



The Acorn Framework

***for Voluntary, Ex-Post, Agroforestry
Carbon Removal Units***

Version 1.0 - September 2021



Growing
a better world
together.

Rabobank

Acorn

*Agroforestry **CRUs** for the **Organic** Restoration of **Nature***

Carbon
Removal
Units



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1. Introduction

Acorn – Agroforestry CRUs for the Organic Restoration of Nature – is an agroforestry program that unlocks the international voluntary carbon market for smallholder farmers. Acorn’s mission is to combat climate change, land degradation and food insecurity with an inclusive agroforestry solution. This solution balances competing land use demands in a way that benefits both human well-being and the environment. This means land use that has a positive impact on food supply and livelihoods, the economy, environmental restoration, climate targets and development goals.

1.1. The Acorn program

To do this, Acorn has built a global, transparent and technology-enabled marketplace for carbon sequestration. This marketplace provides entry to the international carbon market for smallholder farmers who are realizing agroforestry projects for carbon sequestration through biomass growth, predominantly through trees, which is measured with the help of satellite monitoring. Acorn supports the initiation and development of these agroforestry projects and facilitates the subsequent trade of the so-called carbon removal units (CRUs) that are generated from the sequestered carbon. As such, the program:

- is accessible for smallholder farmers on a large scale
- ensures suitable agroforestry systems which capture sufficient carbon and provide decent income to smallholder farmers
- embraces innovative technologies
- encourages the sale of ex-post carbon removal units

In the coming years, Acorn will support hundreds of projects, helping individual smallholder farmers make the switch to agroforestry by compensating them for their contribution to our world’s ecosystem. By 2025, Acorn aims to support millions of such farmers. To do this, Acorn is partnering with dozens of local organizations around the globe: NGOs, farmers’ co-ops, trading companies, big processors (e.g. coffee, cocoa), governments, funds and more.

1.2. The agroforestry concept

Agroforestry is the intentional combination of agriculture with forestry, such as planting trees and bushes on pastureland. This traditional farming principle offers farmers significant ecological and economic benefits, including improved soil fertility, crop protection from wind damage and increased yields.

In developing economies, agricultural value chains often suffer from inefficiencies and low yields, and are disproportionately sensitive to climate change. These conditions affect some five hundred million smallholder farmers around the world. As a significant part the world’s food is produced by smallholder farmers, the role they play is a vital one^{1,2}. Agroforestry can help these farmers overcome some of the challenges they face in their work to support our world’s food security.

¹ [Story, et al., 2016](#)

² [Lowder, et al., 2021](#)

Three agroforestry systems can be distinguished³:

- Agrisilvicultural systems entail a mix of crops and trees, such as shade systems (like coffee with citrus trees) or border planting.
- Silvopastoral systems combine trees and animals, such as cattle grazing in coconut groves.
- Agrosilvopastoral systems integrate all three: trees, crops and animals, such as home gardens involving animals or woody hedges grown for fodder.

1.3. Carbon sequestration with Acorn

A core principle of the Acorn program is the trade of CRUs based on actual sequestration, in other words on already realized, ex-post carbon sequestration rather than credits based on sequestration that is expected to occur in the future (i.e. ex-ante credits).

At Acorn, carbon sequestration is calculated by measuring aboveground biomass (AGB). This value is multiplied by a factor to include belowground biomass (BGB). Together, AGB and BGB represent approximately two-thirds of the sequestered biomass, and soil roughly represents one-third of the carbon sequestration potential^{4,5}. The latter is not included in Acorn's calculations for conservativeness (see Figure 1).

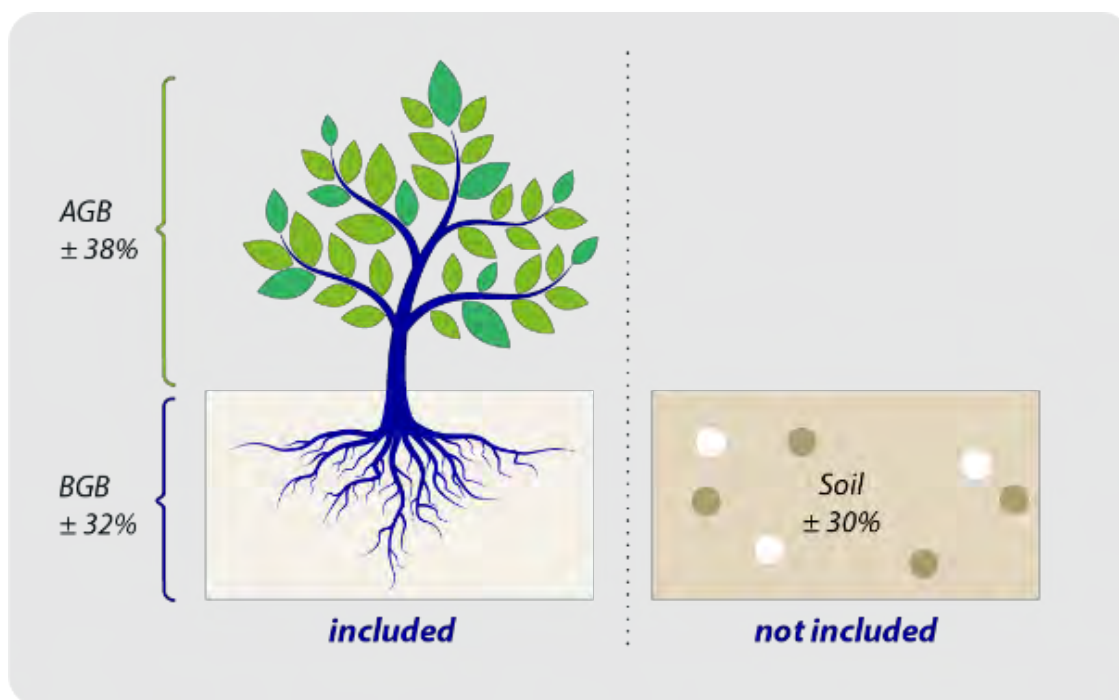


Figure 1. Schematic overview of carbon sequestration values for agroforestry

Acorn's carbon sequestration framework is specifically tailored to the needs and economics of the smallholder farmer, working from the bottom-up to support their role in our global food supply. The Framework supports farmers in improving soil and crop health, building resilience to climate change and weather events, increasing yields, and diversifying their income. The Framework also

³ [FAO, 2015](#)

⁴ [Kim, Kirschbaum, & Beedy, 2016](#)

⁵ [Ravindranath & Ostwald, 2008](#)

works to keep the costs of carbon sequestration and carbon market participation low. For the farmer, the increased annual income from both agricultural production and carbon sequestration needs to exceed the costs associated with the transition to agroforestry and the generation and trading of CRUs. Through scale, Acorn aims to limit the costs of CRU monitoring and certification. Accurate satellite monitoring technologies, including satellite imagery, and a transparent measurement methodology are crucial to the economic viability of the Acorn program. The sales of CRUs provide smallholders with a more sustainable and diverse source of income throughout the year and an income that is not necessarily limited to crop seasonality only. This additional source of income is necessary for smallholder farmers to rapidly adopt more sustainable farming techniques, enabling them to become more climate resilient and contribute to a healthier ecosystem.

1.4. The purpose and scope of this document

Acorn aims to give smallholder farmers cost-efficient access to international carbon markets and enable them to transition to agroforestry at scale. To do this, Acorn has laid out a robust Framework that ensures a scalable and accessible approach to carbon certification, which is complemented by the Methodology. "The Acorn Framework for Voluntary, Ex-Post, Agroforestry Carbon Removal Units", hereafter referred to as the Framework, articulates Acorn's requirements for participating projects and describes the processes and methodologies it applies for its carbon quantification measurements. The "Methodology for Quantifying Carbon Benefits from Small-Scale Agroforestry", hereafter referred to as the Methodology, presents the procedures, models and calculations that ensure that the Acorn program applies to quantify its carbon benefits.

As illustrated in Figure 2, this document serves as a guide for local partners (A), remote sensing partners (B), verifiers, validators and certifiers (C), purchasers (D) and others interested in understanding the process of Acorn's CRU origination to validate its quality, transparency and credibility.

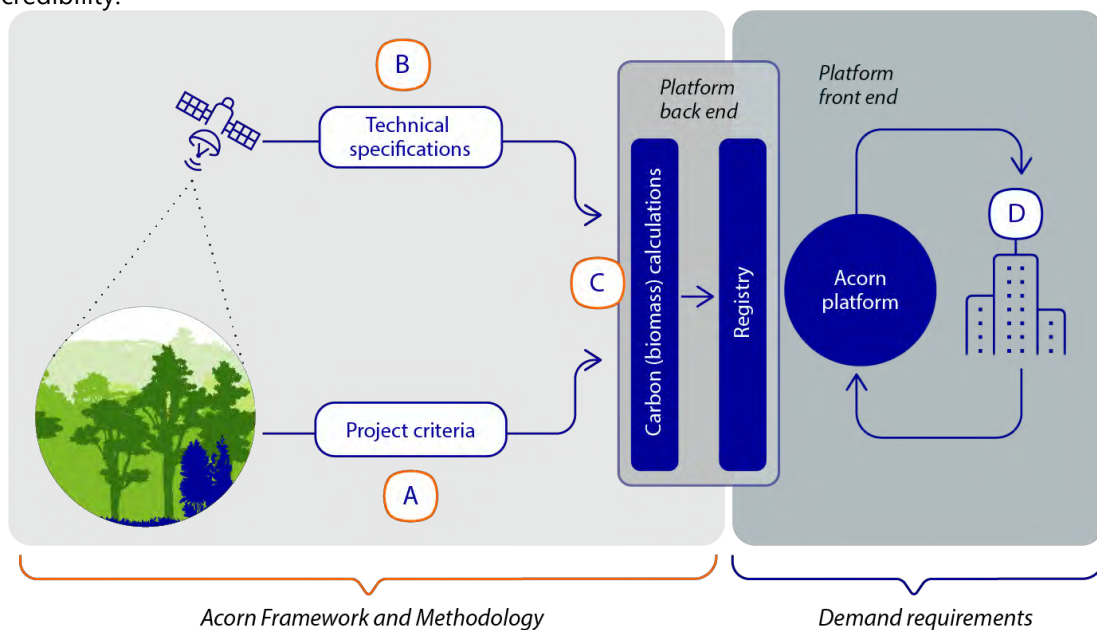


Figure 2. The Acorn program (the scope of this document)

By publishing this Framework for agroforestry projects at the smallholder level, Acorn aims to stimulate substantive dialogue and knowledge exchange towards a highly trustworthy and more accessible carbon removal market. Acorn also hopes to contribute to accelerating the development of market standards that incorporate cutting-edge technology solutions for measurement accuracy – building a carbon removal market that is consistent and recognizable for all stakeholders.

In the Framework, the following terminology is used to assess compliance. This terminology corresponds with international standards that are applied by the International Carbon Reduction and Offset Alliance.

- **Shall** indicates a requirement must be strictly followed in order to conform to the Framework.
- **Should** indicates a certain course of action is preferred but not strictly required.
- **May** indicates a certain course of action is permissible.
- **Can** indicates a possible or suitable situation that is actual or conceivable.

2. Governance

The governance structure is built around several groups of stakeholders. The supply side of the proposition consists of local communities and individual smallholder farmers who are connected to one of Acorn’s local partners in its intermediary network. Local partners could be NGOs, farmers’ co-ops, trading companies or corporations. To join the network, they must outline a clear implementation and monitoring plan that ensures solid agroforestry systems at farm level. As Acorn’s on-site representatives, they play an important role as Acorn’s field advocates, responsible for active farmer engagement, farmer (platform) registration and data collection, and together with the farmers are key stakeholders in ensuring sustainable implementation⁶. One way to enhance smallholder farmer capacities is to equip them with the requisite knowledge to participate in the Acorn program. Acorn therefore provides smallholder farmers with the possibility to represent and amplify their voices through project councils, where they can be actively involved in project design and decision-making.

For monitoring and measurement, Acorn cooperates with a technical network of remote sensing partners (RSPs) that specialize in vegetation monitoring, machine learning, and biomass and carbon stock estimation. Together with these partners, Acorn is developing algorithms to measure biomass growth in a scalable and iterative manner.

To ensure high-quality and credible CRUs, Acorn closely collaborates with the Plan Vivo Foundation, agroforestry scientists and other (market) experts. Together, they form Acorn’s Standards Committee, a sounding board which supports Acorn’s proposition by sharing comprehensive market knowledge and advice.

Acorn also interacts with the demand side of the carbon market, encouraging corporations to offset their emissions through Acorn’s platform, which provides traceability and transparency throughout the supply chain.

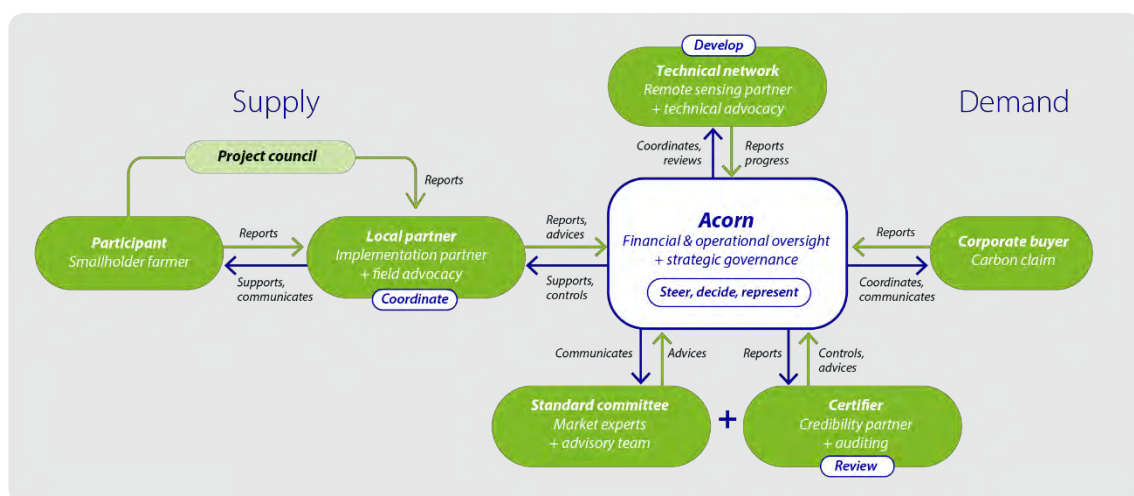


Figure 3. Governance

⁶ [Di Sacco & Hardwick, 2021](#)

3. Principles, contribution to SDGs, and KPIs

Acorn strives to contribute to the global Sustainability Development Goals (SDGs) and realize short-term as well as long-term benefits for individual smallholder farmers, local communities and society as a whole.

3.1 Principles

To realize its ambition, the Acorn Framework is based on ten guiding principles. These principles provide direction for Acorn stakeholders to ensure high-quality projects and CRUs. Further elaboration of these principles can be found in Section 4, where the requirements for each are detailed.

1. All Acorn projects meet the eligibility requirements and actively involve smallholder farmers in the transition to agroforestry to improve their livelihood and that of their community.
2. All of Acorn's local partners have clear responsibilities and are compliant with international and national legislation.
3. All Acorn CRUs are generated with integrity by additional and real project interventions.
4. All Acorn projects realize ex-post carbon sequestration, as well as demonstrable socioeconomic and environmental improvement compared to the baseline.
5. All Acorn CRUs are ex-post, science-based and data-driven in their quantification and measurement, and these are demonstrated to be accurate and verifiable.
6. All Acorn projects take mitigating actions for potential CO₂ emissions that are attributable to the project.
7. All Acorn CRUs are traceable, uniquely registered and accounted for.
8. All Acorn projects deliver CRUs that are based on durable sequestration and come with an appropriate durability period.
9. All Acorn projects adopt robust solutions for reversal risk.
10. All data acquired by Acorn is handled with the highest level of integrity and with stakeholder consent.

3.2 Contribution to SDGs

In addition to carbon removal, Acorn also brings other ecosystem advantages. The project intervention, agroforestry, has the potential to contribute to 8 of the UN's 17 Sustainable Development Goals (SDGs). The table below summarizes the SDGs to which the Acorn agroforestry program contributes. In Appendix 7.1, a more extensive overview of Acorn's contributions to the SDGs can be found.

SDG	Target⁷	Acorn contribution
1	End poverty in all its forms everywhere	Acorn contributes to and increases farmer income and makes farmers more resilient to market and environmental shocks
2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Acorn indirectly enriches the diet of rural populations in emerging economies. Acorn directly contributes to long-term soil health and combats desertification and erosion
6	Ensure available and sustainable management of water and sanitation for all	Acorn indirectly improves groundwater quality
8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Acorn incentivizes farmer productivity and employs innovative technologies for a scalable approach
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Acorn accelerates innovative and scalable climate-smart solutions
13	Take urgent action to combat climate change and its impacts	Acorn contributes to resilience to climate change effects and the availability of nature-based solutions, allowing corporations to claim and report ecosystem impacts results.
15	Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Acorn combats desertification and enhances biodiversity
17	Strengthen the means of implementation and revitalize the global partnership for sustainable development	Acorn provides additional financial resources for agroforestry projects and program participants


Table 1. SDG contributions

⁷ [United Nations, n.d.](#)


3.3 KPIs

For progress monitoring purposes, the following KPIs are defined and visualized in the table below (see Table 2). To maintain simplicity in the Acorn Framework, only a few impact indicators are defined and monitored.


Acorn: Agroforestry CRUs for the Organic Restoration of Nature



**Local
livelihood**



**Carbon
storage**



**Environmental
improvement**

	Local livelihood	Carbon storage	Environmental improvement
KPIs	Farmer income [CRU revenues] Nutritional variety [food group count]	CO ₂ sequestered [metric ton CO ₂ eq]	Agricultural biodiversity [Gini–Simpson index]
Methodology	Score and weights survey	Acorn Methodology	Score and weights survey
# farmers tested	Sample based	All program participants	Sample based

Table 2. Acorn's KPIs to monitor the program's impact

4. Requirements

While the guiding principles represent Acorn's values, there are a number of specific requirements and conditions that support these principles. These requirements relate to eligibility, responsibilities, additionality, the baseline, carbon quantification, leakage, double counting, durability, the buffer pool and data integrity. They set out clear guidelines to which projects and the associated CRUs must adhere.

4.1 Eligibility

Any and all tree planting activities are not necessarily eligible for the Acorn program. In order to preserve the integrity of the program, Acorn conducts a diligent project selection process.

All carbon standard systems set out specific eligibility criteria to identify the kinds of projects that can be certified. These systems tend to apply "base standards" that focus solely on the quantification of emissions reductions and which exclude additional criteria for social, economic and environmental impact. Acorn, however, applies "quality standards" which do include such additional benefits in the quantification of carbon emissions reduction. Therefore, Acorn sees eligibility as a collective term that refers to an accumulation of conditions, including social ecosystem impact and assessment of potential adverse impacts, that determine which projects and partners can be registered for the Acorn CRUs.

Principle 1: All Acorn projects meet the eligibility requirements and actively involve smallholder farmers in the transition to agroforestry to improve their livelihood and that of their community.

Eligible land

- 4.1.1 Acorn projects shall only be pursued in countries without any formal legislative carbon restrictions that prevent the participant-ownership and trading of carbon sequestration generated on smallholder land from agroforestry activities.
- 4.1.2 Acorn projects can provide evidence of land cover over the past five years from the project start date to prevent potential perverse incentives for tree planting⁸. Evidence can be provided using satellite monitoring plot imagery or other forms of proof (e.g. oral or documented) that demonstrate that the land was not cleared prior to the project intervention with the intention to claim CRUs⁹.

Eligible project interventions

- 4.1.3 Acorn projects should emphasize agroforestry practices that include a food and/or medicinal component, whether agrisilvicultural, silvopastoral or agrosilvopastoral. See Appendix 7.2 for an agroforestry analysis.
- 4.1.4 Acorn projects should contribute to the enhancement and/or restoration of degraded, damaged or destroyed land, and improve land use activities.

⁸ [Ebeling & Vallejo, 2011](#)

⁹ [Merger & Williams, 2008](#)

- 4.1.5 Acorn projects should strive to not contribute, or to do their utmost to avoid, environmental or (agricultural) biodiversity harm (e.g. reduction of long-term food security, water pollution, deforestation, soil erosion). All potential negative effects are identified, mitigated and monitored. These negative effects are detailed in annual reports to Acorn and the certifier.
- 4.1.6 Acorn projects should demonstrate that the project intervention increases, or at least does not detriment, the impact KPIs which measure project performance on social, economic and environmental benefits, and that the KPIs are measured over a period that is of sufficient length to provide an adequate representation of the long-term impact of the project intervention.
- 4.1.7 Acorn projects should plant tree species that are native or naturalized, and draw on local and expert knowledge for agroforestry designs. Naturalized species will only be integrated into the design if:
- a. There are livelihood benefits that make the use of the species preferable to any alternative native species.
 - b. The use of the species will not have a negative impact on biodiversity or other provision of key ecosystem services in the project and surrounding areas.

4.2 Responsibilities

Principle 2: All of Acorn's local partners have clear responsibilities and are compliant with international and national legislation.

Smallholder farmer

- 4.2.1 Acorn projects shall exclusively emphasize agroforestry practices at the smallholder or community level, where clear land tenure has been agreed upon and understood by the individual(s) involved, either by means of formal titling, informal titling and/or land mapping.
- 4.2.2 Acorn projects shall involve individual farmers ("participants") with up to ten hectares (ha) of cultivated land to guarantee Acorn's emphasis on smallholder farmers alone.
- 4.2.3 Acorn projects shall have a defined project council governance structure at the start of a project intervention, in which participants or community groups collectively, (i) nominate project representatives who have the capacity to operate on their behalf, and (ii) determine a decision-making mechanism for the project council. At a minimum, project councils should be organized twice per year.
- 4.2.4 Acorn projects shall not exclude participants on the basis of gender, age, income or social status, ethnicity or religion, or any other discriminatory basis, and shall onboard participants in chronological order of registration.
- 4.2.5 Acorn projects shall not employ workers below the ILO minimal age convention on child labor¹⁰.
- 4.2.6 Acorn projects should strive not harm or negatively influence local communities (e.g. reinforce gender inequalities). Where negative socioeconomic impacts are identified, these will be reported, mitigated and monitored to Acorn and the certifier.

