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M001

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Contact:
Ecosystem Restoration Standard
25 Rue de Frémicourt
75015 Paris, FRANCE
info@ers.org

METHODOLOGY

Future Improvements & Limitations

SUMMARY

This document details future improvements and limitations relating to ERS Methodology for Terrestrial Restoration (M001). It covers the core Methodology document and the Quantification Methodology for Terrestrial Forests. ERS is committed to the continuous improvement and development of its methodologies.

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NORMATIVE REFERENCES

The following document should be read in conjunction with:

- M001 -Methodology for Terrestrial Forests
- M001 - Quantification Methodology for Terrestrial Forests

READING NOTES

- The sections are divided between:
    - **Future Improvements**, which refer to limitations that ERS considers addressable with the current "state of the art" science, technology and market practice. ERS has not yet found a way to implement these improvements safely and efficiently into the current methodology but is actively working towards including them in a future version.
    - **Limitations**, which refer to limitations of the methodology for which ERS has no short-term action plan. They often cover fundamental limitations to which all carbon standards are subject to and for which ERS lacks realistic pathways for improvement without significant scientific, technological, or market breakthroughs.
- Reading indications:

💡 These sections offer complementary insights into ERS's Future Improvements & Limitations, offering more in-depth information on future improvements or details on specific topics to facilitate comprehension.

Ecological *Recovery*

FUTURE IMPROVEMENTS

- **Lack of Reference Ecosystems.** ERS requires a physical Reference Ecosystem and Ecosystem Site to carry out its certification process. However, in some instances, there may no longer be a Reference Ecosystem or physically accessible site that the Project can use to inform its Project design. ERS is considering ways to allow Developers to submit Projects in these cases.

- **Climate Change and Reference Ecosystems.** As climate change begins to affect the range of various species, it may make sense for a Developer to use a Reference Ecosystem adapted to the future climatic conditions of the Project Area, rather than one adapted to historical conditions. Doing so with ecological integrity is a non-trivial task, and ERS is considering various safeguards to put in place before allowing for this.

- **Controlled Burning in Ecosystem Management.** In ecosystems where fire is naturally present and beneficial, ERS plans to permit controlled burning for site preparation and ecological treatment. Developing a precise method to quantify the GHG emissions from these controlled burnings is key to this implementation, ensuring ecological benefits are effectively balanced with accurate carbon accounting.

- **Quantifying for Ecosystem Attributes.** M001 currently lacks a methodology for quantifying and monitoring certain ecosystem attributes such as Substrate or Productivity. ERS is actively exploring methodologies to accurately track water, air, and soil quality in an efficient, scalable, and precise way as part of our ongoing Research & Development efforts.

LIMITATIONS

- **Challenges in Quantifying and Monitoring Biodiversity.** A key limitation in ERS's methodology is the absence of mandated quantification and monitoring of specific biodiversity metrics. This decision stems from two key factors. Firstly, the public consultation process revealed a lack of consensus on which biodiversity metrics should be tracked and their appropriate methodologies. The diversity of ecosystems coupled with the varying scientific opinions makes it challenging to standardise these metrics universally. Secondly, current techniques for biodiversity measurement, though advancing, still present significant logistical and financial challenges, particularly when implementing statistically significant sampling protocols. Many of these methods, such as environmental DNA (eDNA) analysis and bioacoustics, have inherent limitations — eDNA does not provide abundance data, and bioacoustics is restricted to species that produce sound — thereby limiting their scope. ERS will continue to follow developments in this space closely and will look to implement commonly agreed-upon metrics and data collection protocols as they begin to emerge.

💡 ERS still encourages the use of eDNA, bioacoustics and camera traps, when these tools are available, to facilitate and increase the accuracy of fauna monitoring, especially for Projects in which specific species are relevant indicators of ecosystem recovery but their observation is difficult. Until there is an ERS-wide methodology to use such devices for ecological and biodiversity monitoring, ERS will continue to request data collection through the Field Assessment.

