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M001

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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 Quantifying and Monitoring in 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

- **Inclusion of 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.
- **Emissions from Site Preparation.** The current ERS M001 methodology 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*.

Benchmarking and Model Improvements

- **Broadending 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. Moving forward, ERS plans to conduct a more extensive benchmarking process by licensing additional datasets of similar quality, to cover the full spectrum of functional groups across all biomes included in M001. The next iteration of the benchmark will also include a public call for applications to encourage the participation of even more 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. Consequently, ERS uses fixed IPCC values for non-woody biomass estimations. Future enhancements of AGB models by data providers could include training on non-woody biomass datasets for more accurate 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.

- **Classifying Recent Land Cover Changes**. The ESA WorldCover models used by ERS are trained on data specific to the year prior to its release, leading to a year-long lag in the availability of new data. As a result, recent land cover changes may be inaccurately classified. To address this, ERS plans to implement a new model that utilises recent cloud-free satellite imagery.
- **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. The accurate quantification of 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 both the biophysical mechanisms of methane release in wetland ecosystems, including mangroves. ERS plans on including 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.

AGB Model

- **Temporal Dynamics.** The AGB model may not fully capture seasonal biomass variations or anomalies due to temporal climatic events.
- **Stochastic Uncertainty.** Uncertainty increases for smaller plots and shorter time frames. To mitigate this, ERS conducts carbon estimations biennially and at the Project level.
- **Data Requirements.** The model's accuracy is contingent on the availability and quality of field data for calibration and validation. In regions where such data are scarce or outdated, the model's performance may be compromised.
- **Reference Site:** Baseline quantification at the Reference Site relies solely on woody AGB data. While the data input into the quantification process is

reliable, this misses potentially non-woody vegetation present in the Reference Site. This approach, while limited in its precision, leans towards an underestimation of the total carbon sequestration capacity of the Projects.

Carbon Estimations

- **Shrublands Ratio Default Value.** ERS utilises a standard ratio of 0.1 for converting forest to shrubland biomass, in line with AR-TOOL14 guidelines. While this approach is streamlined, it risks misestimating shrubland biomass. ERS intends to refine the AGB model to enhance its precision, which will assist in accurately incorporating all shrubland areas within the model's woody classification, thereby improving overall biomass estimations.
- **BGB Default Value.** ERS uses a conservative default ratio of 0.25 for Below Ground Biomass (BGB) estimation, acknowledging its potential imprecision across varied ecosystems and soil types. In the medium term, ERS plans on refining its approach by adopting ecosystem or soil-type-specific values for greater accuracy.
- **BGB Loss Estimation.** 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.
- **Projected Carbon Sequestration Curves.** Currently, the M001 methodology assumes that carbon values at a Project's 40-year mark will mirror those of the Reference Site. The introduction of a sequestration curve would allow for a more nuanced estimation, taking into account the varying rates of carbon

accumulation throughout the lifecycle of an ecosystem, rather than relying on a static end-point comparison. Despite significant investments in resources on literature and tests of available models, ERS's R&D team has thus far been unable to find a suitable approach.

Dynamic Baseline

- **Representativeness of Control Plots.** The indicators selected for dynamic baseline evaluation, while robust, do not fully represent the diversity within and across ecosystems. The selection of control plots is therefore not entirely representative of Project Areas. Additionally, due to the absence of a comprehensive global database detailing land ownership, ERS has opted to exclude land ownership from its list of indicators.
- **Frequency of Data Updates.** The frequency with which some data is updated poses a challenge. While ERS seeks to provide and rely on the most current information, not all indicators are updated as frequently as others. This can impact the accuracy of our quantification process.
  - Landcover; last update on 2021
  - Forest Height; last update on 2019
  - Soil Physical and Chemical Parameters; last update on 2019
  - Distance to Roads; last update on 2022
- **Lack of Publicly-Available Shapefiles.** The absence of systematically published shapefiles on other registries poses a challenge to excluding carbon projects from control plots. ERS recommends that industry accreditations like ICVCM, ICROA, and CORSIA mandate the disclosure of such data for all active Projects. Additionally, the facilitation of data accessibility by platforms such as CADTrust would increase the ease of access to such information and reduce the risk of double-counting.

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.

Carbon Rights

- With the Article 6.4 mechanism of the Paris Agreement still in its early days, governments have yet to establish streamlined processes for issuing Letters of Authorisation for carbon projects. This lack of established procedures presents a significant challenge for Developers seeking to secure carbon rights.

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 programme require a higher level of knowledge on the subject being addressed. To promote higher autonomy and capability building, ERS is setting up an Academy Program 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, we are 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 put in place without overstepping local governance structures.

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, ERS 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, to enable relevant Stakeholders (namely 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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