Eden Reforestation Projects

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Quantified Carbon Modeling

Ankilahila

Madagascar Forest Systems

There are four main classes of forest types in Madagascar: Dry Forest, Humid Forest, Spiney Bush and Transitional Forest due to the unique geography and location on the western edge of the Indian ocean. While coastal areas are dominated by mangrove systems, the inland portions of the island are split between the western side of the island that sees significantly more moisture both in rainfall and humidity, and the eastern side which is dryer and has lest rainfall.

The project is located near the edge of the Dry Forest area and only a few kilometers from coastal mangroves. While the project is in the Dry Forest area, which consists of a subtropical and highly seasonal forest populated by primarily deciduous tree species, this area is also exposed to coastal moisture due to this proximity. This area has a hot, wet season from November to April and a cooler, dryer season from May to October.

While plant diversity is typically lower in the dry forest than in the moister areas on the west side of the country, it has a higher rate of endemism. While all species are not classified, and estimated 70 percent of the species in this area are endemic and home to many endemic species: golden-crowned sifaka, mongoose lemur, western forest rat, the golden-brown mouse lemur, Bernier's teal, Madagascar fish-eagle, Humblot's heron, the Sakalava rail, Namoroka Leaf chameleon and Decary's Leaf chameleon to name a few. Because of the transitional nature of the forest type in the location, both the flora and fauna show a higher species diversity per hectare than other portions of the dry forest.

Quick Stats: Ankilahila

Forest type:
Dry Deciduous Forest

Coordinates:
15°34'03.17"S, 46°33'11.36"E

Area:
414 hectares

Trees Planted:
190,000[1]

Total Projected Sequestration of Tree.com.au's sponsored 3,554 Ha over 30 years:
64,475+/-5,416 tonnes of CO_2e
(+/-8.4% at a 90% confidence level)

Average Projected Sequestration amortized per year:
2,149+/-180 tonnes of CO_2e per year

[1]*Note: Total projected carbon sequestration is based on the carrying capacity of the forest as mature forest conditions are established and not on every tree planted becoming fully mature. Some of the planting will be reduced through grazing/browsing animals, natural selection, and eventual conversion to DOM in the soil.*