¹⁰ [*International Labour Organization, n.d.*](#)

Local partner

- 4.2.7 The local partner is a legal entity, whether NGO, local co-op or trader, that shall take responsibility for on-the-ground practices and adherence to the Acorn Framework throughout the duration of the project.
- 4.2.8 The local partner's responsibilities shall be governed by a formal Partnership Agreement ("Partnership Agreement for the Trade in Carbon Removal Units") signed by Acorn and the local partner. See Appendix 7.3 for contract structure overview.
- 4.2.9 The local partner shall be known by Rabobank, pass a CDD conducted by Rabobank, meet the bank's sustainability requirements, and be onboarded by the Acorn program.
- 4.2.10 The local partner shall comply with GDPR or local data and privacy regulations. For more details on data integrity, see Section 4.10 and the Partnership Agreement.
- 4.2.11 The local partner shall provide a formal Participant Agreement ("Project Implementation and Carbon Removal Unit Purchase Agreement") for each project participant, including a consent for data sharing and confirmation of payment arrangements.
- 4.2.12 The local partner shall be responsible for annual and traceable carbon benefit payments to the participants, as detailed in the "Standard Terms to Project Implementation and Carbon Removal Unit Purchase". At least 80% or more of the proceeds from CRU sales should accrue to participants as either cash payments or individual in-kind contributions. See Appendix 7.4 for a list of in-kind contributions that may be used in Acorn projects and detail or cash payment criteria.
- 4.2.13 The local partner shall have a separate account or earmarked funds for the sole purpose of participant finance, separate to the local partner's operational finances.
- 4.2.14 The local partner should be aware of local, national and international laws and regulations, align project activities to comply accordingly, and integrate proper employment law.
- 4.2.15 The local partner should provide information in an applicable language and/or format that suits all participants and avoid discrimination of illiterate groups.
- 4.2.16 The local partner should provide a stakeholder map to identify key communities, organizations, and local and national authorities that are likely to be affected by or have a stake in the project. See Appendix 7.5 for a stakeholder map template. The local partner is responsible for taking appropriate steps to inform these stakeholders about the project and seek their views, and secure approval where necessary.
- 4.2.17 The local partner should coordinate and provide a business case, including a financial analysis, monitoring and implementation plan, at the start of the project.
- 4.2.18 The local partner should actively inform and involve participants about/in the decision-making process throughout the project, from design, to monitoring, to implementation, to field management, and to payments, by organizing regular project council meetings. Participants should actively contribute to the selection and design of activities, considering:
- a. Local livelihood needs and opportunities
 - b. Local customs
 - c. Land availability and tenure
 - d. Food security
 - e. Inclusion of marginalized groups
 - f. Opportunities to enhance (agricultural) biodiversity

- 4.2.19 The local partner shall be available to handle grievances and provide feedback mechanisms on the project design, in a transparent, fair and timely manner and should organize regular council meetings to provide participants and their local community with a setting in which they can raise any concerns or grievances about the project to the local partner.
- 4.2.20 The local partner should ensure that a proper grievance mechanism is developed, described in detail in the project documentation, communicated to the local communities and followed-up. A summary of grievances received, the manner in which these are dealt with and details of outstanding grievances shall be reported to an Acorn representative(s) within 35 working days. These grievance are detailed by Acorn in annual reports to the certifier.
- 4.2.21 The local partner shall be responsible for the secure storage of project information, including project designs, business case details, proof of payments, records of participant events and monitoring results.
- 4.2.22 The local partner shall follow the Acorn monitoring plan as outlined in the Methodology and contribute to on-the-ground data collection, validation, and verification activities while coordinating the support of participants and local communities on this monitoring plan.
- 4.2.23 The local partner should address and is expected to make efforts to provide equal opportunities to fill employment positions in the project for women and members of marginalized groups where job requirements are met or for roles where they can be cost-effectively trained.

Remote sensing partner (RSP)

- 4.2.24 The RSP's responsibilities shall be written in a formal "Remote Sensing Agreement" which is agreed upon by both the RSP and Acorn.
- 4.2.25 The RSP shall comply with GDPR regulations. For more details on data integrity, see Section 4.10.
- 4.2.26 The RSP shall provide the required input for the Acorn monitoring plan as outlined in the Methodology and contribute to data collection and validation.
- 4.2.27 The RSP shall provide the carbon estimates of the total AGB of an agroforestry project based on satellite information on an annual basis.
- 4.2.28 All RSPs should apply the same methodology for:
- I.) Performance indicators
 - II.) Minimal frequency of monitoring
 - III.) Duration of monitoring
 - IV.) Type of carbon pool
 - V.) Data collection method of inventory plots

See Section 5.1.1 for more details on the eligibility requirements and Appendix 7.6 for an overview of roles and responsibilities.

4.3 **Additionality**

An agroforestry project with Acorn is considered to be additional if the net greenhouse gas (GHG) sequestration benefits are greater than what would have occurred in the business-as-usual scenario, i.e., without the intervention of the project.

Given the evolution and further refinements of the existing additionality assessments observed in the voluntary carbon market and the inherent project characteristics of Acorn – smallholder involvement, agroforestry practices, and the sales of actual sequestration – this Framework further simplifies additionality for small-scale projects by using an Agroforestry Positive List similar to the Gold Standard AGR Positive List, version 2020¹¹. Where needed, further clarification can be provided by the Barrier Analysis corresponding with the Approved Approach for Additionality by Plan Vivo 2015¹². (Please note that the positive list can only be used as a standalone approach after a separate approval of the Plan Vivo Foundation on this list. Until then projects are expected to apply both approaches to help further build proof of applicability.)

Principle 3: All Acorn CRUs are generated with integrity by additional and real projects interventions.

- 4.3.1 Acorn projects shall demonstrate additionality at the start of the project intervention. Projects that wish to expand into a new country should reassess additionality prior to such expansion.
- 4.3.2 Acorn projects shall be additional, i.e. would not have been implemented without the additional revenues generated through the sale of CRUs. At minimum, the local partner shall demonstrate:
- a. Proof of regulatory surplus, meaning it is not required by any form of existing laws or regulations. Exceptions can be made for projects that support laws that are not enforced or commonly met in practice.
 - b. Compliance with the Agroforestry Positive List requirements OR robust proof of at least one barrier as defined in the Acorn Additionality Assessment (Section 5.2). Please note that the Agroforestry Positive List can only be used as a standalone approach after separate approval of the Plan Vivo Foundation. Until then, projects are expected to demonstrate adherence to both criteria to prove applicability.

4.4 **Baseline**

To quantify the actual carbon benefits of a project, estimating the carbon baseline is a crucial step at the start of each project. Only the changes in a carbon stock between $t=0$ and $t=n$ represents the additional carbon sequestered which is eligible for sale. In Acorn's ambition to generate high-quality CRUs, the project baseline is also measured, emphasizing the additional benefits that arise from agroforestry interventions.

¹¹ [The Gold Standard Foundation, 2013](#)

¹² [Plan Vivo Foundation, 2015](#)

Principle 4: All Acorn projects realize ex-post carbon sequestration, as well as demonstrable socioeconomic and environmental improvement compared to the baseline.

- 4.4.1 The local partner should describe the current land use and habitat species within a project area, and explain how these are most likely to change over a period of ten years without the project intervention.
- 4.4.2 As part of the carbon baseline, project areas should identify species with a high local environmental and social conservation value and describe how these species are likely to be affected by the project intervention, and how these effects are monitored. The conservation value of species can be determined by local Indigenous knowledge and/or by referring to the *IUCN red list*¹³ or the *Forest Stewardship Council*¹⁴.
- 4.4.3 At the start of a project intervention, the RSPs shall be responsible for the delivery of plot-level biomass measurements for the carbon baseline.
- 4.4.4 All land within the project area should be either cultivated land or degraded at the start of the project intervention (i.e. baseline).
- 4.4.5 No corrections are to be made for theoretical reductions of the carbon baseline (e.g. for avoided deforestation).
- 4.4.6 The annual delta of existing biomass over a ten-year period should be limited to <10%. All biomass present more than five years prior to the start of the project intervention is considered existing biomass.

Example

A given plot already includes a few trees. After the transition to agroforestry, the farmer has an increase in biomass from trees that are newly planted (C-A) and trees which were already there (A-B). The baseline for CRU calculation is B. As stated in requirement 4.4.6, the A-B share is excluded if older than five years.

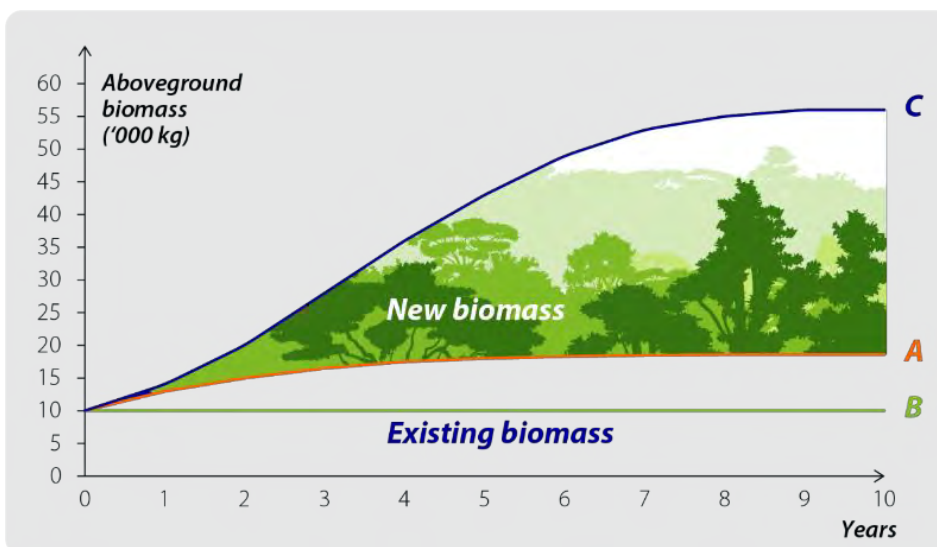


Figure 4. Example of a baseline calculation

¹³ [IUCN, 2021](#)

¹⁴ [Forest Stewardship Council, n.d.](#)

- 4.4.6. In addition to the carbon baseline, a project baseline should be provided by local partners on a project level at the start of a project intervention. This project baseline should describe the current socioeconomic conditions and explain how these conditions are most likely to develop over time (positively and/or negatively) as a result of the project intervention.
- 4.4.7. At least every three years, based on a random sampling, projects shall be verified on carbon and project contributions by an independent auditor.

See Section 5.3 for details on the carbon baseline assessment, and Section 5.4 for details on the project baseline assessment.

4.5 Carbon quantification

To ensure a proper and solid carbon quantification model, Acorn has developed the Methodology in conformance with Principle 5 and the related requirements for carbon quantification.

Principle 5: All Acorn CRUs are ex-post, science-based and data-driven in their quantification and measurement, and these are demonstrated to be accurate and verifiable.

- 4.5.1 All Acorn CRUs shall be generated based on the applicability conditions addressed in the Methodology. See appendix 7.7 for the related responsibilities of the local partner.
- 4.5.2 All Acorn CRUs shall incorporate AGB and BGB. In this version of the Framework, soil is excluded for conservativeness (see Figure 1).
- 4.5.3 All Acorn projects should be monitored by satellite monitoring technologies to calculate the available CRUs per plot per year according the Methodology.
- 4.5.4 All Acorn CRUs shall be adjusted, if required, for uncertainty in the AGB estimates derived from the carbon model. Acorn aims for conservative estimates that take model error and sampling error into account. Further details can be found in the Methodology.
- 4.5.5 Acorn shall check the accuracy of the satellite measurements on a sample basis every year, and satellite measurements shall be verified every three years by an independent and qualified verification body.

4.6 Leakage

Leakage refers to the loss of carbon storage, primarily as woody biomass, in non-project areas caused by shifting land use activities in the project area or by market forces. Leakage emissions in agricultural projects can be considered zero if the project intervention does not lead to a reduction in livestock grazing or a reduction in agricultural production within the project area¹⁵.

In general, agroforestry emits lower levels of CO₂ and requires less fertilizer, energy and water, compared to more intensive agricultural practices, meaning that a switch to agroforestry will have a positive environmental impact¹⁶. Along with the land cover requirements for project areas

¹⁵ [UNFCCC, 2013](#)

¹⁶ [Platis, et al., 2019](#)

(cropland or degraded land)¹⁷, Acorn deems it reasonable to assume that the risk of leakage in its projects is negligible to non-existent¹⁸. Nevertheless, to diminish or avoid any negative forms of leakage, the below requirement should be applied to Acorn projects.

Principle 6: All Acorn projects take mitigating actions for potential CO₂ emissions that are attributable to the project.

- 4.6.1 All Acorn projects should identify potential sources of negative leakages and the location(s) where this leakage may occur. See the leakage assessment in Section 5.5.
- 4.6.2 Where leakage is likely to be significant, a specific leakage mitigation and monitoring plan should be established and a conservative adjustment factor should be applied to the CRU calculations according to the Methodology.

4.7 Double counting

Although Article 6 of the Paris Agreement is very explicit that double counting should be avoided, this topic is approached differently by each market, and double counting risks inevitably arise¹⁹. Acorn echoes the German Environment Agency²⁰ with project designs that are truly additional and do not discourage local governments from increasing their climate mitigation efforts. Rather, Acorn aims to support local governments' own efforts by demonstrating positive social and economic impact through a clear double counting policy.

Principle 7: All Acorn CRUs are traceable, uniquely registered and accounted for.

- 4.7.1 In order to prevent double counting, issuance, use or claim of project emissions reductions, all CRUs shall be registered in a public register with a unique serial number, highlighting when (year), where (country, GPS coordinates) and by whom (local partner) the CRUs were generated.
- 4.7.2 An Acorn project shall not be incorporated by any other accounting program (e.g. compliance, voluntary or national GHG program) unless upon Acorn approval and with official agreement that demonstrates that no double counting is taking place.

4.8 Durability

Commonly used in current market standards is the concept of permanence. Considering Acorn's inherent characteristics, permanence will be difficult to guarantee. Crops and trees are part of the Earth's natural carbon cycle, and therefore, by definition, carbon storage is not permanent²¹. For carbon removal, Acorn thus refers to the concept of durability. Durability is defined as the twenty-year retention of the level of sequestered CO₂ that was sold as a CRU²².

¹⁷ [Schwarze, et al., 2002](#)

¹⁸ [Roshetko, et al., 2002](#)

¹⁹ [Verra, 2020](#)

²⁰ [Fearneough, et al., 2020](#)

²¹ [Roshetko, et al., 2002](#)

²² [Watson, et al., 2000](#)

Principle 9: All Acorn projects adopt robust solutions for reversal risk.

- 4.9.1 Acorn projects shall supply 15% of generated CRUs to the buffer pool for the duration of the project to cover unforeseen premature loss of carbon stock.
- 4.9.2 Acorn projects should review their reversal risks by making use of the reversal risk assessment (see Appendix 7.8), and high-risk areas should be mitigated with appropriate actions and be monitored closely. At least every five years, local partners should reevaluate their reversal risks and report this to Acorn, who again submits this to the certifier for oversight.
- 4.9.3 Every two to five years, the buffer pool percentages should be assessed on coverage ratio and adjusted accordingly.
- 4.9.4 If premature reversal is not recovered within five years, BCRUs should be provided from the buffer pool.

Example of durability and buffer pool scenarios (for illustrative purposes only)

1. Only positive growth in absolute biomass results in the generation of CRUs. For example, year 4 (2022) to year 5 (2023) has an absolute growth of 1 metric ton CO₂eq, equaling 1 CRU, and resulting in the 4th CRU of this project area.
2. If in year 7 (2025) a total biomass of 8 metric tons CO₂eq is measured, in year 8 (2026) a decrease of 2 metric tons CO₂eq, and in year 9 (2027) an increase of 1 metric ton CO₂eq, this means a total biomass of 7 metric tons CO₂eq and no additional CRU generated in this period. A new CRU will only be generated in year 11 (2029), when the metric tons CO₂eq exceeds the highest previous measurement, or 8 metric tons CO₂eq.
3. If the decrease of 2 metric tons CO₂eq is restored within 5 years, no BCRUs are cancelled.
4. If the absolute value of existing biomass is below the absolute value of the related CRU, and if it does not recover within 5 years, the CRU is considered reversed and BCRUs are cancelled to ensure climate integrity.

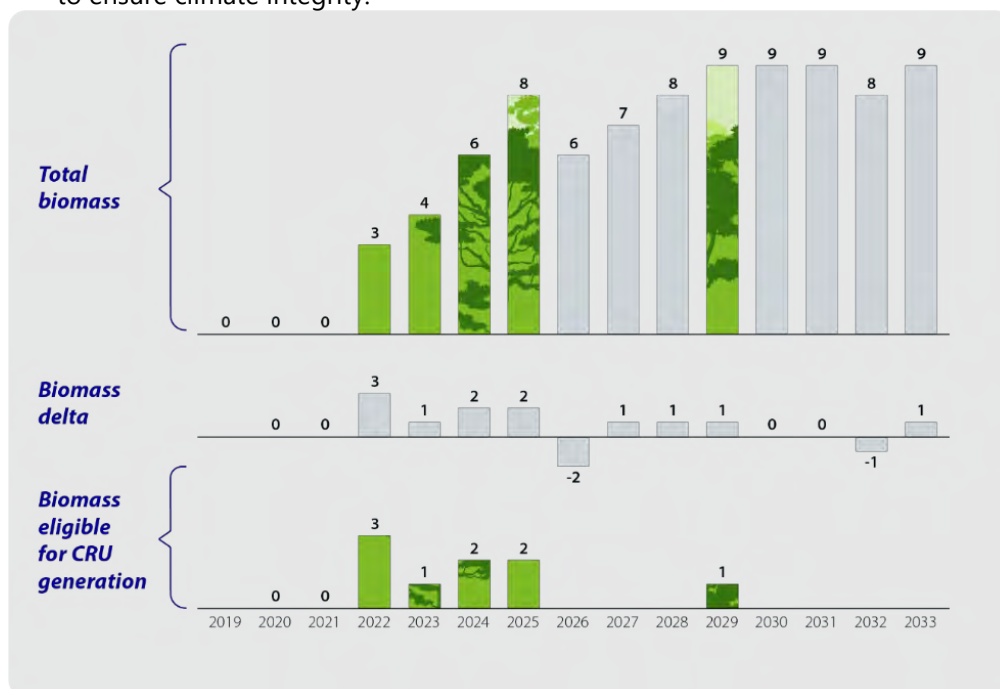


Figure 7. Example of requirement 4.8.2. (for illustration purpose only)

4.10 Data integrity

Rabobank emphasizes careful data handling, and as such Acorn has adopted four of the bank's core data handling values. These values guide the choices Acorn makes and help ensure that its solutions are secure.

Principle 10: All data acquired by Acorn is handled with the highest level of integrity and with stakeholder consent.

4.10.1 All project participants should give permission to share (provide and receive) data relevant for the project (e.g. name and GPS coordinates), either via the local partner or directly with Acorn. A participant's consent is provided at the start of a project intervention in a new area.

4.10.2 All Acorn project data shall comply with GDPR or local legislation.

4.10.3 Acorn should apply the following data handling values from Rabobank:

- Acorn's use of data creates value for its stakeholders.
- Acorn is transparent about the data it uses.
- The customer has control over its data.
- Privacy and security are always self-evident.

5. End-to-end process

The Acorn process follows eight steps, as shown in Figure 8 below. This Section details these steps and explains how stakeholders are expected to adhere to the requirements set out in Section 4.

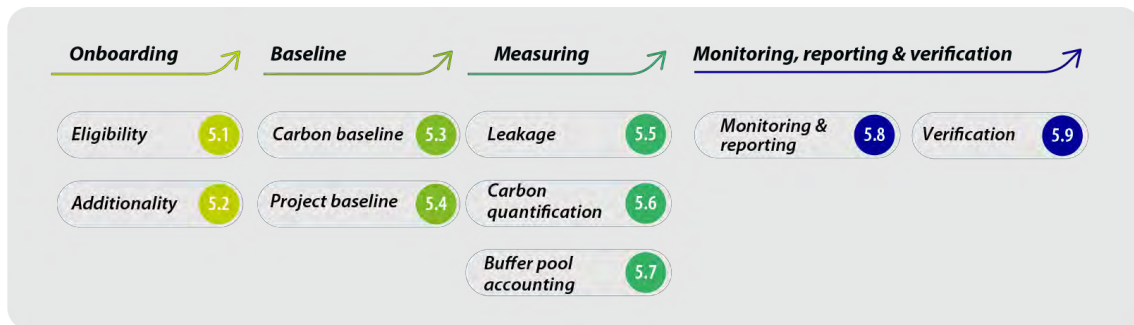


Figure 8. Steps of the Acorn approach

5.1 Eligibility checks

5.1.1 Eligibility checklist

As Acorn projects involve smallholder farmers, information is sometimes difficult to obtain or is unavailable. Acorn therefore selects local partners that work on the ground with the participants and their communities, and understands local needs, cultures and societal nuances. Together with the Acorn team, they play an important role in establishing project eligibility and implementing the project intervention in a sustainable way. The following eligibility checklist should support the local partner in selecting participants eligible for the Acorn program.

Participant eligibility checklist			
<i>Topic</i>	<i>Sub-topic</i>	<i>Requested information</i>	<i>Result</i>
Organizational capacity	Smallholder labor force	Participants are not structurally dependent on permanent hired labor, and manage their land mainly by themselves with the help of their families.	
	Smallholder farm size	The cultivated land of participants does not exceed 10 ha.	
	Resources	The participant has the ability to mobilize the necessary resources to implement the project.	
	Data collection	The participant can allow reliable data to be collected for the project (i.e. GPS polygons, phone numbers, other KYC data).	
	Condition (i)	The participant is aware that their decision to participate in the project is entirely voluntary.	
	Participant identity	The participant is able to provide proof of their identity.	
Land-tenure and carbon rights	Land-tenure and carbon rights (i)	A description of how land tenure is organized.	
	Land-tenure and carbon rights (ii)	The project applies to land over which the participant/community has (formal/informal) ownership or long-term user rights.	

Sustainable land use activity	Land use*	A description of the current land use activities within the project.
	Deforestation*	The participant confirms that no deforestation has taken place five years before the start of the project intervention (project baseline). If this cannot be confirmed, a description of the cause of the deforestation is provided, including the measures that have been taken to prevent deforestation from happening again.
	Additionality	The participant ensures project additionality and is aware that the project has a durability period of 20 years.
	Existing agroforestry (i)	Agroforestry at the farm level has been implemented less than 5 years ago.
	Existing agroforestry (ii)	The participant confirms that previously sequestered CO ₂ on the land has not yet been monetized.
	Existing agroforestry (iii)	The participant has received donor/grant funding for a significant part of their existing agroforestry practices.
	Current habitat*	The current ecosystem and species of the project area is described.

* Applicable for a selected sample of participants/RSPs

Table 3. Participant eligibility checklist

Acorn itself should complete the following checklist in its selection of local partners eligible for the Acorn program.

Local partner eligibility checklist			
<i>Topic</i>	<i>Sub-topic</i>	<i>Requested information</i>	<i>Result</i>
Organizational capacity	Organizational capacity	Organizational structure and “on the ground” capacity are adequate to undertake long-term community-led project(s) and agroforestry implementation.	
	Sustainability	The local partner agrees with the Rabobank’s sustainability policy.	
	GDPR	The local partner’s current data handling policies are compliant with GDPR regulations.	
	Participant organization	The project is organized, or in the process of being organized, into cooperatives, associations, community-based organizations or other organizational forms able to contribute to the social and economic development of the participants and their communities, and which is democratically controlled by the participants.	
	Project effects	The project strives to not contribute, or does its utmost to avoid, environmental or (agricultural) biodiversity harm.	
	Entity	The local partner is an established legal entity that takes responsibility for the project and for meeting the requirements of the Acorn Framework for the duration of the project.	
	Local presence	The local partner has a strong in-country presence and the respect and experience required to work effectively with local participants and their communities.	
	Local policies	The local partner has a solid understanding of local policies and can confirm that the country’s policy allows individual CRUs to be sold.	
	Influence	The local partner is capable of negotiating and dealing with government, local organizations and institutions.	
	Resources	The local partner is focused and has the organizational capability and ability to mobilize the necessary resources to develop the project (e.g. including access to seedlings, inputs, agronomic knowledge, monitoring and technical support).	

