RESIDUAL

METHODOLOGY FRAMEWORK

ARR Credit Quality

Residual's perspective on what high-quality afforestation, reforestation, and revegetation credits require, and how we assess it.

INTRO

Afforestation, reforestation, and revegetation (ARR) carbon credit quality, like any project type in the voluntary carbon market, is assessed across two dimensions: the credibility of the tonnes claimed, and the broader strategic value of supporting the project. Residual organises the first into five main considerations **(Additionality, Carbon Accounting, Permanence, Environmental and Social Safeguards,** and **Delivery Risk)** and the second into two secondary considerations (**Co-Benefits and Scalability**). The relevant details within each consideration and its subsections vary by project type, and this framework outlines Residual's focus when evaluating and designing ARR projects specifically.

The five main considerations assess whether the carbon credit represents a credible, durable, and responsibly delivered climate claim. **Additionality** asks whether the project and land-use pathway would have occurred without carbon finance. **Carbon Accounting** assesses whether the quantification of removals is complete, conservative, and supported by a defensible baseline-to-project comparison, including leakage, project emissions, and MRV integrity. **Permanence** evaluates whether the carbon stored in trees and soil is likely to remain out of the atmosphere over the claimed durability period, based on species selection, site conditions, and risk management. **Environmental and Social Safeguards** assess whether the removal is delivered without material environmental or social harm, including biodiversity degradation, water competition, or adverse impacts on Indigenous Peoples and local communities. Delivery Risk evaluates whether the project can realistically be financed, planted, operated, and monitored at the volumes committed.

Residual also considers two secondary considerations: Co-Benefits and Scalability. These do not determine whether a credit removes the tonnes of carbon dioxide equivalent claimed, but they shape the broader value of supporting a project. Co-benefits can strengthen the project narrative and increase its relevance to buyers, communities, and other stakeholders, while scalability can create future access to larger credit volumes, potential cost efficiencies, and a credible role for investors in helping scale high-quality carbon removal.

This framework covers the major voluntary carbon standards applicable to ARR - Verra VCS (and its VM0047 methodology), Gold Standard, Plan Vivo, and ACR - and applies primarily at the ex-ante stage, where many of the most important questions about project quality can already be assessed if the right evidence is available. This is particularly relevant to Residual, as we co-design and implement projects from early stages rather than assessing mature projects that are already issuing credits. The framework is also intended to help buyers, investors, and project developers identify where quality risks typically arise, what evidence should be requested, and how ARR projects can be designed to meet a higher standard of carbon credit integrity.

The framework serves three roles simultaneously. As a first-pass filter, it surfaces projects missing defensible substantiation on any pillar before deeper diligence begins. As a diligence tool, it gives the assessor a consistent structure for each dimension: the questions to ask and the features that indicate quality. As a public benchmark, it is an articulation of what we believe is required of high-quality ARR credits, against which project developers can hold their own work. The framework is qualitative by design. It is not a points-based scorecard and does not resolve into a composite score; integrity is assessed by whether the evidence on each pillar stands up to informed scrutiny.

GLOSSARY

Short definitions of the technical terms used across the framework, for non-specialist readers.

Allometric equations

Mathematical relationships used to estimate tree biomass (and hence carbon content) from measurable variables such as diameter at breast height (DBH), height, and wood density. Locally validated equations are preferred; pantropical defaults (e.g., Chave et al. 2014) are acceptable where local equations are unavailable.

Buffer pool / buffer reserve

A pool of non-tradeable carbon credits set aside to compensate for unforeseen reversals. Under Verra VCS, this is a centralised Pooled Buffer Account; under Gold Standard and ACR, it is a project-level reserve. Typical ARR buffer contributions range from 10–25% of issued credits.

Crediting period

The window over which a project can issue carbon credits, typically 20–30 years for ARR projects, renewable once or twice depending on the applicable standard.

DBH (Diameter at Breast Height)

A standard forestry measurement taken at 1.3 m above ground. DBH is the primary input variable for most allometric equations used to estimate aboveground biomass.

Dynamic Performance Benchmark (PB)

A key feature of Verra's VM0047 methodology. Rather than a static historical baseline, the PB is derived ex-post from matched control plots in the same landscape at each verification event. The project earns credits only for carbon accumulation that exceeds what the control plots achieved, integrating additionality and baseline-setting into a single dynamic step.

FPIC (Free, Prior and Informed Consent)

A principle drawn from international human rights law (ILO Convention 169, UNDRIP) requiring that Indigenous Peoples and local communities give documented, voluntary, and informed consent before a project proceeds on or near their territories. FPIC is a mandatory requirement under all major voluntary carbon standards where IPLCs are present.

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IPLCs (Indigenous Peoples and Local Communities)

A term used across the voluntary carbon market to refer collectively to groups with customary or legal relationships to project land. IPLC rights — including land tenure, consent, and benefit-sharing — are a central safeguard requirement in all major ARR methodologies.