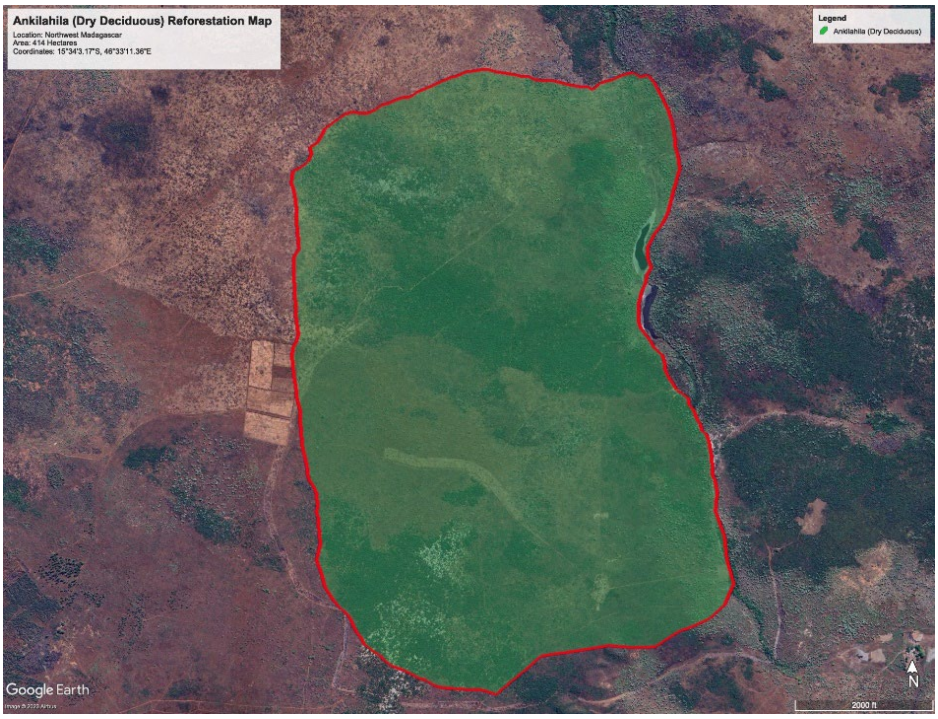
Ankilahila Site Description

The Ankilahila Dry Deciduous Planting Site in northwestern Madagascar is located at the mouth of the Mahamavo Rivier, about 70 road kilometers northeast of the port city of Mahajanga and consists of dry deciduous forests interspersed with palm savanna. Restoration and protection of this area will link the dry deciduous forests with the estuary's mangrove ecosystem, creating a green belt that encompasses a variety of different natural habitats.

The Ankilahila area is critical for protecting and restoring many Madagascar-endemic plants and animals. The Coqueral's Sifaka (Propithecus coquereli), for example, was once common in this area but is now threatened with extinction due to habitat destruction. The fossa, the island's largest predator, has been observed in the area on rare occasions. The IUCN (International Union for Conservation of Nature) Red List of Threatened Species lists Cryptoprocta ferox (fossa) as vulnerable. Many birds' species nest and roost in Ankilahila's dry deciduous forest ecosystem. In this area, the Madagascar Ibis (Lophotibis cristata) and the Van Dam's Vanga (Xenopirostris damii), both endemic to Madagascar and listed as Endangered on the IUCN Red List, have been spotted. This forest is also home to the endemic Malagasy Giant Chameleon (Furcifer oustaleti).

The population of Ankilahila is estimated at about 450 people, most of whom belong to the Sakalava and Tsimihety tribes. Ankilahila is a rural community in Mahajanga district II in the Boeny region. Many residents make a living from subsistence farming, while others are engaged in handicrafts. Some of the residents work as charcoal sellers.

Forests are cleared in the region to make way for agricultural activities, urban expansion, infrastructure development, and charcoal production. This destroys plant and animal habitats, threatening vital ecosystem services and the livelihoods of residents.



Introduction to Forest Carbon

Clarification of terms:

Tonnes of biomass, tonnes of carbon, and tonnes of carbon dioxide equivalent are often used to describe forest sequestration. Distinguishing the subtle differences in meaning of the terms when reading the FREL, IPCC documents, and this report is essential to ensure clear understanding.

- **Biomass** (tonne m) - the total dry mass of the plant -some reports abbreviate this to *t.d.m.* which is tonnes of dry matter.
- **Carbon** (tonne C) - the amount of carbon in the biomass—this is usually around 45% to 50% and varies with species.
- **Carbon dioxide equivalent** (tonne of CO_2e) – Calculated from the carbon using the ratio of the molar weights of Carbon and Carbon Dioxide (44/12). All the values for sequestration used in this document are in CO_2e since that best represents the actual greenhouse gas (GHG) reductions.

This means that 100 tonnes of biomass (m) are equivalent to about 47 tonnes of carbon (tC) which is equivalent to about 172 tonnes of carbon dioxide equivalent (tCO_2e).

It is important to note that the calculated (projected) carbon for this report serves as an estimated amount of carbon that may be sequestered over the course of 30 years, assuming the forest grows in a predictable way. However, this is an unfixed figure, and the actual carbon sequestered at the site can only be measured by in-person field tests after the forest has reached maturity. Likewise, even though the carbon is calculated using a linear function (as is common practice), yearly amounts of carbon accumulation is not a linear process with different amounts of CO_2e sequestered based on the growth stage of the tree as well as a variety of other variables.