	Data collection	The local partner can provide reliable data (i.e. GPS polygons, phone numbers, other KYC data).
	Training	The local partner has the ability to mobilize and train participants, and implement and monitor project activities.
	Condition (i)	The local partner recognizes that the participant's involvement in the project is entirely voluntary.
	Condition (ii)	The local partner recognizes that participants own the carbon benefits of the project intervention.
	Participant payments (i)	The project coordinator ensures that payments are made in a transparent and traceable manner.
	Participant payments (ii)	The project coordinator ensures that mobile payments to participants are either already possible or there are no foreseeable obstacles for this in the near future.
	Contributions	The local partner does not draw more than 10% of sales income for ongoing coordination, administration and monitoring costs. Exceeding this percentage is only possible in exceptional circumstances where justification is provided and Acorn formally approves a waiver.
	Participant identity	The local partner is able to collect and provide proof of participant's identity.
Land-tenure and carbon rights	Land-tenure and carbon rights (i)	A description of how land tenure is organized amongst the target project participants.
	Land-tenure and carbon rights (ii)	The project applies to land over which the participant/community has (formal/informal) ownership or long-term user rights.
	Land use	A description of the current land use activities, before the start of the project intervention, within the project is provided.
	Project design	The project is designed to promote sustainable land-use and has a feasible business case underwritten by agronomist(s) and community representatives.
	Deforestation	The local partner confirms that no deforestation has taken place five years before the start of the project intervention (project baseline). If this cannot be confirmed, a description of the cause of the deforestation is provided, including the measures that have been taken to prevent deforestation from happening again.
Sustainable land use activity	Additionality	The local partner ensures project additionality and ensures a durability period of 20 years.
	Existing agroforestry (i)	Agroforestry at the farm level has been implemented less than 5 years before the start of the project intervention.
	Existing agroforestry (ii)	Participants and local partners confirm that previously sequestered CO ₂ on the land has not yet been monetized.
	Existing agroforestry (iii)	Existing agroforestry has been funded largely by donors/grants.
	New agroforestry	There is sufficient supply of seedlings, inputs, water and other required resources.
	Naturalized species	The local partner promotes the use of native species. The use of naturalized species is acceptable under the conditions outlined in the Framework.
	Current habitat	The current ecosystem and species of the project area is described.

Table 4. Local partner eligibility checklist

5.1.2 Land cover

To demonstrate the state of the land cover at the start of the project (requirement 4.1.4) and the land cover status of five years before the start of the project (requirement 4.1.2.), one of the following should be provided as evidence²³:

- Aerial photographs or satellite imagery, complemented with ground reference data
- Land use or land cover information from maps or digital spatial datasets
- Ground-based surveys
- A written testimony from the local partner, that is supported by participants and local communities, when none of the above can be provided

5.1.3 Land tenure

For Acorn, land tenure is understood as a legal regime or an informal custom, administered by traditional authorities, which defines who owns or holds the right to use the land. A project is only eligible if the local partner can prove clear land tenure that has been agreed upon and understood by the participating smallholder or communities. This can be proven using one of the three approaches;

- *Formal titling* – Preferably legal landownership or user rights documentation or agreements should be provided. Documentation should include boundary maps and formal land titles, and should demonstrate a formal right to transact, make decisions and implement agroforestry activities on the land.
- *Informal titling* – Where no official documentation exists, the local partner can develop a locally relevant method for checking the existence and stability of the land use rights of the project participant(s). Documentation should include boundary maps and land titles, and should demonstrate a right to transact, make decisions and implement agroforestry activities on the land.
- *Land mapping* – Only when neither formal nor informal titling is available, participants and the local partner provide an outline of the land boundaries and allow the wider community to sign-off or reach consensus on these boundaries. This can be done in periodic project councils and/or by making the maps publicly available for anyone to object.

By confirming land tenure in one of these three ways, Acorn aims to prevent potential dishonesty and/or land grabbing through social control amongst participants and the local community.

²³ [*Watson, et al., 2000*](#)

5.2 *Additionality assessment*

The following is the additionality assessment form that local partners need to complete in consultation with the project participants and Acorn.

Project details	Name of local partner		
	Project location		
	Date of assessment		
Positive list	<i>Demonstrate that the project meets requirements (a) and (b) and at least one of the requirements (c) and (d).</i>		
	(a) The project area is located in a country or region with a recent UNDP Human Development Indicator ²⁴ below or equal to 0.8.	<add indicator value>	
	(b) The project shall not be mandatory by any law or regulation, or if mandatory, the local partner shall demonstrate that these laws and regulations are systematically not enforced.	<attach proof of regulatory surplus, i.e. NDC and/or National Forestry Policy, or statement from official governing body>	
	(c) The project is located in a region with a mean annual precipitation of less than 600 mm ²⁵ .	<add precipitation value>	
	(d) The project area is (predominantly) located in a country or region with a recent UNDP Human Development Indicator below 0.6.	<add indicator value>	
Barrier analysis	<i>Demonstrate that the project intervention would not have taken place due to a least one of the following barriers.</i>		
<i>Type of barrier</i>	<i>Examples of barrier</i>	<i>Situation without project</i>	<i>Situation with project</i>
Financial/ economic barrier	<ul style="list-style-type: none"> Insufficient financial resources to develop a project No payment system for ecosystem services in place No access to carbon market due to real or perceived risks associated with domestic or foreign direct investment in the country where the project intervention is to be implemented 	<describe what financial/economic barriers (if any) are being experienced>	<describe how barrier will be overcome by project intervention and climate finance>
	Technical barrier	<ul style="list-style-type: none"> Lack of infrastructure for implementation of the technology Lack of access to planting materials 	<describe what technical barriers (if any) are being experienced>
Institution al/ political barrier	<ul style="list-style-type: none"> Lack of regulations regarding agroforestry and land use management, or poor enforcement of such regulations. 	<describe what institutional/political barriers (if any)>	<describe how barrier will be overcome by

²⁴ [United Nations Development Programme, n.d.](#)

²⁵ [Nasa,2021](#)

	<ul style="list-style-type: none"> • Risk related to changes in government policies or laws 	<i>are being experienced></i>	<i>project intervention and climate finance></i>
Ecological barrier	<ul style="list-style-type: none"> • Degraded soil (e.g. water/wind erosion, salinization) • Catastrophic natural and/or human-induced events (e.g. landslides, fire) • Unfavorable meteorological conditions (e.g. early/late frost, drought) • Unfavorable course of ecological successions • Biotic pressure in terms of grazing, fodder collection, etc. 	<i><describe what ecological barriers (if any) are being experienced></i>	<i><describe how barrier will be overcome by project intervention and climate finance></i>
Social barrier	<ul style="list-style-type: none"> • Poor mobilization of local communities due to remoteness or poor infrastructure • Demographic pressure on the land (e.g. increased demand for land due to population growth) • Social conflict among interest groups in the region where the project intervention takes place • Widespread illegal practices (e.g. illegal grazing, non-timber product extraction and tree felling) 	<i><describe what social barriers (if any) are being experienced></i>	<i><describe how barrier will be overcome by project intervention></i>
Cultural barrier	<ul style="list-style-type: none"> • Lack of skilled and/or properly trained labor force • Lack of organization of local communities 	<i><describe what cultural barriers (if any) are being experienced></i>	<i><describe how barrier will be overcome by project intervention and climate finance></i>
Overall conclusion:			
<i><summary of findings></i>			

Table 5. Additionality assessment form

5.3 Carbon baseline assessment

The following is the carbon baseline assessment form that local partners need to complete in consultation with the project participants or a representative of the participants.

Participant & project details	Name of local partner		
	Name of representative		
	Project location		
	Date of assessment		
Requested information Format Answer			
General	Eligibility of the land has been demonstrated	Yes, formal; Yes, informal; Unknown	
	Description of current land use	Text	<i>[How is the land used? By whom, and is there any cultivation? If so, what type of trees/crops are currently cultivated on the farm? How are pests controlled, and what is the fertilizer intensity? How is land use expected to change without project intervention (hypothetically)?]</i>
Carbon baseline*	Description of current habitat species	Text	<i>[What species are observed on the land? What change in habitat species (biodiversity) would be expected without project intervention (i.e. increase/decrease)?]</i>
	Description of deforestation potential**	Text	<i>[Has any deforestation taken place in the last 5 years? If so, what was the cause? What measures are taken to prevent deforestation from happening?]</i>
	Number of existing trees	Number	
	Number of existing trees older than 5 years	Number	
	Coverage percentage of existing trees older than 5 years	%	

*Actual AGB baseline value will be provided utilizing satellite measuring techniques and, where needed, supported by field measurements.

** The information is supportive to the T-5 check performed by RSPs.

Table 6. Carbon baseline assessment form

5.4 Project baseline assessment

The project baseline in terms of socioeconomic and environmental concerns is established by the local partner at the start of the project intervention. This is similar for existing projects, where CRUs are calculated retroactively. At least every three years, project impact is evaluated along the same metrics of this baseline, based on a random sampling of projects, which is then audited by an independent party.

Given the large geographical variety of the Acorn projects and the opportunity to collect data from a range of participants which operate in different time zones, ecoregions, and social and political contexts, Acorn aims to contribute to the development of global and harmonized reporting on agroforestry projects and their impact. Socioeconomic and environmental benefits are of growing importance for carbon offsetting, and are central to the Acorn proposition, making impact monitoring key to every project. To build a comprehensive understanding of the benefits agroforestry can bring to society and the environment, Acorn has developed a flexible and scalable approach to impact monitoring as part of its project baseline assessment.

This approach monitors three fixed indicators (highlighted in grey Table 7 below) and up to eight discretionary indicators that address additional effects on farmer livelihood and the environment. The metrics for the fixed indicators are predetermined for all Acorn projects to safeguard data uniformity and quality, but these leave room for projects to define how individual values are collected. At a minimum, one additional indicator should be selected for the project assessment. The discretionary indicators are chosen by the program participants; projects will design the metrics themselves.

Sample size for a project baseline assessment equals 1% of the participants, with a minimum sample size of thirty participants and a maximum of one hundred participants per project. This minimum statistically substantiates that the sample standard deviation is a sufficient estimate for the population standard deviation, allowing Acorn to assume a change over time of the project impact indicators.²⁶

²⁶ [Corder & Foreman, 2009](#)

Area	Indicator	Metric	Source	SDG	Result
Local livelihood	Farmer income from carbon finance	Revenue from CRU sales	Survey (information collected on the Acorn platform)	1, 2, 8	
	Agricultural land use productivity*	Farm output value per hectare per crop type [kg/ha/crop]	Survey (information collected on the Acorn platform), FAO TAPE Tool ²⁷	1, 2, 8	
	Farmer income*	(Carbon revenues + farm revenues) – operating expenses	Survey (information collected on the Acorn platform), FAO TAPE Tool	1, 2, 8	
	Farmers bankability*	Score and weights of risk indicators	Survey	9, 17	
	Nutritional variety	Number of food groups in the diet (see Appendix 7.9)	Household Dietary Diversity Score (HDDS) index survey ²⁸	1, 2	
	Pesticides exposure*	Cost reduction of pesticides (organic and synthetic)	Survey, FAO TAPE Tool	2, 3, 6, 14, 15	
	Women's empowerment*	Score and weights of empowerment indicators	Survey (e.g. women employed by local partner or women in project councils), FAO TAPE Tool	5	
	Youth employment opportunities* (15-24 yrs.)	Score and weights of education, training or employment	Survey, FAO TAPE Tool	8	
Environmental improvement	Agricultural biodiversity	Crop/animal/pollinators count	Gini-Simpson Index survey ²⁹	2, 15	
	Land restoration*	Desertification rates	Survey, WaPOR	13, 15	
	Water productivity*	Score and weights of water-saving equipment and retention	Survey, WaPOR, or LEAP Guidelines	6, 14, 15	

*Metrics and sources provided are suggestions only; projects are allowed to select other, more suitable metrics if they wish.

Table 7. Project baseline assessment and impact measurement list

5.5 Leakage assessment

For the leakage assessment, see the Acorn Methodology.

5.6 Quantification methodology

For the carbon quantification, see the Acorn Methodology.

²⁷ [FAO, 2019](#)

²⁸ [Swindale & Bilinsky, 2006](#)

²⁹ [Izsák & Papp, 2000](#)

5.7 Buffer pool process

In the event of a long-term shortfall (more than 5 years), in measured CO₂eq sequestered, from both force majeure or either mismanagement, a claim will be made on the buffer pool. 1 BCRU is equal to 1 CRU, both represent one metric ton of CO₂eq.

1. A reversal is detected (see 4.8.2.)
2. In case, within five years the reversal has not recovered the buyer is notified that the climate benefit associated with the CRU no longer exists
3. A BCRU is allocated to the cancelled CRU
4. Annually the BCRU cancellations are shared with the Plan Vivo Foundation

5.8 Monitoring & reporting

See Appendix 7.10 for a monitoring and reporting overview, including frequency, duration and auditor.

5.8.1 Monitoring durability

Acorn projects guarantee a durability of twenty years. Annual carbon monitoring is performed during the CRU generation period, and after the last generated CRU, every five years a check is executed to ensure that the captured CO₂ is still stored.

5.8.2 Monitoring project performance

Acorn projects undergo initial sample-based assessments conducted by independent, sometimes local organizations. These so-called validators assess the project set-up and accuracy using the Acorn Methodology, taking into account potential local differences.

All Acorn projects gather data and information on various carbon and socioeconomic elements and are asked to keep a record of the sources of this data and information so that they can be checked in the validation process. The validation assessment usually assesses criteria such as additionality, eligibility and baseline calculations – information that is not included in future verification assessments. The elements of the projects that are reviewed at validation are set in an Acorn-specific validation Terms of Reference following the best practice procedures of the certifier.

5.8.3 Reporting – Annual reports

From the start of a project intervention, the local partner is asked to provide annual reports on the project's progress. At a minimum, the following information should be provided in these annual reports:

- Total number of farmers participating*
- Number of new farmers participating*
- Average hectares per farmer*
- Number of CRUs generated (metric ton CO₂eq sequestered)*
- Number of CRUs sold*
- Total payments to participants
- Local partner expenditure
- Any significant updates in the project

*provided by Acorn

5.8.4 Reporting – Registry

All CRUs are reported and registered in a public registry with the following information:

- Issuance date
- Status
- Identification
- Project GPS location
- Project type
- Project developer
- Country
- Certifier
- Standard reference
- Methodology reference
- Co-benefits: Sustainable Development Goals
- GHG reduction type
- Method
- CO₂eq kg
- Storage method
- Durability
- Expiration date
- Retirement date
- Purchase date
- Buyer
- Beneficiary
- Purchase reference
- Corresponding adjustments
- Replacement CRU

5.9 Verification

For quality assurance, projects are validated by local bodies that have appropriate experience in the local ecosystem, and are then verified by approved organizations with documented experience in auditing GHG projects and which are accredited by a proper authority such as the UNFCCC's Clean Development Mechanism (CDM), the Forest Stewardship Council (FSC) or by an IAF member compliant with ISO14064 and ISO14065. Note that verification does not include reporting and evaluation of socioeconomic benefits.

Verification assessments are conducted at least every three years by independent and qualified verifiers. Based upon a set of conditions following the best practice procedures of the certifier. Local partners are asked to keep a record of their data and information sources for the purposes of verification.

6. Glossary

6.1 Abbreviations

AGB	Aboveground biomass
BCRU	Buffer pool carbon removal unit
BGB	Belowground biomass
CDD	Commercial due diligence
CO ₂	Carbon dioxide
CO ₂ eq	Carbon dioxide equivalent
CRU	Carbon removal unit
GDPR	EU's General Data Protection Regulation
GHG	Greenhouse gas
ha	Hectare
HDDS	Household Dietary Diversity Score
kg	Kilogram
LiDAR	Laser imaging, detection and ranging
RSP	Remote sensing partner
SDG	Sustainable Development Goal

6.2 Definitions

Aboveground biomass

The total mass of living matter above the ground, expressed as dry weight.

Additionality

An agroforestry project with Acorn should prove that CO₂ sequestration benefits increase above the baseline scenario with the intervention of the project and would not occur without the additional revenues generated through the sale of CRUs.

Adjustment factor

An adjustment factor of 1.0 is used for the carbon quantification model, unless in the event of high leakage around the project area, signification about of pre-existing biomass and/or low accuracy of the measurement results.

Agricultural biodiversity

The variety of crop species, livestock breeds and other organisms that support agriculture and food production.

Agroforestry

Land-use systems and technologies in which woody perennials (e.g. trees, shrubs, palms or bamboos) and agricultural crops or animals are used deliberately on the same parcel of land in some form of spatial and temporal arrangement.

Baseline scenario

The most likely future scenario for land use and land management in a project area in the absence of project intervention(s).

Belowground biomass

The total mass of living matter below the ground, expressed as dry weight.

Buffer pool

A pool of replacement CRUs, referred to as BCRUs, that are reserved for unforeseen reversal risks associated with the project. BCRUs are not eligible to be sold.

Buyer

A third party which has acquired CRUs offered for sale by the local partner and Acorn on behalf of participants through the Acorn marketplace.

Carbon baseline

The change in carbon stocks and greenhouse gas emissions expected in the baseline scenario.

Carbon benefit

An increase in carbon stock relative to the carbon baseline as a result of a project intervention.

Carbon quantification model

The calculation from biomass data to a precise number of CRUs.

Carbon removal unit (CRU)

Represents one metric ton of CO₂eq, removed from the atmosphere as a result of a project intervention, additional to any carbon reduction that would occur in the absence of the project intervention, and intended to be stored or otherwise sequestered during the durability period. CRUs are only generated based on the delta in biomass accrued in the past year (ex-post) measured by satellite monitoring technologies, in particular by satellite monitoring, complemented by LiDAR (air or terrestrial) and/or ground calculations.

Carbon sequestration

The process of direct (biological) removal of carbon dioxide equivalents from the atmosphere and its capture in aboveground biomass and partly belowground biomass. CRUs are only generated based on the delta in biomass accrued in the past year (ex-post) measured by satellite monitoring technologies, in particular by satellite monitoring, complemented by LiDAR (air or terrestrial) and/or ground calculations.

Carbon stock

The quantity of carbon in a carbon pool.

Certifier

The Plan Vivo Foundation is the certifier of the Acorn program. Plan Vivo is internationally recognised as the leading organization for community land-use projects. Certification under Plan Vivo demonstrates that a project is sustainable over the long-term, truly benefits people's livelihoods and provides vital climate and environmental benefits.

CO₂ equivalent

Carbon sequestered corrected for additional GHG emissions, net sequestered carbon dioxide as a result of a project intervention.

Coverage ratio

An indicator of how well the current buffer pool percentage covers the actual level of CRUs for potential replacement.

Deforestation

Deforestation is defined as the, non-natural, removal of trees compared to the forest baseline. The forest baseline is defined at T-5, which is 5 years prior to the start of biomass predictions (T0), also known as carbon baseline. An area is considered 'forest' when it has been forest since the

year 2000. Forest in the year 2000 is determined by selecting areas with more than 60% tree cover in the Global Forest Watch tree cover dataset³⁰.

Double claim

An instance in which multiple parties claim the same emissions reduction unit to reach mitigation targets: once by the hosting country and once by the entity using the CRUs (= double claiming with international targets – cross-country). Domestic double claiming could potentially occur with emissions trading systems (ETS) or carbon tax programs.

Double counting

An instance in which one removal unit is accounted for more than once. Double counting is a collective term and can occur through double issuance, double use and double claim (for international and domestic mitigation targets). Double issuance and use should be avoided in all instances.

Durability period

The period during which the CO₂ represented by a CRUs is expected to remain removed from the atmosphere or sequestered in the carbon pool. The reversal obligation of Acorn projects will remain in effect and shall be subject to a minimum term of 20 years commencing the year a CRU is created.

Ecoregion

A large area of land and/or water, ecologically and geographically characterized by distinct ecosystems, flora and fauna. Acorn applies the “terrestrial scheme” defined by the WWF, which splits the world’s land surface into 867 ecoregions.

Eligibility

A collective term that refers to an accumulation of conditions that determine which projects and partners can be registered under the Acorn Framework.

Ex-post credits

Credits that are issued after the project intervention has taken place, and when carbon has already been sequestered and monitored.

Food security

Access to sufficient, safe, nutritious food that meets dietary needs for maintaining a healthy lifestyle.

Land cover

The observable physical materials, vegetation and man-made features that cover the Earth’s surface.

³⁰ [Global forest watch, 2019](#)

Land tenure

A legal regime or an informal custom which defines who owns or holds the right to use a given plot of land.

Leakage

An unintended reduction in carbon stocks or increase in CO₂eq emissions outside a Project Area, as a result of Project activities.

Local community

A group of people interacting with each other and living in the same area.

Local partner

A legal entity that takes responsibility for on-the-ground practices and adheres to the Acorn Framework throughout the duration of a project. In formal contracts local partners are referred to as Project Coordinator.

Native species

Plant or animal species that occurs naturally within the project area and was not introduced as a result of human activity.

Naturalized species

A non-native species that reproduces consistently and sustains populations over more than one life cycle without direct human intervention.

Participant

A smallholder farmer (or a community group) who meets the eligibility criteria set out in the Acorn Framework that is participating in a project to develop and implement agroforestry practices.

Project

Overarching term that refers all activities that are somewhat linked to each other, often through the local partner at a particular location.

Project area

A discrete area within which one or more project intervention(s) is applied.

Project intervention

A set of activities designed to restore or improve management of land, increase carbon storage or reduce greenhouse gas emissions, which has a positive impact on local livelihoods and ecosystems.

Satellite monitoring

A collective term for monitoring techniques that do not have direct contact with the surface, like satellites or LiDAR instruments that are used to scan areas to obtain data and information.

Reversal

An escape or release into the atmosphere during the durability period, as a result of a reversal event, of any stored or otherwise sequestered CO₂.

Reversal event

Any event or circumstance occurring after transfer of any CRU and during the durability period, whether intentional or unintentional, that results, or that is reasonably likely to result, in a reversal.

Smallholder farmer

A farmer who manages a small area of land (no more than 10 ha) to cultivate crops and/or livestock, and whose primary income comes from their land management activities.

Validation

An initial assessment of project arrangements and organization to confirm its compliance with the Acorn Framework.

Verification

Periodic evaluations by a verification body to ensure the credibility and integrity of projects.

Validation or verification body

The third party instructed by Rabobank to perform the validation and/or verification that has appropriate accreditation and expertise to complete such audits.

7. Appendices

7.1 SDG targets applicable to Acorn

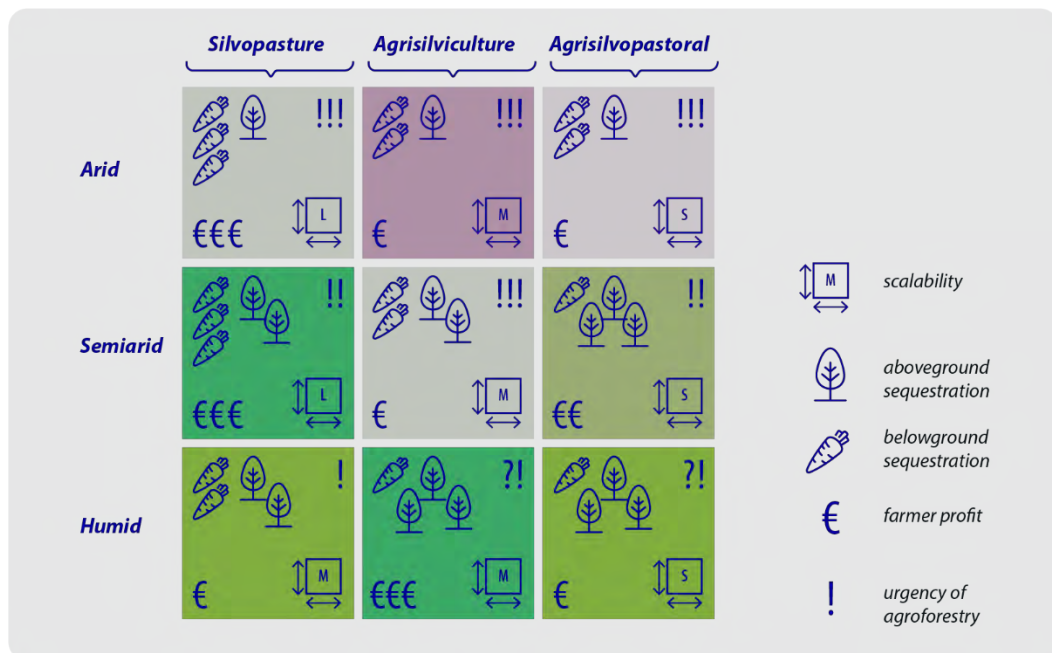
SDG	Target ³¹	Contributions
1.1	By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.25 a day	Agroforestry contributes to and increases farmer income .
1.2	By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	
1.5	By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	Agroforestry makes farmers more resilient to market and environmental shocks.
2.1	By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	Agroforestry enriches the diet of rural populations in emerging markets.
2.3	By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	Agroforestry contributes to the increasing demand for food by diversifying and increasing the yield per hectare in a sustainable manner. Agroforestry indirectly contributes to long-term soil health and prevents desertification and erosion.
2.4	By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	
6.3	By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	Agroforestry indirectly contributes to the decreasing need for fertilizers and to groundwater quality and infrastructure.
8.1	Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labor-intensive sectors	Agroforestry contributes to farmer productivity , and its technology allows for a scalable approach.
9.1	Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all	Satellite monitoring technology contributes to the scalability of practices and accessibility of finance for all, including smallholder farmers.
9.3	Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets	
9.6	Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States 18	
13.1	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	Agroforestry contributes to resilience to climate change effects , like flooding.

