Methodology AR040101 (V1.8)

Avoided Deforestation and Degradation January 2026

Executive Summary

1. Project Details

1.1. Project Background

Give a detailed description of the origin of the project, outlining the participants, area of the project and location.

Include any maps and surveys carried out since the inception of the project.

1.2. Sectoral Scope and Project Type

The Project is categorized under the sectoral scope of Agriculture, Forestry, and Other Land Use (AFOLU), specifically imploring the following activities:

1) Avoided Unplanned Deforestation, and
2) List any other specific sectoral scopes

1.3. Project Design

List the key components whose implementation creates a wholistic approach to sustainable forest management and local community development

1.3.1. Avoided Unplanned Deforestation

To mitigate the risk of deforestation, outline the key components employed inter alia:

Vigilant monitoring

Community engagement.

Assisted Natural Regeneration (ANR) and any other mitigation methodologies.

1.4. Project Proponent

Organization	
Contact Person	
Title	
Contact Details	

1.5. Ownership

Detail all the beneficial owners of the project, listing their corporate structure, domicile and any regulations that need to be adhered to.

1.6. Project Start Date

When was the project officially started (Month and Year)

1.7. Project Crediting Period

Detail the number of years the project will be credited for and any details on extensions that may be applied for.

1.8. Project Scale

What is the anticipated number of credits to be issued annually?

1.9. Description of Project Activity

1.10. Project Location

Provide exact co-ordinates and total size of the project area and provide maps and any satellite imagery already obtained.

1.11. Conditions Prior to Project Initiation

The entire Avoiding Unplanned Deforestation Project Area (UDef PA) must be forest at the project start date and must only include land qualifying as forest for a minimum of 10 years prior to the project start date.

- Projects must use a forest definition consistent with national parameters under UNFCCC/Kyoto (as above) or the host country's legal/national forest definition.
- Often aligns with FAO thresholds for practicality, but requires clear documentation of canopy cover, height, and area thresholds.
- Excludes agricultural/urban tree cover; focuses on areas capable of supporting forest for permanence in carbon sequestration.
- Recent updates (e.g., 2023–2025) emphasize high-integrity remote sensing and minimum mapping units for accurate forest cover classification

Confirm that boundaries do not overlap with the boundaries of any other listed or registered projects that qualify for any form of carbon or diversity credits.

1.12. Compliance with Laws, Statues, and Other Regulatory Frameworks

List and detail all the compliance obligations with respect to required laws, statutes, and other regulatory frameworks that govern the Project.

Reference Law, Statue, and Other Regulatory Framework	Demonstration of Compliance

1.13. Participation Under Other GHG Programs

Confirm that the Project does not currently and will not in the future pursue accreditation for reductions or removals from any project activity under any another GHG program.

1.13.1. Registration with Other Registries

Confirm that the Project is not currently and will not in the future pursue registration under more than one registry.

1.13.2. Rejection from Other Registries

Confirm that the Project has not been rejected from another GHG program.

2. Additionality

Detail all the reasons the project achieves additionality. Confirm that without the revenue from the sale of carbon credits the project would not be viable. A project activity is additional if it results in emission reductions or removals that are above and beyond what would have happened under the most plausible baseline scenario without the revenue or incentive provided by carbon credits.

2.1.1. SDG

List all the United Nations Sustainable Development Goals that apply to the Project.

2.1.2. Investment Analysis

Outline the annual operating and start up costs to be incurred to implement the project. Provide a detailed 3-year budget.

3. Stakeholder Consultation

3.1. Demonstration of Stakeholder Engagement

Detail the process that:

3.1.1. Identifies the project stakeholders.

3.1.2. Lists the meeting with stakeholders including the minutes of the meetings and who attended the meetings.

3.1.3. Ensures ongoing communication with identified stakeholders.

3.2. Identification of Risks to Stakeholders

Provide an overview of the way in which risks were presented to stakeholders (written or verbal, etc.) and provide an outline of what risks were identified and the mitigation action assigned to the risks.

3.3. Identification of Benefit Sharing with Stakeholders

Provide an overview of the way in which benefit sharing was presented to stakeholders and provide documentation of either the benefit sharing percentage or the calculation formula that was agreed to and signed off by the Community Leaders.

3.4. Stakeholder Impact Monitoring Plan

Describe the proposed ongoing communication and monitoring plan to ensure risks are continuously being mitigated and the identified stakeholders are receiving their benefits as agreed. Also, outline how new stakeholders will be identified when changes occur.