Carbon

FUTURE IMPROVEMENTS

Inclusions

- **Soil Organic Carbon (SOC).** ERS acknowledges SOC's significant role in sequestering and emitting greenhouse gases.
    - Currently, ERS's methodology excludes SOC due to its complex nature and the challenges associated with accurately measuring it at a site-specific level. The exclusion of SOC is considered net conservative, as restoration generally leads to increased SOC sequestration. To address the potential for soil disturbance to release unaccounted carbon, ERS has established a guideline that restricts tilling to no deeper than 25 cm. This measure is intended to limit the depth of soil disturbance, thereby reducing the likelihood of significant carbon release from soil disruption. Looking forward, ERS aims to incorporate SOC in its GHG emission estimations, both as a source and a sink.
    - ERS recognises the site-specific nature of SOC and does not consider numbers from regional databases and the literature to be appropriate proxies for project-level SOC values. Acknowledging the technical, logistical, and financial challenges in implementing site-specific SOC measurements, such as core sampling, ERS will likely make SOC inclusion optional in the next version of the M001 methodology. When included, SOC would require monitoring as both a source and sink, with baseline measurements taken before site preparation.
- **AGB model Calibration using Field Data.** ERS acknowledges the potential limitations associated with the use of a large-scale AGB model, especially when applied to specific biomes or regions. However, a remote sensing model presents certain advantages in comparison to a field approach based on sampling. These include a more comprehensive understanding of local

variations and a more holistic perspective of the landscape. In light of these considerations, the optimal approach would be a remote sensing model that is locally calibrated on the Project Area. To facilitate this, ERS is planning to incorporate the possibility of using local field data to calibrate the remote sensing AGB model. This approach, while promising, is not without its challenges. Ensuring the representativeness of the field data in relation to the larger landscape, and the accurate integration of this data into the remote sensing model, will be critical.

- **Emissions from Site Preparation.** ERS' M001 does not include GHG emissions resulting from site preparation activities, notably the eradication of invasive species. Future versions aim to address this by introducing provisions to estimate GHG emissions resulting from these activities.

- **Scope 1 Emissions.** For the next methodology version, ERS may introduce reporting of Scope 1 Project emissions, specifically fossil fuel use. The estimated GHG emissions would be included in the Reversal calculations biennially. The challenge is to create a robust, verifiable approach without overburdening Developers, as such emissions are typically excluded by carbon standards *de minimis*.

Methodological Improvements

- **Uncertainty & Conservativeness**. ERS acknowledges that the current approach to uncertainty and conservativeness can be potentially disadvantageous to Developers. This is particularly evident in the use of the lower 95% uncertainty bound for the Reference Site and the upper 95% uncertainty bound for the Restoration Site. While this method is highly conservative, it also presents a scenario that is statistically improbable. Furthermore, this approach may double-count uncertainty sources, as the calculations for the Restoration and Reference Sites are performed independently. In pursuit of a more balanced and accurate approach, ERS is committed to exploring alternative methods for addressing uncertainty and conservativeness, in collaboration with our partners.

- **Representativeness of Control Plots.** ERS uses a dynamic baseline approach to estimate the net GHG emissions and removals that would have occurred without the Project's interventions. This involves identifying control plots outside of the Project Area that match its characteristics, using indicators such as land cover, forest height, soil physical and chemical parameters, distance to roads, elevation, and other relevant factors.
    - These indicators can vary significantly between regions, making identifying appropriate control plots for all biomes and regions challenging. As a result, ERS has had to make specific choices about the indicators used to identify control plots, which may affect the representativeness of the dynamic baseline. ERS acknowledges this limitation in the current approach and is actively working on developing new methods to improve it.
    - The absence of systematically published shapefiles on other registries makes it difficult to exclude existing carbon projects from control plots. ERS recommends that industry accreditation bodies like ICVCM, ICROA, and CORSIA require the disclosure of such data for all active projects. Additionally, improving geographical data accessibility through platforms like CADTrust would enhance access to this information and help reduce the risk of double-counting.
    - Due to the absence of a comprehensive global database detailing land ownership, ERS has opted to exclude land ownership from its list of indicators.
- **Projected Carbon Sequestration Curves.** M001 assumes that carbon values at a Project's 40-year mark will match the Reference Site's. Introducing a sequestration curve would enable more nuanced estimates by considering the varying carbon accumulation rates throughout an ecosystem's lifecycle, rather than relying on a static end-point comparison. ERS is actively working on a suitable approach to implement.

