Voluntary Carbon Standard
Project Description Template

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1 Description of Project:

1.1 Project title

Carbon Project in the Emas-Taquari Biodiversity Corridor, Goiás and Mato Grosso do Sul, Brazil

1.2 Type/Category of the project

This project follows the guidelines of the small-scale methodology approved under the Clean Development Mechanism (CDM): ***AR-AMS0001*** *"Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on grassland and cropland" – Version 5*, as well as *Tool for AFOLU Methodological Issues and Guidance for Agriculture, Forestry and Other Land Use Projects of Voluntary Carbon Standard***.** The project also fits into the category **Afforestation, Reforestation and Revegetation (ARR)** of AFOLU included in the VCS 2007.1.

This project is not a grouping of different projects; however, the project activities (reforestation) shall be conducted in areas that are not contiguous but which belong to a single design document, and to a single management and execution structure. Nevertheless, it remains within the scope that defines it as a small scale Reforestation/Afforestation project.

1.3 Estimated amount of emission reductions over the crediting period including project size

The project aims at an average removal of 12.13 tons of CO_2 per hectare per year[1], which, after 30 years[2] shall have accumulated 198.26 tons of dry biomass per hectare1 or 363.81 tons of CO_2e/ha. The project start date is **06/12/2010**.

At the end of 30 years all the areas to be reforested in the 588.9 hectares, the project anticipates a total stock of 214,245 tons of carbon dioxide, with 206,115 tCO_2e being the net amount resulting from the project activity (Table 1). In terms of annual net removals, the project shall remove the equivalent of 6,870.5 tons of CO_2e/year.

[1] Above and below-ground dry biomass.
[2] Approximate period in which most of the planting areas will have reached maturity, i.e., when it is expected that the forest growth will stabilize and the biomass concentration will reach a state of dynamic equilibrium.

Table 1: Estimated CO_2e removals above-ground and below-ground due to the reforestation project with native Cerrado species for all extracts (Annex I).

Project area in hectares	Average increase above- and below-ground between 0 and 4.9 years (tCO_2e/ha/year)	Average increase above- and below-ground between 5 and 9.9 years (tCO_2e/ha/year)	Average increase above- and below-ground between 10 and 14.9 years (tCO_2e/ha/year)	Average increase above- and below-ground between 15 and 30 years (tCO_2e/ha/year)	Total stock per hectare after 30 years (tCO_2e/ha)	Total stock of project after 30 years (tCO_2e)	Baseline: stock before the start of project activities (tCO_2e)	Total net amount of GHG[3] removed by the project after 30 years (tCO_2e)
589	5.34	8.19	12.45	14.32	363.81	214,245	8,130	206,115

1.4 A brief description of the project

The project for the reforestation of the Emas-Taquari ecological corridor is part of a broader strategy of conservation and restoration of the Cerrado-Pantanal biodiversity corridor. This project consists of a voluntary partnership involving landowners, non-profit sector institutions, and local conservation units for the recovery of degraded areas and promotion of gene flow among fauna and flora species, through the creation of biodiversity corridors connecting remaining Cerrado fragments in the area surrounding the Emas National Park, GO, and the Nascentes do Rio Taquari State Park, MS. The project includes the reforestation of 589 hectares using native Cerrado species, especially those strongly interrelated with the fauna and/or those with non-destructive economic uses (non-timber), such as fruits, seeds, fibers, oils, and honey.

The non-timber economic use of the planted forest species is a key strategy for the creation of biodiversity corridors, as it will stimulate greater participation and commitment from landowners, who allowed their property to be reforested. We believe that once they realize there are opportunities for economic gain with native species, the landowners involved with the project will more pro actively engage in the maintenance and preservation of reforested areas.

The idea is that owners perceive the program as not only an initiative for the recovery and promotion of biodiversity, but also as an option to generate a sustainable income stream on their properties.

[3] GHG stands for greenhouse gases.

1.5 Project location including geographic and physical information allowing the unique identification and delineation of the specific extent of the project

The Cerrado is the second largest Brazilian biome. Originally, it has occupied an area of about 204 million hectares (Machado et al. 2004), which corresponds to 25% of Brazilian territory (Figure 1). The main vegetation types found are: Riparian Forest, *Vereda*, Seasonal Forest, *Cerradão* (woodland savannah), *Cerrado*, *Campo Cerrado*, *Campo rupestre*, *Campo Sujo* and *Campo Limpo* (grasslands) (Figure 2). The *Cerrado* tallest trees reach 15 meters in height and form irregular structures. Only in riparian forest trees exceed 25 meters and typically have small leaves and deciduous. In sandy plains and rocky fields, are lush and exotic bromeliads, cacti and orchids, with hundreds of endemic species.

Figure 1: Distribution of Brazilian Biomes.

Figure 1: *Cerrado*'s Phytophysiognomies. Source: Embrapa Cerrados.

The types of vegetation and the Cerrado physiognomies found in the project area are described briefly in the Management Plans of the PNE as follows:

- *Campo Limpo*: prevalence of herbaceous species, very low shrub density, and absence of trees.

Occurs on flatter areas, where groundwater is deep. Many grasses can be found in this physiognomy, especially *Tristachya leiostachya*, which dominates the landscap. In the southwestern portion of the reserve, a *Campo Limpo* area becomes flooded during the rain season, and is therefore a hyper seasonal area. In hyper seasonal *Campo Limpo*, another grass prevails: *Andropogon leucostachyus* where the groundwater is shallower.

- *Campo Sujo* prevalence of herbaceous species, but with greater shrub density and a few scattered trees.

Much like *Campo Limpo*, it also occurs in flatter and poorly drained areas. The most abundant grass is, as well, the capim-flecha. Some of the most important species of trees and shrubs are:

  - *Eremanthus erythropappus*
  - *Mimosa amnis-atri*
  - *Pouteria ramiflora*
  - *Pouteria torta*
  - *Rourea induta*, whose heights generally do not exceed 2.5 m.

In more well-drained places, there is a high density of palm trees, such as *Allagoptera leucocalyx*, *Attalea geraensis* and *Syagrus flexuosa*.

- *Campo Cerrado*: prevalence of herbaceous species, but with a reasonable density of shrubs and trees.

Occurs on steeper areas, where groundwater is deep. Some of the most important species of trees and shrubs are:

  - *Anadenanthera falcata*
  - *Eremanthus erythropappus*
  - *Eriotheca pubescens*
  - *Ouratea acuminata*
  - *Piptocarpha rotundifolia*
  - *Pouteria ramiflora*, with heights that can reach up to 5 m.

In some places, the shrub-tree species appear among bamboos, notably the *taquari* (*Actinocladum verticilattum*) and the *cambeúva* (*Apoclada arenicola*).

- *Cerrado sensu stricto*: prevalence of shrub-tree species in very high densities.

It also occurs in steeper areas and with deeper groundwater. Some of the most important species of trees and shrubs are:

  - *Anadenanthera falcata*
  - *Miconia albicans*
  - *Myrcia bella*
  - *Piptocarpha rotundifolia*, with heights that can reach up to 10 m.

- Semideciduous Seasonal Forest: occurs on probably more fertile soils in interfluvial areas.

The canopy is around 20 m high. Some of the most abundant species in this vegetation type are:

  - *Anadenanthera macrocarpa*

- *Bauhinia longifolia*
- *Copaifera langsdorffii*
- *Hymenaea courbaril*
- *Licania kunthiana*
- *Tabebuia roseo-alba*.

- Riparian Forest: occurs in association with watercourses and has a 15 m canopy.

Some of the most abundant species in this vegetation type are:

- *Geonoma brevispatha*
- *Miconia chamissois*
- *Protium heptaphyllum*
- *Tapirira guianensis*
- *Tococa formicaria*
- *Vochysia piramidalis*
- *Xylopia emarginata*.

The riparian forest can be subdivided into **gallery forest,** in which the crowns of trees on both sides of the river touch to form corridors, **riparian forest**, in which the crowns of trees on both sides of the river do not touch another tree, and **swamp forest**, when located in soil that is permanently flooded.

- *Vereda de Buritis*: the *Vereda de Buritis* (*Mauritia flexuosa*) appear in places where the soil is permanently flooded, especially on river springs and, downstream, between the riparian forest and *Campo Úmido*. The *buritis* are around 15 m tall. As far as herbs go, there are mainly Cyperaceae and Xyridaceae.

- *Campo Úmido*: occurs on floodplains of rivers, between the riparian forest or the vereda and the *Cerrado*, and on river springs, where there is upwelling of groundwater.

There is a very high density of herbaceous species; they can reach up to 1 m in height. *Ciperáceas*, *xiridáceas* and grasses prevail, as well as species from other families, such as

- *Eryngium spp.*
- *Drosera spp.*
- *Sisyrinchium vaginatum*.

- Campo de Murundus: occur between the *Campo Úmido* and the *Cerrado* as small raised areas with about 1 m long radius and 0.2 to 0.5 m in height, where some *Cerrado* species can be found among *Campo Úmido* species in lower areas.

The PENT covers a 30,300 hectare area on the slopes of the western edge of the Brazilian plateau, on the pre-*Pantanal* depression. It houses Cerrado formations, with *Cerrado sensu stricto* phytophysiognomy, *Cerradão*, Alluvial Submontane Semidecidual Seasonal Forests and *Campos de Altitude* formations (Executive Summary PENT Management Plan, 2003)

Figure 3 shows the location of the project areas as well as communities and municipalities involved. The areas covered by the project and the communities involved with it are located between southwestern Goiás and northeastern Mato Grosso

do Sul, specifically in the municipalities of Mineiros, Chapadão do Sul, and Alcinópolis. The physical description of the project areas can be viewed in Annex VII. Four private and one state properties are the reforestation project of the Biodiversity Corridor Emas-Taquari (Figure 4).

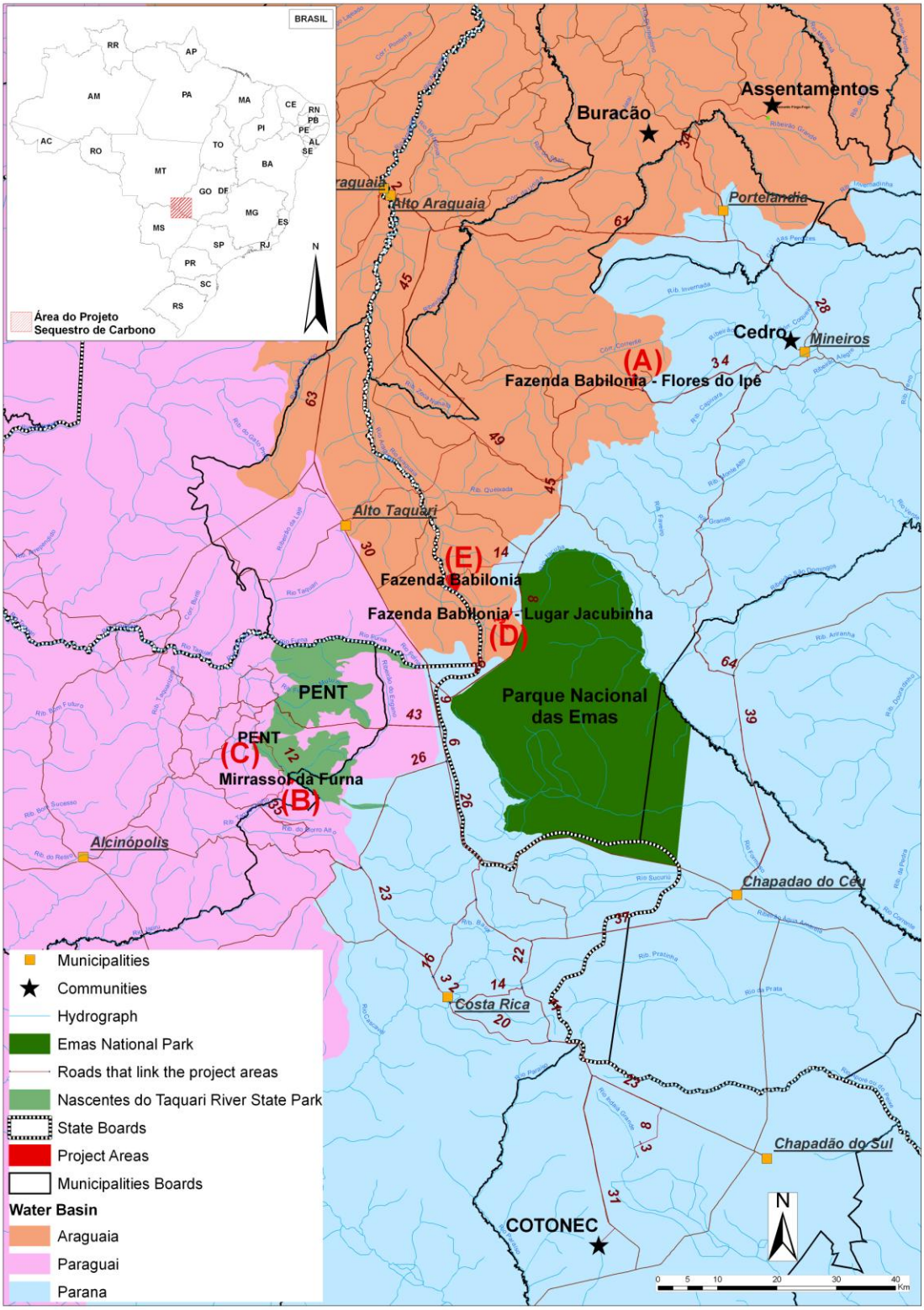
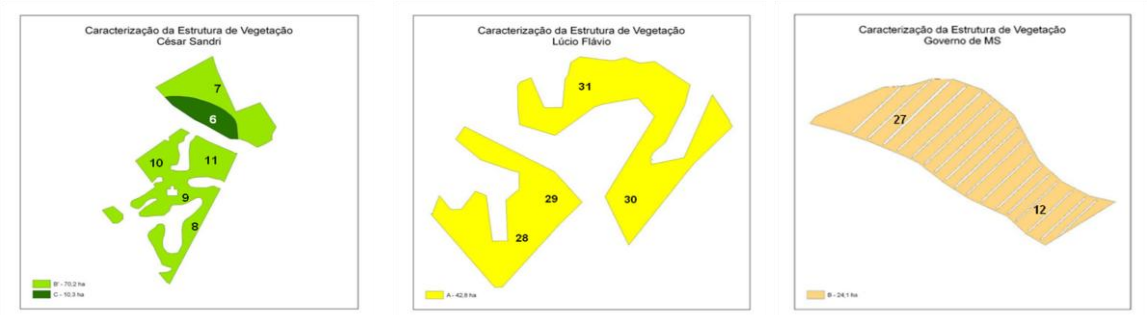


Figure 3: Geographical location of the areas and communities covered by the reforestation project.