³¹ [United Nations, n.d.](#)

13.5	Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	Acorn contributes to the availability of nature-based solutions, allowing corporations to claim and report noteworthy results .
15.1	By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	Agroforestry continuously contributes to afforestation rates and combats desertification .
15.3	By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	
15.5	Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species	Agroforestry contributes to biodiversity .
15.10	Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems	Acorn contributes to a fair and accessible carbon market for everyone.
17.3	Mobilize additional financial resources for developing countries from multiple sources	Acorn contributes to additional financial resources for developing countries.

Table 8. SDG contributions sub level

7.2 Agroforestry analysis



Figure

9. Overview of agroforestry systems

1. Arid silvopastoral:

- Lots of root development, but negligible aboveground biomass
- Easily scalable system, requires little expertise or management, only some water
- Any arable addition will yield more money for farmers in this climate
- Dry climates desperately need trees

2. Arid agrisilvicultural:

- Some root development, but negligible aboveground biomass
- Somewhat scalable system, depending on the total number and variety of plants
- Crops need rain; arid regions are too dry for crop-based agroforestry
- Dry climates desperately need trees

3. Arid agrosilvopastoral:

- Some root development, but negligible aboveground biomass
- Hard system to scale due to the management of animals: cut and carry fodder or separation of crops
- Crops need rain; arid regions are too dry for crop-based agroforestry
- Dry climates desperately need trees

4. Semiarid silvopastoral:

- Lots of root development, but negligible aboveground biomass
- Easily scalable system, requires little expertise or management, only some water
- Additional revenue from tree production for food, combined with more animal food
- Semiarid regions are in danger of desertification, so the need for their protection is urgent

5. Semiarid agrisilvicultural:

- Some root development, some aboveground biomass growth
- Somewhat scalable system, depending on the total number and variety of plants
- Crops most associated with agri-activities do best in humid regions, but tree planting does improve drier regions for cash crops
- Semiarid regions are in danger of desertification, so the need for their protection is urgent

6. Semiarid agrosilvopastoral:

- Mostly tree production for food and fodder, negligible belowground storage
- Hard system to scale due to the management of animals: cut and carry fodder or separation of crops
- Crops most associated with agri-activities do best in humid regions, but there is opportunity for grassland grazing and cropping
- Semiarid regions are in danger of desertification, so the need for their protection is urgent

7. Humid silvopastoral:

- Some root development, some aboveground biomass growth
- Somewhat scalable system; grasslands are uncommon, so different species need to be added
- Humid climate is not ideal for grazing because the land is very valuable and fertile. This system thrives in drier regions
- Humid regions with classic grasslands are rare, but adding trees is always a good investment

8. Humid agrisilvicultural:

- Mostly tree production for food and harvest crops, negligible belowground storage
- Somewhat scalable system, depending on the total number and variety of plants
- Additional revenue from tree production for food, combined with cash crops that benefit from trees
- Humid regions are notorious for deforestation for agriculture; this might compete with forests

9. Humid agrosilvopastoral:

- Mostly tree production for food and harvest crops, negligible belowground storage
- Hard system to scale due to the management of animals: cut and carry fodder or separation of crops
- Additional revenue from tree production for food, combined with crops and more animal food
- Humid regions are notorious for deforestation for agriculture; this might compete with forests

7.3 CRU issuance & trading

Following confirmation of eligibility of a smallholder farmer, the new participant and the local partner enter into a standard Project Implementation and Carbon Removal Unit Purchase Agreement, which is adapted to the applicable host country and specificities of the participant and their farm. This agreement governs the obligations of the participant with respect to the farm, ensuring compliance with the requirements of this Framework and promoting the sequestering of CO₂ on the farm in alignment with agreed milestones, as well as payment to the participant. The agreement also outlines the obligations regarding the issuance of CRUs, whereby title to the CRUs is properly transferred to the local partner and later to the buyer, the monitoring of farm compliance with the Framework and achievement of the milestones, and cooperation between the participant and the local partner, including in the event of actual or threatened reversal events or reputational damage.

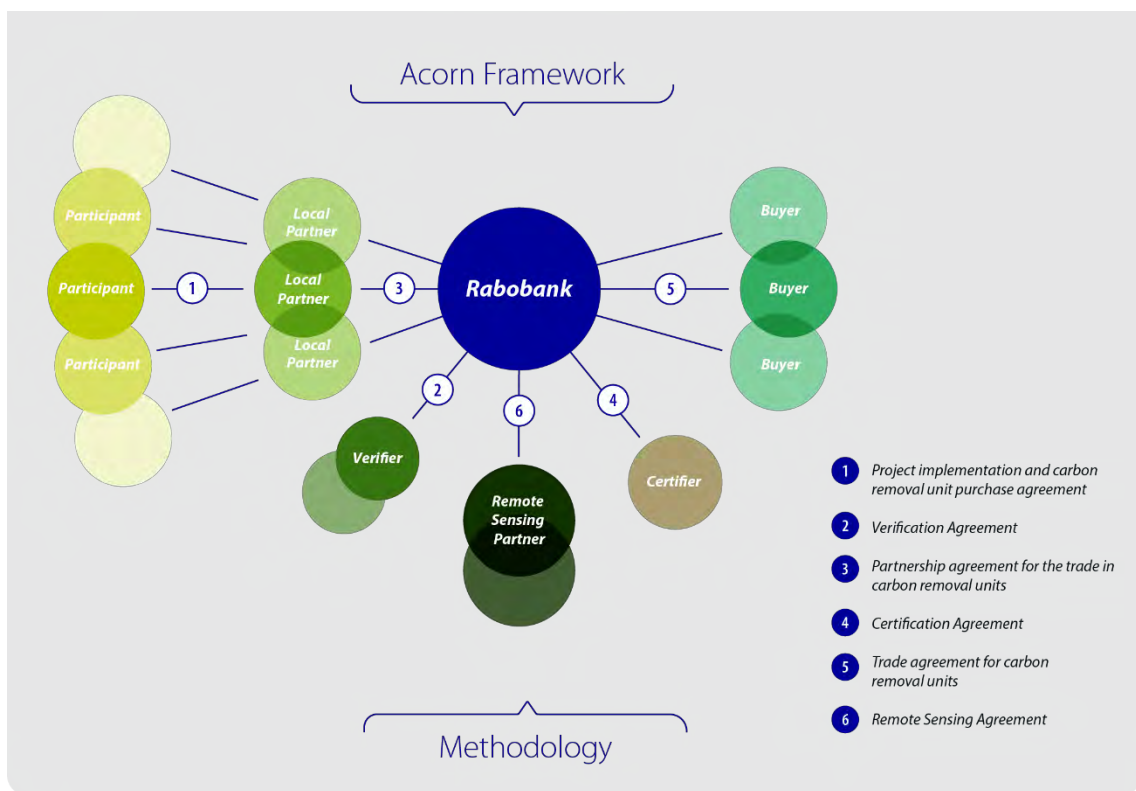


Figure 10. Overview contract set up

7.4 Payments & in-kind contributions

From the CRU sales revenue 90% is paid out by Acorn to the local partner. After, this transaction the local partner is allowed to withhold up to 10% from the CRU sales revenue to cover organizational operational costs. From the remaining 80-90% of the CRU sales revenue, the program participant is paid out at least once a year. Payments from the local partner to the participant can be split by in i.) detail/cash payments and ii.) in-kind contributions. See Table 9 for an overview of individual in-kind contributions considered applicable within the Acorn program. Other in-kind contributions may be suggested by the local partner and will be added to the list of in-kind contributions upon approval from Acorn. These forms of in-kind contributions should always be traceable to the individual participant, therefore community in-kind contributions are not considered applicable within Acorn.

Ideally, payments are made directly into the participant’s bank account via a digital payment system. In the absence of the participant having a bank account or access to another form of a digital payments system, cash payments are handed out. In the event of payments being completed by cash handouts, an appropriate mechanism shall be organized by the local partner to record the receipt of payment (i.e. a form saying who has been paid, what date, how much, their farmer ID and the farmer's signature to acknowledge payment).

Contributions	
Inputs	<ul style="list-style-type: none"> Seedling costs Sapling costs Fertilizer
Education	<ul style="list-style-type: none"> Training costs Agronomist consultation costs
Operation	<ul style="list-style-type: none"> Mobile communication costs Mobile payment costs
Livelihood	<ul style="list-style-type: none"> Land tenure consultation costs

Table 9. Set of in-kind contributions.

7.5 Stakeholder map

This stakeholder map can service project in various ways, i) prevent local conflict, ii) secure authority approval, and iii) create project awareness. Please include any stakeholder who can be affected by the implementation of an Acorn project.

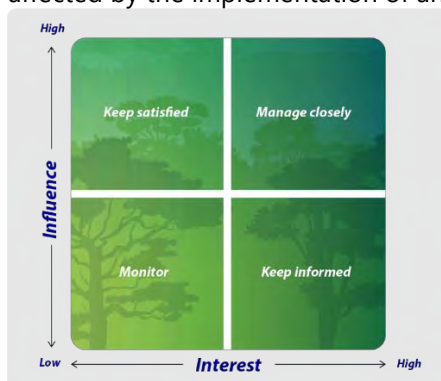


Figure 11. Stakeholder map

7.6 Roles & responsibilities

	Local partner	Acorn	Validator/verifier
Project selection	<ul style="list-style-type: none"> Performs eligibility checks and provides required data 	<ul style="list-style-type: none"> Provides eligibility guidance and selects eligible projects 	
Project preparation	<ul style="list-style-type: none"> Recruits individual farmers for the project Supports creation of project council governance structure Facilitates local agronomist for agroforestry advice, including education for farmers Uploads project documentation to the platform Identifies additional local support (e.g. nurseries, project funds), as required Communicates with and secures commitment from political partners, as required Develops viable business case 	<ul style="list-style-type: none"> Provides general agronomist advice Determines financing need Supports business case development Organizes/supports select financial structures and project funds (note: does not provide complete financing) Facilitates input on roles and responsibilities 	
Project start	<ul style="list-style-type: none"> Onboards farmers and collects details (e.g. field coordinates, land ownership and farmer consent form) Signs agreement with participants (including data consent form) Facilitates regular council meetings and necessary training Organizes logistics and availability of agroforestry designs Assists in tree planting and sustainable implementation of agroforestry designs Supports general monitoring of carbon and project indicators Uploads project documentation and copies of signed agreement to the platform Organizes transparent farmer payout 	<ul style="list-style-type: none"> Provides technical infrastructure for farmer onboarding Monitors delta in biomass and carbon sequestration Connects farmers to CRU buyers (note: does not commit to offtake) Facilitates payment Registers CRUs Reports to Plan Vivo Foundation (annually) 	<ul style="list-style-type: none"> Validator conducts initial validation assessment within one year of the project start
Project maturity	<ul style="list-style-type: none"> Assists validators and verifiers in their regular assessments Prepares and submits annual progress reports Follow described grievance resolution mechanism if grievances made Supports participants in accessing relevant project documentation (e.g. agreements, agroforestry designs, consent forms) 	<ul style="list-style-type: none"> Arranges appropriate validating and verifying bodies Oversees CRU carbon accounting Follow described grievance resolution mechanism if grievances made 	<ul style="list-style-type: none"> Verifier: Conducts random carbon verification checks at least every 3 years
Project completion	<ul style="list-style-type: none"> Provides farmer aftercare 	<ul style="list-style-type: none"> Retires CRUs 	

Table 10. General overview of roles & responsibilities. More details can be found the local partner partnership agreements

7.7 Methodology applicability conditions

In Table 11, the responsibilities of local partners that are related to the Methodology are described. Note that this overview only represents the applicability condition as design by 16-09-2021.

Applicability condition	Responsibility local partner	Comment
The Project Intervention meets the Agroforestry and any trees planted are Native or Naturalized Species.	Local partners should consult the advice of an agronomist to safeguard this applicability condition. The agroforestry design should provide proof of proper execution.	Definition agroforestry: Land-use systems and technologies in which woody perennials (e.g. trees, shrubs, palms or bamboos) and agricultural crops or animals are used deliberately on the same parcel of land in some form of spatial and temporal arrangement.
Project Areas must not have been cleared of native vegetation within 5 years of the start of the Project Intervention.	Initially check by the RSPs with a T-5 check, but the local partner is responsible for confirming this condition by consulting participant on this eligibility criteria.	
Individual Project Areas are between 0.1 and 10 ha and are not on wetlands.	Local partners should check this eligibility criteria for each individual participant at the start of project intervention. RSPs will provide confirmation when checking the GPS coordinates.	
All land within the Project Area is either cropland or degraded land under the Baseline Scenario.	Similar to above part of the eligibility check a local partner performs at participant level	
Project Interventions must not include the planned harvesting of planted trees during or after the Crediting Period, and the risk that unplanned harvesting may take place should be assessed and mitigating actions should be employed to lower the risk where appropriate.	The local partner is responsible for properly informing the participants about this requirement	
Heavy machinery must not be used for site preparation or management.	The local partner is responsible for properly informing the participants about this requirement	
Project Interventions must not increase the use of synthetic (nitrogen-containing) fertilizers relative to the Baseline Scenario.	The local partner is responsible for properly informing the participants about this requirement	

Table 11. *Applicability condition methodology*

7.8 Reversal risk assessment

Project phase	Drivers behind reversal risk	Risk level	Potential mitigating measures	Justification
Project adoption/start	Limited education or inadequate understanding of agroforestry	<High, Medium, Low>	<ul style="list-style-type: none"> • Build on local culture, traditions and markets³² • Ensure accessible training • Secure agronomist assistance 	
	Marginal community support or low community involvement	<High, Medium, Low>	<ul style="list-style-type: none"> • Explore farmer needs • Promote program • Demonstrate positive impact on social and economic well-being 	
	Inadequate operational capacity (limited experience, no local presence)	<High, Medium, Low>	<ul style="list-style-type: none"> • Use the train-the-trainer principle 	
	Insufficient (local) nurseries	<High, Medium, Low>	<ul style="list-style-type: none"> • Make upfront arrangements • Negotiate purchasing power 	
	Animal or human interference	<High, Medium, Low>	<ul style="list-style-type: none"> • Erect fencing (natural, etc.) • Help mediate disagreements between perceived land boundaries 	
Project progress	Negative project cash flow	<High, Medium, Low>	<ul style="list-style-type: none"> • Ensure adequate financial planning • Ensure local financing for unforeseen events 	
	Poor agroforestry schemes	<High, Medium, Low>	<ul style="list-style-type: none"> • Encourage species and genetic diversity • Secure agronomist assistance 	
	Change of land ownership and coverage	<High, Medium, Low>	<ul style="list-style-type: none"> • Involve one entity to manage/track rights status 	
	Political instability (e.g. war, economic crisis)	<High, Medium, Low>	<ul style="list-style-type: none"> • Keep up-to-date on local and national political conditions 	
	Natural risks: <ul style="list-style-type: none"> - Fires - Pests & disease - Extreme weathers - Other events 	<High, Medium, Low>	<ul style="list-style-type: none"> • Perform historical risk analysis and apply applicable preventive measures • Training in effectively containing natural risks 	
Project maturity	Logging risk	<High, Medium, Low>	<ul style="list-style-type: none"> • Ensure alternative fuel for wood • Ensure food productivity of trees 	
	Waning or short-lived local partner commitment	<High, Medium, Low>	<ul style="list-style-type: none"> • Facilitate continuous dialogue and evaluation • Sign commitment agreements 	

Table 12. Reversal risk assessment

³² [Leakey, 2013](#)

7.9 Household Dietary Diversity Index

The Household Dietary Diversity Score (HDDS) will be estimated as described in the HDDS Indicator Guide³³. Participants are randomly be asked to indicate how many different food groups they have consumed over the last 24 hours. Information on the types of food groups monitored and used to calculate the HDDS is provided below.

Food group	Examples of foods	Consumed Food type
1 Cereals	Corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) or other local foods (e.g. ugali, nshima, porridge or pastes or other locally available grains)	Yes/no
2 Root and tubers	Any potatoes, yams, manioc, cassava or any other foods made from roots or tubers	Yes/no
3 Vegetables	Any other vegetables including wild vegetables	Yes/no
4 Fruits	Fresh or dried fruits	Yes/no
5 Meat, poultry, offal	Beef, pork, lamb, goat, rabbit wild game, chicken, duck, or other birds, liver, kidney, heart, or other organ meats	Yes/no
6 Eggs	Chicken, duck, guinea hen or any other egg	Yes/no
7 Fish and seafood	Fresh or dried fish or shellfish	Yes/no
8 Pulses, legumes, nuts and seeds	Beans, peas, lentils, nuts, seeds or foods made from these	Yes/no
9 Milk and milk products	Milk, cheese, yogurt or other milk products	Yes/no
10 Oils and fats	Oil, fats or butter added to food or used for cooking	Yes/no
11 Sweets	Sugar, honey, or sugary foods such as chocolates, candies, cookies and cakes	Yes/no
12 Spices, condiments and beverages	Spices(black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, sweetened soda, alcoholic beverages OR local examples	Yes/no

Table 13. The twelve food groups with examples

³³ [Swindale & Bilinsky, 2006](#)

7.10 Monitoring & reporting overview

	Monitoring frequency	Monitoring duration	Monitored by	Audited by	Scope
Biomass delta during crediting period	Annually	Until end of crediting period	RSP's of Acorn	Verification body	Plot level
Biomass delta after crediting period	At least every five years	Until end of durability period	RSP's of Acorn	Certifier	Plot/Project level
Project impact indicators	At least every three years	Until end of crediting period	Local partner	Verification body	Project level
Buffer pool coverage ratio	Every two to five years	Until program ends	Acorn	Certifier	Program level
Risk reversal	At least every five years	Until end of crediting period	Local partner	Certifier	Project level
Leakage	At the start of the project intervention	One off	Local partner	Acorn	Project level

Table 14. Monitoring & reporting overview

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Methodology

*for Quantifying Carbon Benefits
from Small-Scale Agroforestry*

Version 1.0 - 2021



Rabobank

*Growing
a better world
together.*

Title	Methodology for Quantifying Carbon Benefits from Small-Scale Agroforestry
Version	1.0
Date of Issue	2021
Type	Methodology
Sectoral Scope	Agricultural Land Management (ALM) and Afforestation/Reforestation/Revegetation (ARR) through Agroforestry
Prepared By	Rabobank – Wholesale & Rural Innovation
Contact	fm.global.agroforestry@rabobank.com
Website	<i>Acorn.rabobank.com</i>
Approved by	Aenor & SCS Global Services



Existing methodologies

Methodology	Title	GHG program	Comments
SHAMBA	Smallholder Agriculture Monitoring and Baseline Assessment tool	Plan Vivo	Ex-ante estimation of carbon benefits. Does not include methods for direct measurements
FARM-TRACE	Approved approach for automated forests and carbon assessments	Plan Vivo	Apart from the uncertainty method, the approaches proposed are similar to those in this methodology but are only accessible under license
VM0017	Adoption of Sustainable Agricultural Land Management	VCS	Does not include methods for woody biomass. Refers to CDM Methodologies
VM0042	Methodology for Improved Agricultural Land Management	VCS	Does not include methods for woody biomass. Refers to CDM Methodologies
VT0005	Tool for measuring aboveground live forest biomass using remote sensing	VCS	Includes methods for estimating biomass at one point in time, but not for calculating biomass change and associated uncertainty
AR-ACM0003	Afforestation and reforestation of lands except for wetlands	CDM	Mentions the use of satellite imagery as a possible source of biomass data, but no details are provided. Refers to CDM's AR-TOOL14 methodology
AR-AMS0007	Afforestation and reforestation project activities implemented on lands other than wetlands	CDM	Same as above
AR-TOOL14	Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities	CDM	Determine the carbon baseline

Table 1. Overview of existing methodologies

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1 Sources

This methodology refers to the following CDM Methodologies/Tools:

- AR-ACM0003 A/R Large-scale Consolidated Methodology Afforestation and reforestation of lands except wetlands¹, version 2.0
- AR-TOOL14 *Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*², version 4.2.

2 Summary of the methodology

This methodology describes the procedures for measuring removals of carbon dioxide from the atmosphere by increasing the carbon stored in tree biomass through the adoption of improved agricultural land management practices based on agroforestry. As such, this methodology can be used to measure carbon benefits achieved (ex-post) and is not intended to estimate carbon benefits expected (ex-ante). The approach quantifies the difference in net emissions of CO₂ from aboveground and belowground biomass between project and baseline scenarios and is applicable to areas of 0.1 to 10 ha that is either cultivated or degraded land at the start of a project intervention.

This methodology is applicable to project interventions that are tailored agroforestry practices on smallholder farms, designed based on scientific and local expertise. To estimate the change in tree biomass attributable to a project intervention between two points in time, the methodology incorporates direct measurement of trees in sample plots, as well as satellite imagery that is interpreted using models derived from sample plot data from the ecoregion within which the project is located. The methodology allows for various approaches to the development of such models and includes requirements to ensure that carbon benefit estimates are robust and conservative. In this way, it takes into account rapid developments in earth observation technology and reduces dependency on standalone methods or tools.

This methodology stems from the “Acorn program” founded by Rabobank; a related “Acorn Framework” has been developed in close collaboration with the Plan Vivo Foundation. Under the Acorn program, carbon benefits will be issued in carbon removal units (CRUs).

¹ <https://cdm.unfccc.int/methodologies/DB/C9QS5G3CS8FW04MYYXDFOQDPXWM4OE>

² <https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-14-v4.2.pdf>

3 Definitions

Aboveground biomass

The total mass of living matter above the ground is expressed as dry weight.

Agricultural crop

A plant that is grown and harvested for ecosystem benefits, profits or subsistence. This could be fruit, medicinal plants, or nut plants.

Agrisilvicultural

An agroforestry system that mixes crops and trees, such as shade systems (like coffee with citrus trees) or border planting.

Agroforestry

Land-use systems and technologies in which woody perennials (e.g. trees, shrubs, palms or bamboos) and agricultural crops or animals are used deliberately on the same parcel of land in some form of spatial and temporal arrangement. . Agroforestry practices, whether agrisilvicultural, silvopastoral or agrosilvopastoral, should include a subsistence or medicinal component.

Agrosilvopastoral

An agroforestry system that integrates trees, crops and animals, such as home gardens involving animals or woody hedges grown for fodder.

Baseline scenario

The most likely future scenario for land use and land management in a project area in the absence of project intervention(s).

Belowground biomass

The total mass of living matter below the ground is expressed as dry weight.

Buffer Pool

Holds carbon credits that are left unsold as insurance against the risks of non-delivery and reversal of Carbon Benefits. Projects shall set aside carbon benefits to the buffer pool for the duration of the project to cover unforeseen premature loss of carbon stock.

Carbon baseline

Reflects the total carbon stock before the start of a project intervention.

Carbon benefit

An increase in carbon stock relative to the carbon baseline as a result of a project intervention.

Carbon pool

A system that can store and/or accumulate carbon.

Carbon stock

The quantity of carbon in a carbon pool.

Confidence interval

A type of estimate derived from the observed data gives the probability with which the estimated interval will contain the true value of the parameter. It is a combination of the critical values.

Crediting period

The period in which carbon removals from the project intervention will be claimed.