Benchmarking and Modeling Improvements

- **Refining the AGB Model Benchmark.** The current Above-Ground Biomass (AGB) model adopted by ERS was selected through an intensive benchmarking process, focused on a 50,000-hectare site in Mozambique. The dataset, licensed from Sylvera, uses multi-scale LiDAR to achieve the most precise AGB dataset ERS has come across. Due to budget constraints, ERS could only license a single dataset to start. This particular dataset was chosen for its representation of tropical dry forests, a biome known for the complexities associated with AGB modelling. ERS now has access to a larger dataset, including various biomes, and will work on expanding the benchmark. The next iteration of the benchmark will include a public call for applications to encourage the participation of additional AGB providers.
- **Incorporating Non-Woody Biomass in AGB Modeling.** The AGB model utilised by ERS, primarily trained on woody biomass datasets, is limited in estimating non-woody biomass. ERS is currently working on a new AGB model, in collaboration with partners, which will include non-woody biomass to improve accuracy in GHG removal estimations.
- **Benchmarking Land Cover Models**. ERS currently employs the ESA WorldCover 10m 2021 v200 model for classifying non-woody areas into specific land cover types. This model, which utilises data from Sentinel-1 and Sentinel-2 satellites, was chosen over the Dynamic World model, based on internal benchmarks. In the future, ERS aims to conduct a more comprehensive benchmark of several land cover models, including one developed in-house. The results of the benchmark will be anonymised and made publicly available.
- **Benchmarking Forest Loss Alert Models.** ERS recognises the limitations of the Integrated Deforestation Alerts from Global Forest Watch for forest loss monitoring. In the near term, ERS will be conducting a comprehensive benchmark, including recently released models (including LUCA from Ctrees and a model built internally) to enhance the accuracy and reliability of forest loss assessments.

LIMITATIONS

Exclusions

- **Exclusion of Litter and Dead Wood.** Litter and Dead Wood are conservatively excluded. Accurately quantifying these carbon pools is considered too costly relative to their relative significance to carbon stocks at the Project scale.

- **Exclusion of Soil Inorganic Carbon (SIC).** Soil Inorganic Carbon, while a significant carbon pool, is currently out of scope for this methodology. SIC is typically not included in ARR methodologies. ERS may consider including SIC alongside SOC if measurement protocols apply to both.

- **Exclusion of Nitrous Oxide.** The M001 methodology currently excludes nitrous oxide from its scope, primarily because the use of nitrogen fertiliser – a significant source of nitrous oxide emissions in Afforestation, Reforestation, and Revegetation (ARR) projects – is prohibited.

- **Exclusion of Methane.** Methane emissions from forests, while a notable source of GHG, are presently excluded. This decision stems from the current lack of scientific consensus on the biophysical mechanisms of methane release in terrestrial forests and the absence of commonly accepted, high protocols for efficiently calculating such emissions. ERS will stay abreast of any developments in the scientific literature.

💡 To ERS's understanding, there is broader consensus regarding the biophysical mechanisms of methane release in wetland ecosystems, including mangroves. ERS plans to include methane within the scope of future methodologies that cover these ecosystems.

- **Exclusion of Water Vapour.** In line with common practices in carbon standards, the M001 methodology does not encompass water vapour in GHG estimations. Water vapour, despite its important role as a GHG, is typically not accounted for due to its complex and variable nature.