MRV (Monitoring, Reporting, Verification)

The processes by which a project tracks its emissions and removals (monitoring), documents them (reporting), and has them independently checked (verification). MRV integrity is central to whether a credit can be trusted.

PSPs (Permanent Sample Plots)

Fixed, GPS-registered plots within the project area that are remeasured at each monitoring event to track changes in carbon stocks over time. PSPs are the primary ground-truthing tool for carbon stock measurement and remote sensing calibration.

SOC (Soil Organic Carbon)

The organic carbon stored in mineral soils and litter. SOC changes can be significant in ARR projects converting degraded grassland to forest, but are associated with high measurement uncertainty (±30–50% by IPCC standards) and are frequently omitted from project accounting unless material.

Stocking Index (SI)

A remote sensing-derived metric used in Verra's VM0047 area-based approach as a proxy for aboveground biomass. The SI is generated by vetted Data Service Providers (DSPs) from satellite imagery and is correlated to AGB through field-based calibration.

TRL (Technology Readiness Level)

A 1-to-9 scale describing the maturity of a technology. Most ARR activities rely on well-established silvicultural practices (TRL 8–9), though novel agroforestry designs or remote sensing monitoring methods may sit at lower TRL levels.

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VM0047

Verra's Methodology for Afforestation, Reforestation, and Revegetation, version 1.1. VM0047 is the dominant voluntary methodology for ARR globally and the first ARR methodology to receive ICVCM Core Carbon Principles (CCP) approval. It offers two quantification approaches: an area-based approach using a remote sensing-derived Stocking Index and Dynamic Performance Benchmark, and a census-based approach for dispersed or non-forest planting contexts.

VVB (Validation/Verification Body)

An accredited third-party auditor that independently reviews a project's design (validation) and performance (verification) against the applicable methodology. VVB capacity is a practical bottleneck in the ARR market; validation queues of 12–24 months are common.

ADDITIONALITY ASSESSMENT

Additionality is the foundational claim of any carbon project: that the carbon removal from the project activity would not have occurred in the absence of carbon finance. For ARR projects, this claim operates across three dimensions. Financial additionality establishes that the project economics depend on carbon revenue rather than on revenue from harvesting or forest products. Regulatory additionality establishes that the restoration activity is not legally mandated. Alternative scenario analysis demonstrates that the chosen land-use pathway is preferable to realistic counterfactuals. Together, these three dimensions constitute the additionality argument. The table below considers the aspects of additionality and the details required to prove integrity.

Additionality		
Financial Additionality	Baseline Costs, Revenue, & IRR	• There are no financially viable restoration pathways for the project area in the baseline. • Financially attractive scenarios lead to further land degradation (e.g. cattle grazing).
	Project Costs, Revenue, & IRR	• Project scenario modelled with evidence-based inputs including pilot and region-specific data. • Assumptions are corroborated by third-party data or peer-reviewed literature. • No other revenue stream (timber, agroforestry products, government grants) is sufficient on its own to close the viability gap. • Investment analysis uses a transparent, justified discount rate and is benchmarked against a sector/region hurdle rate; the project return is below benchmark without carbon revenue and at or above it only once conservative carbon revenue is included. • Carbon price assumptions are conservative and disclosed; viability does not depend on optimistic price forecasts. • Sensitivity analysis shows the conclusion is robust across a plausible range of establishment costs, non-carbon revenues, and yields.
	Carbon Credit Revenues	• Project developers retain a majority of carbon credit revenues, directing proceeds to project activity rather than intermediaries. • Revenue-sharing arrangements with communities are documented.
	Prior Consideration	• Carbon credit revenue was contemplated at the time of the investment decision. • Evidence includes board minutes, business plans, or early-stage agreements with carbon buyers.
	Barrier Analysis	• Non-financial barriers (institutional, technological, land-tenure, knowledge/capacity) are identified and shown to be surmountable only with carbon finance, supporting additionality beyond the IRR test alone.
Regulatory Additionality	Existing Regulation	• All relevant support mechanisms identified (government grants, tax credits, preferential financing for forestry). • Analysis confirms that no single mechanism or combination makes the project financially viable without carbon finance. • Where reforestation is mandated by law (e.g., revegetation of degraded land under environmental permits), the analysis isolates the unregulated component and argues additionality from that basis. • Analysis confirms no perverse effect whereby carbon finance substitutes for an existing legal obligation; the credited activity is clearly incremental to any mandated baseline.
	Policy Momentum	• Near-term policy developments assessed, including newly announced national reforestation targets, REDD+ strategies, or credible government commitments. • Analysis considers whether anticipated regulatory changes could have driven the project activity within the crediting period without carbon finance.
	Government Effectiveness	• Where the regulatory environment is not effectively enforced, mandates at local or national level may not represent a genuine constraint. • Country classification as a Least Developed Country and enforcement capacity are considered.
Alternative Scenario Analysis	Alternative land-use scenarios considered	• Plausible alternative fates for the project land are identified and assessed: continued degraded grassland, subsistence agriculture, timber plantation, charcoal production, or natural (spontaneous) regeneration. • Assessment is grounded in local context; scenarios practiced in the region are prioritised. • Dynamic baselining implicitly tests this by comparing against actual control plot behaviour.
	Evidential Basis for the Baseline Scenario	• Baseline scenario supported by documentary evidence: land-use history, satellite imagery, field surveys, official statistics, or academic literature demonstrating what would have occurred without the project.
	Common Practice	• No comparable reforestation activity exists at commercial scale in the region without carbon finance or non-commercial funding. • Common-practice claim is quantified (e.g., share of comparable landholders in the region undertaking equivalent restoration without carbon or grant finance), not asserted qualitatively.

