Yale Carbon Containment Lab
February 17, 2022

Dear Climate Action Reserve,

The Yale Carbon Containment Lab (CC Lab)[1] is grateful for the opportunity to comment on the **Climate Forward Reforestation Forecast Methodology Version 2.0** (hereafter, the "Methodology"). Part of the Yale School of the Environment, the CC Lab aims to mitigate greenhouse gas emissions practicably at large scale and low cost. Pursuant to this goal, the CC Lab is developing multiple carbon containment and carbon removal projects across the United States, including reforestation projects with collaborators in the American West whose forests were destroyed by recent severe wildfires.

As part of these reforestation projects, we hope to implement reforestation practices which have been scientifically shown to increase forests' resilience to climate change and wildfire, but that have not yet been implemented at scale. Such practices include **lower-density planting** and **planting at heterogeneous densities**.

The CC Lab has reviewed existing Agriculture, Forestry and Other Land Use (AFOLU) carbon offset methodologies that may be applicable for supporting post-wildfire reforestation, and determined that none could currently accommodate the implementation of novel reforestation methods. This Methodology is already a market leader in incentivizing reforestation by allowing landowners to recuperate upfront planting costs within a few years, rather than after lengthy verification periods. With minor amendments, this Methodology could become the first offset methodology to successfully incentivize healthier, more resilient reforestation techniques in high-stress ecosystems, and help avoid complete project reversals by reducing the risk of severe wildfire. In this comment, we also highlight a potential redundancy in crediting discounts between Version 2.0's new programmatic ex ante risk discount and the Methodology's tonne-year accounting scheme, which could disincentivize its widespread uptake.

Background

When replanting forests in western North America, especially with the goal of long-term carbon storage, project developers must plan for the compounding stressors of drought, bark beetles, and high-severity wildfire. Business-as-usual high-density replanting results in high inter-tree competition, which can lead to forest-scale decreases in water economy, chronic growth reduction, higher susceptibility to disease and insects, and mortality.[2] On the other hand, landscapes that are not reforested after severe wildfires can be overtaken by shrubs and grasses within 2-3 years, which inhibits passive regeneration from surviving trees.[3] "Shrubified" lands can be considered degraded because shrubs do not provide the same ecosystem services, including carbon sequestration, as trees, and have little economic value. Researchers have proposed two replanting strategies to facilitate forest regeneration in such high-stress ecosystems: planting at lower densities, and planting at heterogeneous densities.

In historically fire-frequent ecosystems in the American West, low-density planting of 40-80 trees per acre produces stocking densities that approximate forest conditions prior to logging and fire suppression, where average tree density was less than 30 trees per acre, and canopy cover averaged less than 25%.[4] Low-density planting results in less competition for water, sunlight, and nutrients, and as a result trees display **increased long-term resiliency** to pests, disease, and wildfire.[5] Greater project resilience also helps maintain the **credibility of reforestation-based carbon offset projects**, which have faced scrutiny after devastating wildfires fueled by dense plantings then resulted in complete project reversals.[6]

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[1] https://carboncontainmentlab.yale.edu/
[2] North, M.P. *et al.* 2022. "Operational resilience in western US frequent-fire forests." *Forest Ecology and Management* 507.
[3] Shive, K.L., C.H. Sieg., and P.Z. Fule. 2013. "Pre-wildfire management treatments interact with fire severity to have lasting effects on post-wildfire vegetation response." *Forest Ecology and Management* 297:75-83.
[4] Hagmann, K. *et al*. 2022. "Contemporary wildfires further degrade resistance and resilience of fire-excluded forests." *Forest Ecology and Management* 506: 119975.
[5] North, M.P. *et al.* 2022. "Operational resilience in western US frequent-fire forests." *Forest Ecology and Management* 507.
[6] Hodgson, Camilla. "US Forest Fires Threaten Carbon Offsets as Company-Linked Trees Burn." *Financial Times*, August 3, 2021. <https://www.ft.com/content/3f89c759-eb9a-4dfb-b768-d4af1ec5aa23>.

Historical ecosystems also had heterogeneous tree spacing as a result of more frequent fires.[7,8] Replanting at heterogeneous densities aims to mimic these conditions and involves establishing clusters of woody vegetation, or "tree islands," across a project area (see Figure 1). Planting in "tree islands" **accelerates regeneration in damaged ecosystems** because clustered trees can ameliorate harsh microclimates, stabilize soil, seed subsequent trees, and provide resources (such as through mycorrhizal networks) to other recruiting trees during primary succession.[9,10]