Critical value

A factor is used to compute the margin of error. It is the value that splits the probability of availability or rejection region, which includes or excludes the targeted value in an interval.

Diameter at breast height (DBH)

The measurement of the diameter of a tree at the height of 1.3 meters. For this methodology's purposes, DBH is measured in centimeters.

Ecoregion

A large area of land and/or water, ecologically and geographically characterized by distinct ecosystems, flora, and fauna. Following the "terrestrial scheme" defined by the WWF³, which splits the world's land surface into 867 ecoregions.

Ground truth measurement

The manual measurement and counting of trees in a specific sample plot of land.

Heavy machinery

Machinery, such as tractors, that does not comply with regenerative agriculture due to high emissions and significant use of non-renewable energy, excluding necessary hand-operated machinery, such as chainsaws, that also require non-renewable energy.

Land property

An entire land property of the farmer (including roads, buildings, timber lots, etc.).

Leakage

An unintended reduction in carbon stocks or increase in t CO₂eq emissions outside a project area, as a result of project activities.

Native species

Plant or animal species that occur naturally within the project area and was not introduced as a result of human activity.

Naturalized species

A non-native species that reproduce consistently and sustains populations over more than one life cycle without direct human intervention.

Non-tree biomass

All non-woody living perennial biomass.

Plot

A discrete area of a smallholder's property within which one or more project intervention(s) is applied, excluding roads, buildings etc. Plots are defined by polygons and can have an extent between 0.1 ha and 10 ha.

Project area

The total area that project interventions are applied to within a project region. A project will include many individual plots of 0.1 to 10 ha in size, which combined make up the total project area of the project.

³ [WWF, 2012](#)

Project intervention

A set of agroforestry activities designed based on scientific and local expertise to restore or improve management of land, increase carbon storage or reduce greenhouse gas emissions, which has a positive impact on local livelihoods and ecosystems.

Sample plot

An area of a maximum of 1 ha within a plot, in which trees are measured to estimate the ground-truth measurement of biomass for models.

Sample subplot

A sample subplot is a 25x25m area located within the sample plot. Established to make ground-truth measurement of biomass easier to execute.

Silvopastoral

An agroforestry system that combines trees and animals, such as cattle grazing in coconut groves.

Soil disturbance

Are referring to activities that result in a decrease in soil organic carbon e.g. ploughing, ripping, scarification, digging of pits and trenches, stump removal etc.

Stratum

By default, this methodology defines a stratum based on a specific ecoregion. Where necessary, further stratification can be done, e.g. based upon variety in pre-project tree biomass or project activities. Sampling only takes place at the stratum (ecoregion) level and is not required on all plots in the project area.

Synthetic fertilizer

Chemically derived fertilizer that is manufactured from minerals, natural gasses and inorganic waste materials.

Tree

A woody perennial biomass that exceeds 2m in height or more than 2.5cm DBH.

4 Applicability conditions

This methodology is intended for the quantification of ex-post carbon benefits from smallholder agroforestry projects in any geographic location. It cannot be used to estimate expected carbon benefits (ex-ante).

This methodology is applicable under the following conditions:

- a) The project intervention meets the agroforestry definition (see Section 3), and any trees planted are native or naturalized species.
- b) The project area must not have been cleared of native vegetation within 5 years of the start of the project intervention.
- c) The project area consists of individual plots that are between 0.1 and 10 ha.
- d) All land within the project area is either cropland or degraded land and not on wetlands in the baseline scenario.
- e) The project interventions must not include activities that increase the total number, weight or number of grazing days for any livestock type, relative to the baseline scenario.
- f) The project intervention must not include the planned harvesting of planted trees during or after the crediting period.
- g) Heavy machinery must not be used for site preparation or management.
- h) The project intervention must not increase the use of synthetic (nitrogen-containing) fertilizers relative to the baseline scenario.
- i) Soil disturbance attributable to the project intervention must not occur on more than 10% of the plot that is under any of the following types of land⁴:
 - o Land containing organic soils (see Annex 1)⁵;
 - o Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in Annex 2.

Applicability conditions *a* and *b* ensure that project interventions applying the methodology fall within an eligible category for Plan Vivo projects, and meet key environmental safeguards in the Plan Vivo Standard.

Conditions *c*, *d* and *e* simplify the carbon baseline, and, if met, indicate that carbon removal through litter, deadwood and soil, and emissions from livestock can be conservatively assumed to be zero in the baseline scenario.

Condition *f* enables the application of stock-change approaches for estimating climate benefits, rather than the common stock approach that would be needed if cyclical harvesting took place.

⁴ [IPCC GPG LULUCF \(iges.or.jp\)](https://www.iges.or.jp/public/ippcc/gpg_lulucf/)

⁵ If land contains high organic soils, projects are expected to contract agreements on limited soil disturbance and clearly stated how soil disturbance is taken into account at the agroforestry design.

Conditions *g*, *h* and *i* ensure carbon emissions from the sources mentioned are likely to be insignificant (collectively less than 5% of the expected climate benefit) or can be conservatively excluded from the estimate of carbon removal.

5 Carbon pools and emission sources

The only carbon pools accounted for in this methodology are aboveground and belowground tree biomass. Justification for the inclusion or exclusion of these and other carbon pools and emission sources is provided in Table 2.

Carbon pool/emission source	Included/excluded	Justification
Aboveground tree biomass	Included	The main carbon pool expected to be impacted by a project intervention
Belowground tree biomass	Included	A major carbon pool expected to be impacted by a project intervention
Aboveground non-tree biomass	Excluded*	Not significantly impacted by a project intervention
Belowground non-tree biomass	Excluded	Not significantly impacted by a project intervention
Litter	Excluded	May increase as a result of a project intervention. Conservatively excluded
Deadwood	Excluded	May increase as a result of a project intervention. Conservatively excluded. The baseline scenario is limited to cropland and degraded land, so there is no potential for removal in this pool
Soil organic carbon	Excluded	Expected to increase as a result of a project intervention. Conservatively excluded. It may be included in future versions of the methodology
Harvested wood products	Excluded	May increase as a result of a project intervention. Conservatively excluded. The baseline scenario is limited to cropland and degraded land, so there is no potential for removal in this pool
Fossil fuel use	Excluded	Not significantly impacted by a project intervention. The use of heavy machinery is excluded
Fertilizers	Excluded	Emissions from this source will be unaffected or reduced by a project intervention, which prohibits any increase in synthetic fertilizer use

*Table 2. Carbon pools and emissions sources * = Note: Non-tree biomass that exceeds 2m in height or more than 2.5cm in DBH may affect the reflectance values of satellite imagery, which will contribute to error in tree biomass estimates, but carbon stocks in non-tree biomass will not be quantified.*

6 Carbon baseline

Following the approach described in AR-TOOL14 v4.2, the carbon stock in aboveground and belowground biomass of pre-project trees can be set at zero in the baseline scenario if:

- The pre-project trees are not harvested, cleared, or removed during the crediting period of the project intervention.
- The pre-project trees do not perish as a result of competing with trees planted in the project or are damaged by project activities, at any time during the crediting period of the project intervention.
- The pre-project trees are not inventoried along with the project trees in the monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the project intervention.

For project areas that meet these conditions, baseline removals in all years are assumed to be zero.

If the approach used to monitor tree biomass does not allow for the exclusion of any increase in tree biomass that occurs from the growth of pre-project trees (for example when using remote sensing imagery for monitoring), the conditions that allow for a change in carbon stock to be assumed as zero cannot be met. In these cases, an adjustment for biomass increase in pre-project trees must be applied, as described below.

If the potential change in pre-project tree biomass is less than 5% of the expected increase in tree biomass expected to result from the project intervention, estimated using an appropriate tree or stand growth models, the carbon stock aboveground and belowground biomass of pre-project trees can be set at zero in the baseline scenario. Otherwise, measurements from sample plots must be used to define an appropriate adjustment factor with Equation 1 to Equation 3 and Table 3. The sample plot data used must allow for distinction between pre-project trees and trees planted as part of the intervention. In project regions where pre-project tree biomass varies substantially between plots (e.g. by more than 10%) calculating a separate adjustment factor for each stratum is likely to reduce the number of samples required to obtain an acceptable level of precision. A minimum of 30 randomly selected sample plots must be measured per stratum. Projects may further stratify or use $y-1$ to optimize measurement.

$$EETB_{y,s} = \frac{\sum_{i=1}^n \left(\frac{(ETB_{y,s} - ETB_{y,s=0})}{(TB_{y,s} - ETB_{y,s=0})} \cdot 100 \right)_i}{n}$$

Equation 1

Where:

$EETB_{y,s}$ = Estimated percentage change in tree biomass in year y that is attributed to pre-project trees, for plots in stratum s

- $ETB_{y,s}$ = Existing tree biomass in sample plot in stratum s , y years after the start of the project intervention (t CO₂eq)
- $ETB_{y,s=0}$ = Existing tree biomass in sample plot in stratum s at the start of the project intervention (t CO₂eq)
- $TB_{y,s}$ = Tree biomass in sample plot in stratum s , y years after the start of the project intervention in the sample plot (t CO₂eq).
- n = Number of sample plots in stratum s

$$U_{EETB_{y,s}} = \frac{1.645 \cdot \sigma}{\sqrt{n}} \cdot \frac{1}{EETB_{y,s}}$$

Equation 2

Where:

- $U_{EETB_{y,s}}$ = Percentage uncertainty of $EETB_{y,s}$ at a 90% confidence level
- σ = Standard deviation of $\left(\frac{(ETB_{y,s} - ETB_{y=0,s})}{(TB_{y,s} - ETB_{y=0,s})} \cdot 100 \right)_i$ for all sample plots within stratum s
- n = Number of sample plots in stratum s

$$AdjU_{EETB_{y,s}} = 0.25 \cdot (U_{EETB_{y,s}} - 0.5)$$

Equation 3

Where:

- $AdjU_{EETB_{y,s}}$ = Adjustment for the uncertainty of $EETB_{y,s}$

Estimated change in existing tree biomass in stratum s after adjustment for uncertainty ($EETB_{y,s} + AdjU_{EETB_{y,s}}$)	Adjustment factor for baseline removal for plots in stratum s ($AdjB_s$)
$(EETB_{y,s} + AdjU_{EETB_{y,s}}) \leq 10\%$	0%
$10\% < (EETB_{y,s} + AdjU_{EETB_{y,s}}) \leq 25\%$	10%
$25\% < (EETB_{y,s} + AdjU_{EETB_{y,s}}) \leq 50\%$	25%
$50\% < (EETB_{y,s} + AdjU_{EETB_{y,s}}) \leq 75\%$	50%
$75\% < (EETB_{y,s} + AdjU_{EETB_{y,s}}) \leq 90\%$	70%
$(EETB_{y,s} + AdjU_{EETB_{y,s}}) > 90\%$	100%

Table 3. Overview of the baseline removal adjustment factor

7 Project carbon removal

This section of the methodology describes how carbon models to measure tree biomass using satellite imagery are developed (see Section 7.1) and applied (see Section 7.2). All carbon models are developed from a combination of sample plot measurements and satellite imagery and are specific to an ecoregion.

Carbon removals from project interventions in each plot, for each year of the crediting period, are calculated as shown in Equation 4.

$$PR_y = \Delta TB_y$$

Equation 4

Where:

PR_y	= Carbon removal for a plot in year y (t CO ₂ eq)
ΔTB_y	= Change in carbon stock in aboveground and belowground tree biomass in year y (t CO ₂ eq) after uncertainty discount

7.1 Model development

7.1.1 Sample plots for ground-truth data collection

Data from sample plots are used to calibrate models for estimating tree biomass from satellite imagery. Sample plots used for model calibration must meet the following requirements:

1. Aboveground and belowground biomass of trees >2m in height or with a DBH of more than 2.5 cm must be measured. For all vegetation of <2m, an inventory list should be collected naming the quantity and species.
2. Sample plots must be within the same ecoregion and with land use similar to that of the plots to which the model will be applied.
3. The location of sample plots must be selected at random from sites that meet the applicability conditions
4. Tree biomass within sample plots can be measured using:
 - The fixed area plot methodology described in Annex 1 of the *Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities* (AR-TOOL14, v.4.2)
 - The Acorn Standard Operating Procedures for Tree Inventory Plot Establishment and Measurement (Annex 3).
 - Airborne or terrestrial LiDAR survey that meets the minimum requirements set out in Annex 4.

7.1.2 Remote sensing imagery

Sources of satellite imagery that can be used include, but are not limited to, those given in Table 4 below. The *minimum* required spatial resolution is 30 m (as currently available with Landsat 8 products). The recommended resolution is 10 m or higher (as currently available with Sentinel-2a and b). Satellite imagery with resolution coarser than 30 m (e.g. MODIS 250m products) cannot be used. For all satellite imagery used, established approaches for pre-processing satellite data must be applied to ensure adequate data quality for estimating aboveground tree biomass, for example, to correct for terrain and cloud effects. The desired temporal resolution for satellite imagery is 1 or more cloud-free observations per 10-day period. For monitoring, at least one cloud-free image every two months must be available so that a minimum of 6 images are available to estimate biomass per year.

Source	Application
Multispectral satellite information	Sentinel-2 is a multispectral imaging mission from the European Space Agency which samples 13 spectral bands with a revisit time of 5 days at the equator. One of the mission objectives is the monitoring and detection of land change ⁶ . Several parameters are derived from this data to increase the performance of the modelled biomass by validating vegetation presence and vegetation change on the plot. These parameters include the normalized difference vegetation index (NDVI), the fraction of absorbed photosynthetically active radiation (fAPAR), and the leaf area index (LAI). Sentinel-2 offers a higher revisit time and resolution data than NASA's Landsat mission, but Landsat will be used for calibration of existing agroforestry that is older than 2015 (when Sentinel-2 was launched).
LiDAR	This technology uses laser light to create a 3D representation of the Earth's surface (or objects). Any type of LiDAR data (including terrestrial and space-borne) can be considered, but due to feasibility and availability, the focus is currently on airborne LiDAR. LiDAR is used only for the validation of ground truth data, and this data is not part of model building. Wang et al. (2019) pointed out that compared to airborne LiDAR, field measurements are more sensitive to stand complexity, crown classes, and species. Overall, field measurements tend to overestimate the height of tall trees, especially tall trees in the codominant crown class. In dense stands, high uncertainties also exist in the field measured heights for small trees in the intermediate and suppressed crown class. However, any validation using LiDAR will not replace ground measurements. Satellite-based LiDAR (GEDI) may be used in model building, although it is tested for its value to future model development.
Future satellite missions	The ESA's Biomass mission should be launched in 2022 and will be the first mission to use P-band synthetic aperture radar (SAR) measurements to determine biomass and carbon amounts stored in forests ⁷ . This technology and the data it generates will be very useful for estimating biomass and carbon in dense vegetation. Another future mission, NISAR, is also set to launch in 2022. From NASA and the Indian Space Research Organisation (ISRO), this mission comprises L-band and S-band polarimetric synthetic aperture radar to monitor biomass, with a 6-day sampling time. As NISAR will be suitable for low-density vegetation ⁸ , it will complement the Biomass mission.

Table 4. Overview of satellite data sources

⁶ [ESA - Sentinel-2](#)

⁷ https://www.esa.int/Applications/Observing_the_Earth/Biomass

⁸ [Ecosystems | Science – NASA-ISRO SAR Mission \(NISAR\)](#)

The two preferred satellite platforms are Sentinel-2a and b and Landsat 8 and 9. These platforms, if and when they go offline, will be followed by a launch of new platforms. These platforms have an operational lifetime between 12-20 years, as guaranteed by ESA and NASA. If and when they go offline, they will be followed by new and improved satellite missions, which will be compatible and transferable; such launches are planned by both space agencies.

7.1.3 Model calibration and uncertainty assessment

Machine learning models for estimating tree biomass from satellite imagery must be calibrated using sample plot data for each ecoregion they are applied to. A minimum of 30 sample plots⁹ must be used to calibrate the model for each eco-region, and a further set of at least 20 sample plots that are not used for model calibration must be used to assess model uncertainty. The number of plots used for model calibration and accuracy assessment should be determined based on data availability, variability in the landscape and the desired level of precision.

Model calibration must use six months of composite images, combined using moving averages. At least one pixel must be fully contained within each sample plot used for model calibration. Pixels that have centroid outside the sample plot boundaries are excluded. If multiple pixels fall within the sample plot boundaries, the median value is used for model development.

Model performance must be assessed by calculating model performance (R^2), and model error (MAPE and RMSE) based on a testing set of sample plots that are not used for model calibration¹⁰. *The mean absolute percentage error (MAPE) is calculated as shown in Equation 5*

$$MAPE = \frac{1}{n} \cdot \sum_{i=0}^n \frac{|\hat{y}_i - y_i|}{y_i}$$

Equation 5

Where:

<i>MAPE</i>	= Mean absolute percentage error
y_i	= Measured value of tree biomass within sample plot i (tC)
\hat{y}_i	= Value of tree biomass within sample plot i estimated from satellite imagery (tC)
n	= Total number of sample plots

After the model performance has been quantified, the uncertainty of model predictions can be quantified in terms of confidence intervals, which should be estimated in conjunction with the point estimates \hat{y}_i as part of the modelling output.

⁹ Corder & Foreman, 2009

¹⁰ R^2 and RMSE are regular output of model validation and therefore not mentioned as a separate equation.

7.1.4 *Model validation*

Independent validation of each new model must be performed before it is accepted for use in the production environment. Model validation is a two-step approach.

7.1.4.1 *Independent model validation*

All models used for measuring tree biomass must be validated by an independent legal body that will perform a due diligence and model assessment of the model IP owner (remote sensing partner). The remote sensing partner is not obliged to share details of its IP, but is required to demonstrate the integrity of its processes and data handling.

7.1.4.2 *Internal validation*

A validation dataset should be based on at least 20 randomly selected sample plots that are not used for model calibration or uncertainty assessment. This validation dataset must not be shared with the remote sensing partners that develop the model until model development is complete. The validation dataset must be representative of the sites to which the model will be applied and must conform to the requirements in Section 7.1.1.

After the models are developed, the validation dataset should be shared with the remote sensing partner, which is then asked to apply the model and make biomass estimates.

MAPE, R² and RMSE are calculated using the validation data set and confidence interval to evaluate which model is suitable and accurate for use. 10% of the plots in the validation set can be removed as outliers, the remaining 90% is used for the calculation.

Model performance must be evaluated at least every 5 years during a project's crediting period. This evaluation is performed using MAPE, R² and RMSE as described above. Every new or optimized model, whether improved or with modified accuracy from the current model in place, must be evaluated following the same procedure.

7.1.5 *Accuracy criteria*

The accuracy criteria is based on the withheld validation dataset. The expected accuracy of the model is 70% (with an uncertainty of 30%), calculated on 90% of the validation set. If multiple remote sensing partners are building models for the same ecoregion, the model with the lowest uncertainty is selected for use.

7.2 Model application

7.2.1 Estimating tree biomass at a point in time

Aboveground biomass is estimated using a machine learning model. The model is applied to satellite imagery acquired at the time of farmer onboarding (or when required). The model makes an estimate of the total biomass within the plot. The pre-processing of the satellite data must be conducted as stated in Section 7.1.1.

The model can only be applied if the plot is within the relevant ecoregion and applies a project intervention, that the model was calibrated for. If models are unavailable for a particular region, as an alternative, it is also possible to estimate biomass using the ground-truth data approach.

7.2.2 Estimating change in tree biomass between two points in time

If a suitable model or measuring tree biomass with satellite imagery is not available, sample plots can be used to estimate tree biomass in a plot directly. In this case, the approach for estimating a change in tree biomass between two points in time, as described in Section 6.1 of the *Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (AR-TOOL 14 v4.2)*, must be applied. This approach estimates the change in carbon stock in trees as the difference between two successive and independent carbon stock estimates. If tree biomass is estimated using satellite imagery, change in tree biomass must be calculated using Equation 6

$$\Delta TB_{y,s} = (AGB_y - AGB_{y-1}) \cdot (1 + R) \cdot CF \cdot \frac{44}{12} \cdot (1 - AdjU)$$

Equation 6

Where:

$\Delta TB_{y,s}$	= Change in carbon stock in aboveground and belowground tree biomass in stratum s , in year y (t CO ₂ eq) after uncertainty discount
AGB_y	= Aboveground tree biomass per plot in year y (metric tons of dry matter)
AGB_{y-1}	= Aboveground tree biomass per plot in year $y-1$ (metric tons of dry matter)
R	= Root-shoot ratio to calculate the belowground biomass factor
CF	= Carbon fraction of tree biomass
$\frac{44}{12}$	= Conversion from carbon to carbon dioxide
$AdjU$	= Adjustment factor for uncertainty

If no transparent and verifiable information on local project values is available to justify a particular root-shoot ratio, the root-shoot ratio is determined per ecoregion as determined by IPCC 2006 (see Annex 5) or otherwise, a default value of 0.32¹¹ will be applied. The carbon fraction has a default value of 0.47¹² and is used unless transparent and verifiable information can be provided to justify a different value.

If aboveground biomass in a plot is estimated using satellite imagery, the uncertainty in the temporal change of the aboveground biomass in a plot can be calculated using Equation 7 and Equation 8. Using the value of U_y , the appropriate uncertainty adjustment factor () must be selected from Table 5 below.

$$U_y = \frac{\sqrt{(u_{y-1} \cdot AGB_{y-1})^2 + (u_y \cdot AGB_y)^2}}{|(AGB_y - AGB_{y-1})|}$$

Equation 7

Where:

U_y	= Uncertainty for AGB change estimated in year y
AGB_y	= Aboveground biomass per plot in year y (metric tons of dry matter)
AGB_{y-1}	= Aboveground biomass per plot in year $y-1$ (metric tons of dry matter)
u_y	= Uncertainty for AGB estimated in year y
u_{y-1}	= Uncertainty for AGB estimated in year $y-1$

The variable u_y is calculated using Equation 8:

$$u_y = \frac{CI_y}{AGB_y}$$

Equation 8

Where:

u_y	= Uncertainty for AGB point estimate in year y
CI_y	= Half-width of a 90% confidence interval
AGB_y	= Aboveground biomass per plot in year y (metric tons of dry matter)

The confidence interval is provided by the remote sensing partner and is determined during model development.

¹¹ [Kim, Kirschbaum & Beedy, 2016](#)

¹² [UNFCCC, 2015](#)

Uncertainty ($U_{y,s}$)	Uncertainty adjustment factor ($AdjU$)
$U_y \leq 50\%$	0%
$50\% < U_y \leq 75\%$	5%
$75\% < U_y \leq 100\%$	15%
$100\% < U_y \leq 150\%$	25%
$150\% < U_y \leq 200\%$	40%
$200\% < U_y \leq 300\%$	60%
$300\% < U_y \leq 400\%$	90%
$U_y > 400\%$	100%

Table 5. Overview of uncertainty adjustment factors based on confidence interval.

8 Leakage

The likelihood of activity shifting leakage (displacement of farmer activity leading to an increase in emissions outside the project area) must be assessed using Equation 9 to determine an appropriate leakage adjustment. To come up with a conservative deduction, the following three parameters are evaluated: i) which activities may be displaced? ii) where would the activity be displaced to? and iii) what amount of emissions would be associated with the displacement? Market leakage from changes in production by smallholders is not expected to be significant and is assumed to be zero.

$$AdjL = P \cdot A \cdot LF \cdot 100$$

Equation 9

Where:

<i>AdjL</i>	= Adjustment factor for leakage (percentage)
<i>P</i>	= The estimated reduction in productivity that will result from the project intervention, as a percentage of the productivity expected in the baseline scenario. If no change or an increase in productivity is expected, the score should be 0%
<i>A</i>	= The proportion of the project area used to produce the most important product, or carry out the activity, that contributes to productivity in the baseline scenario, e.g. if half the plot is used to grow a specific crop the score should be 0.5
<i>LF</i>	= Leakage factor for the type of land that production will be likely to shift to as a result of the project intervention: cropland or degraded land is 0 and forest land or wetland or organic soils ¹³ is 1

¹³ [PCC GPG LULUCF \(iges.or.jp\)](http://PCC.GPG.LULUCF(iges.or.jp))

9 Quantification of carbon benefits

Carbon removal is calculated for each year of the crediting period using Equation 10

$$CB_y = PR_y \cdot \frac{1}{1 + BP} \cdot (1 - AdjB_s) \cdot (1 - AdjL)$$

Equation 10

Where:

- CB_y = Carbon benefit for a plot in year y (t CO₂eq)
- PR_y = Carbon removal for a plot in year y (t CO₂eq)
- BP = Buffer pool percentage
- $AdjB_s$ = Adjustment factor for baseline removal for plots in stratum s
- $AdjL$ = Adjustment factor for leakage

Only a positive change compared to the previous highest AGB calculation during the project intervention is considered. No negative change at plot level is accounted for (see Figure 1 below).