The monitoring plan must cover systematic, rigorous, and ongoing process of data collection, analysis, and reporting to accurately quantify carbon sequestration/removals, verify project performance against the baseline, detect risks (e.g., reversals like tree mortality or disturbances), and ensure compliance with standards. It must go beyond basic oversight to include thorough, evidence-based practices that withstand independent third-party verification and support credible carbon credit issuance.

4. Application of Methodology

4.1. Reference Methodologies

List any other methodologies (excluding AR040101) that apply to the project and insert the methodologies into the table below:

Methodology/ Module/Tool	Applicability Condition	Project's Satisfaction of Applicability Condition

4.2. Project Boundary

Requirements:

- Map of area (digital format)

- Geographic coordinates of each polygon vertex.

4.3. Baseline Scenario

The baseline for the Project must reflect the land use and land composition prior to intervention by project developers. A historical analysis of at least 10 years prior to the project start date to outline the level of degradation in the area over time before the implementation of the Project design must be supplied here.

4.4. Carbon Pools

Carbon Pools need to be selected and detailed, the following pools must be included:

- Aboveground tree biomass
- Belowground tree biomass
- Aboveground non-tree biomass
- Belowground non-tree biomass (Optional)
- Soil Organic Carbon (Optional)

4.5. Quantification of Emission Reductions

The project proponent must present conservative ex ante estimations of the project activity's total net GHG emissions reductions.

Refer to the relevant accounting modules and the parameter tables within these modules for instructions on ex ante estimations of specific parameters.

The potential number of Verified Carbon Units (VCUs) for the monitoring period *t* is estimated as follows:

VCUt = Number of potential Verified Carbon Credits at year t=t2-t1(VCU)

Where:
VCUt = Number of potential Verified Carbon Units at year $t = t2 - t1$ (VCU)
VCUAUDef = Number of potential Verified Carbon Units from unplanned deforestation at year $t = t2 - t1$ (VCU)
VCUAPDef = Number of potential Verified Carbon Units from planned deforestation at year $t = t2 - t1$ (VCU)

4.6. Baseline Design

The baseline calculations can be a desk study of relevant project documents and satellite imagery conducted using information provided by the project developers.

Notwithstanding other rules and requirements, the most plausible baseline scenario described in this section must at minimum be consistent with and referred to when:

- Describing the conditions prior to project initiation.
- Identifying the stakeholders to be engaged and consulted.
- Selecting carbon pools and estimating the post-deforestation carbon stocks
- Assessing and quantifying the risk of leakage:
- Estimating ex ante project effectiveness at reducing deforestation.
- Creating the Forest Stratification Map

The analysis of the data should include the following:

• **Topography**: Showing the elevation in meters.

• **Contour:** A contour line is a line drawn on a topographic map to indicate ground elevation or depression. A contour interval is the vertical distance or difference in elevation between contour lines.

• **Slope:** is the measure of steepness or the degree of inclination of a feature relative to the horizontal plane

•**Hydrology:** hydrologic characteristics and tools to calculate flow across an elevation surface, calculate flow path length, and assign stream orders. Additionally, the watershed will be created. A watershed is a region draining into a river, river system, or body of water.

Below are the steps required for a viable baseline calculation:

Step 1: Define Project Scope and Boundaries

- Procedure: Delineate the project area, reference jurisdiction (e.g., national or subnational unit like North-Western Province in Zambia), and leakage belt. Use GIS tools (e.g., QGIS, ArcGIS) to map boundaries with coordinates, ensuring the area qualifies as forest (≥10 years pre-project per FAO/IPCC definitions).
- Integration of Drivers: Collect spatial data layers for drivers, including topography (elevation from SRTM DEM), slope (derived from DEM, e.g., >15% reduces suitability), and hydrology (proximity to rivers/water bodies via Euclidean distance, as they facilitate access/agriculture).
- Quantifiable Standard: Project area must be ≥90% forested at start; exclude non-qualifying lands (e.g., wetlands unless approved).

Step 2: Develop Forest Stratification Map

- Procedure: Create a stratified map to account for varying carbon stocks, informing emission factors.
    - Collect multi-temporal satellite imagery (e.g., Landsat 8/9, Sentinel-2, resolution ≤30m) for at least two dates (historical benchmark + current).