Projected Carbon Sequestration Calculations

To calculate the total Biomass (m), Carbon (tC), and Carbon Dioxide Equivalent (CO_2e), Eden Reforestation Projects used data from Forest Reference Emission Level of Madagascar for reducing emissions from deforestation and forest degradation and from 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 4: Forest Land. The following data was used to calculate the eventual mature condition of the forest.

- Forest Aboveground Biomass (AGB): 69.82 Tonnes of Dry Biomass per hectare
- Forest Belowground Biomass (BGB): 19.85 Tonnes of Dry Biomass per hectare
- Dead Organic Matter (DOM): 0.7 Tonnes of Dry Biomass per hectare (IPCC)
- Total number of hectares under reforestation: 414 ha.

See Table 1 for an overview of all the data and their sources used to calculate the total amount of Carbon Dioxide Equivalent

Table *1*. **Overview of data used and their sources to calculate the total amount of Carbon Dioxide Equivalent.**

Description	Value	Source
AGB (T.d.m /ha)	69.82	Government of Madagascar, FREL (Dry Forest)
BGB (T.d.m /ha)	19.85	Government of Madagascar, FREL (Dry Forest)
DOM (biomass tonnes/ha)	0.7	IPCC (not included in FREL)
Area (ha)	414	Eden GIS
Biomass to Carbon conversion	0.47	Government of Madagascar, FREL (Dry Forest)

Table 2 provides an overview of the carbon calculations for each component. The estimated (projected) total carbon sequestration for the **414 hectares** at the Ankilahila Project Site is projected to be **64,475+/-5,416 (8.4% at a 90% confidence level) tonnes of CO_2e** over the project lifetime (30 years). This includes both Above Ground and Below Ground calculations as well as accumulated dead organic matter.

Table *2*. **Overview of calculations of amount of carbon sequestered in 414 hectares over a 30-year period.**

	Biomass	Carbon	CO_2e
AGB	*69.82 Tdm/ha * 414 ha* **28,905 T.d.m.**	*28,905 Tdm * 0.47 tC/tdm* **13,586 Tc**	*(44/12) * 13,586 Tc* **49,814 T CO_2e**
BGB	*19.85 Tdm/ha * 414 ha* **8,218 T.d.m.**	*8,218 Tdm * 0.47 tC/tdm* **3,862 Tc**	*(44/12) * 8,218 Tc* **14,162 T CO_2e**
DOM	*0.7 Tdm/ha * 414 ha* **290 T.d.m.**	*290 tdm * 0.47 tC/tdm* **136 TC**	*(44/12) * 136 Tc* **499 T CO_2e**
Total ABG+BGB+DOM			**64,475 T CO_2e**

One thing to note is the absence of a soil carbon calculation. While carbon will be sequestered in the soil for this project, no reliable models currently exist at the time of this report and need to be directly measured over the lifetime of a project. Some estimates show this could be anywhere from 3% to 20% of the total listed above, but with such a wide possible range, it has been conservatively excluded from this report.

With a projected 64,475+/-5,416 (8.4% at a 90% confidence level) tonnes of CO_2e over 30 years, the yearly average conversion of GHG is **2,149+/-180 tonnes of CO_2e per year** when amortized at a linear rate. Note: Trees do not grow at a uniform rate, therefore any particular year may have a rate above or below the average and the rate presented is calculated from the condition of a mature forest

Eden Reforestation Projects hopes these estimated projected carbon calculations help tree.com.au communicate its commitment to the environment to its stakeholders. However, these calculations are not to be used as verified carbon tonnes (aka carbon credits), as these require a Monitoring, Reporting, and Verification (MRV) approach with vigorous field data collection and third-party verification instead of predictive modeling and calculations contained herein.

Thank you for supporting Eden Reforestation Projects and sharing our commitment and values towards restoring our natural environment and the importance of these ecosystems to the communities who live and depend on these forests.