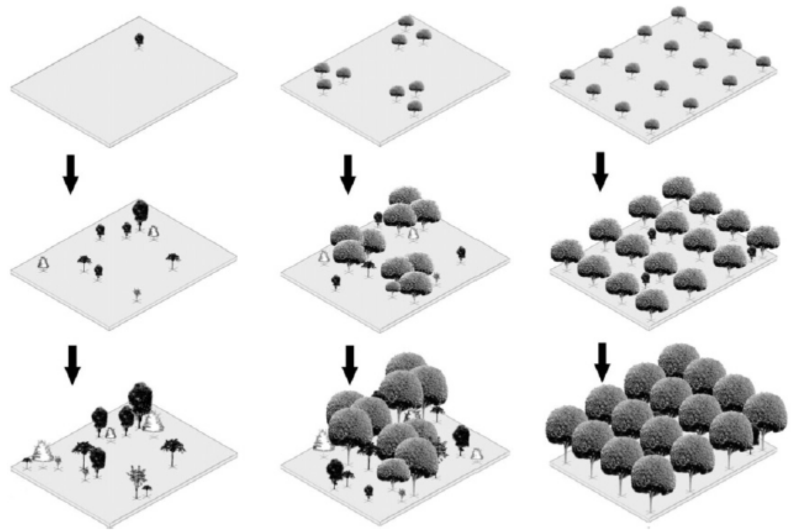

Figure 1: Forest regeneration patterns following three replanting methods. Column 1 represents natural regeneration only, resulting in the establishment of shrubs. Column 2 represents "tree island" reforestation, resulting in heterogeneous stocking densities and mixed-age stands. Column 3 represents plantation-style reforestation, resulting in high-density stocking and trees vulnerable to disturbance. Adapted from Corbin and Holl, 2012.

Both strategies are likely to increase seedling and tree survivorship, even after severe disturbance events, and may result in more reliable long-term carbon storage. Additionally, by extending the lifespan of individual trees, the **carbon sequestration potential** for each tree is increased.[11] These strategies could be applied on commercial and non-commercial lands, and both carry the added **economic benefit of requiring fewer seedlings** to implement eligible projects. Replanting efforts are often constrained by the cost of growing and distributing seedlings, but also by the physical capacity of nurseries. Recently, nurseries in the Western U.S. have been unable to meet seedling demand for post-wildfire reforestation projects.[12]

Finally, these approaches provide opportunities to gain scientific insight: reforestation science is a developing field, and project developers may wish to partner with researchers to better understand and improve forest regeneration dynamics in their project area.

Proposed Amendments

1. ***Heterogeneously spaced planting***: The current Methodology already allows for relatively low-density planting (40 trees per acre), but it assumes uniform planting density across the project area.

   Recommendation: We recognize that solely planting in clusters or islands would be insufficient to consider the project area fully reforested under any offset methodology. A baseline of at least 40 trees per acre could be required on all project acres, while allowing for stands within the project area to be planted at locally higher densities. Adding this option would require two changes:

   a. Extend the option to "stratify" the project area, outlined in Section 5.2.4 "Determining Gross Forecasted GHG Removals," to also designate stands with different planting densities. At the time of project submission, maps included with the project portfolio would outline the boundaries of stands with different planting densities.

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[7] North, M.P. *et al*. 2019. "Tamm Review: Reforestation for resilience in dry western U.S. forests." *Forest Ecology and Management* 432:209–224.
[8] Hessburg, P.F. *et al*. 2016. "Tamm Review: Management of mixed-severity fire regime forests in Oregon, Washington, and Northern California." *Forest Ecology and Management* 366: 221–250.
[9] Policelli, N. *et al*. 2020. "Back to Roots: The Role of Ectomycorrhizal Fungi in Boreal and Temperate Forest Restoration." *Front. For. Glob. Change* 3:97.
[10] Corbin, J.D. and K.D. Holl. 2012. "Applied nucleation as a forest restoration strategy." *Forest Ecology and Management* 265:37-46.
[11] Hurteau, M.D. *et al.* 2016. "Restoring forest structure and process stabilizes forest carbon in wildfire-prone southwestern ponderosa pine forests." Ecol. Appl. 26:382-391.
[12] Dauphinais, Sydney. "Oregon's post-wildfire reforestation efforts hampered by tree seedling shortage." *OPB,* March 23, 2021. <https://www.opb.org/article/2021/03/23/oregons-post-wildfire-reforestation-efforts-hampered-by-tree-seedling-shortage/>.

b. Alter the protocol for "Confirmation of Site Stocking" described in Appendix A. Under a density-stratified scenario, "least-stocked areas" would need to be identified within each density stratum (according to how they were designated during project submission). Sample plots within sample areas could maintain their gridded formulation, but would need to be displaced from the edges of the stratum by at least the sample plot radius appropriate for the stratum's stocking density (outlined in the Methodology's Table A1). Sample plots should not be allowed to fall directly on stratum boundaries because they will disproportionately fail the site stocking test.

2. ***Risk discounting in tonne-year accounting***: While it is importantly to fully account for the potential risks faced by reforestation projects, including through buffer pools and sufficient discounting for conversion risk, crediting based on tonne-year accounting already steeply discounts FMUs issued based on the increased risk of project failure over time. The new programmatic ex ante risk discount additionally penalizes the project for the same pool of risks, namely project abandonment, harvest, and conversion. Further discounting will likely make certification under this Methodology economically untenable for many parties, especially in cases where the planting is additional and would not happen without other external support.

   Recommendation: There is a concerning potential redundancy between the new programmatic ex ante risk discount (Section 3.8.3, "Conservative Crediting and Permanence Risk Pool") and the de facto crediting discount baked into tonne-year accounting (Section 3.8.2). The Methodology should either remove the additional programmatic ex ante risk discount, which is already encapsulated within tonne-year accounting, or otherwise change the crediting equation $ER_f = \sum_{y=1}^{CP_f} \left(\Delta AC_{f,y} \times 1\% \times (CP_f - y + 1) \right)$ to remove the time-dependent penalty component "-y+1".

We hope these comments will be useful to the continued development of this Methodology and for enabling project proponents to adopt forward-thinking, more resilient reforestation approaches.

Sincerely,
Members of the Yale Carbon Containment Lab

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