Financial Additionality

Financial additionality risk in ARR projects is primarily associated with the possibility that the land-use change would have occurred under existing incentives without the intervention of carbon revenue. In many geographies, government reforestation programmes, timber market conditions, or non-timber forest product revenues can make tree-planting financially attractive without carbon finance. The main uncertainty, therefore, lies in whether carbon finance is truly decisive in overcoming the project's capital costs - particularly site preparation, seedling production, and aftercare - or whether it merely improves returns for an activity that would have proceeded regardless. This risk is typically highest where government reforestation subsidies are substantial, where timber revenues are significant, or where the project is integrated into an existing commercial forestry operation. In contrast, projects in regions with weak existing incentives for forest cover, thin timber markets, and high upfront establishment costs are generally more likely to depend on carbon finance as a genuine enabling condition.

Regulatory Additionality

Regulatory additionality in the ARR sector is primarily affected by whether the planting activity goes beyond existing legal obligations or government-mandated reforestation programs. Risk arises where land clearing permits require revegetation, where watershed protection laws mandate riparian buffer restoration, or where reforestation is prescribed as part of environmental impact mitigation for an adjacent development. The central assessment is whether carbon finance supports a genuinely voluntary action that exceeds baseline legal requirements, rather than simply monetizing an activity already mandated by the jurisdiction.

Alternative Scenario Analysis

Alternative scenario analysis in the ARR sector depends on whether the project has considered plausible, locally relevant counterfactual land uses and provided credible evidence for rejecting them. The main risk is that an alternative pathway like natural regeneration, low-intensity pasture, or continued degraded grassland would have delivered some carbon removal without the project, reducing net additionality. Where natural regeneration is a plausible baseline, the project must demonstrate either that natural regeneration would not have occurred (due to seed source absence, invasive species, grazing pressure) or that the project significantly accelerates the rate and scale of carbon accumulation relative to the counterfactual. Dynamic baselines mitigate these risks by accounting for alternative scenarios implicitly.

Carbon Accounting Assessment

Carbon accounting assesses the integrity of the quantification and measurement system that underpins every credit a project issues. A project can have a strong additionality case and deliver genuine climate benefit but still issue low-quality credits if its monitoring, quantification, and verification systems are weak. The table below considers the aspects of carbon accounting and the details required to prove integrity.

Carbon Accounting		
MRV Integrity	LCA design, system boundary, emissions accounting	• System boundary clearly defined and consistent across all project documentation. • All relevant emission sources included: land preparation (burning, tillage), seedling nursery operations, transport, planting maintenance, monitoring activities, and any harvest-related emissions. • LCA results are transparently calculated and reproducible from the disclosed inputs and emission factors. • Factors used in calculation (e.g. wood density, root-to-shoot ratio, etc.) are site-, species, and management-specific from peer-reviewed literature or third-party derived numbers. • Non-CO_2 greenhouse gases (CH_4 and N_2O from biomass burning and any fertiliser use) are quantified, not only CO_2.
	Monitoring Plan	• Third-party produces both the baseline and project area data for monitoring reports. • Monitoring plan covers all parameters that drive the credit calculation, reversal risk mitigation, and quality substantiation. • Continuous monitoring of stand conditions, invasive species pressure, and fire risk is documented. • QA/QC protocols documented, including calibration schedules, instrument redundancy, and treatment of data gaps. • All carbon pools are listed with an explicit, conservative rationale for inclusion or exclusion: aboveground biomass, belowground biomass, deadwood, litter, soil organic carbon, and harvested wood products. • Remeasurement interval is defined and aligned to the verification cycle.
	SOPs for processes	• Written SOPs exist for key operational and monitoring functions: seedling production, planting, aftercare, PSP measurement, species identification, remote sensing data handling, and off-specification batch exclusion. • SOPs specify the procedure when equipment malfunctions or monitoring falls outside specification.
	Remote sensing calibration & validation	• Remote sensing products (Stocking Index, biomass maps) are calibrated and independently validated against field plots, with reported accuracy metrics and explicit handling of saturation in high-biomass stands.
	Double-counting safeguards	• Credits are tracked in a registry with measures to prevent double issuance/claiming; where relevant, corresponding adjustments (Article 6) or CORSIA eligibility status are addressed.
Leakage	Market leakage	• If the project area has a baseline of revenue producing activities (e.g. agriculture, ranching, plantations), region-specific leakage numbers are considered in the ex-ante considerations. • Monitoring reports check local downstream business (e.g. saw mills, processing facilities) for changes in production in order to assess practical leakage.
	Activity-shifting leakage	• Commercial production identified in the project's baseline is assessed in surrounding areas before and after implementation - any change in land activity nearby is incorporated into carbon accounting. • Assessment of how project activities may alter surrounding land management, nutrient flows, or seed dispersal in ways that affect carbon stocks beyond the project boundary. • Positive leakage effects, such as natural regeneration stimulated by seed dispersal from the project, are identified but not credited.
Baseline Scenario	Comprehensiveness of emissions considered	• Dynamic baseline is set with a comprehensive list of parameters for representative project area selection, baseline plot selection, and matching between the two (stratifications by soil type, land type, management style, fire regime, precipitation, water table, etc.). • Control-plot selection is tested for statistical balance against project plots across the matching covariates, and the dynamic benchmark is reassessed on the methodology's schedule. • All relevant emission sources in the baseline scenario identified: decomposition of existing biomass, soil carbon dynamics, any burning practices, and emissions associated with existing land management activities.
	Plausibility of baseline evidence	• Claims supported by documentary evidence: official land-use statistics, field surveys, third-party assessments, satellite land cover data, peer-reviewed literature. • Both historical precedent and local context are considered when determining the counterfactual.
Project Scenario	Comprehensiveness ex-ante removal quantification accuracy	• All direct and indirect emissions from the project identified and quantified: seedling production, land preparation (including burning if used), planting and aftercare operations, monitoring activities, infrastructure. • Where multiple species mixes or land-use zones are planned, scenario-specific LCAs used. • Allometric equations validated for the species, region, and management style; sources disclosed and uncertainty quantified. • MRV rigor, which is captured in the "MRV Integrity" section. • Measurement and model uncertainty is propagated through the estimate, and a conservative deduction is applied where uncertainty exceeds the methodology's threshold. • Ex-ante growth/yield projections are validated against permanent sample plot data at each monitoring event, with credited removals reconciled to measured performance.