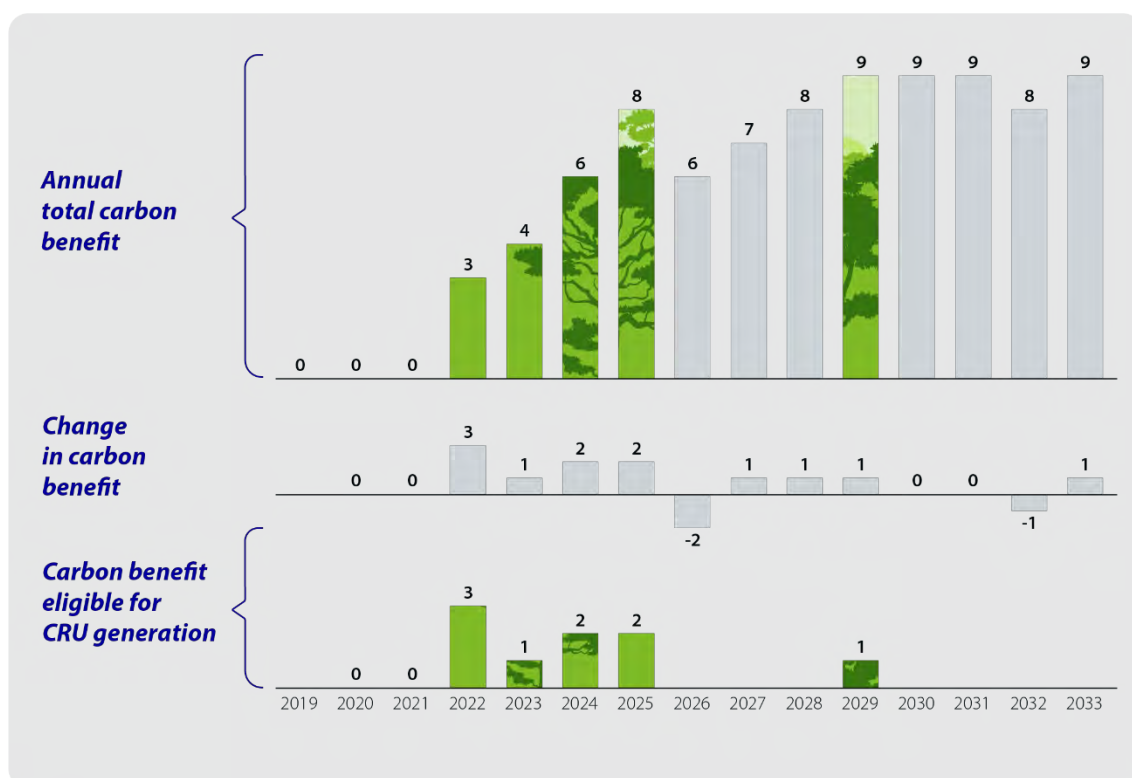


Figure 1. Carbon benefit calculation

10 Data and parameters

10.1 Data and parameters available at validation

Data / parameter:	$ETB_{y=0,s}$
Data unit:	t CO ₂ eq
Description:	Existing tree biomass in sample plot in stratum <i>s</i> at the start of the project intervention
Equations	<i>Equation 1</i>
Source of data:	Survey of sample plots defined by type of project intervention, time since establishment of the intervention, and pre-project tree biomass or analysis of satellite imagery.
Description of measurement methods and procedures to be applied:	The Acorn Standard Operating Procedures for Tree Inventory Plot Establishment and Measurement (Annex 3); or fixed area plot methodology that is described in Annex 1 of the Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (AR-TOOL14 v.4.2); or another established SOP that follows international best-practice in plot measurements. Or see Section 7.2.
Frequency of monitoring/recording:	Once at the start of the project intervention in the Sample Plot
Purpose of data:	Calculation of the baseline removal adjustment factor to account for change in pre-project tree biomass in the baseline scenario
Calculation method:	Sum of above and below ground biomass of all pre-project trees within the Sample Plot
Comments:	Only required for plots where change in biomass of trees cannot be estimated as zero in the baseline scenario
Data / parameter:	<i>R</i>
Data unit:	No unit
Description:	Root-shoot ratio for belowground biomass factor
Equations	<i>Equation 6</i>
Source of data:	Determined by local data project value or ecological zones (Ravindranath & Ostwald, 2008) or otherwise, a default value of $R=0.32$ (Kim, Kirschbaum & Beedy, 2016) unless transparent and verifiable information can be provided to justify a different value
Description of measurement methods and procedures to be applied:	N/A

Frequency of monitoring/recording:	Once at start of project. Can be updated at time of verification
Purpose of data:	Estimation of belowground biomass contribution
Calculation method:	N/A
Comments:	N/A
Data / parameter:	<i>CF</i>
Data unit:	No unit
Description:	Carbon fraction of tree biomass
Equations	<i>Equation 6</i> Equation 6
Source of data:	<u>UNFCCC, 2015</u>
Description of measurement methods and procedures to be applied:	N/A
Frequency of monitoring/recording:	Once at start of project. Can be updated at time of verification
Purpose of data:	Estimation of carbon stocks in tree biomass
Calculation method:	N/A
Comments:	N/A
Data / parameter:	<i>P</i>
Data unit:	No unit
Description:	The estimated reduction in productivity will result from the project intervention, as a percentage of the productivity expected in the baseline scenario. If no change or an increase in productivity is expected, the score should be 0%
Equations	<i>Equation 9</i> Equation 9
Source of data:	Analysis of the business case and baseline scenario
Description of measurement methods and procedures to be applied:	N/A
Frequency of monitoring/recording:	Once at the start of a project. Can be updated at the time of validation
Purpose of data:	Calculation of the leakage adjustment factor to account for a potential increase of emissions outside the project area
Calculation method:	Sum of activity leakage parameters
Comments:	N/A
Data / parameter:	<i>A</i>

Data unit:	No unit
Description:	The proportion of the project area used to produce the most important product, or carry out the activity, that contributes to productivity in the baseline scenario, e.g. if half the plot is used to grow a specific crop the score should be 0.5
Equations	<i>Equation 9</i>
Source of data:	Analysis of the business case and baseline scenario
Description of measurement methods and procedures to be applied:	N/A
Frequency of monitoring/recording:	Once at the start of a project. Can be updated at the time of validation
Purpose of data:	Calculation of the leakage adjustment factor to account for a potential increase of emissions outside the project area
Calculation method:	Sum of project area proportions
Comments:	N/A

Data / parameter:	<i>LF</i>
Data unit:	No unit
Description:	Leakage factor for the type of land that production will be likely to shift to as a result of the project intervention: cropland or degraded land is 0 and forest land or wetland or organic soils is 1
Equations	<i>Equation 9</i>
Source of data:	Analysis of the baseline scenario
Description of measurement methods and procedures to be applied:	N/A
Frequency of monitoring/recording:	Once at the start of a project. Can be updated at the time of validation
Purpose of data:	Calculation of the leakage adjustment factor to account for a potential increase of emissions outside the project area
Calculation method:	N/A
Comments:	N/A

10.2 Data and parameters monitored

Data / parameter:	$ETB_{y,s}$
Data unit:	t CO ₂ eq
Description:	Existing tree biomass in sample plot in stratum s , y years after the start of the project intervention
Equations	<i>Equation 1</i>
Source of data:	Survey of sample plots defined by the type of project intervention, time since the establishment of the intervention, and pre-project tree biomass
Description of measurement methods and procedures to be applied:	Similar to measurement of $ETB_{y=0,s}$ but additional inventory procedures must distinguish between pre-project trees and those established since the start of the project intervention within the sample plot
Frequency of monitoring/recording:	Periodically throughout the crediting period
Purpose of data:	Calculation of the baseline removal adjustment factor to account for a change in pre-project tree biomass in the baseline scenario
Calculation method:	Sum of aboveground and below ground biomass of all pre-project trees within the sample plot
Comments:	Only required for plots where a change in biomass of trees cannot be estimated as zero in the baseline scenario
Data / parameter:	$TB_{y,s}$
Data unit:	t CO ₂ eq
Description:	Tree biomass in sample plot in stratum s , y years after the start of the project intervention in the sample plot
Equations	<i>Equation 1</i>
Source of data:	Analysis of satellite imagery or survey of sample plots
Description of measurement methods and procedures to be applied:	As described in Section 7; or the Acorn Standard Operating Procedures for Tree Inventory Plot Establishment and Measurement (Annex 3); or as described in Annex 1 of the <i>Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities</i> (AR-TOOL14 v.4.2); or another established SOP that follows international best practice in plot measurement
Frequency of monitoring/recording:	Periodically throughout the crediting period
Purpose of data:	Calculation of the baseline removal adjustment factor to account for a change in pre-project tree biomass in the baseline scenario
Calculation method:	Sum of above and below ground biomass of all trees within the sample plot

Comments:	Only required for plots where a change in biomass of trees cannot be estimated as zero in the baseline scenario
Data / parameter:	y_i
Data unit:	tC
Description:	The measured value of tree biomass within sample plot i
Equations	Equation 5
Source of data:	Sample plot
Description of measurement methods and procedures to be applied:	Fixed area plot methodology as described in Annex 1 of the <i>Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (AR-TOOL14 v.4.2)</i> ; the Acorn Standard Operating Procedures for Tree Inventory Plot Establishment and Measurement (Annex 3); or another established SOP that follows international best practice in plot measurement
Frequency of monitoring/recording:	Before each verification
Purpose of data:	Development and performance assessment of model for estimating tree biomass from satellite imagery
Calculation method:	As described in SOP adopted
Comments:	N/A
Data / parameter:	\hat{y}_i
Data unit:	tC
Description:	Value of tree biomass within sample plot i estimated from satellite imagery
Equations	Equation 5
Source of data:	Analysis of satellite imagery
Description of measurement methods and procedures to be applied:	Section 7
Frequency of monitoring/recording:	Before each verification
Purpose of data:	Development and performance assessment of model for estimating tree biomass from satellite imagery
Calculation method:	Section 7
Comments:	N/A

Data / parameter:	$AGB_y; AGB_{y-1}$
Data unit:	metric tons of dry matter
Description:	Aboveground tree biomass per ha in year y ; aboveground tree biomass per ha in year $y-1$
Equations	Equation 6
Source of data:	Survey of sample plots or analysis of satellite imagery
Description of measurement methods and procedures to be applied:	Section 7.2
Frequency of monitoring/recording:	Annually, or at least every 3 years
Purpose of data:	Estimation of project removals
Calculation method:	Section 7.2
Comments:	N/A

Data / parameter:	$u_y; u_{y-1}$
Data unit:	metric tons of dry matter
Description:	Uncertainty for AGB point estimate in year y ; uncertainty AGB point estimate in year $y-1$
Equations	Equation 7
Source of data:	Analysis of satellite imagery
Description of measurement methods and procedures to be applied:	Section 7.2
Frequency of monitoring/recording:	Before each verification.
Purpose of data:	Estimating uncertainty of change in aboveground biomass
Calculation method:	Section 7.2
Comments:	N/A

Data / parameter:	CI_y
Data unit:	metric tons of dry matter
Description:	Half width of a 90% confidence interval
Equations	Equation 8
Source of data:	Analysis of satellite imagery
Description of measurement	Section 7.2

methods and procedures to be applied:

Frequency of monitoring/recording: Before each verification

Purpose of data:

Estimating uncertainty of change in aboveground biomass

Calculation method: Section 7.2

Comments: N/A

Data / parameter: *BP*
Data unit: No unit

Description: Buffer pool percentage

Equations *Equation 10*
Source of data: Coverage ratio and Acorn Framework

Description of measurement methods and procedures to be applied: N/A

Frequency of monitoring/recording: Once at the start of a project. Can be updated at the time of verification

Purpose of data: Carbon removal buffer for reversal events

Calculation method: N/A

Comments: N/A

 *This parameter may be used but is only necessary for projects under the Acorn program

Data / parameter: Biodiversity

Data unit: No unit

Description: A count of crops species and animal breeds shall be used to calculate a Gini-Simpson index of diversity for both crops and animals

Equations N/A

Source of data: A survey amongst a group of sampled farmers should be conducted on a frequent basis to track changes in the biodiversity situation of a project.

Description of measurement methods and procedures to be applied: Species and animals are counted and the numbers are reported in the survey

Frequency of monitoring/recording: Sample based once every 3 years

Purpose of data:	Determine the Gini-Simpson index to indicate the appropriate biodiversity category and allow for comparison amongst projects and operational years
Calculation method:	Multiple species count with related livestock equivalent ¹⁴ . Monitoring templates can be requested from Acorn
Comments:	Please note that this parameter is only necessary for project applying under the Acorn program. More information about the monitoring requirements can be found in the Acorn Framework Section 5.4 Project baseline available via the Acorn website
*This parameter may be used but is only necessary for projects under the Acorn program	
Data / parameter:	Soil disturbance
Data unit:	Ha
Description:	If projects operate on considered high organic soils, the land should be taken care of caution (i.e. limited digging)
Equations	N/A
Source of data:	The SoilGrid ¹⁵ of ISRIC
Description of measurement methods and procedures to be applied:	Sample-based check if extensive soil disturbance activities have taken place e.g. ploughing, ripping, scarification, digging of pits and trenches, stump removal
Frequency of monitoring/recording:	Sampled validation and verification checks. Very unlikely, but only if projects operate on high organic soils. Agroforestry system growth models allow to validate and verify the appropriate implementation of the agroforestry system respecting the soil disturbance limitations
Purpose of data:	Avoid projects to transition to agroforestry on land that already contains high carbon stock and this transition causes emission loss rather than additional storage
Calculation method:	N/A
Comments:	Please note that this parameter is only necessary for a project applying under the Acorn program. More information about the monitoring requirements can be found in the Acorn Framework Section 5.4 Project baseline available via the Acorn website

Table 6. Overview of parameters

¹⁴ [Glossary: Livestock unit \(LSU\) - Statistics Explained \(europa.eu\)](#)

¹⁵ [ISRIC — World Soil Information](#)

Annex 1 Organic soils

As per IPCC (2006), soils are characterized as organic if the following characteristics are met 1 and 2, or 1 and 3 (FAO, 1998).

1. Thickness of 10 cm or more. A horizon less than 20 cm thick must have 12 percent or more organic carbon when mixed to a depth of 20 cm;
2. If the soil is never saturated with water for more than a few days, and contains more than 20 percent (by weight) organic carbon (about 35 percent organic matter);
3. If the soil is subject to water saturation episodes and has either:
 - I.) At least 12 percent (by weight) organic carbon (about 20 percent organic matter) if it has no clay; or
 - II.) At least 18 percent (by weight) organic carbon (about 30 percent organic matter) if it has 60 percent or more clay; or
 - III.) An intermediate, proportional amount of organic carbon for intermediate amounts of clay.

Annex 2 Soil disturbance

Region	Land use	Management	Inputs
Boreal	Long-term cultivated cropland	Full tillage	High with manure
		Reduced tillage	High with manure
		No-till	High without manure
	High with manure		
	Short-term or set aside cropland	Full tillage	High with manure
		Reduced tillage	High with manure
No-till		High without manure	
		High with manure	
Temperate, cold, dry	Long-term cultivated cropland	Full tillage	High with manure
		Reduced tillage	High with manure
		No-till	High with manure
	Short-term or set aside cropland	Full tillage	High with manure
		Reduced tillage	High with manure
		No-till	Medium
High without manure			

Region	Land use	Management	Inputs
Temperate, cold, moist	Long-term cultivated cropland	Reduced tillage	High with manure
		No-till	High with manure
	Short-term or set aside cropland	Full tillage	High with manure
		Reduced tillage	High with manure
		No-till	High without manure
			High with manure
Temperate, warm, dry	Long-term cultivated cropland	Full tillage	High with manure
		Reduced tillage	High with manure
		No-till	High with manure
	Short-term or set aside cropland	Full tillage	High with manure
		Reduced tillage	High with manure
		No-till	Medium High without manure
Temperate, warm, moist	Long-term cultivated cropland	Reduced tillage	High with manure
		No-till	High with manure
	Short-term or set aside cropland	Full tillage	High with manure
		Reduced tillage	High with manure
		No-till	High without manure
			High with manure
Tropical, dry	Short-term or set aside cropland	Full tillage	High with manure
		Reduced tillage	Medium
			High without manure
			High with manure
	No-till	All	
Tropical, moist	Short-term or set aside cropland	Full tillage	High with manure
		Reduced tillage	High without manure

Region	Land use	Management	Inputs
		No-till	High with manure
			High without manure
			High with manure
Tropical, montane	Long-term cultivated cropland	No-till	High with manure
	Short-term or set aside cropland	Full tillage	High with manure
		Reduced tillage	High without manure
			High with manure
		No-till	Medium
			High without manure
Tropical, wet	Short-term or set aside cropland	Full tillage	High with manure
		Reduced tillage	High without manure
			High with manure
		No-till	High without manure
			High with manure

Temperature / Moisture Regime	Management	Inputs
Boreal	Improved	All
	Non-degraded	All
	Moderately degraded	High
Temperate, cold, dry	Improved	All
	Non-degraded	All
	Moderately degraded	High
Temperate, cold, moist	Improved	All
	Non-degraded	All
	Moderately degraded	High
Temperate, warm, dry	Improved	All
	Non-degraded	All
	Moderately degraded	High
Temperate, warm, moist	Improved	All
	Non-degraded	All
	Moderately degraded	High
Tropical, dry	Improved	All
	Non-degraded	All
Tropical, moist	Improved	All
	Non-degraded	All
	Moderately degraded	High
Tropical, montane	Improved	All
	Non-degraded	All
	Moderately degraded	High
Tropical, wet	Improved	All
	Non-degraded	High
	Moderately degraded	High

Table 7. List of cropland and grassland in which soil disturbance is restricted based upon AR-ACM003 v.2.0

Annex 3 SOP for tree inventory plot establishment and measurement

The plot, sample plot and subplot overview



Figure 2. Graphical representation of a farmer's land property, incl. relevant definitions

1. Land-property: entire land-property of the farmer (excluding roads, houses, timber lots, etc.).
2. Plot (GPS Polygon): A plan figure with straight sides corresponding to the entire land property.
3. Sample Plot: 1 ha plot within the total land property of the farmer.
4. Subplot: a 25x25m subplot that is located within the main plot.
5. 1 hectare: 100x100m of land (during field collection should be located within the land property).

Instructions for obtaining ground-truth measurements for aboveground biomass

1 Download an offline map for identifying coordinates

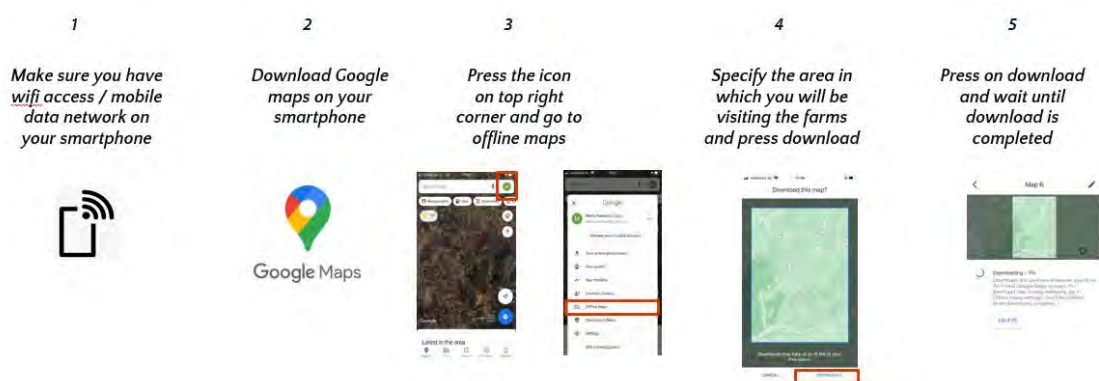


Figure 3. Step-by-step approach for offline map

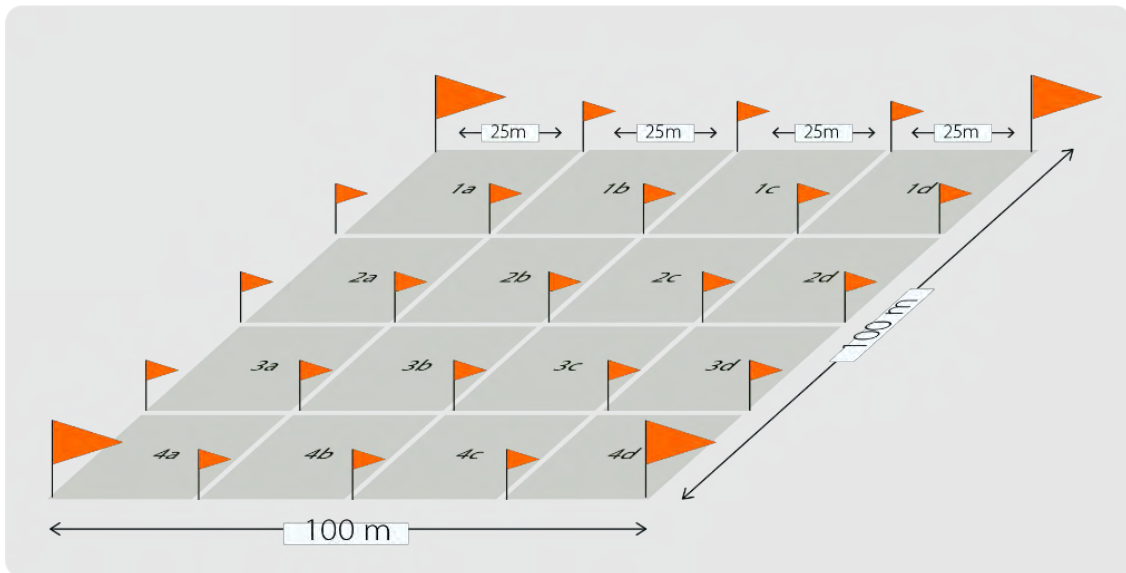


Figure 5. Example of a sample plot

4 Measure trees per subplot

After the subplots are demarcated, the trees are measured in a structured way from west to east and from north to south, working from one side of the subplot to the other. All trees with a DBH of more than 2.5 cm or a height of 2 m should be measured. Once all data on a tree has been gathered, the tree can be marked with chalk which prevents double counting of trees. If a tree is located on the plot border, determine whether the majority of the stem is located in or outside the plot– if within, the tree will be counted and if outside, the tree will not be counted.

For each tree, the scientific species name or common name must be noted. If a species cannot be identified in the field, photographs should be taken of the whole tree, the top and bottom sides of the leaves including the petiole, the trunk of the tree, and, if present, the fruits or flowers. The picture code or exact time when the photographs were taken are recorded to link the tree data to the pictures.

To measure DBH, the circumference (the orange line in Figure 6) of each tree is measured horizontally at a height of 1.3 m using a measuring or diameter tape. The corresponding diameter (blue line in Figure 6) is reported. Figure 7 below illustrates several tree shapes and is followed by a description of how to measure DBH in each of these cases.