(A) Flores do Ipê (80.5 ha) (B) Mirassol da Furna (42.8 ha) (C) PENT (24.1 ha)

(D) Lugar Jacubinha (60.1 ha) (E) Babilônia Lots 8, 9 and 10 (381.4 ha)

Figure 4: Polygons representing reforestation areas and identifying the five substrata.

1.6 Duration of the project activity/crediting period

The crediting period of the reforestation project is **30 years**[4] after which the forest is expected to reach both maturity and, consequently, a balanced flow of carbon dioxide between the atmosphere and the biomass. Legal instruments from the Brazilina Forest Code will permanently ensure the continuity of the forest and carbon stocks contained[5]. The sites for reforestation within the PENT consist of lands that have already gone through regularization (expropriation of land) and as they are areas located within a conservation unit of protected areas ensure the permanence of the plantations[6] . In particular properties that are retrieved areas not required by the Forest Code (multiple use areas), the owner's intention is to increase the area of native Cerrado vegetation on his property, pledging to ensure the preservation of the plantations, and not open new areas for relocation of agricultural activities (Annex XV).

The activities involving the articulation and definition of services involving the landowners, communities, and the project proponent began in February 2009. The starting of physical implementation of the project is scheduled for 2010. The planting activities will last up to three years and maintenance activities in each area to be reforested will follow for

[4] *Agriculture, Forestry and Other Land Uses Projects*according to the VCS Guidance for AFOLU, must have a crediting period lasting from 20 to 100 years.
[5] Law 4771/65 Articles 2 and 16.
[6] National System of Conservation Units - SNUC, Law 9985/00 and Decree 4340/02.

another five years until the last plot has gone through the same process of maintenance; and the prevention, control and fight fires will occur annually throughout the duration of the project. After the final stages of planting, monitoring activities will be carried out in the plots every five years by the end of the project's 30-year crediting period (Annex XI).

The start of the crediting period is linked to the completion of the reforestation activities. The first monitoring to quantify the units of CO_2 removed by the project in each stand will be made each five years after completing the step of planting their plot. The start of planting activities, however, is subject to the prior selling of carbon credits (or a portion of them) to be generated by the project during its crediting period (ex-ante calculations). The costs required for the physical development and project implementation are in Annex XIV. Additionally, analysis of the Financial Health of the Project prepared by the proponent institution can be viewed in Annex XII.

1.7 Conditions prior to project initiation

The areas to be reforested by the project consist of four private properties and one public area (Nascentes do Rio Taquari State Park - PENT) that are currently devoid of their original forest cover, are underutilized, degraded, or otherwise occupied by pasture or agriculture (Table 2 and Figure 4). These areas are frequently affected by fires and current conditions arising from the natural soil and climate characteristics, as well as the continuation of current land use practices (e.g.: agriculture, grazing and fire) tend to hinder or even prevent the natural regeneration re-establishing the original forest cover.

Table 2: Description of the areas before the start of project activities.

Reference	Area/owner	Area status	Current use	Fate of current activity after the start of the reforestation project
A	Flores do Ipê César Sandri	Non-timber multiple use.	Pasture.	The cattle will be moved to other grazing areas existing on the property, and the total capacity of the number of animals per hectare is low.
B	Mirassol da Furna Lúcio Flavo	Non-timber multiple use. Permanent Preservation area (APP) and part of the area meant for Legal Reserve (RL), but not yet registered	Leased for pasture purposes	Suspending of the pasture lease within the area covered by the project. The cattle will be moved to other grazing areas existing on the property, and the total capacity of the number of animals per hectare is low.
C	PENT Government of Mato Grosso do Sul (MS)	Expropriated area for the creation of the State Park (Conservation Unit/Public area).	Abandoned pasture.	Area will be isolated to prevent invasion by the neighbors' cattle.
D	Lugar Jacubinha Rogério Vian	Permanent Preservation Area (APP)	Agriculture (soybean, cotton, and corn)	Owner shall reduce the cultivated areas for APP space (there shall be no expansion of cultivation into other areas to make up for APP space).
E	Babilônia – lots 8, 9 and 10 Vanir Potrich	Area meant for the Legal Reserve (RL), but has not yet endorsed, including compensation related to other farms of the owner.	Abandoned pasture area with no evidence of significant regeneration	-

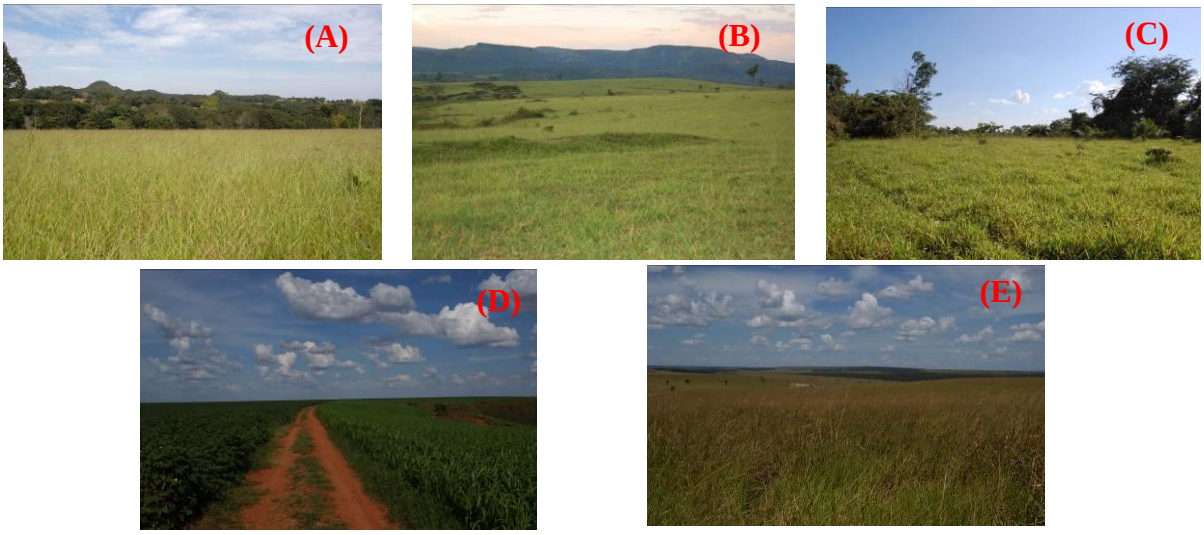


Figure 4: (A) Flores do Ipê; (B) Mirassol da Furna; (C) PENT; (D) Lugar Jacubinha and (F) Babilônia Lots 8, 9, and 10.

1.8 A description of how the project will achieve GHG[7] emission reductions and/or removal enhancements

The removal of GHG (CO_2) shall take place during the growth of the seedlings introduced as part of project's activities, through photosynthesis. In the absence of the project, the areas would not be reforested and instead remain as they currently are, with a low biomass stock in the vegetation and reduced concentrations of carbon per hectare. The carbon dioxide removed biologically from the atmosphere by individual trees will be stored in the woody parts of plants and will remain fixed in dynamic equilibrium [8] in the project's forest areas. Permanence of the carbon stock removed from the atmosphere by the plants after the project's crediting period shall be ensured by legal instruments, which will determine areas for restricted use, where the vegetation must be protected, and appear in the registration documents of the rural properties. In this case, the protection of forest fragments is ensured by articles 2 and 16 of the Brazilian Forest Code, as Permanent Preservation Areas and Legal Reserves, respectively. Additionally, the permanence of carbon stocks within the PENT would be assured by being a unit of conservation of integral protection and as for private properties that are retrieved areas not required by the Forest Code (multiple use areas), the owner's intention is to increase the area of native Cerrado vegetation on his property, pledging to ensure the preservation of the plantations, and not open new areas for relocation of agricultural activities (Annex XV).

Accidental or criminal threats, such as fire, shall be mitigated through conservation strategies developed specifically for this project, like the building of fire-breaks and periodic monitoring of fire outbreaks with help from the property owners during critical times. To achieve this, the project intends to train and support the local forest fire brigade as well as develops environmental education activities and information campaigns aimed at local communities, landowners involved in the project and residents of neighbouring project areas.

[7] GHG stands for greenhouse gases.
[8] It is a common situation in forest ecosystems where younger individuals who are recruited during the opening of clearings replace adult trees as they die.

1.9 Project technologies, products, services and the expected level of activity

The project activities shall focus on reforesting areas that are deforested, degraded, and currently occupied by agriculture and livestock. To this end, the project plans to involve and empower the association of poor communities in the region with regard to seed collection, seedling production, planting techniques, monitoring and driving the reforested area. The techniques for the recovery and maintenance of planted areas consist of:

Diagnosis and planning, subdivided into:

- Characterization of degradation type
- Substrate condition
- Survey of vegetation cover
- Construction of the work plan for each area subject to the project

Pre-planting and soil preparation activities, subdivided into:

- Selection of pioneer and secondary native species
- Gathering seeds
- Producing seedlings
- Isolation of program area
- Elimination of degradation factors
- Topographic recomposition and/or surface waterway alteration.
- Soil preparation through pH correction and fertilization, if necessary, according to the soil analysis (Annex II)

Activities related to planting and recovering degraded areas, subdivided into:

- Fighting natural and exotic competitors
- Construction of sketches for the plantation and opening pits
- Producing seedlings

Maintenance and planting monitoring activities, subdivided into:

- Pruning and mowing of rows
- Pruning
- Pests and disease
- Firebreaks
- Presentation of technical reports of systematic monitoring of the reforestation areas

- Non-timber economic use, as each species is reaching reproductive maturity[9] .

Activities concurrent with planting:

- Education and cooperation with communities and landowners about biodiversity conservation.
- Environmental education, training, prevention and fighting forest fires.
- Direct involvement of communities in reforestation activities, with emphasis on seed collection, seedling production, planting, maintenance, and management of non-timber forest products.

To meet the project's demand for seedlings, the proponent (Oréades) and some of the communities and groups involved (*quilombolas* remnants[10] Cedro and Terapêutica Nova Esperança), already have an initial structure of nurseries currently operating (Figure 5), with a capacity of producing at least 183,000 seedlings per year (Annex III). The current structure, however, will be expanded, especially the community nurseries, so that they can meet the project's seedling demand of approximately 243,000 seedlings per year, considering a planting schedule of three years and any losses by mortality (Annex XI).

Figure 5: Education Center and Production of Native Plants of the Cerrado (L) - 120 thousand native seedlings/year; Cedro community nursery (M) - 13 thousand native seedlings per year; and Nova Esperança Therapeutic Community nursery (R) - 50 thousand native seedlings per year.

The reforestation technique (Annex IV) will follow the logic of ecological succession of species, so that fast-growing species (pioneer and early secondary species) should be interspersed with slow-growing species (late secondary and climax species), as shown in Figure 6. However, this approach will be dynamic, depending on the physiology, adaptation and growth response of species available to be used in reforestation. In practice, what has been observed is that the growth dynamics of native species of the Cerrado in reforestation areas does not necessarily reflect what is in some literature and

[9] Detailing on management techniques and gathering intensity will be set at a later stage and under the supervision and technical support of Oréades and its partners (Conservation International - CI, the communities, and research centers in the region, among others).
[10] Remnant ex-slavery communities.

that the level of tolerance, adaptation and resilience often independent of the sussecional stage of plant. This approach aims to ensure adequate conditions for the development of groups of species to be used in reforestation areas.

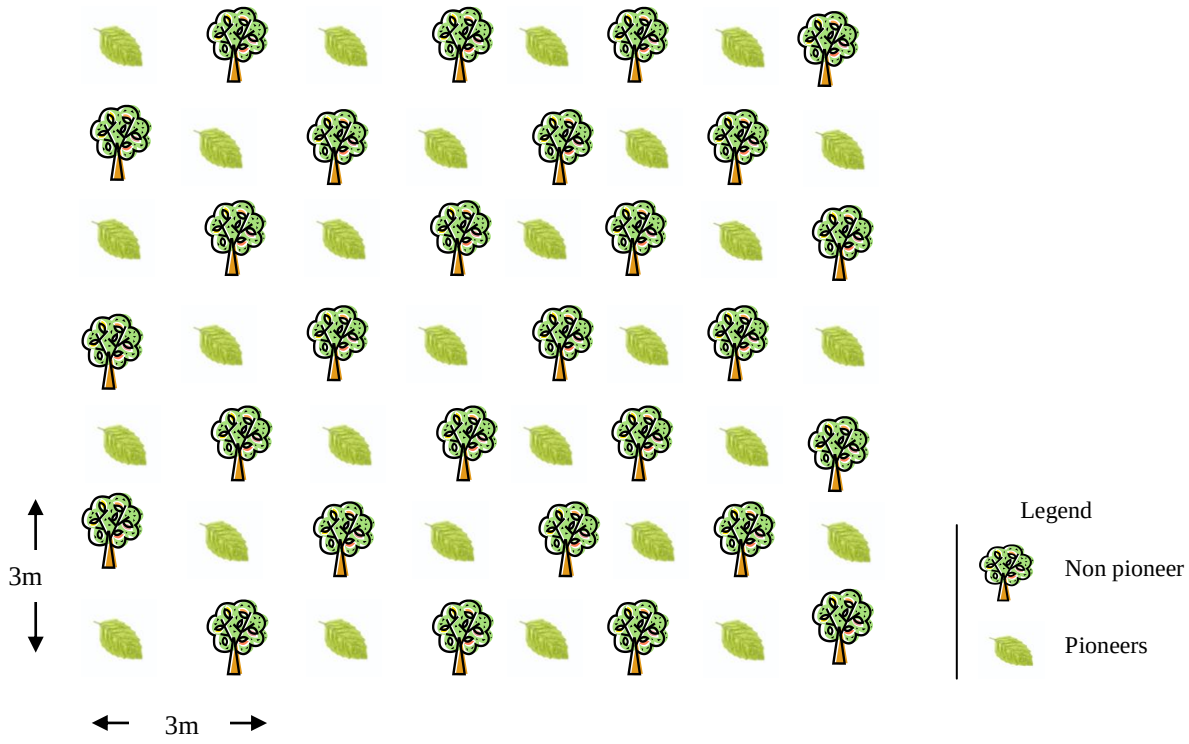


Figure 6: A planting system based on ecological succession of tropical forest ecosystems.

The services and products generated by the project focus mainly on biodiversity and the well-being of the populations, and can be listed as follows:

- Providing environmental services by creating ecological corridors for gene flow between remaining Cerrado fragments surrounding the Emas National Park, incorporating the macro structuring strategy of the Cerrado-Pantanal Corridor.