MRV Integrity

MRV integrity depends on whether the project has a complete, consistent, and reproducible system for tracking carbon stocks across the full project area and over time. Three risks recur in ARR projects: system boundaries defined inconsistently across documentation; omitted material emission sources, including land preparation emissions, nursery operations, and non-CO2 gases from burning; and monitoring procedures too weak to support the claimed credit volumes. High-integrity MRV practice therefore includes a clearly documented monitoring plan, permanent sample plots that meet statistical power requirements, use of validated allometric equations, and where relevant, a remote sensing approach tied to a vetted DSP. The monitoring plan should cover all carbon pools, define data gap treatment, and specify QA/QC procedures that an independent reviewer can follow. Where measurement uncertainty exceeds the methodology's threshold, a conservative uncertainty deduction should be applied so that credited volumes are not overstated.

Leakage

Leakage risk is primarily associated with the possibility that displacing pre-project land uses causes emissions to shift outside the project boundary. Activity-shifting leakage arises where smallholders, livestock herders, or charcoal producers are displaced from the project area and continue their activities elsewhere. Market leakage arises where timber or biomass products from the project substitute for supply from other sources, affecting harvesting pressure in adjacent forests. Ecological leakage can arise where over-extraction of existing vegetation for site preparation alters surrounding biomass dynamics or nutrient flows. Leakage assessment in this sector therefore depends on identifying plausible offsite effects, quantifying them conservatively where material, and applying appropriate deductions so that credited removals are not overstated.

Baseline vs Project Scenario

Baseline and project scenario risk is primarily associated with whether the credited comparison is built on a realistic, evidence-based counterfactual and a complete accounting of project emissions. The baseline should reflect current practice in the project region, supported by documentary evidence. For VM0047 area-based projects, the quality of the Dynamic Performance Benchmark depends critically on the quality of matched control plot selection; if control plots are systematically different from project plots in soil type, water access, or management history, the PB may understate the counterfactual and inflate credits. On the project side, risk arises where direct or indirect emissions are omitted — particularly from land preparation activities such as burning, mechanical clearing, or drainage modification — or where allometric equations are applied outside their validated size class or species range.

Permanence Assessment

In the ARR sector, permanence risk is primarily associated with three uncertainties: whether the established trees will survive and grow over the full crediting period given climate change projections; whether the land will remain under forest management against economic, political, and social pressures; and whether the project's monitoring system is robust enough to detect and account for reversals when they occur. ARR projects face a category of permanence risk absent from engineered removal approaches; biological and climatic forces operate over the entire crediting period and cannot be managed out of the system. This makes species selection, site-climate matching, diversification of planting design, and the quality of the buffer pool mechanism particularly critical.