- Use supervised classification (e.g., Random Forest or Maximum Likelihood in Google Earth Engine) to define strata based on forest types (e.g., dense, degraded) and carbon classes (e.g., high: >150 tC/ha).
- Incorporate drivers: Overlay topography, slope, and hydrology to refine classes (e.g., steep slopes as low-carbon degraded strata).
- Validate: Field plots (≥30 per stratum) for biomass (using Chave allometric equations); achieve ≥85% accuracy via confusion matrix and stratified random sampling.

- Explicit Formula for Carbon Stocks: Average emission factor per stratum =

$\sum(C_{ab} + C_{bb} + C_{dw} + C_{li} + C_{soc}) \times 44/12$\sum (C_{ab} + C_{bb} + C_{dw} + C_{li} + C_{soc}) \times 44/12

, where

C_{ab}C_{ab}

= aboveground biomass,

C_{bb}C_{bb}

= belowground, etc. (tC/ha), converted to tCO_2e/ha (IPCC 2006/2019 guidelines).

- Output: Raster map with strata; used for baseline emissions as

$E_{baseline} = \sum(A_{def,str} \times EF_{str})$E_{baseline} = \sum (A_{def,str} \times EF_{str})

, where

$A_{def,str}$A_{def,str}

= deforested area per stratum,

EF_{str}EF_{str}

= emission factor.

- Technical Robustness: Machine learning for classification enhances accuracy; deduct uncertainty if >10%.

Step 3: Calculate Historical Average Deforestation Rate

- Procedure: Establish the 10-year historical reference period (HRP, ending ≤2 years before project start) using consistent land-cover data.
    - Source data: Satellite-based forest change datasets (e.g., Hansen Global Forest Change, GLAD alerts) or jurisdictional benchmarks from Verra Data Service Providers (DSPs).
    - Calculate average annual unplanned deforestation (AD, ha/year) in the jurisdiction: Sample-based interpretation (not wall-to-wall) for statistical robustness (>90% accuracy).
- Explicit Formula: Historical average AD =

$\frac{1}{10}\sum_{y=1}^{10} A_{def,y}$\frac{1}{10} \sum_{y=1}^{10} A_{def,y}

, where

$A_{def,y}$A_{def,y}

= deforested area in year y (ha).

    - Project forward flatly (no trends) for conservatism over the baseline validity period (BVP, 6-10 years).

- Role of Drivers: Historical data informs driver analysis but not directly the average; used in Step 4 for allocation.

Step 4: Develop Risk Map for Deforestation Probability

- Procedure: Create a spatially explicit risk map to quantify and allocate deforestation risk.
    - Definition: Pixel-based probability (0-1) or relative score of deforestation under BAU.
    - Data Required: Historical deforestation locations (binary maps from HRP); driver layers including accessibility (distance to roads/settlements/markets, cost-distance models), biophysical (slope, elevation, soil fertility from WorldClim/SoilGrids), hydrology (distance to water bodies), socioeconomic (population density, land tenure from global datasets like WDPA for protected areas).
    - Quantification Method: Use multivariate statistical or machine learning models trained on historical data.
        - Preferred: Logistic regression (binomial: dependent = deforested vs. non-deforested points, sampled randomly).
        - Alternative: Random Forest, MaxEnt, or Gradient Boosting for complex interactions.
        - Role of Topography/Slope/Hydrology: Negative weights for steep slopes (>30%) or high elevations (reduce accessibility); positive for proximity to hydrology (e.g., <5km to rivers increases risk by factor of 1.5-2 in models).
        - Validation: AUC >0.8; figure of merit for spatial accuracy; sensitivity testing.

- Protocol for Stand-Alone Projects: In non-nested (project-level) contexts, use provisional/final risk maps (from DSPs); no custom maps for new projects to ensure consistency. Pay fee for allocation via VT0007.

- Explicit Formula for Risk: Probability per pixel =

$\frac{1}{1+e^{-(\beta_0+\beta_1 X_1+\dots+\beta_n X_n)}}$\frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \dots + \beta_n X_n)}}

(logistic), where

X_iX_i

= drivers (e.g.,

$X_{slope} = -0.05 \times slope\%$X_{slope} = -0.05 \times slope\%).

  - Relative risk = Normalized score across jurisdiction.

Step 5: Project Baseline Deforestation and Emissions

- Procedure: Allocate jurisdictional AD to the project area using the risk map.
  - Useful Tools: Inputs = jurisdictional AD, risk map, forest benchmark maps (FCBMs).
  - Allocate proportionally: Highest-risk pixels deforested first.
  - Statistical Projection: Flat historical average; deduct leakage/uncertainty.
  - Explicit Formula for Allocated Baseline: Project AD =

$AD_{juris} \times \frac{Risk_{project}}{Risk_{total}}$AD_{juris} \times \frac{Risk_{project}}{Risk_{total}}

, where

$Risk_{project}$Risk_{project}

= sum of pixel risks in project area.