- Providing biodiversity products with market value and which can be exploited in a sustainable manner, without damaging the forest, and which benefit the landowners and communities involved.

Because it is a project where most of the reforested areas are located on private properties, representing the main source of income for their owners, it was deemed necessary to include elements of income generation within the scope of the project. Thus, the project also anticipates, at medium and long term, the creation of non-timber forest products such as seeds, fiber, fruits, preserve, honey, and oil from native Cerrado species. This approach aims mainly to expand the owners' participation and commitment regarding the maintenance and protection of reforested areas, as they start to see the reforestation areas as an extra source of income, complementing their activities.

Besides those relating to biodiversity and climate, we also foresee other environmental services from project activities, most notable of which are watershed protection and soil conservation.

Planting activities (Annex IV) will be conducted in accordance with the conditions of each area to be reforested with respect to topographic characteristics, vegetation cover remaining and current land use if it is pasture, abandoned pasture or agriculture. In this item it will be specified all the procedures to be adopted in each planting area for the quantity of seedlings required, replacement, preparation of land, use of machinery and agricultural equipment, containment of soil erosion, forestry techniques, maintenance and monitoring. The schedule for implementation and logistics of reforestation will be defined later by developing a work plan for each property by addressing several items, such as potential use of non-timber reforestation in areas where this practice is allowed.

1.10 Compliance with relevant local laws and regulations related to the project:

There is no federal, state, or municipal laws restricting reforestation with native species on private lands; in the case of reforestation in the Nascentes do Rio Taquari State Park (PENT), the project aims to restore an area currently dominated by *Brachiaria* sp., an invasive grass species of African origin. It is an aggressive species, and if not controlled, may spread to other areas inside the park. Therefore, the project will follow the park's management plan, as it seeks to conserve native species by controlling invasive species.

Reforestation with native tree species complies with all federal or state laws, except in specific cases, such as planting trees on roads under power lines, or on areas near airports. However, none of these conditions apply in any of the project areas, cases that do not apply to any of sites selected by the project. Additionally, Brazilian environmental legislation[11] , as it relates to land use, tends to agree with the purpose of the project in question, as it aims to promote the recovery of degraded areas using native species.

No products prohibited by law will be used during planting or maintenance of plots, and the project should not resort to using fire to clear areas. Thus, the project includes no element or activity that would violate the country's current environmental law. To the contrary, the project aims to promote improvements in the natural environment without losing sight of the economic aspect that will ensure sustainability, permanence and social benefits in the future. With the exception of the area included within the PENT and areas located in Permanent Preservation Areas (APP)[12] the particular properties, such as farm Lugar Jacubinha all remaining areas could be available to non-timber forest management.

1.11 Identification of risks that may substantially affect the project's GHG emission reductions or removal enhancements:

Reforestation projects, especially using native species, have numerous inherent risks, among which are:

[11] National Policy of Water Resources - Law 9433/97, Brazilian Forest Code - Law 4771/65, National Environment Policy - Law 6938/81, Law on Public Forest Management - Law 11.284/06, National Forest Program - Decree 3420/00.
[12] Law 4771/65 – Art. 2nd.

- Risk of fire: Forest fires are the greatest threat to the current project's ability to remove and store carbon dioxide. Consequently, one of the major project activities, aside from the reforestation activity in itself, is the construction and maintenance of fire-breaks around the planting areas, the training of fire brigades, information campaigns discouraging the use of fire as a management tool, and associating with relevant authorities to curb the criminal use of fire in the project region. It is important to note that most of the species to be used in the project have adaptive strategies to survive fire, since they are native Cerrado species, have in most cases, adaptive strategies to survive fire[13]. Hence, if fires affect any area of the project, there will be some biomass loss and carbon emission, though widespread tree mortality is not expected, as in other biomes less adapted to this type of extreme event. The vegetation of the Cerrado has high resilience (capacity to recover after the passage of fire) when compared to other Brazilian biomes[14] .

- Risks of poor training or mortality of seedlings in the first five years, exceeding 20%: because it is a heterogeneous reforestation pattern using native species, since there is a significant knowledge gap about the physiology, phytoecology, growth, and nutritional requirements for the species to be used. On the other hand, the institutions involved in the project (Oréades and CI) have extensive experience both in reforestation projects with native species in the region (Annex V), and, more generally, in conservation projects in the Cerrado[15]. Both institutions have already developed several studies on the conservation, ecology of species, and recovery of Cerrado fragments in the project area[16]. Additionally, periodic monitoring will be done visually and also by the project partners (landowners, communities, and the Oréades' technical staff) shall conduct periodic visual monitoring, in order to allow for decision-making in time to deal with possible complications in seedling development and implement measures replacement in cases of mortality.

- Withdrawal of owners to participate in the project (providing areas for planting): the structure of this project is based on the identification of priority areas for reforestation within the Cerrado-Pantanal biodiversity corridor. However, the total number of eligible areas identified significantly exceeds the total area covered by the project. Thus, there are "spare" areas available and eligible that could replace any withdrawals by current landowners involved, with no harm to the goals set by the project.

1.12 Demonstration to confirm that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction.

The areas to be reforested by the project are part of previously deforested areas due to the great agricultural expansion that occurs in the Midwest of Brazil for at least three decades resulting in the development of economic activities such as livestock production, soybeans, corn and cotton, and the demand for charcoal to fuel the demand for steel poles from other

[13] Castro-Neves (2007) - Efeito de Queimadas em Áreas de Cerrado *strictu sensu* e na Biomassa de Raízes Finas (The Effect of Fires on Areas of Cerrado *strictu sensu* and on Fine Root Biomass).
[14] Hoffmann et al. 2009 - Tree topkill, not mortality, governs the dynamics of alternate stable states at savanna-forest boundaries under frequent fire in central Brazil.
[15] Oréades http://www.oreades.org.br/pagina.php?menu=programas
http://www.oreades.org.br/pagina.php?menu=programas Conservation International: http://www.conservation.org.br/onde/cerrado/
[16] Conservação Internacional – Programa Cerrado/Corredor Emas-Taquari
http://www.conservation.org.br/onde/cerrado/index.php?id=155

states. Considering that the largest fraction of the area covered by the project (southwestern Goiás and northeastern Mato Grosso do Sul) had been experiencing some form of degradation long before the emergence of the first discussions of the carbon market, CDM or voluntary markets, it makes little sense to suspect that the existing areas have been deforested in order to later develop projects emissions reduction project through reforestation. In fact, the revenue from the sale of credits would be insufficient to turn into profit, covering only the cost of reforestation activities in their entirety, the maintenance of plantation areas, and training and environmental education activities. The areas that make up the project had been cleared over 10 years before the conception of the project (Annex VII).

1.13 Demonstration that the project has not created another form of environmental credit (for example renewable energy certificates)

There is no other environmental credit scheme under negotiation or assigned to this project or to areas where it shall be implemented.

1.14 Project rejected under other GHG programs (if applicable)

This project has not been submitted to or rejected by any greenhouse gas reduction/removal program. This project was specially designed in order to meet both the Voluntary Carbon Standard (VCS) and the Climate Community and Biodiversity Standard (CCBS).

1.15 Project proponents roles and responsibilities, including contact information of the project proponent, other project participants

The table below shows the roles and responsibilities of all actors involved in the project. Annex XIII contains the documents formalizing the partnership and involvement of all organs described here to develop the project and Annex XV contains the Terms of Agreement and Cooperation, respectively, signed by the farmers and by the PETN management. The Center for Education and Production of Native Seeds of the Cerrado, belonging to the project Oréades - Geoprocessing Center proponent is the only agency quoted below that did not need this kind of formalization.

Entities	Stakeholders	Roles and Responsibilities	Contacts
Non-governmental organizations	Oréades - Geoprocessing Center	Project proponent, responsible for managing, coordinating, and implementing the project with help from other parties involved; will manage the proceeds from the sale of carbon credits. Also responsible for coordinating the other parties involved, and for working with GIS and georeferencing areas.	**Renato Alves Moreira** Phone: (64) 3661-5825 Mobile: (64) 8141-2646 email: rmoreira@oreades.org.br

	Conservation International Brazil (CI)	Promoting and coordinating different parties, the voluntary carbon market, and providing technical, financial, and operational support for the development and implementation of the physical project on site.	**Alexandre Padro** **Artur Paiva** **Paulo Gustavo Prado** Phone: (61) 3226-2491 email: a.prado@conservacao.org a.paiva@conservacao.org p.prado@conservacao.org
City Halls	Mineiros Goiás	Representing the town hall in the project referendum.	**Suesley Carrijo Silva** Secretary of the Environment Phone: (64) 3661-0051 Mobile: (64) 8119-8244 email: meioambiente.mineiros2009@gmail.com
	Costa Rica Mato Grosso do Sul	Representing the town hall in the project referendum.	**Wilson Mateus** Secretary of the Environment Phone: (67) 3247-7083 Mobile: (67) 9964-2737
	Chapadão do Sul Mato Grosso do Sul	Representing the town hall in the project referendum.	**Edson Pereira Borges** Secretary of the Environment Phone: (67) 3562-5647 Mobile: (67) 9988-1657 email: sedema@chapadaodosul.ms.gov.br
	Alcinópolis Mato Grosso do Sul	Representing the town hall in the project referendum.	**Daniel Cochita** Secretary of the Environment Phone: (67) 3260-1739 Mobile: (67) 8413-1006 email: secretariadesenvolvimento@bol.com.br
Settlements and Communities	Formiguinha	Gathering seeds and producing seedlings of native species for the project.	**Zenaide Jesus Almeida** - President of the Association of Residents Mobile: (64) 9648-0913
	Serra das Araras	Gathering seeds and producing seedlings of native species for the project.	**Eudes Felizardo da Silva** - President of the Association of Residents Mobile: (64) 9989-2873
	Pouso Alegre	Gathering seeds and producing seedlings of native species for the project.	**Carla Simone Oliveira Neves** - President of the Association of Residents Mobile: (64) 9954-4195
	Cedro	Gathering seeds and producing seedlings of native species for the project.	**Lucely Moraes Pio** (64) 8113-1685 Simone Morais (64) 9981-1458 Epaminondas (64) 9906-2548

			Laboratory (64) 3028-1001
	Buracão	Gathering seeds and producing seedlings of native species for the project.	**Nair Rosa dos Santos Novais** Mobile: (64) 9974-0132
Conservation Unit	PNE (Emas National Park)	Support the creation of a Volunteer Fire Brigade to serve in the region.	**Marcos Silva Cunha** Director of Parque Nacional das Emas Phone: (64) 3929-6000 Mobile: (64) 9217-6732 email: marcos.cunha@icmbio.gov.br
	PENT (Nascentes do Rio Taquari State Park)	Providing areas for reforestation and committing to their maintenance.	**Martha Gutierrez** Phone: (67) 3247-2553 email: imapcostarica@yahoo.com
Educational Institutions	FIMES	Development of technical and scientific knowledge in the fields of carbon sequestration, reforestation, and planting of Cerrado species.	**Ita de Fátima Silva Assis** General Director Phone: (64) 3675-5100
	UEG	Development of technical and scientific knowledge in the fields of carbon sequestration, reforestation, and planting of Cerrado species.	**José Maria de Sousa** Phone: (64) 3661-1613 e-mail: dir.mineiros@ueg.br
	Dom Bosco School	Participating in the Environmental Education Program.	**Vilma Rodrigues Silva** Phone: (64) 3661-7456
Mineiros Fire Department	6th Military Independent Fire Fighting Squad	Supporting the training of Volunteer Brigade members and working in the prevention of fires in the areas reforested by the project.	***Lieutenant* Amilton Conceição** Phone: (64) 36613040
Farmers	César Sandri	Providing areas for reforestation and committing to their maintenance.	Phone: (64) 3661-5624 Mobile: (64) 8402-9159
	Lúcio Flavo	Providing areas for reforestation and committing to their maintenance.	Mobile: (63) 9994-0514
	Rogério Vian	Providing areas for reforestation and committing to their maintenance.	Mobile: (64) 9989-1847
	Vanir Potrich	Providing areas for reforestation and committing to their maintenance.	Phone: (64) 3661-1356 Mobile: (64) 9989-2700
Nurseries	Nova Esperança Therapeutic Community	Production of seedlings for the project.	Phone: (67) 3562-1116 (Claudiomar Bocalon)
	Education Center and Production of Native Plants of the Cerrado	Production of seedlings for the project.	Phone: (64) 3661-5825 (Godofredo Martins)
	Cedro Community Nursery	Production of seedlings for the project.	Mobile: (64) 8113-1685 (Lucely Pio)

1.16 Any information relevant for the eligibility of the project and quantification of emission reductions or removal enhancements, including legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and temporal information.

To analyze the eligibility of this project, we used both the CDM[17] and the VCS[18] eligibility criteria, in order to adjust in the best possible way the demands of the two criteria to the project's conditions; therefore, the project activities are eligible and meet the CDM and VCS methodological criteria, as follows:

- ✓ The reforestation project will occur only in areas currently devoid of forest cover, according to the national definition of forest.[19]

- ✓ The reforestation project shall occur only in areas where forest cover was removed before the year 1998 (Annex VII), according to the definition from the Voluntary Carbon Standard Tool for AFOLU Methodological Issues and Guidance for Agriculture, Forestry and Other Land Use Projects.

- ✓ According to the applicability criterion of the AR-AMS0001 methodology, the total agricultural area within the project area is less than 50% (10.2% of the total area is currently occupied by agriculture).

- ✓ The areas that currently include some livestock activity do not exceed 50% of the total project area, and are characterized by a low concentration of animals per hectare, due to under productivity or inadequately managed pastures.

- ✓ The carbon pools to be used are: above- and below-ground tree and woody perennials biomass and below-ground biomass of grasslands, as determined by methodology AR-AMS0001.

- ✓ The project geographically defines the six areas where the reforestation activities shall take place.

- ✓ Ex-ante calculations indicate that total amount of GHG removed annually by the project activities does not exceed the limit of 16 tons/year.[20]

- ✓ The ex-ante quantification of climate benefits were calculated based on the most recent studies on the growth of the Brazilian native species to be used by the project (TIER 3). Calculations regarding real and verifiable

[17] Procedures to demonstrate the eligibility of the areas for the afforestation and reforestation project, EB31.
[18] Voluntary Carbon Standard Guidance for Agriculture, Forestry and Other Land Use Projects.
[19] Minimum average height of the tree stratum equal to 5 m at maturity, over 30% crown cover and minimum area of 1.0 hectares (Interministerial Commission on Global Climate Change).
[20] -/CMP.3 (Implications of possible changes to the limit for small-scale afforestation and reforestation clean development mechanism project activities).

removals (*ex-post*) shall follow the procedure for forest biomass inventory for permanent parcels described in detail in section 3.0.