Carbon Estimations

- **BGB Estimation.** ERS currently estimates below-ground biomass (BGB) using the IPCC root–shoot (RS) ratio, which assumes a relatively constant ratio of above-ground to below-ground biomass for a given plant species or ecosystem. Although this method is widely accepted, it holds limitations due to factors like soil nutrient availability, moisture, and disturbances, which can affect the RS ratio and introduce uncertainty into BGB estimates. ERS is dedicated to exploring alternative methods to improve the accuracy and precision of BGB estimates. However, we have not yet identified a more reliable solution than the IPCC RS ratio.
- **BGB Loss.** ERS cannot accurately model BGB reversals resulting from loss events. As a result, the methodology conservatively assumes a 100% loss.
- **Carbon fraction.** ERS currently applies a fixed carbon fraction value of 0.47 when converting biomass to carbon, a figure that does not account for the species-dependent nature of wood. In the medium term, ERS is considering the adoption of species-specific carbon fraction values to enhance the precision of its carbon estimations. However, the lack of documented carbon fraction values in the literature, especially for tropical species, is likely to be a limiting factor.

Leakage

- **Leakage Estimation.** ERS tracks Project leakage using satellite monitoring in disclosed Leakage Areas, as well as a five-kilometre Leakage Belt around the Project Area. However, it is difficult to precisely quantify the amount of leakage and to tie a causal link to the Project, especially when the leakage source is geographically far from the intervention area.

- **Market Leakage.** ERS does not include market leakage in its quantification methodology, a decision driven by the inherent complexities in measuring shifts and establishing causal relationships between market demand or supply as a consequence of Project activities.

- **Upstream/Downstream Leakage.** ERS does not currently quantify the impacts of upstream and downstream leakage. Quantifying these impacts requires a comprehensive lifecycle analysis of all inputs and outputs associated with a Project, which can be complex and data-intensive. In the near term, ERS aims to include Scope 1 emissions from Project activities (refer to the *Inclusions* section above for more details). In the medium term, ERS may consider the inclusion of Scope 2 and Scope 3 emissions.

- **Displacement Factor.** The displacement factors for Project activities are provided by the Developer. The subjective nature of these assessments, coupled with the variability in local contexts and the lack of standardised methodologies for such analysis, makes the objective and precise quantification of displacement factors difficult. In the near term, ERS will continue to look for alternative methods of assessing displacement factors at the Project level.

Livelihoods

FUTURE IMPROVEMENTS

- **Accessibility to Local Communities.** As one of the goals of the Standard is to empower Developers and Local Communities, ERS does acknowledge that some of the tooling and methodologies used by the Standard require a higher level of knowledge on the subject being addressed. To promote higher autonomy and capability building, ERS is setting up an 'Academy' with institutional content that will allow self-paced training on how to design an ecosystem restoration Project that complies with the Standard's requirements, and on how to use the Standard's toolings.

- **Intra-Community Equity in Benefit Sharing.** ERS is currently evaluating how to enhance the equitable distribution of benefits within communities, particularly for IPLCs. On the one hand, ERS aims to maximise local autonomy and decision-making. On the other, ERS is conscious of the potential for disproportionate benefits to local elites and men. In addressing this, ERS is considering whether guidelines that acknowledge and address internal community dynamics can be implemented without overstepping local governance structures.

- **Livelihood audits.** To increase assurance of Livelihood reporting, ERS will be designing a specific protocol for Validation and Verification of all Livelihood aspects.

LIMITATIONS

- **Subjectivity in Livelihood Indicators.** ERS acknowledges the challenges in measuring livelihood indicators that rely heavily on Stakeholders' perceptions, especially when qualitative. Consequently, their accuracy and results will most likely vary depending on the data provider. Although ERS tries to reduce the subjectivity of indicators by requesting key results to be backed by evidence, it recognises a need for further improvements to increase the objectivity and reliability of assessments. To achieve this, ERS plans on collaborating with specialised researchers, including anthropologists and sociologists.

- **Benefit Sharing on Secondary Transactions.** In the medium term, ERS would like to implement a mechanism to allow kickback from secondary sales to the Developer, enabling relevant Stakeholders (IPLCs) to benefit from secondary market transactions. ERS has not yet found an efficient way to do so using existing registry infrastructure.

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info@ers.org | www.ers.org