PV CLIMATE MODULE

PU009

Module for Estimation of Carbon Benefits from Small-scale Agroforestry with Partial Felling and Harvesting of Trees

Version 1.0

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1 Summary

This *Module for Estimation of Carbon Benefits from Small-scale Agroforestry with Partial Felling and Harvesting of Trees v1.0* outlines the applicability conditions and procedures for implementation at *Harvesting Design* level within a *Project*. It details the approach for classifying *partial felling* and *harvesting* land use systems within *Projects*, emphasizing the importance of maintaining *carbon recovery time* and modelling the *carbon sequestration.* The *Module* also specifies the criteria for classifying *Projects* to include either *partial felling* or *harvesting* activities and provides guidelines for calculation and limiting total eligible *Aboveground Biomass* for *r/vPVC* issuance. 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* and *Modules*:

- **PM002** Methodology for Quantifying Carbon Benefits from Small-scale Agroforestry v1.0
- **PU007** Module for Performing Adaptive Pre-project Woody Biomass Baseline for Small-scale Agroforestry
- **PU008** Module for Estimating Uncertainty of Carbon Benefits from Small-scale Agroforestry

3 Definitions

All terms in this document follow the PV Climate Glossary and **PM002**, with the addition of the following definitions:

Harvesting Design
An *Agroforestry Design* that includes *harvesting.*

Harvesting project
A *Project* that plans to include *harvesting* activities.

4 Applicability Conditions

For this *Module*, the applicability conditions of *Methodology* **PM002** should be met. The method described in this *Module* is applicable at an *Agroforestry Design* level.

5 Procedures

5.1 Partial felling

Partial felling concerns the activity of removing *biomass* as part of the *Project Intervention* after the establishment of the *agroforestry* system, resulting in a *carbon stock* reduction below 20% over a 5-year period, starting when a reduction of *carbon stock* occurs, and with carbon stock recovered in within this 5-year period. *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.

An *Agroforestry Design* is considered "*partial felling*" if *carbon stock* reduction is limited and falls under the *partial felling* definition (see **PM002** Section 3).

To determine whether an *Agroforestry Design* falls under this definition, modelling of the estimated *carbon sequestration* should be done based on the *Agroforestry Design. Projects* are required to define felling levels per tree species, indicating the percentage of trees removed compared to tree planting density. Furthermore, growth and *biomass* modelling should be done for each tree species, considering 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 sequestration* over the *Crediting Period* for the *Project Intervention*. A 50-year period is used as default value to determine the long-term average (LTA) increase in *Aboveground Biomass* resulting from *the Project Intervention.* This duration accounts for tree removals over a long period of time and reflects the long-term implementation of the *agroforestry* system that do not have a clear cut harvest cycle. The growth models to estimate *biomass* growth are explained in **PU007**, with reported *uncertainty* following **PU008**. If a more accurate model, tool or equation is available, the model requirements should be met, including a peer-reviewed publication or independent model assurance report. The models should be available openly or via license and come with estimated *uncertainty* for all relevant sources.

To determine whether a *carbon sequestration* of an *Agroforestry Design* falls under the definition of *partial felling* (see **PM002** Section 3), expected post-felling decrease in *biomass* at any point in the *Crediting Period* must be less than 20% over the 5-year period of the pre-felling *biomass*, and growth models must show that *biomass* will equal or exceed the pre-felling *biomass* within 5 years of the felling event (i.e. recover within the 60-month period).

Project coordinators are required to re-assess at least every 10 years that general felling practices remain within those foreseen within the formulated *Agroforestry Design*. *Project coordinators* are required to realize *monitoring* of *Project Areas* to determine the level of deviation from the *Agroforestry Design* and if update the felling type classification to reflect management practices, whereby *Project coordinators* will adhere to the felling *monitoring* protocol.

5.2 Harvesting

Harvesting concerns the activity of removing *biomass* as part of the *Project Intervention* after the establishment of the *agroforestry* system, resulting in a *carbon recovery time* to pre-*harvesting* levels of more than 5 years during the *Crediting Period,* or when *carbon stock* reductions are above 20% over this 5-year period.

An *Agroforestry Design* is considered a "*Harvesting Design*" if it falls under the definition of *harvesting* (see Section 3). In *Harvesting Designs*, the potential issuance of the number of *r/vPVCs* over the *Crediting Period* will be limited per *Project Area*, according to the *Project Intervention*. The issuance of *r/vPVCs* over the *Crediting Period* will be limited by a cap on the *Aboveground Biomass increase* from the *Project Intervention*, based on *Project Area* size. *r/vPVC* issuance stops when the *Project Area* has reached the cap for the maximum *Aboveground Biomass increase* for issuance of *r/vPVCs*.

To determine whether a *carbon sequestration* of an *Agroforestry Design* falls under the definition of *harvesting* (see **PM002** Section 3), expected post-felling decrease in *biomass* at any point in the *Crediting Period* must be more than 20% over the 5-year period of the pre-felling *biomass,* or growth models must show that *biomass* is below the pre-felling *biomass* after 5 years of the felling event (i.e. in the year after the 60 month period).

The maximum *Aboveground Biomass* increase for *r/vPVC* issuance from the *Project Intervention* is calculated with a long-term-average (LTA) of management system based on the *Project Intervention* over the *Project Period* (Equation 1). $AGB_{\Delta,cap}$ is calculated by forecasting 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 previous 5 years.

$$AGB_{\Delta,cap} = \frac{\sum_{t=1}^{T} AGB_y}{T}$$

Equation 1

Where:

$AGB_{\Delta,cap}$ = Maximum long-term average *Aboveground Biomass* increase from the *Project Intervention* in the *Project Area(s)* in the *Project Period* for *r/vPVC* issuance (tonne/ha)

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

T = A 50-year period over which the LTA is calculated (years)

6 Parameters

Data/Parameter	AGB_y
Units	Tonne/ha
Description	Ex-ante estimation of *Aboveground Biomass* in *agroforestry* system in a given year.
Equations	Equation 1
Source	Sigmoid-based growth curve model described in Module **PU007**
Value	Number
Justification of choice of data or description of measurement methods and procedures applied	Estimated *carbon stock* for all species in the *Project Area* in a given year following the model described in Module **PU007** for each individual species of the *Agroforestry Design*. Alternative methods such as allometric equations, sigmoid models (e.g. Richards, Gompertz), photosynthetic efficiency models (including multiscale models) or other equations within tools can be used if they can demonstrate a lower uncertainty estimate.
Purpose of Data	Estimate of *Aboveground Biomass* stock in a given year as input for Equation 1.
Comments	N/A

Data/Parameter	T
Units	Year(s)
Description	A 50-year period over which the LTA is calculated
Equations	Equation 1
Source	*Business Case* and *Agroforestry Design*
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	T is defined as a 50-year period over which the LTA is calculated, to cover tree removals over a long period of time and reflects 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 but must not exceed the number of full or partial rotations included within period T.
Purpose of Data	Calculation for determining the maximum number of *biomass* used for *r/vPVC* calculations, due to *harvesting* activities taking place within the *Project Area*
Comments	N/A

7 References

Cardinael, R., et al., (2018). Revisiting IPCC Tier 1 coefficients for soil organic and biomass carbon storage in agroforestry systems', Environmental Research Letters, 13(12), p. 124020.

Villanova, P. H., et al., (2018). Accumulation of carbon and age of thinning of the tree component in agroforestry systems. doi: https://doi.org/10.5039/agraria.v13i2a5526