✓ The project shall be developed with the direct involvement of low-income communities in virtually all activities, including decision-making.

✓ Regarding legal aspects, the project does not violate any current legislation in the country, state, or municipality where the project activities are located.

✓ In terms of technical details, the project will make use of the most recent skills and techniques available about conservation and reforestation in Cerrado areas, as well as the choice of species. With regard to partner institutions, the project includes an interdisciplinary and highly qualified staff for the activities proposed.

✓ The areas needed for the project depend only on the approval of the landowners, who have already formally agreed to participate in the project, thereby allocating part of their properties for permanent forest recovery (Annex XV - Statement of Commitment of owners' approval to cede land and carbon credits).

✓ From an economic perspective, besides the carbon revenue that will be used for reforestation, maintenance, and training of community workers, the project aims to make use of species with non-timber economic value. Thus, the management of fruits, oils, fibbers, and seeds shall support maintenance costs in the long term.

✓ As far as environmental issues go, the project represents the best efforts in the country currently under development to conserve biodiversity and restore degraded areas, and thus the area is of fundamental importance for conservation. The project shall also serve as a pilot to encourage more initiatives of this kind.

✓ The project also considers social aspects, as it proposes to absorb the local labour force in the activities of seed collection, seedling production, and reforestation, in addition to implementing programs for fire fighter training, environmental education, and sustainable income generation using native Cerrado species for people in the communities and social groups included in the project.

1.17 List of commercially sensitive information (if applicable)

No project information is commercially sensitive or requires a degree of secrecy during the publication of the VCS PD. Access to any technical data shall be widely available for consultation by auditors and the public.

2 VCS Methodology:

2.1 Title and reference of the VCS methodology applied to the project activity and explanation of methodology choices

The methodology used was AR-AMS0001: "*Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on grassland and croplands*" – Version 5.

Regarding calculations, baseline approaches, and additionality, this PD faithfully follows the guidelines contained in the AR-AMS0001 methodology. Regarding area eligibility, we also incorporated aspects of the Voluntary Carbon Standard Guidance for Agriculture, Forestry and Other Land Use Projects.

Options for ex-ante removal calculations

For the *ex-ante* estimate calculations, the methodology provides no guidance, indicating only that values obtained from national sources for stem volume in different years for different species should be used, as well as values for the biomass expansion factor (BEF). In the absence of national values, the methodology recommends the use of default data provided by the IPCC. Therefore, the project used national data on different species at different ages and the IPCC default data for defining the BEF (Annex I).

Options for baseline calculation

The areas that include project activities, for stratification purposes, follow the description of the items "A" and "B" of paragraph 7, section II, where: "A" are agricultural areas where changes in carbon stocks in living biomass do not exceed 10% of the amount expected to be removed in the project, which was calculated in the *ex-ante* estimates for the entire project duration; and "B" corresponds to grazing areas where changes in carbon stocks in living woody biomass do not exceed 10% of the amount expected to be removed in the project, which was calculated in the *ex-ante* estimates for the entire duration of the project .

Still on the baseline, the methodology's instructions say that the most likely scenario should be the continuation of pre-project land use practices, which is precisely the baseline scenario best suited to the characteristics that were observed during field visits to areas and consultation with the owners.

Under the assumption of continued pre-project practices, the AR-AMS0001 methodology, section II, offers the possibility of adopting three different baseline scenarios, among which two are best suited to the different strata of the project, according to the vegetation's behaviour history (Annex VII). They are the scenarios described in options (A), paragraph 6, in which carbon stock gains in the absence of the project shall not exceed 10% of the total amount removed by the project, and (B), paragraph 6, in which carbon stock reductions are foreseen in the absence of the project. In both cases, the methodology stipulates that the value of pre-existing carbon stocks in the project area before the start of activities be taken as the baseline value (Annex VI).

Options for calculating the leakage

Following the methodology AR-AMS0001, the average annual leakage is equal to 15% of removals *ex ante* planned for the first crediting period of the project (section 3.2.4).

2.2 Justification of the methodology choice and why it is applicable to the project activity:

We chose to use the AR-AMS0001 methodology, as this is a reforestation project with native species with the potential for GHG removal below the 16,000 tons/year on average (small-scale project), in which many of the activities shall be directed to low-income communities. Moreover, the areas selected by the project are mostly unproductive areas or even abandoned pastures, as well as degraded lands.

In addition to the AR-AMS0001 methodology, we also used the Voluntary Carbon Standard Guidance for Agriculture, Forestry and Other Land Use Projects applicable for both scopes the project is applicable, as follows:

Regarding AR-AMS0001:

- ✓ The project is appropriate in the scope of small-scale projects since the total amount of GHG removed from the atmosphere each year shall not exceed 16,000 tons of CO_2 per year (see section 4.4); additionally, the essence of the project is based on the direct involvement and participation of low-income communities in project activities.

- ✓ The project activities shall be developed in abandoned pastures or grassland areas that are unproductive (semi-abandoned) and have low density of animals per hectare, and, to a lesser extent, in areas under agricultural cultivation.

- ✓ There shall be no displacement of farmland covering over 50% of the project area, since total cultivated area amounts to less than 15% of total project area. The relocation of animals is also minimal, since only a few areas still have cattle, and even in these areas, livestock serves the purpose of ensuring land use and occupation[21], and is not a particularly important source of revenue, when compared to other activities in the property.

- ✓ Less than 10% of the soil in the areas selected for the development of the project activities has been plowed for farming.

[21] Due to the National Agrarian Reform Program, private areas that fail to show productive use of the property are at risk of being expropriated by the National Institute of Agrarian Reform (INCRA) to make way for settlements. Consequently, landowners involved with the project, who have agriculture as their main source of income, occupy with livestock areas unsuited for agriculture or which for whatever reason are not cultivated, as a way to prevent the expropriation due to under-using the property.

- ✓ Regarding the baseline, the reality of the project areas meet the requirement of paragraph 5, section II of AR-AMS0001, which considers the continuation of current land use, so that the carbon stocks would also be a reflection of such land use dynamics.

- ✓ The areas selected for the project are eligible under paragraph 1 of the annex to decision 16/CMP.1, as they do not fit the national definition of forest defined by the MCT (Ministry of Science and Technology) – the Designated National Authority (DNA).

Under the Voluntary Carbon Standard Guidance for Agriculture, Forestry and Other Land Use Projects, the reforestation activity area had its forest cover removed over 10 years prior (before 1998) (Annex VII).

Finally, the project does not anticipate the use of fire for preparing the areas, and emissions caused by project activities shall be restricted to those from nitrogen-based fertilizers. They are not significant when compared to the total amount of emissions removed by the project and thus can be neglected, as per the AR-AMS0001 guidelines.

2.3 Identifying GHG sources, sinks and reservoirs for the baseline scenario and for the project

Table 3: GHG Reservoirs considered by the project.

	Gas	Source/sink	Included?	Justification/explanation
Baseline	CO_2	Above and below ground biomass of trees and woody plants and perennial ground biomass of grasses.	Yes	Biomass within the vegetation, prior to project activities, which should be deducted from the final volume.
	CH4	-	No	Does not apply
	N2O	-	No	Does not apply
Project activities	CO_2	Above and below ground biomass of trees and woody plants and perennial ground biomass of grasses.	Yes	Removal due to the growth of trees introduced by the project.
	CH4	-	No	Does not apply
	N2O	Organic fertilizers (manure)	No	Emissions due to manuring.

2.4 Description of how the baseline scenario is identified and description of the identified baseline scenario

The most likely baseline scenario identified in the project areas is one of continuation of common land use and occupation practices associated with agricultural and livestock practices and which use fire, all of which lead to low carbon stocks. While interviewing the landowners, there was no evidence of a change in current practices in the project areas. Therefore, we do not expect change in the medium term regarding current land use and occupation practices, nor do we expect significant changes in carbon stocks of productive systems in the project areas. However, in the absence of project activities, it is not possible to exclude the scenario of maintaining the current productive activities of low concentration of carbon, namely livestock, monoculture soybean, corn, cotton and sugar cane, since these cultivations have been the predominant activities in the region, including present trend of growth area in the last decade (Annex VII, Figure 7, 8 and 9, Table 4).

In the area located within Nascentes do Rio Taquari State Park (PENT), the areas set aside for reforestation are those that have suffered land use regularization (land expropriation) and which are now cleared and occupied predominantly by exotic grasses. For these particular areas, the baseline is most likely a weak or even absent natural regeneration process. This is due to intense competition with exotic grass species (*Brachiaria sp.*) introduced in previous years, which tend to stay even in abandoned areas, hindering the growth of native woody species.

The observed regeneration of trees is significantly lower in the Cerrado, due to its natural soil and climate characteristics as well as fire events, than in other Brazilian forest biomes, such as the Amazon and the Atlantic Forest. This can be substantiated through the analysis of satellite images taken in previous years of different project areas (Annex VII), which show that the areas that had their forest cover removed nearly 20 years ago have not shown significant biomass gain. Thus, we do not expect that the ecosystem be able to naturally convert its currently deforested areas into forest physiognomies without human interference[22]. That suggests the need for direct intervention through soil preparation, planting seedlings, and fire-preventing activities.

Due to the lower potential for regeneration of Cerrado tree and because the areas are very susceptible to fire, it is expected that in a scenario without the project, the current stocks of carbon contained in biomass may in some cases even undergo a slight decrease[23]. So the scenario to the baseline in the project areas follows the logic of item b of paragraph 6 of section II of the AR-AMS0001.

22 Regeneration, in the project areas, tends to be well below 10% of the amount the project intends to remove over its lifetime through induced reforestation (section 4), so that the change in carbon stocks in the baseline scenario can be disregarded, as instructed by the AR-AMS0001 methodology.

23 It is important to remember that among the project activities, preventing, controlling and fighting fires is a major conservation strategy, along with the reforestation activities.

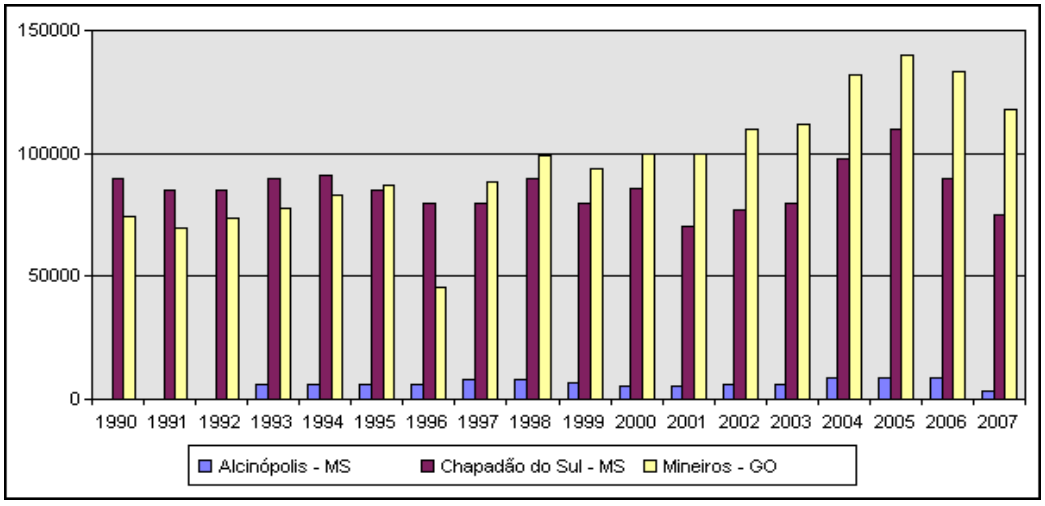


Figure 7: Dynamics of soybean cultivation in the towns covered by the project.

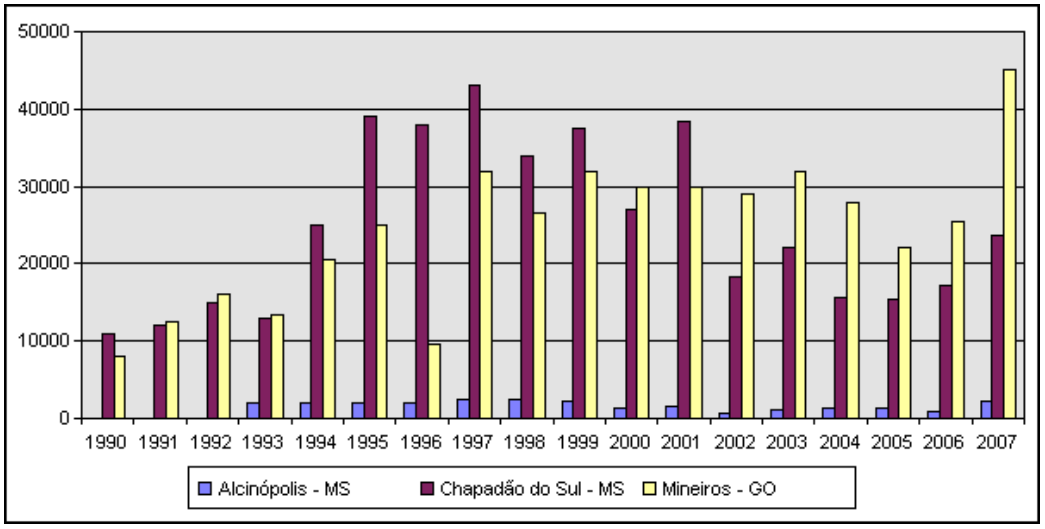


Figure 8: Dynamics of corn cultivation (in hectares) in the towns covered by the project.