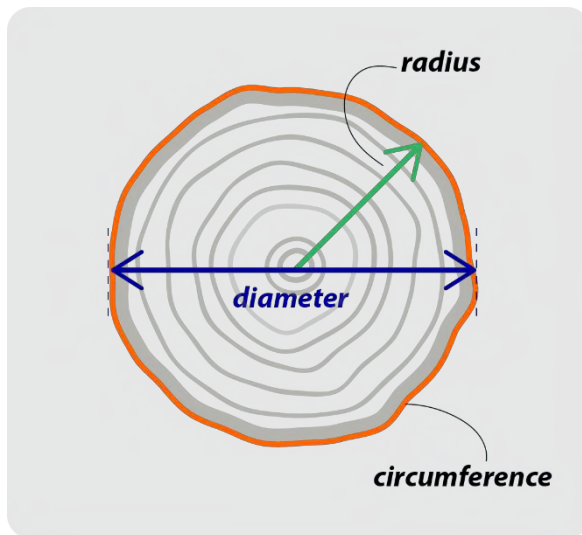


Figure 6. Diameter, circumference, and radius

At least the following information should be reported

Per sample plot

- GPS coordinates (preferably in DD format)
- Name of collector
- Name of farm/farmer
- Date, location

Per subplot

- GPS coordinates (preferably in DD format)
- Per type of tree
 - Height
 - Diameter
 - Scientific name
 - Year planted

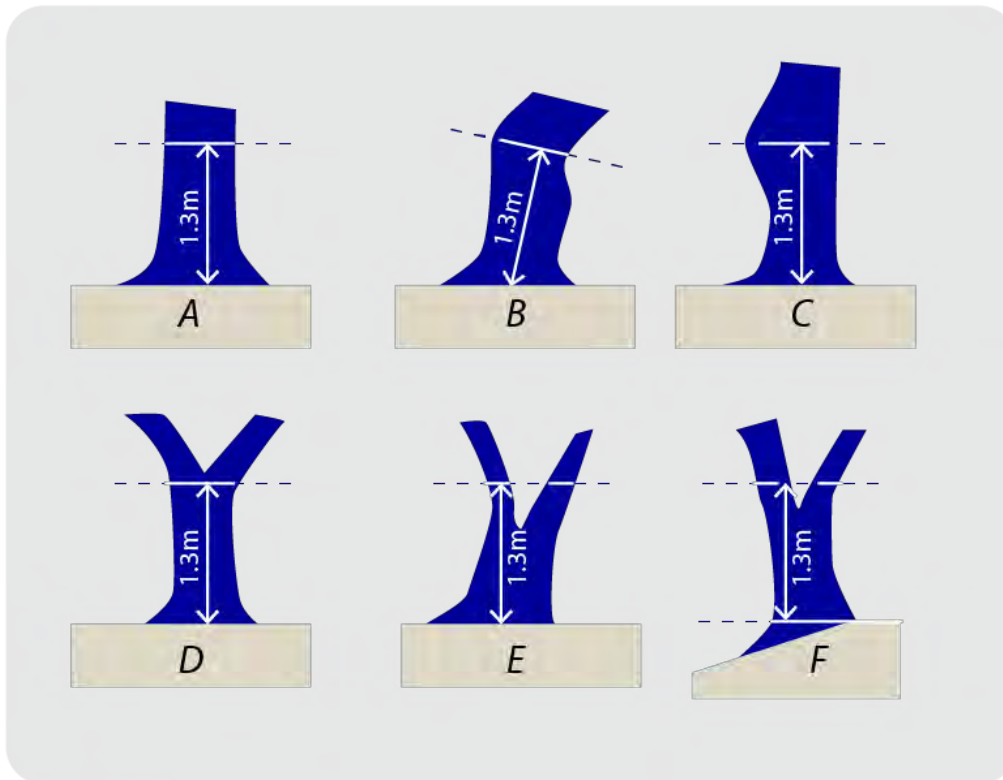


Figure 7. Where to measure DBH on different shapes of trees

- a) Normal tree: Wrap the measuring tape horizontally around the tree.
- b) Bent tree: Wrap the measuring tape around the tree in the shortest way, which is often not horizontal.
- c) Tree with an irregular diameter at 1.3 m: Measure DBH below and above the irregularity and report the average value.
- d) Tree forked above 1.3 m: Measure as a normal tree.
- e) Tree forked below 1.3 m: Measure stems as separate trees.
- f) Tree located on a hill: Measure at 1.3 m height from the highest point of the soil.

Additionally, for each tree, the tree height must be noted. To measure tree height, the use of a laser tool such as a Nikon Forestry Pro Rangefinder is preferred, as it gives the most accurate tree height measurements. If one is not available, estimates of tree height using a ruler can be made according to the method illustrated in Figure 8.

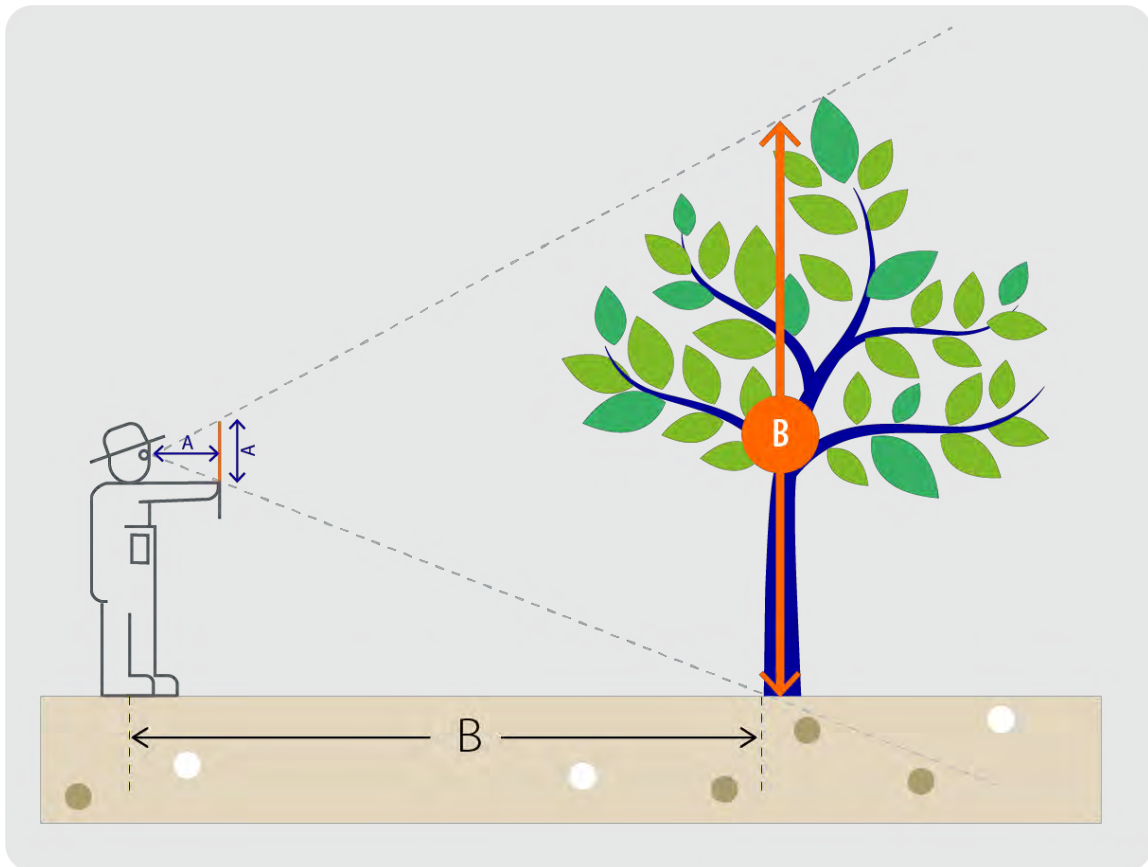


Figure 8. How to measure the height of a tree without a laser measuring tool

1. Measure the horizontal distance from your eye to the hand of your outstretched arm (a).
2. Hold the ruler vertically in front of you. The distance from the top of the ruler to where you hold it must be the same length as the distance from your eye to your hand (a).
3. Walk towards or away from the tree until the tree is visually the same length as the length between the top of the ruler to your hand (a).
4. Mark the location where you are standing and measure the distance from there to the trunk of the tree (b). This distance is roughly the height of the tree (b).

5 Translate tree measurement into AGB

The last step to convert collected data to a biomass value is to apply the aboveground biomass model as developed based on Equation 4 of Chave et.al. (2014). This model takes DBH, tree height, and wood density as variables to estimate the actual biomass.

Annex 4 LiDAR survey requirements

Attribute	Ideal	Minimum
Average point density	20-24 point/m ²	20 points/m ²
LiDAR data platform	Helicopter/aircraft	Helicopter/aircraft
Lateral overlap	60%	30% +/- 3%
Product accuracy	25 cm	10 – 30 cm
Ground control points	Needed, 3-5 ground control points	Yes, 3 ground control points
Processed data products	Georeferenced point cloud, DSM, DTM, orthophoto, contour lines	Georeferenced point cloud, DSM, DTM, orthophoto

Table 8. LiDAR requirements

Annex 5 Root-shoot ratio

Domain	Ecological zone	Above-ground biomass	R [tonne root d.m. (tonne shoot d.m.) ⁻¹]	References
Tropical	Tropical rainforest		0.37	Fittkau and Klinge, 1973
	Tropical moist deciduous forest	above-ground biomass <125 tonnes ha ⁻¹	0.20 (0.09 - 0.25)	Mokany <i>et al.</i> , 2006
		above-ground biomass >125 tonnes ha ⁻¹	0.24 (0.22 - 0.33)	Mokany <i>et al.</i> , 2006
	Tropical dry forest	above-ground biomass <20 tonnes ha ⁻¹	0.56 (0.28 - 0.68)	Mokany <i>et al.</i> , 2006
		above-ground biomass >20 tonnes ha ⁻¹	0.28 (0.27 - 0.28)	Mokany <i>et al.</i> , 2006
	Tropical shrubland		0.40	Poupon, 1980
Tropical mountain systems		0.27 (0.27 - 0.28)	Singh <i>et al.</i> , 1994	
Subtropical	Subtropical humid forest	above-ground biomass <125 tonnes ha ⁻¹	0.20 (0.09 - 0.25)	Mokany <i>et al.</i> , 2006
		above-ground biomass >125 tonnes ha ⁻¹	0.24 (0.22 - 0.33)	Mokany <i>et al.</i> , 2006
	Subtropical dry forest	above-ground biomass <20 tonnes ha ⁻¹	0.56 (0.28 - 0.68)	Mokany <i>et al.</i> , 2006
		above-ground biomass >20 tonnes ha ⁻¹	0.28 (0.27 - 0.28)	Mokany <i>et al.</i> , 2006
	Subtropical steppe		0.32 (0.26 - 0.71)	Mokany <i>et al.</i> , 2006
Subtropical mountain systems		no estimate available		
Temperate	Temperate oceanic forest, Temperate continental forest, Temperate mountain systems	conifers above-ground biomass < 50 tonnes ha ⁻¹	0.40 (0.21 - 1.06)	Mokany <i>et al.</i> , 2006
		conifers above-ground biomass 50-150 tonnes ha ⁻¹	0.29 (0.24 - 0.50)	Mokany <i>et al.</i> , 2006
		conifers above-ground biomass > 150 tonnes ha ⁻¹	0.20 (0.12 - 0.49)	Mokany <i>et al.</i> , 2006
		Quercus spp. above-ground biomass >70 tonnes ha ⁻¹	0.30 (0.20 - 1.16)	Mokany <i>et al.</i> , 2006
		Eucalyptus spp. above-ground biomass < 50 tonnes ha ⁻¹	0.44 (0.29 - 0.81)	Mokany <i>et al.</i> , 2006
		Eucalyptus spp. above-ground biomass 50-150 tonnes ha ⁻¹	0.28 (0.15 - 0.81)	Mokany <i>et al.</i> , 2006
		Eucalyptus spp. above-ground biomass > 150 tonnes ha ⁻¹	0.20 (0.10 - 0.33)	Mokany <i>et al.</i> , 2006
		other broadleaf above-ground biomass < 75 tonnes ha ⁻¹	0.46 (0.12 - 0.93)	Mokany <i>et al.</i> , 2006
		other broadleaf above-ground biomass 75-150 tonnes ha ⁻¹	0.23 (0.13 - 0.37)	Mokany <i>et al.</i> , 2006
		other broadleaf above-ground biomass >150 tonnes ha ⁻¹	0.24 (0.17 - 0.44)	Mokany <i>et al.</i> , 2006
Boreal	Boreal coniferous forest, Boreal tundra woodland, Boreal mountain systems	above-ground biomass <75 tonnes ha ⁻¹	0.39 (0.23 - 0.96)	Li <i>et al.</i> , 2003; Mokany <i>et al.</i> , 2006
		above-ground biomass >75 tonnes ha ⁻¹	0.24 (0.15 - 0.37)	Li <i>et al.</i> , 2003; Mokany <i>et al.</i> , 2006

Table 9. Ratio (R) of belowground biomass to aboveground biomass (metric tons of root dry matter; metric tons of shoot dry matter) From IPCC 2006, Guidelines for National Greenhouse Gas Interventions – Chapter 4 Forest Land, Table 4.4, pp 4.49.

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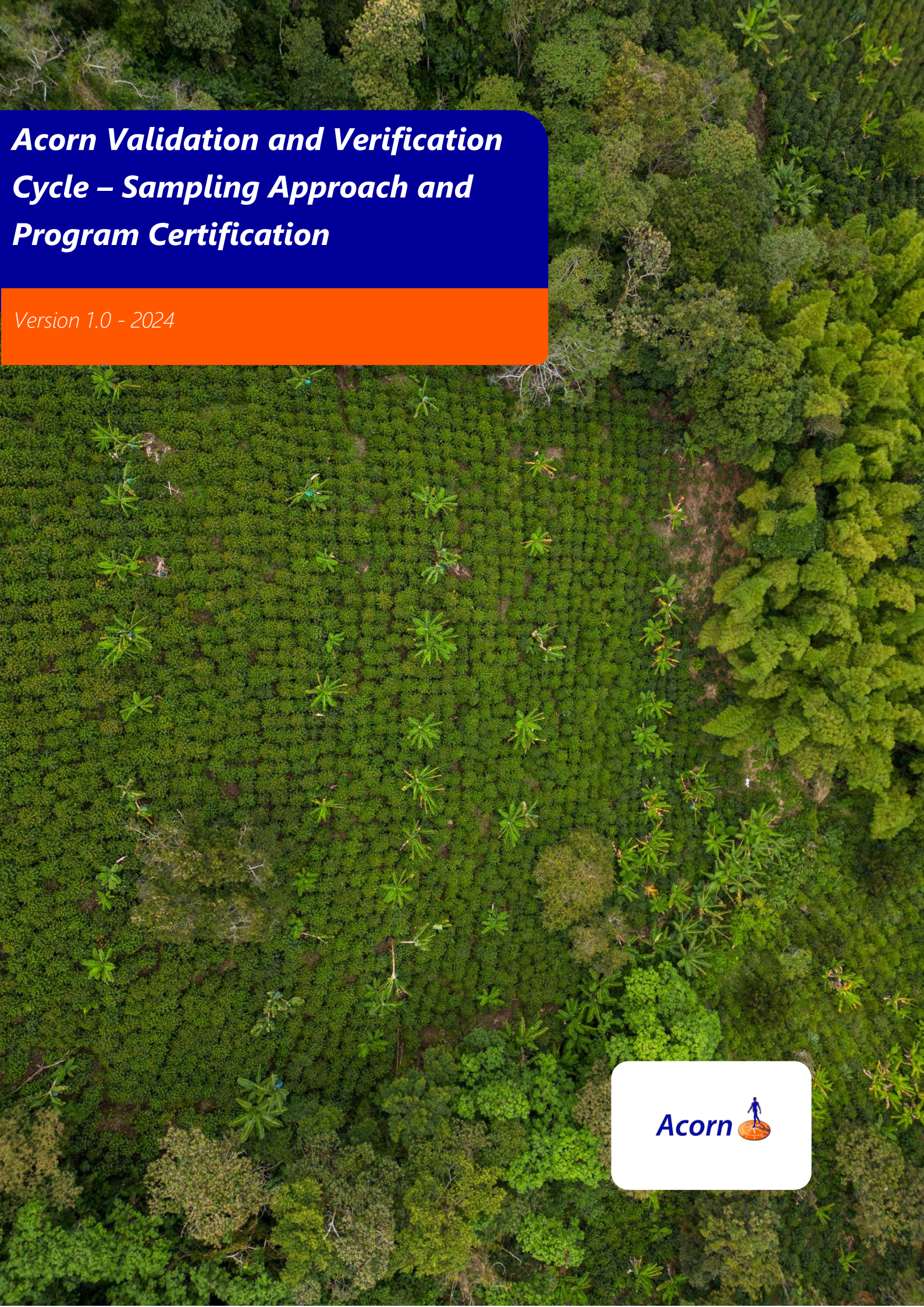
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Acorn Validation and Verification Cycle – Sampling Approach and Program Certification

Version 1.0 - 2024



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1. Introduction

The Acorn program consists of multiple projects around the globe which all apply the same carbon removal interventions and measurement technologies. Unlike other carbon removal standards, certified Acorn projects can issue Carbon Removal Units (CRUs) before they are audited by an independent third-party expert. This proactive certification approach enables projects to scale up faster, keeping their operational costs down, and in turn increasing accessibility to the Voluntary Carbon Market for the smallholder farmers we work with.

Our selected Certifier, Plan Vivo, assesses all projects for eligibility criteria on the basis of the so-called Eligibility Document. Once deemed eligible, and after the project's Acorn Design Document is complete, a project can start issuing CRUs for the Acorn program.

To confirm the veracity of our projects and the Acorn program as a whole, Acorn continuously undergoes what we call the Validation and Verification Cycle (VV Cycle). In this process, a sample of projects is taken according to Acorn's Certifier-approved sampling approach. Sampled projects are then submitted to the Certifier for desk review. An independent Validation and Verification Bodies (VVBs), selected according to the criteria in the Acorn Framework, then conduct field audits on the sampled projects. Their findings identify measures, if any, that need to be taken to ensure the Acorn program and our projects are issuing valid and verifiable CRUs.

This document details Acorn's Validation and Verification Cycle from the sampling approach to the outcomes that can be issued by the Certifier, and the steps taken to resolve any issues found.

2. Overview of the cycle

The Acorn program is continuously assessed by independent third-party experts to ensure our projects are issuing valid and verifiable CRUs. In this process, which we refer to as the Validation and Verification Cycle, or VV Cycle, we take a sample of Acorn projects from our portfolio on a yearly basis. These projects are then assessed by the Certifier and Validation and Verification Bodies (VVBs) to determine the veracity of not only the projects themselves but of Acorn as a whole.

A VV Cycle begins with project sampling and ends when all the sampled projects are issued a final opinion by the VVB and, in consultation with the Certifier, the reports are closed. Activities in the cycle include desk reviews by the Certifier and VVBs, field audits, reassessments, and the publication of the final reports.

At the start of a cycle, projects in the Acorn program are sampled according to our certified sampling approach (see chapter 4). The sampled projects are then submitted to the Certifier for a desk review of the project's documentation (see chapter 3), which are reviewed against the Acorn Framework and the Acorn Methodology. The sampled projects are then sent to VVBs for auditing (see chapter 5).

After their own desk reviews and site visits, the VVBs report their findings using the Certifier-approved Validation Report and/or Verification Report templates. These reports describe whether a project has met the requirements in the Acorn Framework and Acorn Methodology, and whether project documentation accurately represents the project's intervention on the ground. Disparities, or what we call non-conformities, can be found on a project level (see chapter 6) but can also be determined to be systemic and therefore program-level concerns (see chapter 7).

The VVB's report is first discussed with the Certifier before being forwarded to Acorn. In the case that one or more non-conformities are found, Acorn and the Local Partner(s) take corrective measures until resolved.

A cycle closes once all the sampled projects have been issued a final opinion. See Figure 1 for a simplified depiction of a single VV Cycle.



Figure 1. Simplified depiction of a single VV Cycle.

3. Project documentation requirements

For the VV Cycle, all certified projects must possess the following documents:

- **Acorn Design Document (ADD):** A project-specific report that details the project design (e.g. agroforestry design and business case), implementation plans and processes (e.g. benefit-sharing mechanism and project council governance structure), potential risks and negative impacts, and other assessments (e.g. additionality and adjustment factors) to demonstrate conformance with the Acorn Framework and Acorn Methodology;
- **Appendix to the ADD:** project area and ecoregion map,, sub-contractor assessment (if applicable), land tenure documentation, evidence of engagement with Local Stakeholders, organizational structure, evidence of government communication, Participant and Partnership agreements, Agroforestry Design(s), Business Case(s), Benefit Sharing Mechanism, CRU calculations and rationale for the adjustment factors, among others¹;
- **Annual Report (AR):** Yearly-submitted report detailing project implementation, progress, scaling, finances and payments, monitoring (e.g. carbon, risks and indicators), grievances, project council meetings, and any changes made to the project design during the corresponding reporting period.
- **Appendix to the AR:** CRU calculation sheets and rationale for the adjustment factors, Project Council reports, sample of signed Participant Agreements, updated/new Agroforestry Design(s), updated/new Business Case(s), updated/new Benefit Sharing Mechanism, updated project area and ecoregion map, among others.

¹ This list is not exhaustive. The Certifier can request additional evidence and documentation that is relevant to the project's ADD and AR.

4. Sampling approach

Each year, projects are selected for the VV Cycle according to Acorn's Certifier-approved sampling approach. Sampling is overseen by the Certifier to safeguard its accuracy, and, at least once every five years, the sampling approach is reviewed by Acorn and the Certifier.

First, clusters of similar projects are formed using a hierarchical-based clustering method. Second, a random sample of projects is selected from each cluster. The number of total projects sampled depends on the total number of projects in each cluster. The methodologies for clustering and random sampling are described in detail in sections 4.1 and 4.2 respectively. Examples of sample sizes are provided in section 4.3.

4.1. Agglomerative hierarchical-based clustering method

An agglomerative hierarchical-based clustering method (Sneath 1973) is applied to construct a hierarchy of clusters. The method starts by treating each data point as a distinct cluster. At each step of the algorithm, pairs of clusters which are most similar to each other are merged into a new cluster. This procedure is repeated until all projects are one single cluster.

Similarity between projects is calculated using Gower's distance (Gower 1971). This algorithm was chosen because it can handle mixed data (quantitative, ordinal, and nominal data). The minimum project characteristics used to calculate the Gower's distance between projects are land size (ha), geographical location (by continent), and Local Partner entities. Other characteristics might be added at a later stage.

In order to calculate the distance between clusters, a linkage method needs to be chosen. Three non-Euclidean linkage methods are considered (see Figure 2). The silhouette score (Rousseeuw 1987) is then used to decide which linkage method produces the best clusters.

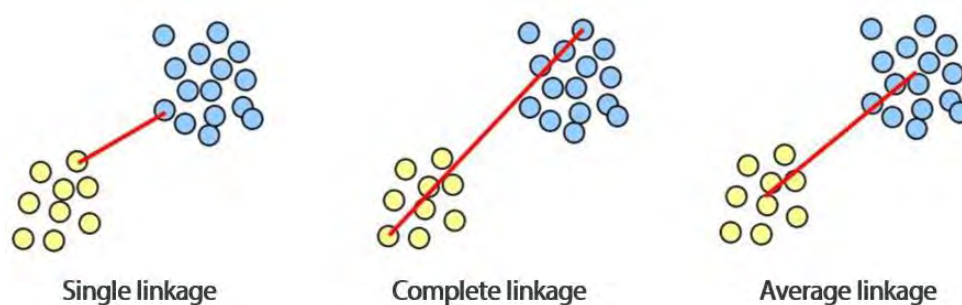


Figure 2. Linkage method

The result of the hierarchical clustering procedure can be represented by a dendrogram (see Figure 3). A dendrogram visualizes the steps of the hierarchical clustering by showing the distance between clusters in graph form. The projects are shown on the x-axis and the Gower's distance between them on the y-axis. This implies that the further apart the vertical lines in the dendrogram, the greater the distance between the clusters.

