitoring of *plots* to determine the level of deviation from the *Agroforestry Design and* update and reflect management practices accordingly.

## *5.2 Harvesting*

An *Acorn Agroforestry Design* is considered a "*harvesting design*" if the *carbon recovery time* to pre-thinning carbon levels takes longer than 5 years, for example, when the maximum felling thresholds from Section 5.1 are surpassed. In *harvesting designs*, the potential generation of the number of *CRUs* over the *Crediting Period* will be limited per *plot*, according to the *Acorn project intervention*. The generation of the number of *CRUs* over the *Crediting Period* will be limited by introducing a cap on the *Aboveground Biomass* per hectare used in the calculation of *CRUs* ($AGB_{cap}$). In such instance, the maximum *CRUs* for the *plot* of land are reached

therefore the *Smallholder Farmer* will not receive further compensation based on the increase in *Aboveground Biomass* beyond ($AGB_{cap}$).

The cap is calculated (Equation 1) by summing the average long term *Aboveground Biomass* (based on *ground truth measurement*), and the *Long-Term Average (LTA)* of the *Aboveground Biomass* from the *Acorn project intervention* (equation 2).

$$AGB_{cap} = AGB_{GTBaseline} + AGB_{LTA}$$

Equation 1

Where:

$AGB_{cap}$ = Maximum *Aboveground Biomass* cap (tonne/ha) in the *project area(s)* for *CRU* generation

$AGB_{GTBaseline}$ = Long-term Average *Aboveground Biomass* baseline based on *ground truth measurement* in the *Acorn project Period* (tonne/ha)

$AGB_{LTA}$ = Long-Term Average *Aboveground Biomass* in the *project area(s)* in the *Acorn Project Period* (tonne/ha)

The *Aboveground Biomass* within *harvesting designs* fluctuates over time. The average net gain of *Aboveground Biomass* is calculated with a long-term-average (LTA) of management system based on the *Acorn project intervention* (Equation 2). The *Aboveground Biomass* LTA is calculated based on a forecast of the expected *carbon sequestration* based on the *Agroforestry Design*. This forecast is updated every 5 years and calibrated with data including the actual sequestration from the recent past 5 years.

$$AGB_{LTA} = \frac{\sum_{t=1}^{T} AGB_y}{T}$$

Equation 2

Where:

$AGB_{LTA}$ = Long-term average *Aboveground Biomass* in the *project area(s)* in the *Acorn Project Period* (tonne/ha)

$\sum_{t=1}^{T} AGB_y$ = Sum of *Aboveground Biomass* in the *project area* in year y over all years in the *Acorn Project Period* (tonne/ha)

$T$ = *Acorn Project Period* (years)

# 6 Parameters

| Data/Parameter | $AGB_{GTBaseline}$ |
|---|---|
| Units | Tonne/ha |
| Description | Long-term Average *Aboveground Biomass* baseline based on *ground truth measurement* in the *Acorn project Period* (tonne/ha) |
| Equations | Equation 1 |
| Source | *Ground truth measurement* |
| Value | N/A |
| Justification of choice of data or description of measurement methods and procedures applied | This parameter is calculated using *ground truth data* for Diameter at Breast Height (DBH) and height as well as the allometric equation for the tree species present in 1 hectare of land. The value is updated at least every 3 years based on Ground Truth data. |
| Purpose of Data | Calculation for determining the limit of *CRUs* to be generated due to *harvesting* activities taking place within the *project area* |
| Comments | N/A |

| Data/Parameter | $AGB_{LTA}$ |
|---|---|
| Units | Tonne/ha |
| Description | Long-Term Average *Aboveground Biomass* in the *project area(s)* in the *Acorn Project Period for 50 years.* |
| Equations | Equation 1 & Equation 2 |
| Source | *Biomass estimates* |
| Value | Number |
| Justification of choice of data or description of measurement methods and procedures applied | Calculation of the cap to avoid overestimation of carbon benefits for agroforestry designs falling under the harvesting methodology |
| Purpose of Data | To establish a cap value for CRU generation at plot level |
| Comments | N/A |

| Data/Parameter | $AGB_y$ |
|---|---|
| Units | Tonne/ha |
| Description | *Aboveground Biomass* in the *project area* in year y |
| Equations | Equation 2; |

| | |
|---|---|
| Source | The *Agroforestry Design* and best available and applicable scientific insights for a *harvesting* scenario in the *project area* over all years over 50 years. AM-007 Equation 1 & Equation 2 |
| Value | N/A |
| Justification of choice of data or description of measurement methods and procedures applied | By estimating the *Aboveground Biomass* levels from the *ground truth data* over the years, an average of the *biomass* levels can be calculated. For the modeling of ex-ante carbon forecasts of *Acorn projects* with thinning and *harvesting* and to determine the $AGB_t$ over the years, this will be realized through recognized (agro)forestry tree carbon estimation tools or models, or allometric equations. The modeling should include felling levels per tree species, the % of trees removed compared to tree planting density. Furthermore, the growth modeling should be done for each tree species, taking into account the species growth characteristics, tree phenology, environmental parameters including climate conditions, and management practices such as pruning, thinning and felling. |
| Purpose of Data | Calculation for determining the maximum number of *biomass* used for CRU calculations, due to *harvesting* activities taking place within the *project area* |
| Comments | N/A |

| | |
|---|---|
| Data/Parameter | $T$ |
| Units | Year(s) |
| Description | *Acorn Project Period* in years (50 years) |
| Equations | Equation 2 |
| Source | *Business Case* and *Agroforestry Design* |
| Value | N/A |
| Justification of choice of data or description of measurement methods and procedures applied | *Acorn Project Period (50 years),* or *T,* is defined at 50 years, to cover tree removals over a long period of time and reflecting the long-term implementation of the agroforestry system. For those designs with clear rotations, it covers at least one full rotation cycle including the final harvest. |
| Purpose of Data | Calculation for determining the maximum number of *biomass* used for CRU calculations, due to *harvesting* activities taking place within the *project area* |
| Comments | N/A |

# 7 References

Bhardwaj, D.R., Salve, A., Kumar, J. et al. (2024) 'Biomass production and carbon storage potential of agroforestry land use systems in high hills of north-western Himalaya: an approach towards natural based climatic solution', Biomass Conversion and Biorefinery, 14, pp. 18079–18092. doi: 10.1007/s13399-023-03952-0.

Cardinael, R., Umulisa, V., Toudert, A., Olivier, A., Bockel, L. and Bernoux, M. (2018) 'Revisiting IPCC Tier 1 coefficients for soil organic and biomass carbon storage in agroforestry systems', Environmental Research Letters, 13(12), p. 124020. doi: 10.1088/1748-9326/aaeb5f