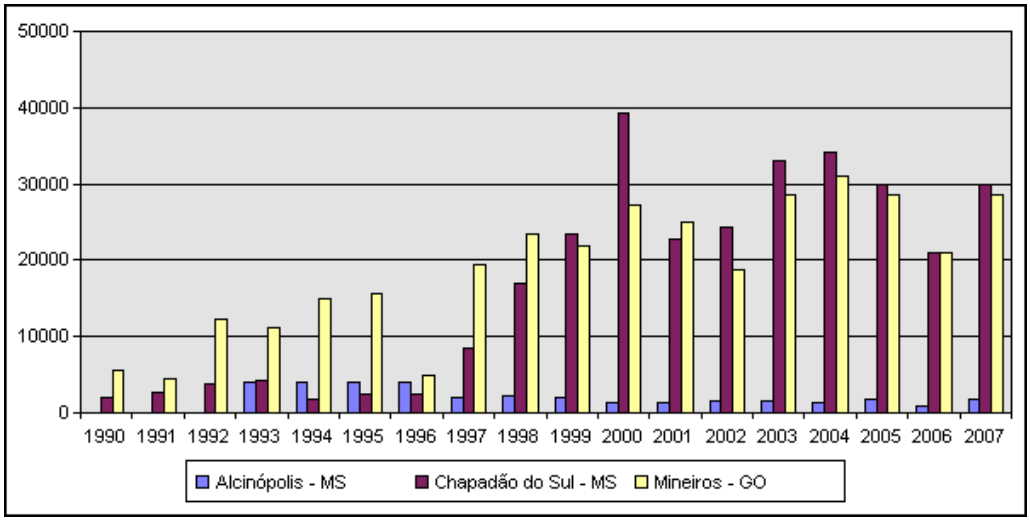


Figure 9: Dynamics of the cultivation of sorghum, sugar cane, cotton, beans, and rice (sum of all crops in hectares) in the municipalities covered by the project.

Table 4: Cattle in 2007 in the towns covered by the project.

Variable = Actual herd count (head)		
Herd type = Bovine		
Year = 2007		
#	**Municipality**	
3	**Mineiros, GO**	308,000
4	**Alcinópolis, MS**	283,002
6	**Chapadão do Sul - MS**	203,889

Finally, the constant fires that affect the region (Table 5), whether accidental, criminal, or used for pasture management, make up, together with the agricultural activities, the most plausible baseline for the project area. Therefore, in the absence of project activities, rudimentary practices using fire, as well as the regional vocation for commercial agriculture based on monoculture, reinforce the logic of a likely and systematic reduction of carbon stocks currently retained by the biomass in the project areas, just as it currently is in the surrounding areas (Annex VII).

Table 5: Fires reported in the last 5 years in the municipalities covered by the project.

Municipality	Number of fires reported each year				
	2004	2005	2006	2007	2008
Alcinópolis, MS	117	62	94	168	58
Chapadão do Sul - MS	161	55	104	89	43
Mineiros, GO	437	447	200	291	137
Total occurrence in the project area	**715**	**564**	**398**	**548**	**238**

Source: region INPE/CPTEC- Fire Database (BDQueimadas)[24]

2.5 Description of how the emissions of GHG by source in baseline scenario are reduced below those that would have occurred in the absence of the project activity (assessment and demonstration of additionality)

In the absence of project activities, the 589 hectares mapped in the program for the creation of the Emas-Taquari Biodiversity Corridor would not be reforested; therefore, the removal of carbon dioxide through photosynthesis and plant growth would not occur. Additionally, the protection of reforested areas against forest fires, as project activities, would not be implemented, further compromising the remaining biomass stocks in the project areas; or, at best, the stocks would remain at stable levels.

The assessment of additionality in this small scale reforestation project was based on Appendix B – "Assessment of Additionality" – of the AR-AMS0001 methodology.

Generally speaking, the additionality of the project is guaranteed by the non-commercial aspect of reforestation, aimed at the restoration of forest areas within the macro strategy to recover the *Cerrado-Pantanal* Biodiversity Corridor. Even considering the possibility of a sustainable management of non-timber resources in the project areas in the long term, such management should be understood only as an economic alternative for the sole purpose of enabling the maintenance of the areas when the proceeds from the sale of carbon credits come to an end.

Thus, the revenue generated from sales of carbon credits is critical to the physical implementation of the project, representing the only significant source of revenue capable of supporting the activities of planting and maintenance of reforested areas. In other words, the carbon credit mechanism was the tool found by the project proponents in order to obtain funding for the activities related to the conservation and recovery of the area corresponding to the Emas-Taquari Biodiversity Corridor.

The following is a list of the main obstacles to the implementation of the project, in accordance with the AR-AMS0001's tool of additionality for afforestation and reforestation:

[24] *http://www.dpi.inpe.br/proarco/bdqueimadas/*

✓ Investment Obstacles

- High reforestation costs, estimated at roughly R$ 6.482,00 per hectare, considering only planting and maintenance activities, meaning that such an amount does not include the range of parallel activities envisaged by the project, such as: work on environmental education, support fire brigade, working with the community, among others.

- Difficult access to credit: Most property owners fear or show no interest in getting bank loans for the reforestation of their areas. The ignorance of the commercial potentials for non-timber use of native species, as well as fear of debt, makes long-term investment in native forests not an option for income generation in the region, unlike agriculture and livestock. Under these conditions, private owners and those responsible for the management of the PENT are unable to shoulder the high costs of implementing a reforestation project or get funding for such a project. Furthermore, due to general unawareness as well as lack of pilot projects that could serve as examples, investments in plantations with native species shall seldom be profitable, except through timber management, which contradicts the aims of this project to strengthen the genetic link of *Cerrado* fragments (Biodiversity Corridor).

- Lack of funds for the activities of non-timber forest management: There is no possibility of obtaining bank loans or access to international capital markets through regular means for the sustainable management of native species (non-timber management).

✓ Technological Obstacles

- Difficulty of access to the techniques of seedling production and reforestation in the Cerrado biome: there are technical constraints in obtaining seeds and seedlings (dormancy that is difficult to break for many of the Cerrado seeds) and the use of appropriate techniques to reduce mortality, such as hydrogel[25] and CPM[26]. These, in addition to other innovative techniques for reforestation in the Cerrado area, shall be widely used and spread by the project.

- Technical constraints and qualified staff only through the partnerships proposed by this project for reforestation and to reduce emissions from non-governmental institutions[27] and boards of conservation of the region and owners turns the reforestation project to become feasible both by the technical and execution points of view, since none of the actors involved have their own, technical or operational structure for carrying out the initiative of reforestation.

[25] A product that enhances water retention by the seedling, thus significantly reducing the amount of deaths from water stress.
[26] Seeding Protector Shield (CPM) consists of a disk made of recycled paper that deteriorates two years after having been placed around the seedlings at planting and is used to control grasses (inhibits weed competition) and assists in the retention of soil moisture.
[27] Oréades and Conservation International.

✓ Obstacles related to common practice

- This small scale reforestation project is the first activity related to recovery of degraded areas and improvement of environmental conditions in the region, since common practice there includes deforestation to make the land suitable for grazing and agriculture and the use of fire as a management tool.

- Reforestation is not a part of the area's culture, and the benefits of such an undertaking are not well understood by locals and landowners, especially due to the scarcity of cases that serve as examples. Thus, this project aims at – aside from the goals already described – proposing a new paradigm of regional development based on environmental adaptation and income generation from forest products.

- The additionality of reforestation activity in legal reserve areas is guaranteed by the extensive and systematic negligence on the part of the farms in the region before the environmental legislation[28], particularly regarding Articles 2 and 16 of the Brazilian Forest Code - Law 4771/65, as shown below:

O Popular newspaper published the following news on May 24, 2008: "A survey conducted by the Brazilian Institute of Environment (IBAMA) found that 53% of the properties surrounding the Emas National Park, in southwestern Goias, have some kind of issue with legal environmental reserves. Such issues may range from lack of appropriate documentation, preservation areas held hundreds of miles away from the original farm and even endorsed legal reserves (which exist in theory) that, in practice, have been completely devastated."[29]

The article *Caminhos da Sustentabilidade no Brasil* ("Paths of Sustainability in Brazil"), published in 2005, provides information on the Emas-Taquari Biodiversity Corridor area. The article reports that the region's environmental liabilities are estimated at 9,159 hectares of Legal Reserve in the analyzed properties[30].

During the 2004 pilot study by FELTRAN, 77 farms belonging to municipalities of Chapadão do Céu and Mineiros were visited; 42 of those followed an agricultural system and 35 farms were doing livestock farming (priority was given to properties located in the vicinity the PARNA Emas). When examining the total number of farms sampled (n=65), it was discovered that only 20% of them comply with the Forest Code, 13% consisting of the ones that focus on agriculture and 28% on livestock, meaning 80% of them are in irregular conditions. 21 of the properties or 32% of the sample (of which all follow a system of agriculture on plains) do not even have any remaining native vegetation covering.[31]

On January 28, 2008, *O Popular* newspaper printed the following article: "Deforestation threatens conservation areas". The story reports a statement from the Department of Public Prosecution revealing that out of the 184 properties identified

[28] The additionality tool for projects of RA determines that: once proven that over 30% of properties in the region where it operates the project do not meet the legal requirements, failure to comply with the law is regarded as "business as usual". Thus, the fulfillment of legal requirements is considered additional activities in the "business as usual" scenario.
[29] *http://www.ocorreionews.com.br/index.php?news=187*
[30] *Caminhos da Sustentabilidade no Brasil*/Eliezer Batista, Roberto Cavalcanti, Marco Antônio Fujihara, presented by Stephan Schmidheiny.- São Paulo: Terra das Artes Editora, 2005.
[31] FELTRAN-BARBIERI, R. *Cerrados sob fazendas: história agrária do Domínio do Cerrado*. 2004. Dissertation (Master's degree in Environmental Science) Environmental Science Post-Graduation Program. University of São Paulo, 2004.

by the Emas National Park area, only 35 were considered to be inside the norms – properly registered and continuing the preservation of legal reserves; others properties presented issues. Nine of the farms have an obligation to preserve 1.9 thousand hectares of Cerrado vegetation, and yet have not seek the Environment Agency to get the reserves registered. In 39 other farms, the ownership documents handed over to IBAMA were either incomplete or the permanent preservation areas had been registered as legal reserves, which is illegal.

Finally, even in areas where legal reserves (RL) are already registered, the law requires that the restoration be done in 30 years. The project, even without registered RL areas, anticipates that the restoration of the areas to be registered for that purpose shall be done in less than 3 years; therefore, despite the common practice of not complying with environmental legislation, the project activities have the advantage of temporal additionality, through which the owner, even with a non-registered RL, would fulfil legal requirements in far less time than the deadline set by the Forest Code.

- ✓ Obstacles related to environmental conditions

- The continued employment of current soil management practices have created unfavourable conditions to natural regeneration in most areas covered by the project. These areas also lost its original forest cover to make way for agricultural activities are currently exposed to erosive processes, such as fire, floods, transit of animals (livestock), agricultural activities and occupation predominantly aggressive invasive grass species (kikuia, *Andropogon* and *Brachiaria).* Consequently, the physical, chemical and biological soil standards in most areas mapped by the project have and continue to gradually change over the years, which have sharply reduced the possibility of establishment and growth of individual trees in such areas. Among the limitations edaphic (soil) areas to be reforested (Annex II), stands out for most areas: low organic matter content, high acidity, soil compaction, basic saturation (V%) at less than 50% (dystrophic soils / low fertility), low levels of P (phosphorus) and K (potassium), low presence of micro-organisms and the absence of seed bank and seeding. Additionally, in many of the areas the soil is predominantly sandy, with low concentration of clay. In some areas, however, such as Lugar Jacubinha farm, the V% values and soil acidity are at acceptable or good levels because they have been managed for agricultural purposes, meaning they have already gone through the processes of acidity correction and fertilizing.

- Starting fires during the dry season as a management tool to restore pasture is sometimes used in the area covered by the project, and even though the project participants have abandoned it, it continues to threaten the project areas.

- The climate in the area covered by the project includes a 5-month drought period, so the project activities are essential in monitoring and preventing fires, as well as in watching the water stress levels of seedlings.

- The presence of exotic grasses in the pastures affects the process of regeneration in the areas, as they compete with native species for nutrients, light, and water. Therefore, mechanically or chemical controlling the grasses is extremely important for the establishment of the reforestation process. Without such direct human intervention, it is unlikely that natural regeneration would take place or even that the introduced seedlings would be able to restore forest physiognomy in the project areas.

✓ Social Obstacles

- Lack of qualified or trained: there is a strong lack of knowledge and environmental awareness in the local population. This neglect of the importance of environmental services provided by the Cerrado ecosystems hampers the establishment of projects aimed at conservation and restoration of the natural and genetic resources of species. Such lack of commitment to environmental issues, associated with ignorance of the economic potential of native species of the Cerrado, hinder social adherence to this type of initiative for conservation and sustainable use of local forests. Project activity is thus introduced with the intention to change the current situation through the stimulation of sustainable business, such as the construction of a value-added supply chain for the production and sale of native plants and herbal products, and the processing of the baru (*Dipteryx alata*).

3 Monitoring

3.1 Title and reference of the VCS methodology (which includes the monitoring requirements) applied to the project activity and explanation of methodology choices

The methodology used to develop the monitoring plan is AR-AMS0001 "*Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on cropland and grassland*" - Version 5.

Options for baseline calculation

When it comes to baseline, the methodology indicates that, according to decision 6/CMP.1, Appendix B, paragraph 6, baseline monitoring is not necessary and should be equal to the amount estimated in *ex-ante* calculations (sections 2.1 and 4.2).

Options for leakage line calculation

Following the methodology AR-AMS0001, the average annual leakage is equal to 15% of removals *ex ante* planned for the first crediting period of the project (section 3.2.4).

Options for the calculation of *ex-post* removals

For ex-post estimates of net GHG removals by sinks, the methodology stipulates that the project area be split in order to improve the accuracy and precision of the calculations (see section 3.4).

Carbon stocks should be measured every five years; in this case, the AR-AMS0001 methodology offers different calculation options, as follows:

✓ To calculate above-ground biomass the methodology suggests the use of allometric equations developed locally or nationally (TIER 2 or 3). In case such equations are not available, the methodology offers two other options.

- Option 1: use the allometric equations included in Appendix C of the methodology or in Annex 4A.2 of the IPCC good practice guidance for LULUCF (TIER 1)

- Option 2: Use of Biomass Expansion Factor, trunk volume and wood density as follows:

E(t)i = SV(t)i * BEF * WD

Due to the existence of national equations the project chose the first alternative (TIER 2), as explained in section 3.2.2.

✓ For calculating below-ground biomass, the AR-AMS0001 methodology suggests that national data be used (TIER 2) to determine R (Root-shoot ratio); in the absence of such data the methodology suggests 2 options:

- Use the default values from table 3A.1.8 of the IPCC good practice guidance for LULUCF (TIER 1), and in the case of absence of references on the species used.

- The methodology indicates the use of the Cairns et al equation: (1997):

PB(t)i = exp(–1.085 + 0.9256 * ln E(t) i) * 0.5

For this project, since there are no national data on root / shoot relations for *Cerrado* physiognomies, we chose the first alternative (TIER 2)[32].

3.2 Monitoring, including estimation, modeling, measurement or calculation approaches

The purpose of monitoring is to verify the remotions by the project's reforestation activities during its crediting period of 30 years.