Permanence		
Biological & Climate Risk	Biodiversity of planting design and species-site matching	• Species selection documented and supported by locally validated silvicultural evidence for survival, growth rates, and climate resilience. • Multi-species designs used to reduce catastrophic pest or disease risk compared to monocultures. • Species allocation is based on mapped soil, drainage, hydrology, topography, and micro-site conditions. • Species suitability is assessed against forward climate projections (mid- to late-century scenarios), not only current conditions, with provenance/genetic diversity chosen for adaptive capacity.Species suitability is assessed against forward climate projections (mid- to late-century scenarios), not only current conditions, with provenance/genetic diversity chosen for adaptive capacity.
	Fire risk management	• Fire risk assessment conducted for the project area. • Where fire risk is rated medium or high, a documented fire management plan is in place including fire breaks, controlled burning protocols, community engagement, and monitoring. • Insurance, contingency financing, and buffer pool contribution is considered where fire risk is material.
	Drought and water stress risk	• Drought risk assessment is conducted using historical rainfall, dry-season length, water-table depth, ENSO sensitivity, and climate projections where available. • Species selection includes drought-tolerant or locally adapted species for drier microsites. • A drought response plan is in place, including survival monitoring, gap-filling, mulching or micro-catchments where appropriate, and contingency irrigation for high-risk establishment areas. • Insurance, contingency financing, and buffer pool contribution is considered where drought risk is material.
	Extreme weather risk	• Planting layout, road design, drainage planning, and species placement are adjusted to reduce damage from extreme weather. • Monitoring systems are capable of detecting canopy loss, mortality, erosion, or flood damage after major events. • Insurance, contingency financing, and buffer pool contribution is considered where extreme weather risk is material.
	Flooding and waterlogging risk	• Hydrological mapping is used to identify areas prone to seasonal inundation, poor drainage, or prolonged waterlogging. • Flood-tolerant species are used in suitable low-lying areas, while high-risk areas are excluded, conserved, or restored with appropriate riparian/floodplain species. • Monitoring tracks mortality, root stress, erosion, and sediment movement in flood-prone compartments. • Insurance, contingency financing, and buffer pool contribution is considered where flooding risk is material.
	Pest and disease risk	• Pest and disease risk assessment is conducted for selected species and local plantation conditions. • Monitoring includes regular field inspections for symptoms, mortality clusters, defoliation, fungal disease, ant damage, and other biological stress indicators. • Response procedures include sanitation thinning, targeted biological or chemical control where appropriate, replacement planting, and adjustment of species mix if repeated outbreaks occur. • Insurance, contingency financing, and buffer pool contribution is considered where pest or disease risk is material.
Human & Political Risk	Land tenure security	• Project developer holds formal title, long-term registered lease, or documented customary rights to project land for the full crediting period. • Legal opinion from local counsel on tenure security obtained. Known tenure disputes disclosed. • No historic risk of land disputes. • Country-level political risk assessed including historical record of land confiscations, regulatory reversals, and conflict. • Where political risk is elevated, buffer contribution is increased and additional contractual protections (insurance, escrow arrangements) are in place.
	Economic pressure to convert	• Analysis of whether rising commodity prices, infrastructure development, or other economic incentives could create pressure to convert the project area. • Long-term community benefit-sharing and alternative livelihood design reduces economic conversion risk.
Reversal Detection & Management	Monitoring frequency and detection capability	• Monitoring frequency sufficient to detect reversals within a single verification period. • Detection combines annual satellite change-detection (with deforestation-alert systems) and periodic ground or LiDAR verification; alerts trigger a documented field-response protocol.
	Buffer pool integrity	• Detailed response and mitigation plans for significant reversal risks. • Buffer contributions reviewed and adjusted at each verification. • Buffer contribution is set by the applicable non-permanence risk tool, with the risk rating and its drivers documented; the buffer covers both unavoidable (e.g., fire, drought) and avoidable (e.g., conversion) reversals. • A defined reversal-compensation mechanism (buffer cancellation, replanting obligation, insurance payout) restores any lost tonnes on a like-for-like basis.
	Commitment period vs crediting period	• Projects document how post-crediting period land stewardship will be maintained, including legal encumbrances, conservation easements, or community governance structures. • 100+ year solution for supporting forest growth and reversal mitigation (e.g. permanence trust, insurance, land trusts, financial obligations). • Durability commitment is aligned to a recognised standard (e.g., ICVCM CCP requirements), with the monitoring and compensation obligation surviving the crediting period.

Biological and Climate Risk

Biological and climate risk is a unique challenge for ARR compared to other carbon removal approaches. Unlike engineered removals, trees are living systems subject to fire, drought, pest outbreaks, and the ongoing effects of climate change, none of which can be fully engineered out. Risk is lowest where planting designs are species-diverse and use climate-adapted native species; where fire management plans are in place and enforced; where the project is in a climate zone that is expected to remain suitable for the target species across the crediting period; and where the monitoring system can detect mortality events quickly. Risk is highest for large-scale monocultures of exotic species in climate zones facing increasing drought or fire probability, or in regions with a history of pest or disease outbreaks in the same species.

