

GCF SAP Proposal: Scaling up Climate Resilience Solutions for Burundian Smallholders - Annex 14: Explanation of GHG Emissions Reduction Estimates (Round 3 feedback)

GCF-project estimate - Ex-ACT CO₂ sequestration methodology

One Acre Fund's (1AF) estimate of **1.99M tCO₂eq of permanent removals** is based on the Ex-ACT methodology (which uses a land-based approach), together with 1AF's knowledge of smallholder crop farming and agroforestry systems in Burundi. 1AF has assumed 20 years of capitalization after 5 years of program implementation (the GCF grant period), translating to 25 total years of project lifespan.

Note—however—that 1AF expects agroforestry impacts to persist beyond the project period. Namely, the 1AF agroforestry project will (1) raise farmers' awareness of the importance of diverse tree planting as investments; in terms of future fuel wood, farm-level assets, and soil health. 1AF will also (2) develop hundreds of skilled nursery operators at the village level that run their nurseries as small enterprises (with 1AF being the primary client). This 'decentralized nursery' approach is explained in more detail in section B.2.1 in the full proposal.

Below, please find an explanation of the key steps/assumptions made using the Ex-ACT tool:

- **Description:** Completed with basic information of the 1AF program, with support from the internal Agricultural Research Team, comprising internal expert agronomists.
- **Land Use Change (LUC):**
 - *Agroforestry:* Only section 2.3 applies to 1AF, as the organization works on crop land and is pursuing perennial agroforestry land use, not complete afforestation. Namely, the change made is from "annual cropland" to an agroforestry system. Based on the descriptions from Ex-ACT, the "hedgerow" system is the most comparable to the 1AF model. Note that in farmer fields, there is often likely to be some additional tree planting (e.g. in-field, near home).
 - *Total hectares:* The land size applicable to this project (26,402 ha) was calculated as follows:
 - Land size estimated as conservatively as possible: assuming 200 surviving trees per ha. This is about as dense as this program could get to, given that most planting is done on the boundaries.
 - Land size = [# surviving trees] / [max tree density of 200 surviving trees/ha]
 - Note that if 1AF used [avg farmers' land size] * [# farmers estimated to serve in this project], the land size is much larger (3x the more conservative version).
- **Cropland:** Entered using characteristics of the 1AF program (grain cultivation and agroforestry).
- **Inputs:**
 - Entered using real values from 1AF's program in Burundi (extrapolated from 2023 data): lime application, nitrogen fertilizers and compost.
 - The input estimates are based on the average input use for maize; the most important staple crop in Burundi. However, the reality for all the land that a farmer owns would be slightly different in terms of input intensity given the fact that farmer fields in Burundi tend to be diverse across grains, cereals and legumes (albeit with likely lower levels of input intensity—for the most part—compared to maize).
 - One assumption made is that input use will *not* decline. If this project is highly successful, there is a chance that this would decline slightly over time.

Ex-ACT Tool - CO2 Sequestration estimates (tCO2) - GCF attributable (303k clients)

	Without project	With project	Balance	Without project	With project	Balance
	Extensive restoration			Intensive restoration		
ha restored	75,179			26,402		
Deforestation	0	0	0	0	0	0
Afforestation	0	0	0	0	0	0
Other land-use	0	0	0	0	0	0
Annual	-698,623	-87,328	611,295	-245,349	-30,669	214,680
Perennial	0	-6,301,504	-7,225,981	0	-2,213,016	-2,213,016
Flooded rice	0	0	0	0	0	0
Grasslands	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Forest mngt.	0	0	0	0	0	0
Inland wetlands	0	0	0	0	0	0
Coastal wetlands	0	0	0	0	0	0
Fisheries and aquaculture	0	0	0	0	0	0
Inputs & Invest.	13,475,973	13,475,973	0	13,475,973	13,475,973	0
Sum	12,777,350	7,087,141	-5,690,209	13,230,624	11,232,288	-1,998,336

Figure 1: Summary of main data points used in the 1.99M tCO₂eq of permanent removals estimate

In the screen shot above, 1AF used the 'intensive restoration' estimate of permanent sequestration (which considers surviving trees versus just the number of trees planted).

TerraCarbon-validated CO₂ sequestration methodology

***1AF's internal methodology used to validate outcomes from the Ex-ACT tool*

In order to validate outcomes from the Ex-ACT tool, 1AF also ran an estimate of removals using its third-party verified methodology. **Important note: the full proposal submitted does not include CO₂ sequestration estimates on the basis of this model; this methodology is detailed below in order to demonstrate 1AF's internal approach to estimating carbon removals.** Using this method, with what we believe is an even more conservative approach, 1AF returned <1M tCO₂eq of permanent removals. Though this estimate scales significantly when used across our entire global tree work, which is what it was designed to measure. One of the reasons that 1AF's internal estimates come out lower than Ex-ACT is that 1AF has been much more conservative about surviving trees (and only considers 20-yr growth), whereas Ex-ACT assumes that this is a permanent change in land use.