The CO_2 removal shall be monitored using the biomass forest inventory as a measurement and quantification tool used to support the development of the monitoring report, which shall be submitted after the checking process. The forest inventory shall allow the quantification, every five years, of the forest biomass accumulated by the project activity, which in turn shall be used to quantify the amount of equivalent CO_2 removed by the project activity.

The change in carbon stocks shall be monitored through permanent parcels as recommended by the AR-AMS0001 methodology and Section 4.3.3.4 of the IPCC GPG for LULUCF, i.e. the number of parcels will be set for each of the different strata following the procedures described in section 3.4

3.2.1 Monitoring times and periods, types of data, information to be reported, units of measurement and origin of the data

The project anticipates six monitoring sessions conducted every five years during the crediting period of 30 years; information regarding the monitoring shall be available for consultation for 32 years.

[32] Abdala et al (1998).

Table 6 shows the data to be collected or used for the verifiable monitoring of carbon stock changes in carbon tanks within the project boundaries described in Table 6. All monitoring data on the variables described below will be archived in a database under the responsibility of Oréades and Conservation International.

Table 6: Data to be collected or used to monitor carbon stock changes in carbon reservoirs within the reforestation project boundaries and how such data shall be collected.

Variables	Sources	Unit	Measured, calculated or estimated	Frequency in years	Proportion	Archiving	Responsibility	Comments
Exact location of the area where the project activities shall take place.	Field surveys, georeferenced maps and thematic maps based on satellite images.	Latitude and Longitude	Measured	5	100%	Digital, photographic, and on paper Database of Oréades and CI.	Oréades and Conservation International.	Remote sensing images (Landsat 5).
Ai – Size of the area where the project activity shall be implemented by type of stratum.	Field surveys, georeferenced maps and thematic maps based on satellite images and on-field collection by GPS.	Hectare (ha)	Measured	5	100%	Digital, photographic, and on paper Database of Oréades and CI.	Oréades and Conservation International.	GPS shall be used for field surveys.
Location of permanent parcels.	Geo-referenced thematic maps.	Latitude and Longitude	Calculated and set at random	5	100%	Electronically and on paper Database of Oréades and CI.	Oréades and Conservation International.	GPS localization, demarcation on site and on georeferenced maps.
Height (H)	Permanent parcels.	Meters (m)	Measured	5	For each tree within the parcels	On paper and digitally Database of Oréades and CI.	Oréades and Conservation International.	Measurement of all trees contained within permanent parcels using a telescopic rod.
Base diameter at 30 cm high (D30)	Permanent parcels.	Centimeters (cm)	Measured	5	For each tree within the parcels	On paper and digitally Database of Oréades and CI.	Oréades and Conservation International.	Measurement of all trees contained within the permanent parcels at a 30 cm height, using calliper.
Basic wood density	Technical Literature	Tons of dry	Estimated	Once	A value	On paper and	Oréades and	Data of basic wood

		matter per volume (m^3) of green wood.			taken for each species and adoption of average values for species with no available data.	digitally Database of Oréades and CI.	Conservation International.	density for wet (12%) converted to basic wood density on a dry basis were used, according to Reyes et al in 1992 (Annex I).
Total CO_2	Project monitoring	Mg (ton)	Calculated	5	All project information	Digitally and on printed documents Database of Oréades and CI.	Oréades and Conservation International.	Based on data from different strata.

3.2.2 Ex post estimate of the net baseline GHG removal by sinks

There shall be no monitoring of the baseline, since, according to the 6/CMP.1 decision, appendix B, paragraph 6, baseline monitoring is not necessary. The premises assumed for arguing the choice of baseline approach can be seen in section 2.4 of this document.

3.2.3 Ex post estimation of the actual net greenhouse gas removals by sinks

The formulas used to calculate the project's carbon stocks are the following:

$$P_{(t)} = \sum_{i=1}^{I} (P_{A(t)\,i} + P_{B(t)\,i}) * A_i * (44/12) \quad (1)$$

$P_{(t)}$ = Carbon stocks within the project boundary at time t achieved by the project activity (t CO2-e)

$P_{A(t)i}$ = Carbon stock in above-ground biomass at time t of stratum i achieved by the project activity during the monitoring interval (t C/ha)

$P_{B(t)i}$ = Carbon stock in below-ground biomass at time t of stratum i achieved by the project activity during the monitoring interval (t C/ha)

Ai = Project activity area of stratum i (ha)

i = Stratum i (I = total number of strata)

Above-ground biomass

$$P_{A(t)} = E_{(t)i} * 0.5 \quad (2)$$

$P_{A(t)i}$ = Carbon stocks in above-ground biomass at time t achieved by the project activity during the monitoring interval (t C/ha)

$E_{(t)i}$= Estimate of above-ground biomass at time t achieved by the project activity (t d.m/ha)

0.5 = Carbon fraction of dry matter (t C/t d.m.)

To calculate above-ground biomass **[$E_{(t)i}$]** the methodology AR-AMS0001 suggests the use of allometric equations developed locally or nationally (TIER 2 or 3). In case such equations are not available, the methodology offers two other options.

Option 1: Use the allometric equations included in Appendix C of the methodology or in Annex 4A.2 of the IPCC good practice guidance for LULUCF (TIER 1)

Option 2: Use the biomass expansion factor and stem volume, as follows:

E(t) i = SV(t) i * BEF * WD

However, because there already is a previously developed allometric equation specifically for quantifying the biomass of Brazilian Cerrado trees (TIER 2), options 1 and 2 described above were discarded; thus, we opted for equation (3), shown below:

$$E_{(t)i} = Y*10 \quad (3)$$

$E_{(t)i}$ = Estimate of above-ground biomass at time t achieved by the project activity (t d.m./ha)

Y = Total dry biomass in tons within the parcel (1000m² or 0.1 hectare)

10 = Converting the parcel's area (2 m^2) into hectares (10,000 m^2)

$$Y = \sum y_j * 10^{-6} \quad (4)$$

Y = Total dry biomass in tons within the parcel (1000m² or 0.1 hectare)

yj = Total dry biomass in trees (g)

10^{-6} = Conversion from grams to tons

$$\log(y_j) = 0.9967 * \log(V_j) + 2.587 \quad (5)$$

y_j = Total dry biomass per individual trees (g)[33]

Vj = Volume of cylindrical trees (dm^3)

$$V_j = \pi . \left(\frac{D30_j^2}{4} \right) . H_j \quad (6)$$

Vj = Volume of cylindrical trees (m^3)

D30j = Diameter at 30 cm high (cm)[34]

Hj = Tree slant height (m) [35]

Below-ground biomass

$$P_B(t)i = E(t)i * R * 0.5 \quad (7)$$

$P_{B(t)i}$ = Carbon stocks in below-ground biomass at time t achieved by the Project activity during the monitoring interval (t C/ha)

$E_{(t)i}$ = Estimate of above-ground biomass of stratum i at time t achieved by the project activity (t d.m/ha)

R = Root to shoot ratio (dimensionless)

0.5 = Carbon fraction of dry matter (t C/t d.m.)

When calculating below ground biomass, the AR-AMS0001 methodology suggests that national data be used (TIER 2) to determine R; in the absence of such data, the methodology indicates the use of default values from table 3A.1.8 of IPCC Good Practice Guidance for LULUCF (TIER 1).

Ultimately, if there is no reference on the species chosen the methodology supplies the Cairns et al (1997) equation:

[33] The biomass equation by Abdala et al (1998) does not need the wood density data since the parameters of the equation already include this variable regarding the Cerrado species.
[34] Data collected in the field during forest inventory (section 3.4)
[35] Data collected in the field during forest inventory (section 3.4)

PB(t) i = exp(–1.085 + 0.9256 * ln E(t) i) * 0.5

For this project, since there are no national data on root / shoot relations for Cerrado physiognomies, we chose the first alternative (TIER 2).[36]

3.2.4 Ex post estimation of leakage

There are no plans for displacement of population during the project activities. Similarly, the displacement of some animals will not be associated with opening new areas for grazing, but the incorporation of the quota already established for cattle grazing within their own farms, since the total capacity of the number of animals per hectare is low and can be maintained in the broad expanse of grasslands that exist outside the project boundaries. However, it is observed that these old pastures already established are not properly handled and the number of animals to be displaced would require more than 10% of the average capacity of these pastures on the supply of food for cattle. The turnover number of animals displaced would also require more than 10% of average production capacity per hectare of these pastures. Furthermore, currently the area of agriculture represents 10.2% of the total project area to be reforested. Therefore, the leakage for the first crediting period of the project will be determined at the time of verification according to the equations below by methodology AR-AMS0001:

[36] Abdala et al. (1998)

For the first verification period:

$$L_{tv} = 0.15 * (P_{(tv)} - B_{(t=0)} - \sum_{t=0}^{tv} GHG_{PROJ,(t)}) \quad (8)$$

For subsequent periods

$$L_{tv} = 0.15 * (P_{(tv)} - P_{(tv-k)} - \sum_{tv-k}^{tv} GHG_{PROJ,(t)}) \quad (9)$$

L_{tv} = GHG emission due to leakage at the time of verification (t CO_2-e).

$P_{(t)}$ = Carbon stocks within the project boundary achieved by the project activity at time t (t CO_2-e)

$GHG_{PROJ,(t)}$ = Project emissions (CO_2-e/year t)

$B_{(t=0)}$ = Carbon stocks in biomass at time 0 that would have occurred in the absence of the project activity (t C/ha)

tv = Year of verification (years)

κ = Time span between two verifications (year)

During the first three years, the project team shall work with the owners to ensure that no activities occur outside the project boundaries with potential for emission and that directly relate to the project activities, such as opening new grazing areas and agriculture to offset the area occupied by the reforestation project.

3.2.5 Ex-post estimation of the net anthropogenic GHG removals by sinks

The formulas used for ex-post calculation of net removals by the project activities shall be quantified as follows:

$$Credits_{(tv)} = P_{(t)} - \sum_{t=0}^{tv} (GHG_{PROJ,(t)} - \Delta C_{BSL,t}) - L_{tv} - Credits_{(tv)} \quad (10)$$

For the subsequent periods:

$$Credits_{(tv)} = P_{(t)} - \sum_{t=0}^{tv} (GHG_{PROJ,(t)} - \Delta C_{BSL,t}) - L_{CP1} - Credits_{(tv)} \quad (11)$$

$P_{(t)}$ = Carbon stocks within the project boundary achieved by the Project activity at time t (t CO_2-e)

$GHG_{PROJ,(t)}$ = Project emissions (CO_2-e/year)

$\Delta C_{BCSL,t}$ = Baseline net GHG removals by sinks (CO_2-e/year)

L_{tv} = Total GHG emission due to leakage at time of verification (t CO_2-e)

L_{CP1} = Total GHG emission due to leakage at the end of the first crediting period (t CO_2-e)

$Credits_{(tv-k)}$ = Units of carbon credits issued following the pervious verification

tv = Years of verification (year)

κ = Time span between two verifications (year)

Table 7 presents the final balance of VCUs (Voluntary Carbon Units) to be generated by the project, calculated on the tool *Guidance for Agriculture, Forestry Land Use and Other Projects of VCS*, taking into account the discount and the leakage of the buffer that must be retained according to risk analysis of non-permanence (section 4.4.1).

Table 7: Final balance of VCUs as AFOLU Guidance for VCS.

Parameter	**Calculated volume (t CO_2-e)**	**Comments**
Changes in carbon stock	214,244.81	Not permanent
Baseline	8,130.21	Permanent
Net removals	206,114.60	= 214,244.81 – 8,130.21
Total leakage	30,917.19	= 206,114.60 – 15% (defined in AR-AMS0001)
Total credits	175,197.41	= 206,114.60 – 30,917.19
Buffer	41,222.92	= 206,114.60 – 20%
Total VCUs	**133,974.49**	= 175,197.41 – 41,222.92

Quality Control (QC) and Quality Assurance (QA)

The procedures designed to ensure quality control are mainly focused on collecting primary data, i.e. the collection of field information, as they are the ones to support all subsequent stages.
To ensure the quality of data collected on site, we shall follow the following guidelines:

- Data shall be collected unsurpassably and using appropriate equipment, as described in Section 3.4.4.
- Dendrometric data can only be collected using the field form as shown (Annex VIII).
- Data notes shall be made by the head of field operations of the forest inventory; either a forest engineer or an agronomist.
- The field team shall be composed of trained personnel and/or with previous experience in collecting dendrometric data and forest inventories.

In addition to the precautions at the data collection stage, we shall carefully watch the office steps, which consist of processing, analysing, and archiving the data collected on site.
This should be accomplished by the technical staff of the project proponent and its partners, which shall consist of at least: 1 business manager, 1 forest engineer, 1 agronomist, 1 environmental engineer, 1 geoprocessing technician, plus field and office helpers.

The processed data and information shall be available to all project participants and shall be archived in paper and electronically in different machines; they shall be fully available for up to two years after the end of the project's crediting period and may be retrieved at any time by the checking company/designated operational entity (DOE).

3.3 Data and parameters monitored / Selecting relevant GHG sources, sinks and reservoirs for monitoring or estimating GHG emissions and removals:

Data / Parameter:	**D30j**
Data unit:	Centimeters
Description:	Diameter at 30 cm high for each tree in the monitoring parcel.
Source of data to be used:	Forest field inventory.
Value of data applied for the purpose of calculating expected emission reductions	N/A
Description of measurement methods and procedures to be applied:	Measuring dimensions on site using calipers (Figure 11).
QA / QC procedures to be applied:	Previously trained staff for data collection, coordinated by an agronomist or forester, who is responsible for writing down the values on the field form, so that errors can be avoided. Outlier values are excluded.
Any comment:	D30 shall be measured for each tree in the parcel (20m x 50m) for a total of around 100 individuals.

Data / Parameter:	**Hj**
Data unit:	Meters or decimeters.
Description:	Oblique height of each tree in the monitoring parcel.
Source of data to be used:	Forest field inventory.
Value of data applied for the purpose of calculating expected emission reductions	N/A
Description of measurement methods and procedures to be applied:	Measuring of height values using a telescopic rod (Figure 12).
QA / QC procedures to be applied:	Previously trained staff for data collection, coordinated by an agronomist or forester, who is responsible for writing down the values on the field form, so that errors can be avoided. Outlier values will be excluded.
Any comment:	The Hj shall be measured for each tree in the parcel: around 100 individuals.