- Baseline emissions (tCO_2e/year) = Project AD × Average EF (from stratification).

Step 6: Validate, Monitor, and Reassess

- Procedure: Third-party audit for registration; monitor deforestation annually (e.g., remote sensing); reassess baseline at end of BVP or if major changes (e.g., policy shifts).
- Quantifiable Standard: Deduct ≥20% buffer for non-permanence risk (VCS AFOLU Tool); ensure net ERRs >0.

$ERR_t = E_{baseline,t} - E_{project,t} - L_t$ERR_t = E_{baseline,t} - E_{project,t} - L_t

, where

L_tL_t

= leakage.

4.7. Required Level of Conservatism for Ex-Ante Estimates of Total Net GHG Emission Reductions/Removals in ARR Projects

Parameter Selection:

- Choose the lowest plausible values for parameters increasing removals (e.g., growth rates, survival rates) and highest plausible values for those decreasing net removals (e.g., project emissions from fertilizer, leakage).

- For example, conservative allometric equations or defaults (e.g., lower biomass accumulation) are selected if multiple options exist.

Uncertainty Deductions:

- Quantify sampling/measurement uncertainty (e.g., from plot data).
- Apply confidence deductions where uncertainty in key parameters (e.g., carbon stocks, growth models) exceeds thresholds:
    - If uncertainty >10% of the mean estimate, methodologies require procedures for deductions (often tiered, e.g., 15–30% deduction based on confidence interval width).

- Set uncertainty to zero for conservative parameters (e.g., emissions from burning/fertilizer).

Baseline and Leakage:

- Use dynamic performance benchmarks (jurisdictional/regional growth data) conservatively ex-ante assumes lower project outperformance if uncertain.
- Leakage: For area-based approaches, census-based often assumes zero (conservative if no displacement).

Pool/Source Exclusion:

- Pools/sources may be excluded only if it leads to conservative (lower) net removals (e.g., omitting positive SOC changes).

Ex-ante estimates are replaced by ex-post (actual monitored) data in verification reports for credit issuance, further ensuring no over-crediting. Non-permanence risk is separately addressed via buffer pool contributions (10–40% withholding, based on AFOLU Non-Permanence Risk Tool). This approach ensures high-integrity removals. For project-specific application, parameters must be justified in the PDD as conservative during validation. Consult the full methodology PDF for equations and tools.

Please indicate the project type from the list below in your PDD:

Project Types:

- **Stand-alone project (avoided unplanned deforestation)**

10-year historical average and a risk map.

- **Jurisdictional/nested project**

Adopt national/subnational FREL or use a historical average

- **High Forest Low Deforestation (HFLD) jurisdiction**

ART-TREES with crediting-level adjustment or forward-looking adjustment

- **Avoided planned deforestation**

Legally authorized plans

5. Additional Project Net Positive Impacts

Itemise the implemented or proposed initiatives that have or will yield significant positive impacts on both the environment and local communities.

5.1. Monitoring Plan

Detail the monitoring plans objectives and ensure that the following points are covered: (See section 3.4)

- Ensure accuracy in quantifying greenhouse gas (GHG) emission reductions.
- Verify sustainable land management practices.
- Track biodiversity conservation and socio-economic benefits.
- Identify and mitigate potential leakage risks.

5.1.1. Monitoring Parameters

The following parameters must also be monitored:

- Forest Cover Change: Remote sensing and field surveys.
- Carbon Stock Changes: Biomass inventory measurements.
- Deforestation Drivers: Monitoring land-use practices.
- Leakage Monitoring: Land use changes in leakage belts.
- Community Engagement: Surveys on alternative livelihood adoption.

5.1.2. Data Collection Methods

Record your methods and processes in detail which can include the methods listed below which at a minimum must show:

Minimum Acceptable Standards for Biomass Inventory Measurements

- Biomass inventory must use non-destructive field measurements combined with allometric models, adhering to best practices for accuracy and repeatability.