The methodology is explained below:

- **Step 1:** The model determines additionality and establishes a baseline by taking the difference in the number of surviving trees on “adopter” plots with the number on similar “non-adopter” plots. An increase in trees and woody biomass within the project area is compared over time to changes in tree cover and woody biomass in plots nearby that share similar economic and biophysical characteristics.¹
- **Step 2:** The model estimates total carbon temporarily sequestered in harvested trees based on individual tree growth, yield models and time to harvest.
 - **Step 2a:** Annual carbon sequestration per tree for each tree species determined. 1AF has developed approximate growth and yield models for individual species represented in the tree seedlings it distributes. The accuracy of species-specific growth and yield models depends on the quality of data used to determine how rapidly a tree typically grows year-over-year and how appropriate the allometric equation used to convert trunk diameter growth into overall biomass estimates are for a given species. Species-specific allometric equations are often lacking, leading to some measure of uncertainty.²
 - Note: TerraCarbon has reviewed and helped to refine the species-specific growth and yield models used in this analysis. Although there may be opportunities to improve the individual models, they serve as reasonable approximations of growth and biomass in their current form, and 1AF has applied conservative discounts for select species' biomass models that contribute significantly to overall carbon estimates, such as reducing overall carbon estimates by 20%.
 - **Step 2b:** Calculate the total tonnes CO₂ temporarily sequestered across all distributed trees that are eventually harvested based on species-specific sequestration rates, anticipated tree age at harvest, and percentage of trees likely to be harvested. The 1AF model then calculates the total carbon sequestered by the time of typical tree harvest for all trees planted. This calculation is performed by multiplying the total number of additional trees of a given species and a given cohort (planted in the same year) by the portion of trees of each species expected to be harvested. The total number of harvested trees of each species is then multiplied by the total amount of carbon sequestered in a single tree of that species between planting and harvest. These values are then summed across species and cohorts to estimate the total temporary carbon impact of the first phase of the program.

¹ This method reflects the dynamic performance benchmark approach that has been included in the new Afforestation/Reforestation/Revegetation (ARR) methodology (VM0047) under the Verified Carbon Standard (VCS). The performance benchmark is used to determine the net climate impact of the project versus the baseline scenario.

² More common are general allometric equations suited to trees growing in certain forest types rather than in fields or agroforestry systems where their growth forms and biomass allocations may be different due to tree management activities (e.g. pruning) or reduced competition and increased growing space.

- **Step 3:** The model estimates total carbon permanently sequestered in long-lived trees based on individual tree growth and yield models and permanence assumptions. 1AF's model considers permanence on a 20-year timeframe, where carbon is considered permanent if it is sequestered in trees that live for the full 20-year permanence period. Typically, permanence in carbon accounting is defined on 100-year not 20-year time frames, though permanence requirements vary by standard.³ Permanence periods form the basis on which a project evaluates the risk that carbon stored in the project will be released shortly after, which would undermine its ability to offset emissions. Permanence in the case of short-lived or harvested tree species is also addressed through the long-term average.
 - **Step 3a:** Based on typical harvesting patterns or lifetimes of each species, the portion of distributed trees that are likely to live to at least 20 years is determined. Since 1AF distributes various trees, their ultimate fates vary. For each type of distributed tree, 1AF built out assumptions around time to harvest or death and the portion of each species distributed that are likely to be harvested or have early mortality before 20 years. These assumptions were informed by species-specific use surveys that 1AF conducts to gather data on how farmers use the trees and what values they derive from them. Survey data includes responses on if and when farmers intend to harvest trees. Insights from survey responses are contextualized and conservatively adjusted based on 1AF expertise. When tree use varies significantly or is uncertain, 1AF adopts conservative estimates (i.e., a lower percentage of trees expected to survive to 20 years). The output of this step is an estimate of the portion of trees distributed that can be considered permanent (living at least 20 years) for each species in the program. This allows 1AF to build out data-informed permanence assumptions on a species-by-species basis.
 - **Step 3b:** Apply the permanence assumptions to the amount of carbon stored in each tree after 20 years to determine program-wide long-term carbon sequestration impacts. The final step is to determine how much carbon is held permanently in trees that are not harvested. To calculate this long-term carbon impact, 1AF multiplies the number of each species distributed in a given year by the percent of trees of each species expected to live to 20 or more years, then multiplies by the amount of carbon stored in each tree of each species at 20 years. The amount of carbon stored in each tree of each species at 20 years is based on the species-specific long-term growth and yield models described in Step 2a. It is worth noting that belowground biomass carbon is included in estimates of permanent carbon stored in long-lived trees that are not harvested. This is appropriate and in line with typical carbon accounting calculations.

³ For example, the Verified Carbon Standard adopts a permanence period of 100 years, whereas Plan Vivo considers permanence on 50-year timeframes.