Human and Political Risk

Human and political risk is the second major permanence challenge for ARR projects. Unlike biological risk, which is managed primarily through planting design and monitoring, political and tenure risk is managed primarily through legal documentation, community relationships, and financial instruments. Projects in jurisdictions with strong rule of law, secure property rights, and stable government policy have materially lower political permanence risk than those in fragile or conflict-affected states. Community benefit-sharing is not only a social safeguard requirement but also a permanence tool — communities with a direct economic stake in the standing forest have a demonstrated track record of defending it against encroachment and clearing pressure.

Reversal Detection and Management

Reversal detection depends on whether the project's monitoring system is frequent and spatially comprehensive enough to identify and quantify carbon losses between verification events. Annual remote sensing change detection, supplemented by community monitoring is best practice. Projects should demonstrate that their buffer contributions — typically calibrated using the applicable non-permanence risk tool, whether a shared buffer pool or a form of insurance — are conservative relative to the risk profile, and that the monitoring system is designed to detect reversals at the scale that would exhaust the buffer.

Environmental & Social Safeguards Assessment

The Environmental and Social Safeguards assessment covers the environmental and social context within which the carbon removal activity takes place. A project can have strong carbon accounting and a credible additionality case but still carry material risks through its environmental footprint, community relationships, and non-carbon outcomes. This section does not assess carbon quality directly, but it does assess the conditions that determine whether a project is sustainable, insurable, and attractive to the range of buyers who increasingly evaluate carbon credits on a wider set of criteria than additionality and permanence alone. The table below considers the aspects of non-GHG performance and the details required to prove integrity.

Non-GHG Performance		
Environmental	Biodiversity and ecosystem integrity	• Project does not convert natural ecosystems (grassland, wetland, scrub) that support significant biodiversity in favor of monoculture plantation. • Native species preferred for resilience. • Project avoids conversion of High Conservation Value, High Carbon Stock, peatland, or wetland areas; siting is screened against these and against key biodiversity areas. • A biodiversity monitoring plan defines a pre-project baseline, indicators, and targets (no net loss / net gain), tracked alongside carbon.
	Water impacts	• Water impact assessment conducted, particularly for projects in semi-arid or water-stressed catchments. • Fast-growing tree plantations in water-stressed regions assessed for streamflow reduction risk. • Projects demonstrate net positive or neutral water balance for downstream communities.
	Soil health	• Soil preparation methods documented and assessed for erosion risk. • Projects avoid deep tillage or burning practices that cause net SOC loss. • Soil pH, nutrient status, and contamination assessed; species selection matched to site conditions. • Long-term soil health monitoring integrated into the monitoring plan. • Seedlings use genetically appropriate, diverse native provenances; agrochemical and pesticide use is minimised and managed under a documented protocol.
	Invasive species risk	• Risk assessment for invasive species introduction, particularly where exotic tree species are planted adjacent to native ecosystems. • Protocols for detection, containment, and removal of invasive species documented.
Social	Free, Prior and Informed Consent (FPIC)	• FPIC process documented in three phases: initial disclosure, structured consultation, and documented consent or absence of objection. FPIC applies wherever IPLCs are present in or adjacent to the project area. • Documentation includes community mapping, meeting records, attendance lists, and formal consent documentation from recognised community authorities. • Women's participation explicitly addressed. • FPIC is treated as an ongoing, iterative process (not a one-time sign-off), with the right to withdraw consent and gender-disaggregated participation in decisions, not only attendance.
	Land rights and displacement	• Project does not encroach on customarily owned or used IPLC land without documented FPIC. • Unconsenting physical or economic displacement of community members avoided. • Land rights assessment conducted by local legal counsel.
	Stakeholder engagement and grievance mechanism	• Affected communities and other key stakeholders identified before project development begins. • Structured engagement plan in place, with meetings, consultations, and communications documented. • Accessible grievance mechanism in place in local language(s); response timeframe defined; escalation pathway documented.
	Workers H&S and working conditions	• Health and safety plan in place for all project activities. • Emergency response protocols documented and appropriate PPE provided. • Child labour and forced labour prohibited; age verification procedures documented. Wages at or above local minimum wage.
	Benefit-sharing with affected communities	• Benefit distribution is considered and reasonable: smallholders, community members, and IPLC members benefit (employment, agroforestry income, reduced input costs), not only commercial investors or project developers. • Benefit-sharing mechanism documented in a formal agreement, specifying the proportion of carbon revenue or in-kind benefits directed to community stakeholders. • Benefit-sharing outcomes are monitored over time (not only agreed on paper), with transparent reporting on amounts and recipients.
	Cultural heritage & rights frameworks	• Tangible and intangible cultural heritage and sacred sites are identified and protected; safeguards align with recognised frameworks (UNDRIP, IFC Performance Standards, UN Guiding Principles on Business and Human Rights).