References:

Hending, D., Holderied, M., McCabe, G., & Cotton, S. (2022). “Effects of Future Climate Change on the Forests of Madagascar.” Ecosphere 13(4): e4017. https://doi.org/10.1002/ecs2.4017

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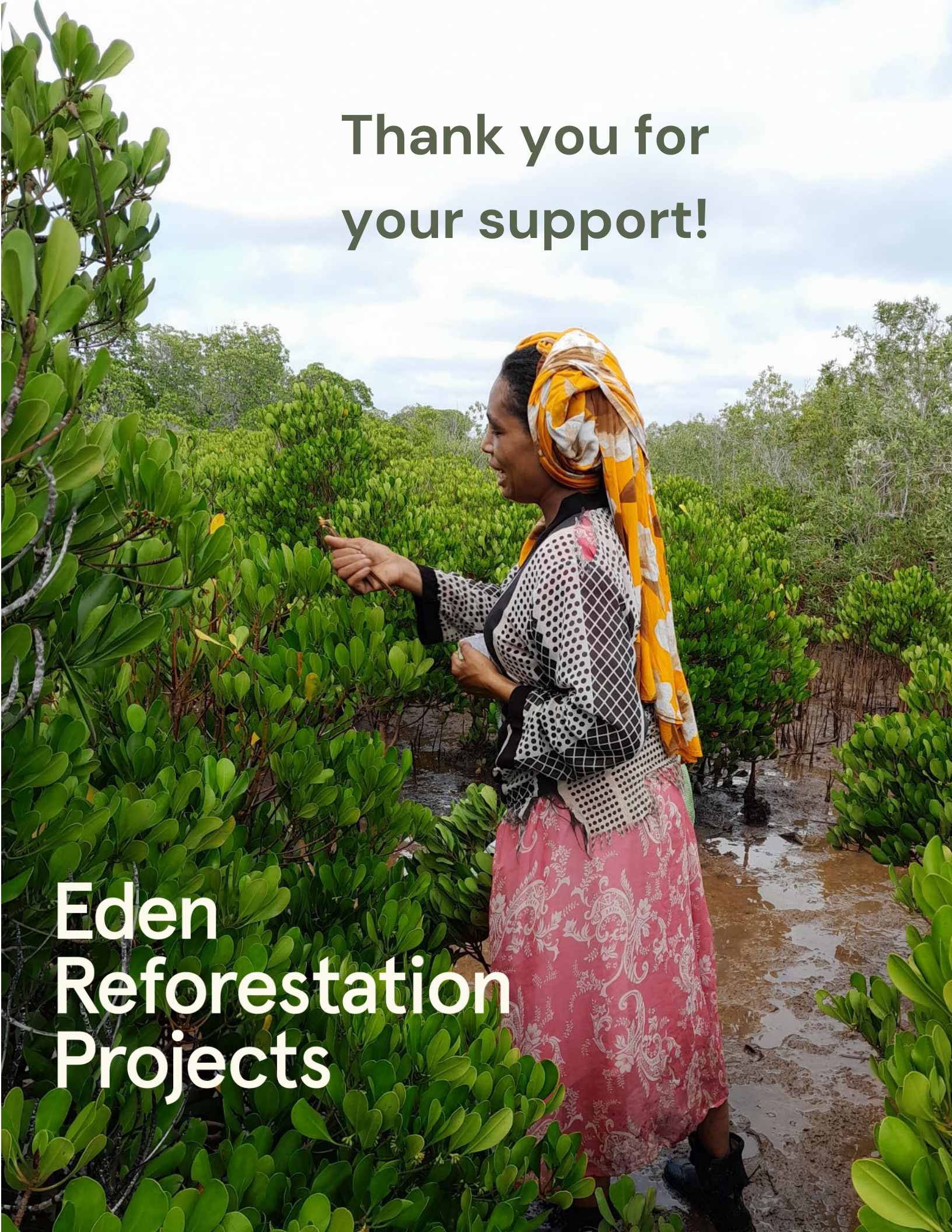
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