The dendrogram is also used to calculate the final number of clusters. This is done by setting a threshold distance (e.g. the red horizontal line in Figure 3) at a height where the line can traverse the maximum distance up and down without intersecting a merging point. The final number of clusters for use in the sampling is the number of vertical lines intersected by the threshold line. In the example provided here, there are two resulting clusters (the orange cluster and the green cluster).

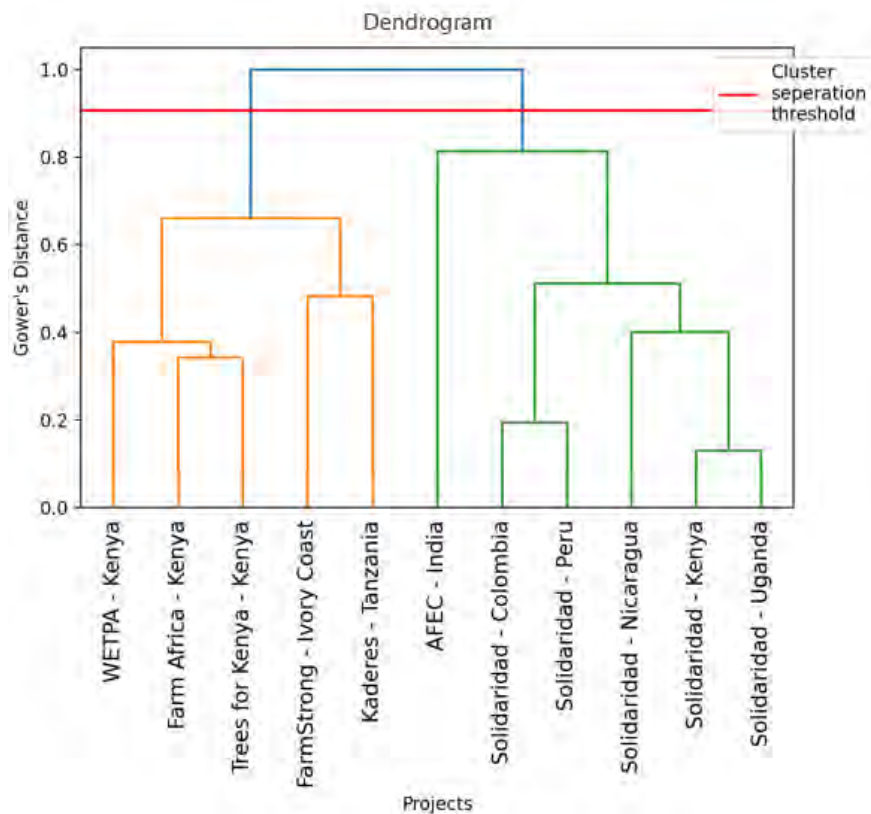


Figure 3. Example dendrogram.

4.2. Weighted random sampling

The number of projects sampled from each of the selected clusters (c) is determined as follows:

$$y_c = \left\lceil \sqrt{x_c - x_{c0}} \right\rceil$$

where:

- y_c = Sample size, i.e. total number of projects sampled from cluster c
- $\lceil \cdot \rceil$ = Ceiling. Rounds up a number to the nearest integer
- x_c = Total number of projects in cluster c
- x_{c0} = Total number of projects in cluster c that have weight zero (see below)

Once the sample size is determined, specific projects in a cluster (c) are selected based on a weighted random draw (Vitter 1984). This entails the following steps:

Acorn Sampling Procedure version 1.0

1. Assign weights $\{w_1, w_2, \dots, w_n\}$ for a set of n projects $\{project\ 1, project\ 2, \dots, project\ n\}$ in cluster c at time t

The weight is a number that increases ($w_i > 1$) or decreases ($w_i < 1$) the chance of being selected. There are two situations that affect weight:

- When a project is included in the current year's sample, it should have a zero probability of being chosen again in the following year, or $(t + 1)$.
- The weight is also affected by the outcome of the Risk Assessment for environmental, social, and carbon reversal risks, in a project's ADD. A project with a higher risk should have a higher chance of being selected (i.e. a higher weight) than a project with lower risk. In the Risk Assessment, there are three levels of risk: low, medium, and high. The overall risk score (rs_i) for the risks $\{r = 1, \dots, R\}$ for project i is determined as follows:

$$rs_i = \sum_{r=1}^R 0 * I_{r,i,low} + 1 * I_{r,i,medium} + 2 * I_{r,i,high}$$

where:

rs_i	= Overall risk score for project i
$I_{r,i,low}$	= Indicator equal to one if risk r for project i is assigned as low, and zero otherwise
$I_{r,i,medium}$	= Indicator equal to one if risk r for project i is assigned as medium, and zero otherwise
$I_{r,i,high}$	= Indicator equal to one if risk r for project i is assigned as high, and zero otherwise

2. Calculate the total weight in cluster c (W_c) for project $i = 1, \dots, n$

$$W_c = \sum_{i=1}^n w_i$$

3. Determine the selection probability of project i ($P_c(i)$), based on its weight relative to the total weight in cluster c :

$$P_c(i) = \frac{w_i}{W_c}$$

4. Compute the cumulative probabilities in cluster c for project i ($CP_c(i)$):

$$CP_c(i) = \sum_{j=1}^i P_c(j)$$

Note that $CP_c(1) = P_c(1)$ and $CP_c(n) = 1$

5. Select the projects from cluster c :

- Generate a random number r between 0 and 1 (including zero, excluding one)
- Determine the selected projects based on which interval r falls into:
 - i. If $0 \leq r < CP_c(1)$, select project 1
 - ii. If $CP_c(1) \leq r < CP_c(2)$, select project 2
 - iii. ...
 - iv. If $CP_c(n - 1) \leq r < CP_c(n)$, select project n

6. Repeat step 5 until all y_c projects are selected.

As the Certifier's expertise is vital to guaranteeing independent audits, at any time the Certifier can request the inclusion of a project that was not sampled. When such a request is made, a clear reason must be given, and consideration of costs must be included in the request.

4.3. Example sample sizes

Table 1 provides an example of the number of projects that would be sampled given a certain number of clusters in the dendrogram. Note that if only ten projects are in the Acorn program's portfolio, a minimum of five projects must be sampled.

Table 1. Example of the number of projects sampled, where x_c includes the total number of projects in cluster c , and y_c includes the total number of projects selected from cluster c

Number of clusters in dendrogram		10 projects		30 projects		100 projects		120 projects	
		x_c	y_c	x_c	y_c	x_c	y_c	x_c	y_c
2 clusters	Cluster 1	6	3	10	4	40	7	80	9
	Cluster 2	4	2	20	5	60	8	40	7
	Total	5		9		15		16	
4 clusters	Cluster 1	2	2	7	3	17	5	23	5
	Cluster 2	1	1	12	4	30	5	56	8
	Cluster 3	3	2	6	3	16	4	12	4
	Cluster 4	4	2	5	3	37	7	29	6
	Total	7		13		21		23	
7 clusters	Cluster 1	1	1	3	2	8	3	15	4
	Cluster 2	2	2	4	2	12	4	23	5
	Cluster 3	1	1	2	2	24	5	29	6
	Cluster 4	2	2	6	3	19	5	13	4
	Cluster 5	2	2	3	2	12	4	8	3
	Cluster 6	1	1	8	3	9	3	11	4
	Cluster 7	1	1	4	2	16	4	21	5
	Total	10		16		28		31	

5. **Validation and verification**

If chosen in a sample, a project is subject to one of the following in the VV Cycle:

- If a project has **not** been validated yet and **is** issuing CRUs, both validation and verification are conducted
- If a project has **not** been validated yet and **is not** issuing CRUs, only validation is conducted
- If a project **is** validated and **is** issuing or **has** issued CRUs, only verification is conducted
- If a project **is** validated and **is not** or **has not** issued CRUs, no verification or validation are conducted
- If a project **is** validated but has expanded outside of the initial ecoregion listed in the ADD at the time of validation, validation is conducted on only the new ecoregion area. Verification is also conducted if the new ecoregion area **is** issuing CRUs

The sampled projects are first sent to the Certifier for an initial desk review. The Certifier then sends the projects to the applicable VVBs with its request for validation and/or verification, including recommendations for any specific inquiries to be conducted in the audit.

In a validation, the accuracy, completeness, quality, and veracity of information reported in the project's ADD, and the knowledge, capacity and functionality of the project coordinator and project participants, are assessed by a VVB. The VVB conducts both a desk review and a field audit. Validation is executed only once per project, unless the project expands to a new ecoregion, different from the one initially listed in its ADD.

In a verification, the accuracy, completeness, quality, and veracity of information provided in the AR, quality assurance of the CRU calculations, and any revisions to the ADD made since the last verification are assessed by a VVB. This includes verifying the number of CRUs issued by the project since the previous verification. The VVB conducts both a desk review and a field audit. Verification can be executed more than once per project.

A VVB's Validation and/or Verification Report on a project determines the project's compliance or non-compliance with the requirements in the Acorn Framework and Acorn Methodology. Non-compliance is reported as a so-called non-conformity (see chapter 6). The report states whether the project's documentation accurately represents the project and its activities, and provides the VVB's preliminary opinion on a project's compliance with the Acorn requirements.

The VVB submits the report(s) to the Certifier. Upon consultation with the Certifier, Acorn and the Local Partner of the project address any non-conformities found by the VVB. After measures have been taken and conformance demonstrated, the project is issued a final opinion. Once all the sample of a VV Cycle has been issued a final opinion, the VV Cycle is closed.

During a VV Cycle, Acorn and the Certifier consult the incoming reports to determine the presence of program-level non-conformities, in other words systemic or procedural issues that are affecting the veracity of the program as a whole.

6. *Non-conformities on a project level*

The VVB's Validation and/or Verification Report details any non-conformities, its preliminary opinion on the project's compliance with the Acorn program, and recommendations for resolving any non-conformities, if found.

6.1. *Types of project non-conformities*

6.1.1. Corrective Action Request (CAR)

Non-conformity which could have negative impact or reduce benefits in the project area or project region, requiring immediate action. The project coordinator needs to resolve a CAR within a timeframe set by the VVB. No CRUs can be issued if a project has an open CAR.

6.1.2. Procedural Corrective Action Request (PCAR)

Non-conformity likely to arise due to one or more processes in place, or lack thereof, at Acorn. A PCAR is determined by the VVB and confirmed in consultation with the Certifier and Acorn, and is considered a SCAR that must to be addressed on both the project and program levels (see chapters 6 and 7).

6.1.3. Forward Action Request (FAR)

Non-conformity that does not require immediate action but may require time and effort to resolve. Although not likely, if left unresolved, a FAR could affect a project's delivery of the intended benefits. The project can continue to issue CRUs. The VVB proposes the action required and the timeframe within which it must be implemented. Any open FAR is reviewed by the Certifier within one year. A project can have no more than three open FARs to close the validation and/or verification. If more than three FARs are found, then additional non-conformities will be categorized as CARs by the VVB.

6.1.4. New Information Request (NIR)

Lack of clarity to determine compliance, and additional information is needed. No CRUs can be issued if a project has an open NIR.

6.1.5. Observation

Also called recommendation, an observation is advice given when the VVB identifies one or more areas where procedures, data, or documentation could be clarified or improved, but which is not deemed material enough to impose a CAR, PCAR, FAR, or NIR. Acorn is responsible for following up on an observation at its own discretion.

6.2. *Preliminary opinion*

Following its audit, the VVB must provide a concrete and preliminary opinion as to the status of the validation and/or verification of a project. This opinion takes the form of positive, or pending:

- **Positive opinion:** When a sampled project passes the validation and/or verification assessment because it exhibits no non-conformity.

- **Pending opinion:** When a sampled project has not yet passed the validation and/or verification assessment due to the presence of one or more non-conformities. The VVB specifies a timeframe to resolve the open non-conformities.

The preliminary opinion also includes a summary of whether a project's documentation accurately and clearly represents the project and its activities.

6.3. Process to resolve project non-conformities

Project non-conformities are handled as follows (see Figure 4):

Step 1: Measures taken

Acorn together with the Local Partner work together to resolve any non-conformities identified by the VVB, and must do so within the timeframe specified in the VVB's report. The VVB then reviews the action(s) taken; this may include a site visit.

Step 2: First reassessment

The VVB assesses the measures taken. If resolved, the non-conformity is closed, and the project is issued a final positive opinion. If unresolved, but ongoing, the VVB provides an extension; appropriate mitigation actions are then defined to resolve the non-conformity within the extended timeframe. Any open FAR will be reviewed by the Certifier within one year.

Step 3: Second reassessment

If the non-conformity continues after the second reassessment, the project is issued a final negative opinion. Acorn, in consultation with the Certifier, defines appropriate rectification measures (e.g. placing the project on hold, suspension of CRU issuance, and offboarding of the project), depending on severity of the non-conformity.

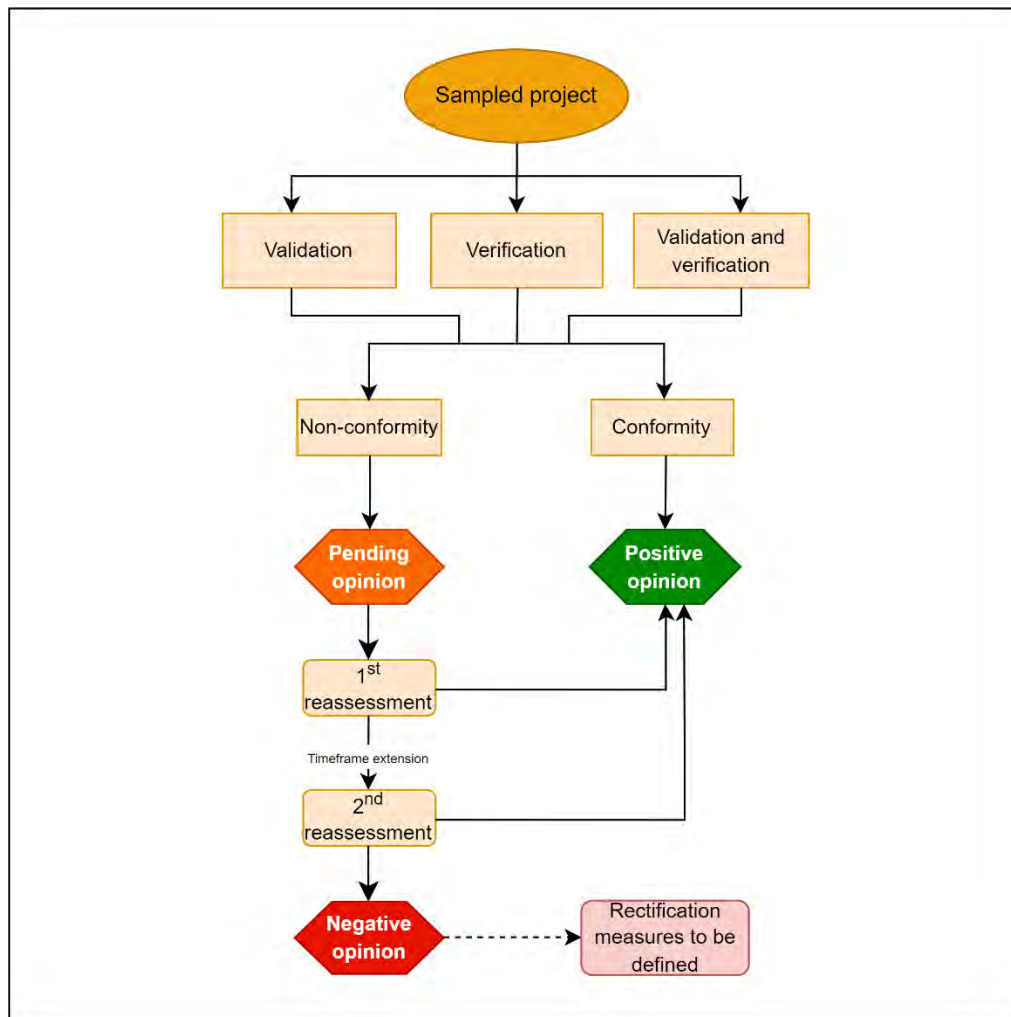


Figure 4. Process to address a project non-conformity.

6.4. Final opinion

After Acorn and the Local Partner have addressed the non-conformities, and the VVB in consultation with the Certifier assess the evidence, the VVB issues a final opinion on the project's validation and/or verification. This updated and final opinion takes the form of positive or negative:

- **Positive opinion:** When a sampled project passes the validation and/or verification assessment because it has successfully resolved any non-conformities within the given timeframe
- **Negative opinion:** When a sampled project has not passed the validation and/or verification assessment due to the presence of one or more non-conformities that have not been resolved within the given timeframe

The opinion also includes a summary that describes whether a project's documentation, after the corrective actions have taken place, accurately and clearly represents the project and its activities.

7. *Non-conformities on a program level*

In addition to identifying non-conformities on the project level, it is essential that these are also identified on a program level (i.e. across the Acorn portfolio) to ensure projects are not undertaking activities or lacking activities that result in non-compliance in the same areas. As reports are submitted over the course of a VV Cycle, Acorn and the Certifier review those reports for any non-conformities which indicate systemic or procedural issues within the program itself.

7.1. *Types of program non-conformities*

7.1.1. Systemic Corrective Action Request (SCAR)

Non-conformity assumed to arise in other projects that have not been selected for validation and/or verification due to the sample-based approach. When a CAR or NIR is repeated in three or more projects, the non-conformity is considered a SCAR.

7.1.2. Procedural Corrective Action Request (PCAR)

Non-conformity of a project that is likely due to processes in place, or lack thereof, at Acorn. As stated in section 6.1.2, a PCAR is considered a SCAR and, therefore, needs to be addressed on both the program and project levels.

7.2. *Program review*

The Acorn program is continuously reviewed through the annually-initiated sampled VV Cycles. Project-level findings can indicate areas for improvement, but can also testify to systemic issues in the program. The veracity of the program is confirmed through a SCAR as follows:

- I. t – SCAR is identified. Acorn, in consultation with the Certifier, defines mitigation measures at the program level.
- II. $t+1$ – The presence of the SCAR is assessed in the following VV Cycle. Depending on the sample size², a SCAR remains open if it appears again in $> 5\%$ of sampled projects, and closed if it appears in $\leq 5\%$ of sampled projects. If closed, the program's veracity is confirmed.
- III. $t+2$ – If in the third VV Cycle since the SCAR was found, the same SCAR is still present in $> 5\%$ of sampled projects, the program's is not confirmed. Acorn, in consultation with the Certifier, must define measures to return the program to Validated/Verified status. If the same SCAR is no longer present, the program's veracity is confirmed.

² If the number of projects in the sample size is < 50 , 1 CAR needs to occur in 3 projects to be considered systemic. If the sample size is ≥ 50 projects, 1 CAR needs to occur in $> 5\%$ of the sample to be considered systemic.

7.3. Process to resolve program non-conformities

Program non-conformities are handled as follows (see Figure 5):

Step 1: Confirmation of SCAR(s)

Acorn and the Certifier confirm the SCAR(s) identified in a VV Cycle. The Certifier can suspend CRU issuance for a selection of projects or for all projects.

Step 2: Project-level and program-level measures

The SCAR is addressed at the sample level (i.e., the project must resolve the CAR or NIR that led to the determination of a SCAR, see section 6.3) and at the program level. For the latter, Acorn develops a mitigation and monitoring plan, agreed upon with the Certifier, to close the SCAR.

Step 3: Reassessment

The SCAR is reassessed in subsequent VV Cycles until closed by $t+2$. At any time, but especially after identifying a SCAR, the Certifier can instruct the VVB to collect certain information or evidence, or pay special attention to specific areas in its field audit. If the SCAR does not appear in the subsequent cycle, the SCAR is closed. If the same SCAR does appear, then Acorn, in consultation with the Certifier, revises the mitigation and monitoring plan and develops a roadmap for resolving the SCAR.

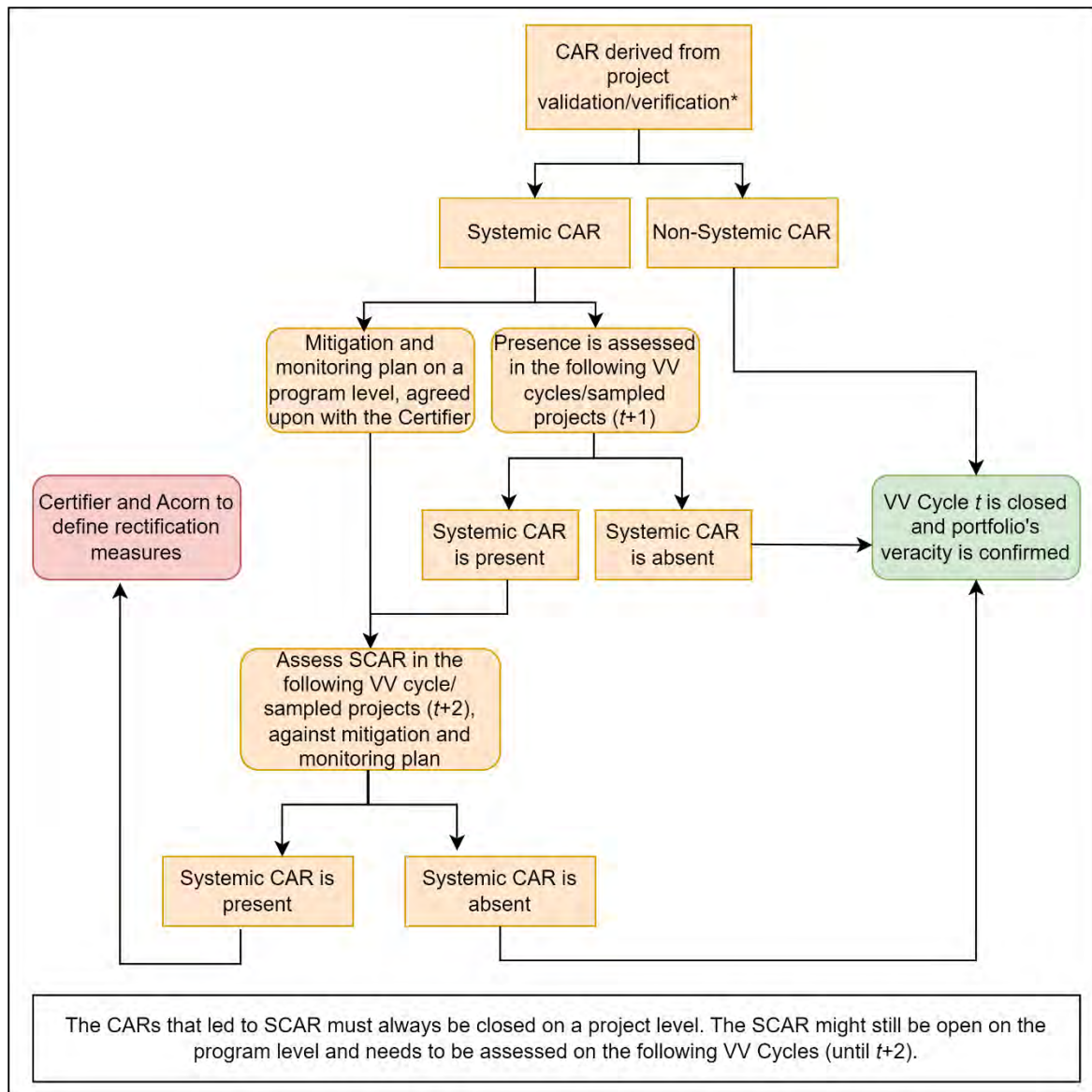


Figure 5. Process to address a program non-conformity

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