Environmental Performance

Environmental performance depends on whether the project can demonstrate that planting design, site preparation, and long-term management do not create material harm to biodiversity, water, or soil. Risk arises where monocultures of exotic species replace biodiverse grasslands or shrublands; where fast-growing plantations in water-limited catchments reduce dry-season streamflow; where deep tillage or burning for site preparation causes soil erosion or SOC loss; or where invasive species introduced via planted seedlings escape into adjacent natural ecosystems. A further concern arises where the project lacks a biodiversity monitoring plan capable of detecting harmful impacts after planting. Environmental performance assessment in this sector therefore depends on thorough pre-project assessment, appropriate species selection and planting design, and a long-term monitoring plan that tracks non-carbon environmental outcomes alongside carbon stocks.

Social Performance

Social performance depends on whether the project identifies affected stakeholders early, engages them through a structured and accessible process, respects IPLC land and tenure rights, protects worker health and safety, and shares benefits fairly with the communities connected to the project land. Risk arises where consultation is limited or poorly documented; where FPIC processes are procedurally compliant but substantively inadequate; where community members are displaced from land they depended on; where grievance mechanisms are inaccessible or unresponsive; or where economic benefits are captured mainly by commercial investors rather than shared with local workers, smallholders, or nearby communities. Social performance assessment in this sector therefore depends on credible, documented FPIC, appropriate labour and safety protections, and a clear benefits framework that demonstrates the project is socially responsible as well as operationally viable.

Delivery Risk Assessment

This section assesses whether the project has the foundations to do what it says it will do over the crediting period: issue credits, establish and maintain forest cover, and sustain operations. A project that cannot secure its land tenure, establish its nursery supply chain, or attract the financial backing it needs is at high risk of not delivering at all, making it a low-quality ex-ante credit.

Delivery Risk		
Financial Viability	Proponent track record	• Proponent's financial standing is documented and sufficient to support the project through development and establishment stages. • Track record of delivering comparable reforestation or ARR projects to commissioning and first verification. In-country operational presence confirmed.
	Financial backing	• Project has secured committed funding sufficient to cover establishment costs, ongoing maintenance, monitoring, and MRV through to first credit issuance. • Financial backers are reputable and have relevant experience: development finance institutions, strategic corporate investors, or established carbon market participants. • Forward offtake agreements or binding letters of intent in place for a material proportion of forecast annual credit volume, providing revenue visibility and reducing price and delivery risk. • Budget includes contingency for cost overruns and replanting; material currency, inflation, and interest-rate exposures are identified and mitigated. • Financing is milestone-linked to establishment and verification gates rather than fully front-loaded on optimistic assumptions.
Seedling Supply & Security	Nursery capacity and seedling supply	• Nursery capacity sufficient to supply the planned annual planting programme confirmed. • Nursery operator has documented experience producing the target species at scale. • Seed provenance documented; locally adapted seed sources preferred for species survival and climate resilience. • Seed sourcing follows documented provenance and genetic-diversity standards, with phytosanitary/biosecurity controls and nursery QA to protect survival and resilience. • Survival-rate targets and replanting/gap-filling triggers are defined and budgeted.
	Seasonality and continuity management	• Planting windows matched to local climate (rainfall onset, frost-free period). • Contingency plans in place for seedling mortality requiring gap-filling. • Storage and hardening protocols documented. • Species mix diversified to reduce dependence on single-species supply chains.
Operational Capacity	Local technical expertise and operations management	• Operations team has documented experience with silviculture, forest establishment, or comparable land management at scale. • Technical support arrangements in place with silvicultural specialists for establishment, training, and the first operational period. • Required worker capacity confirmed.
	Technology and monitoring track record	• Monitoring approach (PSP measurement protocols, remote sensing methodology, allometric equations) validated for the species, region, and size class. • Partnership with research institutions (whether public or private) that have relevant local expertise.
	Land rights	• The project developer holds formal title, long-term registered lease, or documented customary rights to the project area for the full crediting period. • Legal opinion from local counsel on tenure security. • The project developer owns the rights to the carbon credits that are produced. Known tenure disputes disclosed and managed. • The proponent holds clear, documented legal title to the carbon (distinct from land title), holds a registry account, and has confirmed no competing or overlapping credit claims on the area.
	MRV and verification capacity	• Accredited VVB identified and available for validation within a reasonable timeframe. • VVB has experience with the applicable methodology. • Project developer understands and has budgeted for ongoing verification costs throughout the crediting period.
	Adaptive management & data systems	• An adaptive-management plan links monitoring results to operational adjustments; a defined data-management system ensures traceability and audit-readiness of field and remote data.

Financial Viability

Ex-ante financial viability risk in ARR projects is primarily associated with whether the project proponent has the financial standing, delivery track record, and committed backing needed to reach first verification and sustain operations through the crediting period. ARR projects have a distinctive cash flow profile: high upfront establishment costs - site preparation, seedling production, planting, and aftercare in years one to three - with carbon revenues deferred until first verification, typically three to five years after planting. Risk is lower where capital expenditure and initial operating costs are covered by credible committed finance, where backers have relevant experience, and where the proponent can show a track record of bringing comparable projects to verification. Revenue visibility also matters: forward offtake agreements and commercial arrangements for agroforestry products can materially reduce price and delivery risk.