3.4 Description of the monitoring plan

The monitoring of planting in a broader sense will be a continuous and periodic process for ensuring the integrity of the reforested areas, the monitoring will include regular patrols to identify: i) pest attack, ii) susceptibility to forest fires, iii) mortality seedling, iv) high water deficit, especially in the early years after planting, and v) signs of anthropogenic disturbance in individual trees.

The monitoring of biomass and carbon stocks, in turn, shall start at 5 years after planting and take place every five years until the end of the project's 30-year crediting period. The calculation for CO_2e removal will be done using the biomass quantification calculated by the forest inventory. The project proponent shall conduct the inventory[37]. The monitoring report shall include descriptions and explanations of all procedures used and contain field photographs for later

[37] Oréades may also decide to outsource this service by hiring a specialized company. In this case, an Oréades' employee will accompany the inventory teams during the data collection activities to ensure the quality of their service.

evaluation. According to the guidelines set in this PD, a third party company shall conduct the carbon equivalent calculations.

3.4.1 Stratification of the project area within the forest inventory

The project shall stratify the reforestation zone into homogeneous areas, to enable a significant reduction both in cost and in sampling efforts at the time of field inventory, while contributing to the quality of analyses results. For the purposes of baseline calculation, there was an initial stratification process (baseline stratification), in which we considered the following aspects: the vegetation cover, soil characteristics and current use of the soil. However, this stratification will not necessarily be considered in the biomass inventory.

In the months interceding the first verification period (5 years after planting) there is another stratification process (inventory stratification), in order to group areas into homogeneous blocks and reduce biomass inventory sampling effort. At this stage of stratification are considered: planting date, location (proximity between areas), and structural similarity of the forest in different areas (number of individuals, height and D30). The limits of different inventory strata shall be georeferenced and periodically monitored via satellite images by Oréades.

3.4.2 Quantification of sampling effort for each stratum (number of permanent parcels per stratum)

Following the standard procedure for forest inventory, a few months before the determination of permanent parcels and the first stage of monitoring, two or three preliminary parcels (pilot parcels) per stratum shall be allocated on site, so that the exact number of permanent parcels for the entire area can be calculated. The preliminary number of parcels shall depend on the empirical heterogeneity observed for each stratum, as well as its size.

From the preliminary parcels one can simply and satisfactorily determine the standard deviation through the variability range obtained from the lowest and highest possible volumes found in "j" stratum.

The procedures for determining the total number of permanent parcels will proceed by the following logic:

Calculation of dry biomass of individuals in the preliminary parcels using D30 and oblique height measurements of trees and using equation 5 for each stratum.

Calculation of the variability of the strata, using the following formula:

$$S_j = (Y_{maxj} - Y_{minj})*S_j/4.5 \quad (12)$$

Sj = Standard deviation in the j stratum

Y_{maxj} = Higher dry biomass per parcel value in stratum j

Y_{minj} = Lower dry biomass per parcel value in stratum j

Calculation of population variability using the following formula:

$$S_{str} = \sum_{j=1}^{M} (N_j / N) * S_j \quad (13)$$

Sstr = Deviation of the population that underwent stratification

M = Number of strata

Nj = Number of sample units fitting in stratum j

N = Total number of sample units pre-determined for the population (considering all strata)

By obtaining the average and variability values of above-ground live wood dry biomass of the stratified population (dry biomass / parcel), one can then obtain the sample intensity (n), or total number of permanent parcels per stratum for the final inventory using the following formula:

$$n = (t^2 * {S_{str}}^2) / (E^2 + \frac{t^2 * S_{str}}{N}) \quad (14)$$

n = Number of parcels arranged in strata

t = t for Student (charted value based on the 95% confidence interval)

Sstr = Deviation of the population that underwent stratification

E = Error (average dry biomass x 0.1 to obtain 10% accuracy)

N = Total number of sample units pre-determined for the population (considering all strata)

The next step after setting the overall number of parcels per stratum is deciding how they shall be distributed in each of the different strata, considering that the parcel number should be proportional to the size of each stratum according to equation 15.

$$n_j = \frac{(\frac{N_j}{N}) * S_j}{(\sum_{j=1}^{M} (\frac{N_j}{N}) * S_j) * n} \quad (15)$$

nj = Number of parcels for each stratum

Sj = Standard deviation of stratum j

M = Number of strata

Nj = Number of strata in the sample

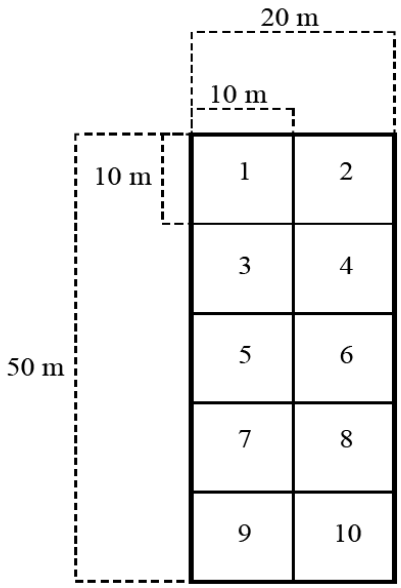
n = Number of plots per stratum

N = Total number of samples pre-determined for the population (considering all strata)

3.4.3 Allocation of forest inventory permanent parcels (optimal distribution or Neyman distribution)

The parcels are distributed per stratum in order to assure the lowest possible margin of error, i.e., strata with a greater amount of variability receive, proportionately, more parcels than more homogeneous strata, as shown by equation 15.

Effect a random distribution of parcels into the strata, each with a 1,000 m² area (20m x 50m) (Figure 10). Each parcel is subdivided into 10m x 10m squares to facilitate orientation and measurement of individuals at the time of field inventory.



Source: Felfili (2005)[38]

Figure 10: 20m x 50m parcels are subdivided into ten 10m x 10m squares.

The parcels shall be geographically allocated at random by superimposing a grid with numbered quadrants (each quadrant with a 1,000m² area in scale) on a map in the same scale as the grid. Next, the location of the parcels shall be drawn at random by the number of each quadrant.

Having defined the location for each parcel, the four corners shall then be georeferenced and their areas shall be physically identified on site, so that they can be fully available for technical visits for verification and evaluating, as well as for subsequent monitoring periods that should occur every 5 years.

3.4.4. Data collection on site

The information gathered during the inventory of forest biomass of the plantation areas will be based on two pieces of information collected in the field: oblique total height (H) and the diameter of 30 cm of soil (D30) of trees included within the permanent plots of 1,000 $m^{2.}$. Regarding the species belonging to the Palmaceae and Arecaceae plant families (palm

[38] Guide for the monitoring of permanent parcels in the Cerrado and Pantanal biomes.

trees), the volume calculation shall be based on allometric equations provided in Annex 4 A.2. of the Good Practice Guidance for LULUCF by IPCC, and later converted into dry biomass per individual, with the aid of wood density data for different species.

For the measurement of D30, a caliper (Figure 11) shall be used, an instrument made of aluminium alloy with milimeter graduations. Its size tends to vary depending on the forest population sampled (45 cm to 120 cm). The usual caliper dimensions for planted forests range from 45 cm to 65 cm.

Figure 11: Caliper Use.

Height measurement (H) shall be done using a telescopic rod (Figure 12). This method is very suitable for young populations, whose trees' heights do not exceed 10 m, or for the kinds of Cerrado vegetation. Its use consists of leaning the telescopic rod on the tree and reading its oblique height measurements. One of its great advantages is that the reading is taken at operator eye-level.

The data collected shall be marked on field datasheets containing each tree's number, common name, and D30 and slant height measurements of all individuals included in the permanent parcels.

Figure 12: A telescopic rod used for measuring the oblique height of the individuals in the parcels.

Finally, all data collected shall be entered into tables to generate dry biomass estimates (dry biomass / parcel, dry matter / ha and dry biomass / stratum). The elemental carbon and CO_2 equivalent values shall be calculated using the dry biomass values.

3.4.5 Overview of carbon stock monitoring procedures in the project areas

The procedures for i) stratified sampling, ii) data collection and iii) calculation of carbon stocks can be summarized in the following logical sequence:

1. A few months before the monitoring for the preparation of the project's carbon stock monitoring report, the total area shall be divided into visually homogeneous strata.
2. Three pilot sampling units are randomly allocated for each stratum.
3. The averages and standard deviations are calculated for each stratum.
4. The required sampling intensity for biomass inventories in each stratum, as well as sampling errors and confidence intervals, are calculated.
5. From the procedure described above the final number of parcels per stratum is calculated.
6. Final permanent parcels are randomly allocated for all strata, which shall serve as the basis for the biomass (and carbon) calculation throughout the project's crediting period.
7. The D30 and oblique height of all trees within the boundaries of the parcels are measured.
8. The above ground dry biomass for each individual and for the parcel as a whole is calculated.
9. The value of above-ground dry biomass is extrapolated over the stratum area.
10. The below ground dry biomass is quantified using the above-ground dry biomass data.
11. The total dry biomass value is converted into tons of equivalent CO_2
12. The volumes of all strata are added to reach the project's total stock of CO_2e at the time of checking.

4 GHG Emission Reductions:

4.1 Explanation of methodological choice:

The emissions reduction calculation is alsobased on the guidelines and methodological tools of the AR-AMS0001 methodology, which proved adequate to the project, since:

- ✓ The total amount of GEE annually removed from the atmosphere shall not exceed the 16,000 tons of CO_2e (see section 4.4), which, in terms of reducing emissions, qualifies this as a small-scale project.

- ✓ The project activities shall be developed in abandoned pastures or grassland areas that are unproductive (semi-abandoned) and have low density of animals per hectare, and, to a lesser extent, in areas under agricultural cultivation.

- ✓ There shall be no displacement of farmland covering over 50% of the project area, since total cultivated area amounts to less than 15% of total project area. The relocation of animals is also minimal, since only a few areas still have cattle, and even in these areas, livestock serves the purpose of ensuring land use and occupation[39], as well as controlling wild grasses, and is not a particularly important source of revenue, when compared to other activities in the property.

- ✓ Less than 10% of the soil in the areas selected for the development of the project activities has been plowed for farming.

- ✓ Regarding the baseline, the reality of the project areas meet the requirement of paragraph 5, section II of AR-AMS0001, which considers the continuation of current land use, so that the carbon stocks would also be a reflection of such land use dynamics.

- ✓ The areas selected for the project are eligible under paragraph 1 of the annex to decision 16/CMP.1, as they do not fit the national definition of forest defined by the MCT – the Designated National Authority (DNA).

Under the Voluntary Carbon Standard Guidance for Agriculture, Forestry and Other Land Use Projects, the reforestation activity area had its forest cover removed over 10 years prior (before 1998).

Finally, the project does not anticipate the use of fire for preparing the areas, and emissions caused by project activities shall be restricted to those from nitrogen-based fertilizers. They are not significant when compared to the total amount of emissions removed by the project and thus can be neglected, as per the AR-AMS0001 guidelines.

[39] The National Agrarian Reform Program of the National Institute of Agrarian Reform (INCRA) determines that private properties that prove unproductive are subject to expropriation for agrarian reform (rural settlements). Therefore, it is common in many Brazilian regions, as well as in the project region, that owners whose main rural activity and source of income is agriculture maintain livestock in areas unsuited for agriculture, or which, for whatever reason, have not been cultivated. Such a situation ends up, in many cases, acting as more of a way to demonstrate the productive use of the area, than as an essential income generating activity for the property. While there are many exceptions, this is a common practice in areas where commercial agriculture prevails in relation to livestock activities.

4.2 Quantifying GHG emissions and/or removals for the baseline scenario:

The project followed the AR-AMS0001 methodology guidelines regarding the criteria for area stratification. According to the methodology criteria, the project was stratified into two groups: "A" and "B" (see section 2.1):

A. Agricultural areas where changes in carbon stocks in the living biomass do not exceed 10% of the amount anticipated for removal by the project.
B. Grazing areas where changes in carbon stocks within the living woody biomass do not exceed 10% of the amount of removal proposed by the project.

Since there is no biomass increase in the project areas in the baseline scenario, the project baseline is equal to the existing biomass stock in the areas before the start of the reforestation project.

The current existing stock within each stratum was calculated following the equations provided by the AR-AMS0001 methodology, as follows:

$$B_{(t)} = \sum_{i=1}^{I} (B_{A(t)i} + B_{B(t)i}) * A_i \quad (16)$$

$B_{(t)}$ = Carbon stocks in the living biomass within the project boundary at time t in the absence of the project activity (t C)
$B_{A(t)i}$ = Carbon stocks in the above-ground biomass at time t of stratum i in the absence of the project activity (t C/ha)
$B_{B(t)i}$ = Carbon stocks in the below-ground biomass at time t of stratum i in the absence of the project activity (t C/ha)
A_i = Project area of stratum i (ha)
i = Stratum i (I = total number of stratum)

$$B_{A(t)} = M_{(t)} * 0.5 \quad (17)$$

$B_{A(t)}$ = *Carbon stocks in living biomass that would existed at time t in the absence of project activity (t C/ha)*

$M_{(t)}$ = *Above-ground biomass at time t that would have occurred in the absence of the project activity (t d.m./ha)*

0.5 = Carbon fraction of dry matter (t C/t d.m.)

$$B_{B(t=0)} = B_{B(t)} = 0.5 * (M_{grass} * R_{grass} + M_{woody\ (t=0)} * R_{woody}) \quad (18)$$

$B_{B(t)}$ = *Carbon stocks in living biomass that would have occurred at time t in the absence of project activity (t C/ha)*

M_{grass} = *Above-ground biomass in grass pastures at time t that would have occurred in the absence of the project activity (t d.m./ha)*

$M_{woody\ (t=0)}$ = *Above-ground biomass of woody perennials at t=0 that would have occurred in the absence of the project activity (t d.m./ha)*

R_{woody} = *Root to shoot ratio of woody perennials (t d.m./t d.m.)*

R_{grass} = *Root to shoot ratio for grassland (t d.m./t d.m.)*

During the field surveys, we identified different biomass concentrations per hectare within the two main strata (A and B), so that the strata A and B were further divided into sub-strata (a, b, b', c, and agriculture), allowing for more accurate calculation, as shown in Table 8:

Table 8: Description and distribution of the sub-strata's areas within the project.