Key Standards (Area-Based Approach):

- **Plot Design**: Fixed-area plots (size up to 10 ha for practicality), permanent or temporary but representative. Nested plots optional for different components (e.g., smaller subplots for non-woody).
- **Measurements:**

- Woody Biomass: Diameter at breast height (DBH) at 1.3 m (minimum threshold typically 5–10 cm, consistent across events), total height, species identification. Measure using callipers/tapes (precision ±0.1 cm for DBH, ±0.5 m height).
- Non-Woody Biomass (if included): Clip harvest from sample frames (e.g., 1x1 m), dry to constant weight at 70°C, or use dry:wet ratios.
- Dead Wood: Standing—measure DBH/height with decomposition class discounts; lying—line intersect sampling (Van Wagner 1968).
- Litter: Collect from fixed frames, dry at 70°C.
- Soil Organic Carbon (if included): Composite samples to ≥30 cm depth, measure bulk density and carbon content (e.g., dry combustion).

- **Remote Sensing & GIS Analysis:** Use of satellite imagery to monitor land cover and forest integrity.
- **Field Surveys & Biomass Inventory:** On-the-ground measurements for biomass and carbon stock estimation.
- **Community Surveys:** Structured interviews to assess livelihood changes and sustainable practice adoption.
- **Logbooks & Digital Records:** Forestry management data collected using mobile applications and databases.
- **Other**

Quality Assurance/Quality Control (QA/QC) Standards for Data Collection

Procedures:

- Develop SOPs for all measurements, handling, analysis (e.g., calibration of instruments, crew training).
- Field: Blind re-measurements (10–20% of plots by independent crew), hot/cold checks for consistency.
- Lab: Standardized methods (e.g., ISO-accredited labs for SOC), subsampling protocols.
- Data Management: Electronic entry with validation rules, version control; archiving ≥2 years post-crediting period.
- Remote Sensing (if used): Geo-registration accuracy, independent validation.
- General: Independent checks on results; documented evidence (photos, logs) for activities; third-party verification.

5.1.3 Monitoring Frequency

Detail the frequency intended which must be at least as often as below.

Intensity Calculation:

- Sufficient plots to ensure the half-width of the 90% confidence interval for total removals is ≤100% of mean ex-post CO_2 removals (eligibility threshold; aim much lower for credibility, e.g., ≤20–30%).
- Use standard formulas (e.g., Cochran 1977 for sample size):

  $n = \frac{t^2 \times CV^2}{E^2}$n = \frac{t^2 \times CV^2}{E^2}

  where CV = coefficient of variation, E = allowable error).

- Double/two-phase sampling allowed (e.g., remote sensing for auxiliary data like stocking index, subsample for biomass).
- Distribution: Evenly across strata/project instances; for census-based, representative subsample from total planting units (N).
- Practical Guidance: Often 20–50+ plots for large projects, adjusted iteratively based on preliminary variability. Uncertainty deducted conservatively if high.

Parameter	Frequency
Forest Cover Change	Annually

Biomass & Carbon Stock	Every 5 years
Deforestation Drivers	Annually
Leakage Assessment	Annually
Soil Carbon Sequestration	Every 3 years
Adoption of Sustainable Practices	Annually

6. Conclusion

This methodology forms the basis of your PDD (Project Design Document). Project developers should also include as much other information available to ensure that PDD is accepted by a third-party VVB.

Project Developers should also ensure that they observe the framework of the Assidium Registry's Programme and Protocols. (Available at www.assidiumregistry.com)

7. Acronyms

AD Activity data GHG Greenhouse gas

JNR Jurisdictional and Nested REDD+

SOP Standard operating procedure(s)

UDef Unplanned deforestation

ART TREES Architecture for REDD+ Transactions

FREL Forestry Reference Emission Level

GIS Geographic Information Systems

PDD Project Design Document

VCU Verified Carbon Unit

8. References

8.1. **ICVCM Core Carbon Principles**

8.2. **IPCC (2003). Good Practice Guidance for Land Use, Land Use Change and Forestry. Institute for Global Environmental Strategies (IGES).**

8.3. **IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Institute for Global Environmental Strategies (IGES).**

8.4. **IPCC (2019). 2019 Refinement to the 2006 IPCC Guidelines on National Greenhouse Gas Inventories. Institute for Global Environmental Strategies (IGES).**

8.5. **Baccini, A, Goetz, S.J., Walker, W.S, N. T. Laporte, N.T, Sun,M, Sulla-Menashe, D, Hackler, J, Beck, P.S.A. Dubayah, R, Friedl, M.A, Samanta, S, and Houghton,R. A. (2012). Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps. Nature Climate Change, doi:10.1038/NCLIMATE1354**

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