Seedling Supply & Security

Seedling supply and security is analogous to feedstock security in engineered removal projects, and is a significant operational risk in large-scale ARR programmes. Risk arises where nursery capacity is insufficient, where seed provenance is poorly documented (reducing survival and growth rates), where planting windows are missed due to seedling production delays, or where a single species monoculture approach creates catastrophic supply chain vulnerability if that species faces outbreak, drought mortality, or regulatory restriction. Best practice involves multiple nursery sources, locally adapted seed provenance, contingency gap-filling budgets, and planting designs that diversify across multiple species and stocking densities to buffer against supply disruption.

Operational Capacity

Operational capacity assesses whether the project team has the species expertise, equipment, and management capability to establish and maintain forest cover at forecast throughput over the crediting period. ARR at commercial scale is operationally demanding: site preparation quality directly affects survival rates, weed competition management in years one to three is critical to achieving stocking targets, and PSP remeasurement requires trained and quality-controlled field teams. Sensible operational conservatism in planting survival assumptions, combined with a credible aftercare and gap-filling strategy, is the mark of a well-prepared project.

Secondary Considerations

Secondary considerations assess features of a carbon project that sit outside the core question of credit integrity but still matter to buyers, investors, and other market participants. Whereas the primary quality pillars determine whether a credit credibly represents a real tonne of CO_2 removed, secondary considerations examine whether supporting the project creates wider strategic value. This includes the extent to which the project delivers meaningful environmental or social co-benefits beyond its greenhouse gas impact, and whether it has the potential to scale in a way that increases climate impact, lowers delivery costs, or improves market accessibility over time. These factors do not by themselves make a low-integrity credit high quality, but they can strengthen the overall attractiveness of a high-integrity project by showing that it offers broader positive impact and longer-term growth potential.

Secondary Considerations		
Co-Benefits	**Environmental benefits**	• Active restoration of soil organic matter and improvement of soil structure in previously degraded or cultivated areas. • Improved water regulation and quality in downstream catchments through riparian and watershed ARR. • Biodiversity habitat creation and connectivity: native species multi-strata designs support bird, mammal, and invertebrate populations. • Invasive species management as part of site preparation, releasing ecological space for native regeneration. • Co-benefits are quantified against a baseline using measurable indicators and, where pursued, certified (e.g., CCB Standards, SD VISta, Plan Vivo) and mapped to specific SDGs rather than asserted narratively. • Potential to stack or layer biodiversity or water credits is assessed without creating double-counting of the carbon claim.
	Social benefits	• Local employment and skills development across seedling production, planting crews, monitoring, and aftercare, where the project builds a local delivery chain rather than relying entirely on external contractors. • Agroforestry income for smallholders and community members from timber, fruit, fodder, fuelwood, and non-timber forest products. • Benefit-sharing with IPLCs and local communities, where the project distributes value beyond the core developer and commercial counterparties.
Scalability	**Future price impact**	• Experience lowers unit costs as the developer gains silvicultural expertise and reduces establishment failures over time. • Larger planting programmes spread fixed costs (nursery infrastructure, monitoring, MRV, VVB fees) across more credits, reducing average cost per tonne. • Standardised site assessment, planting design, and PSP measurement protocols reduce engineering and operational costs in future projects. • Stronger seedling supply chains and community relationships reduce future establishment risks.
	Carbon credit proliferation	• Growth in agroforestry and timber markets associated with the project can improve overall project economics and reduce barriers. • Improved MRV systems reduce monitoring, verification, and issuance costs over time. • Building local technical expertise, community monitoring capacity, and government relationships enables a wider pipeline of future projects. • A credible land pipeline exists that is ecologically suitable, tenure-secure, and non-food-competing; the enabling policy environment and community demand support replication of the model.

Co-Benefits

ARR projects have particularly strong co-benefit potential compared to most other carbon removal approaches, because forest restoration delivers a well-established package of ecosystem services alongside carbon sequestration. The most important co-benefits including biodiversity habitat, watershed protection, soil health improvement, and rural livelihoods, are strongly correlated with the design decisions that also improve permanence: native species planting, multi-strata designs, IPLC benefit-sharing, and active community stewardship. Projects that invest in co-benefit documentation and certification (CCBS, Gold Standard SDG Impact Statements, Plan Vivo) command market premiums that reflect the genuine additional value these outcomes deliver.

Scalability

Scalability assesses whether supporting an ARR carbon project is likely to help expand the future supply of high-quality credits, reduce their cost, or both. ARR is one of the most land-abundant removal pathways globally, with estimates of 1–2 billion hectares of degraded land potentially suitable for restoration. However, high-quality land that is ecologically appropriate, tenure-secure, non-food-competing, and accessible to community benefit-sharing is significantly scarcer than gross area estimates suggest. A highly scalable ARR project is therefore one where capital today contributes not only to current credit delivery but also to developing the nursery capacity, community relationships, monitoring infrastructure, and silvicultural knowledge base that enables future projects to be deployed more efficiently and at lower cost.

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