Reference area	Owner/farm	Area (ha)	Stratum	Sub-stratum	Sub-stratum area	Reference Image[40]	Image area[41]	Points	UTM Coordinate for picture-taking (S/W)	
(A)	César Sandri/ Flores do Ipê	80.5	B	c	10.3	CR08 and CR09	1797; 1801; 1804	6	8052516	306847
				b'	70.2	CS04 and CS07	1817; 1820	7	8052839	306712
							1838	8	8051585	306529
							1856; 1859	9	8051805	306438
							1863; 1873	10	8052062	306209
							1877; 1882	11	8052068	306704
(B)	Lúcio Flavo/ Mirassol da Furna	42.8	B	a	42.8	CL01 to CL07	2068; 2069	28	7983966	248547
							2076; 2077	29	7984241	248744
							2087; 2091	30	7984332	248920
							2102; 2106	31	7984759	248874
(C)	PENT/ Government of Mato Grosso do Sul (MS)	27.2	B	b	24.1	CS01-CS05	2006; 2015; 2019; 2029; 2035	12	7991509	243884
								27	7992025	243268
(D)	Rogério Viana/ Lugar Jacubinha	60.1	A	agriculture	60.1	-	4254	4	8011650	285141
						-	4261; 4272	5	8011017	284387
(E)	Vanir Potrich/ Babilônia Lots 8,9,10	381.4	B	a	289.6	CL01 to CL07	4158; 4161; 4165; 4179	1	8018897	276436
			B	b	91.8	CS01-CS05	4162; 4164; 4171	2	8018867	276027
							4186; 4204; 4206	3	8017897	277035
Total amount		592			588.9	The difference between the sum of the areas is due to the vegetation areas within the PENT, which have been excluded from the area of the strata.				

[40] Ottmar et al. 2001. Series of stereo-photographs for quantifying the vegetation biomass in the Central Brazil Cerrado area - Volume I: Reference used for quantification of biomass stocks in different strata.
[41] Annex VI.

The references used to quantify the mean biomass per hectare (woody biomass and grasses) for each of the different strata was extracted from the study conducted by Ottmar et al. (2001), entitled: Series of stereo-photographs for quantifying the vegetation biomass in the central Brazil Cerrado area – Volume I, according to Table 9.

Table 9: Quantification of the average biomass and average carbon stocks per hectare for each of the different strata[42].

Sub-stratum	References from Ottmar et. al (2001)	Average woody biomass stock (tones of dry biomass/ha)		Grass biomass stock (tons of dry biomass/ha)	Total stock in biomass above and below ground (tons of dry biomass/ha)	CO_2e stock in the woody biomass (t/ha)		CO_2e stock in the grass (t/ha)	Total stock of CO_2e per hectare ***B(t)****
		above ground ***M(t)***	below ground* ***Bb(t)***	below ground** ***Bb(t)***		above ground ***Ba(t)i****	below ground ***Bb(t)i****	below ground ***Bb(t)****	
a	CL01 to CL07	0.59	0.59	4.12	5.30	1.08	1.08	7.57	9.73
b	CS01 to CS05	3.46	3.46	2.17	9.09	6.35	6.35	3.97	16.68
b'	CS04 and CS07	6.06	6.06	2.44	14.56	11.12	11.12	4.48	26.72
c	CR08 and CR09	28.19	28.19	1.17	57.55	51.73	51.73	2.15	105.61
agriculture	-	0	0	0	0	0	0	0	0

* ***Rwoody:*** root/shoot ratio of 100% for trees and bushes (Abdala et al, 1998).

** ***Rgrass:*** average root/shoot ratio of 48% for savannah (TIER 1: 3 A.1.8 of the IPCC good practice guidance for LULUCF).

*** In this spreadsheet the Ba(t)i, Bb(t)i, Bb(t) and B(t) is expressed in tones of CO2e/ha and not in tones of C.

[42] Annex VI.

Table 10 displays the quantification of existing carbon stock within each area, each of the sub-strata, and the complete amount for the entire project.

Table 10: Total carbon stock in the sub-strata areas of the project.

Reference area	Owner/Farm	Area (ha)	Stratum	Sub-stratum	Sub-stratum area	Total stock per stratum in the area before the start of the project (tCO2e)
(A)	César Sandri/ Flores do Ipê	80.5	B	c	10.3	1,087.75
				b'	70.2	1,875.99
(B)	Lúcio Flavo/ Mirassol da Furna	42.8	B	a	42.8	416.32
(C)	PENT/ Government of Mato Grosso do Sul (MS)	27.2	B	b	24.1	401.98
(D)	Rogério Vian/ Place Jacubinha	60.1	A	agriculture	60.1	-
(E)	Vanir Potrich/ Babilônia Lots 8,9,10	381.4	B	a	289.6	2,816.97
			B	b	91.8	1,531.20
Total amount		592			588.9	**8,130.21**

4.3 Quantifying GHG emissions and/or removals for the project:

The quantification of GHG removals by the project was based on equations provided by the methodology, as follows:

Carbon stock within the project area:

$$N_{(t)} = \sum_{i=1}(N_{A(t)\,i} + N_{B(t)\,i}) * A_i \quad (19)$$

$N_{(t)}$ = *Total carbon stocks in biomass at time t in the project scenario (t C)*

$N_{A(t)i}$ = *Carbon stocks in biomass above-ground level at time t of stratum i in the project scenario (t C/ha)*

$N_{B(t)i}$ = *Carbon stocks in biomass below-ground level at time t of stratum i in the project scenario (t C/ha)*

Ai = Project activity area of stratum i (ha)

i = Stratum i (I = total number of strata)

$$N_{A(t)\,i} = T_{(t)i} * 0.5 \quad (20)$$

$N_{A(t)i}$ = *Carbon stocks in above ground biomass at time t under the project scenario (t C/ha)*

$T_{(t)i}$ = *Above-ground biomass at time t under the project scenario (t d.m./ha)*

0.5 = Carbon fraction of dry matter (t C/t d.m.)

As there are reference studies on the volumetric values of most species used by the project, above-ground biomass was calculated using equation 20, as shown below:

$$T_{(t)i} = SV_{(t)i} * BEF * WD \quad (21)$$

$T_{(t)i}$ = *Above-ground biomass at time t under the project scenario (t d.m./ha)*

$SV_{(t)i}$ = *Stem volume at time t for the project scenario (m^3/ha)*

BEF = Biomass expansion factor (over bark) for total above-ground biomass (dimensionless)

WD = Basic wood density (t d.m./m^3)

$$N_{B(t)\,i} = T_{(t)} * R * 0.5 \quad (22)$$

$N_{B(t)i}$ = *Carbon stocks in below-ground biomass at time t under the project scenario (t C/ha)*

$T_{(t)}$ = *Above-ground biomass at time t under the project scenario (t d.m./ha)*

R = Root to shoot ratio (t d.m./t d.m.)

0.5 = Carbon fraction of dry matter (t C/t d.m.)

4.3.1 Total CO_2e stock in the project area

$$\Delta C_{PROJ,t} = (N_t - N_{t-1}) * (44/12) / \Delta t \quad (23)$$

$\Delta C_{PROJ,t}$ = *Removal component of actual net GHG removals by sinks per annum (t CO_2-e/year)*

$N_{(t)}$ = *Total carbon stocks in biomass at time t under the project scenario (t C)*

Δt = *Time increment = 1 (year)*

The calculation memory is described in Annex I and was based on volumetric data from 34 native species (Annex IX), obtained from different forest inventory studies conducted in reforestation processes using native species. The data were charted according to age, making it possible to obtain a mean biomass and CO_2e increase between the following periods: 0-5, 5-10, 10-15 and 15-30 years, according to Table 11 and Figure 13.

Table 11: Ex ante GHG removals in the project area during the 30-year crediting period[43].

CO2e Removal					
Year	Trees/ha	Area (ha)	Annual tCO2e removed by the project activities (all strata)	Cumulative t CO2e removed by the project activities for all strata	Plantation GHG removal potential (t CO2e/ha/year)
		588.9	8,130.21	8,130.21[44]	5.34
0	1111	294.5	2,251.09	10,381.30	
1	1099	471.1	3,561.36	13,942.66	
2	1087	588.9	4,402.92	18,345.58	
3	1075	588.9	4,354.49	22,700.07	
4	1063	588.9	4,306.59	27,006.66	
5	1051	588.9	4,932.70	31,939.36	8.19
6	1040	588.9	4,878.44	36,817.80	
7	1028	588.9	4,824.78	41,642.58	
8	1017	588.9	4,771.71	46,414.28	
9	1006	588.9	4,719.22	51,133.50	
10	995	588.9	7,491.99	58,625.49	12.45
11	984	588.9	7,409.58	66,035.07	
12	973	588.9	7,328.08	73,363.15	
13	962	588.9	7,247.47	80,610.62	
14	952	588.9	7,167.74	87,778.36	
15	941	588.9	8,576.67	96,355.03	14.32
16	931	588.9	8,482.33	104,837.36	
17	921	588.9	8,389.02	113,226.38	
18	910	588.9	8,296.74	121,523.13	
19	900	588.9	8,205.48	129,728.60	
20	891	588.9	8,115.22	137,843.82	
21	881	588.9	8,025.95	145,869.77	
22	871	588.9	7,937.67	153,807.44	
23	861	588.9	7,850.35	161,657.79	
24	852	588.9	7,764.00	169,421.79	
25	843	588.9	7,678.59	177,100.38	
26	833	588.9	7,594.13	184,694.51	
27	824	588.9	7,510.59	192,205.11	
28	815	588.9	7,427.98	199,633.08	
29	806	588.9	7,346.27	206,979.35	
30	797	588.9	7,265.46	214,244.81	

[43] Annex I
[44] Baseline: total biomass existing in the project area before the start of its activities.

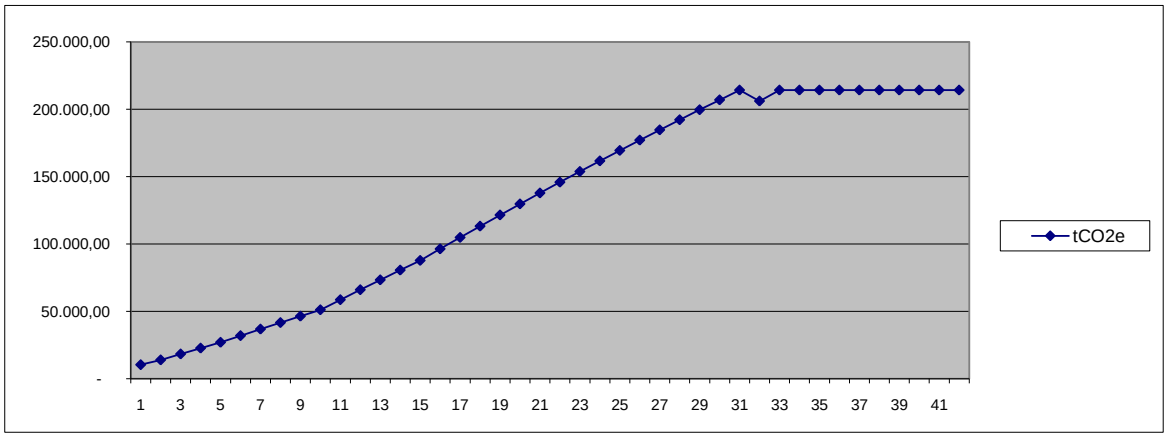


Figure 13: Graphic demonstration of ex-ante GHG removals within the project area in the 30-year crediting period.

As a result, it is expected that the project reach a total average stock of 198.26 tons of dry biomass per hectare, which is equivalent to 363.81 t CO_2e/ha, at the end of the crediting period. As such, the average annual increment was estimated at 12.13 t CO_2e/ha (Annex I). It is hoped that in the end of the crediting period of 30 years the cumulative total in the project area (589 ha) is approximately 214,245 t CO_2 e[45].

Figures 14 and 15 show some Cerradão areas (forest physiognomy of the Cerrado biome) near the project area; despite having suffered human intervention disturbance, they serve as a reference in terms of the minimum result expected for the project areas regarding physiognomy and biomass, in 20 or 30 years.

[45] See risk analysis for non-permanence and buffer determination, section 4.4.1

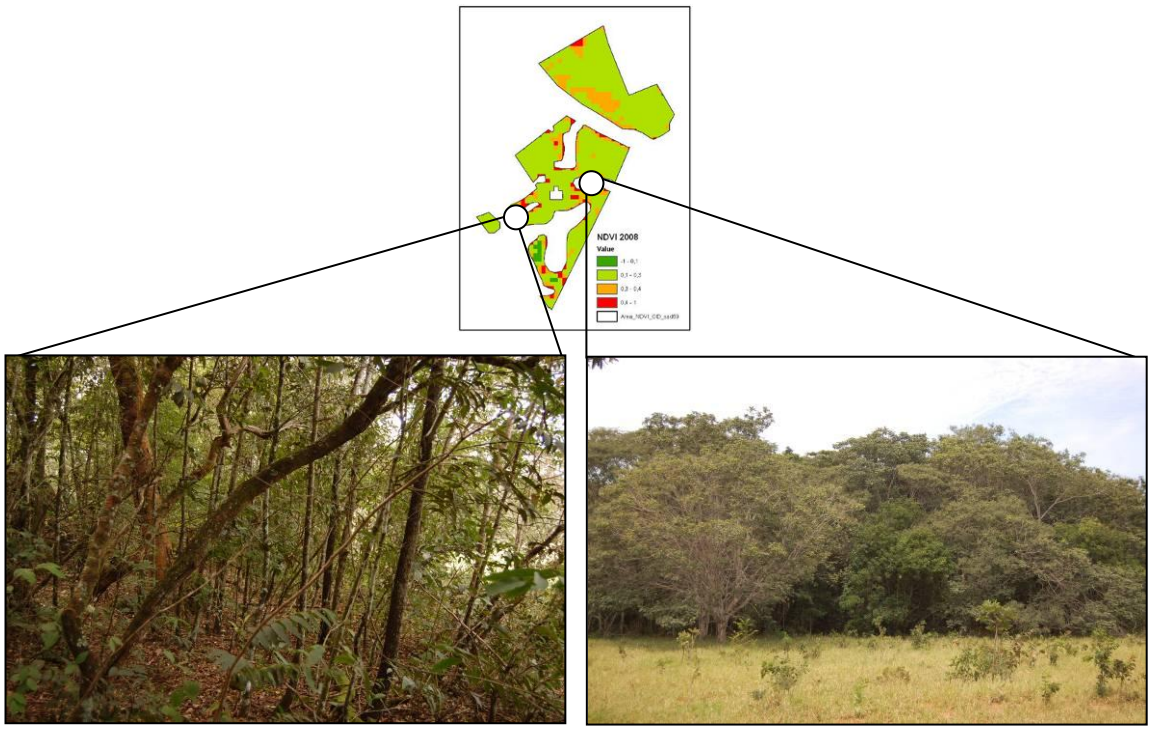


Figure 14: Cerradão physiognomies within the property of Mr. César Sandri (Flores do Ipê).

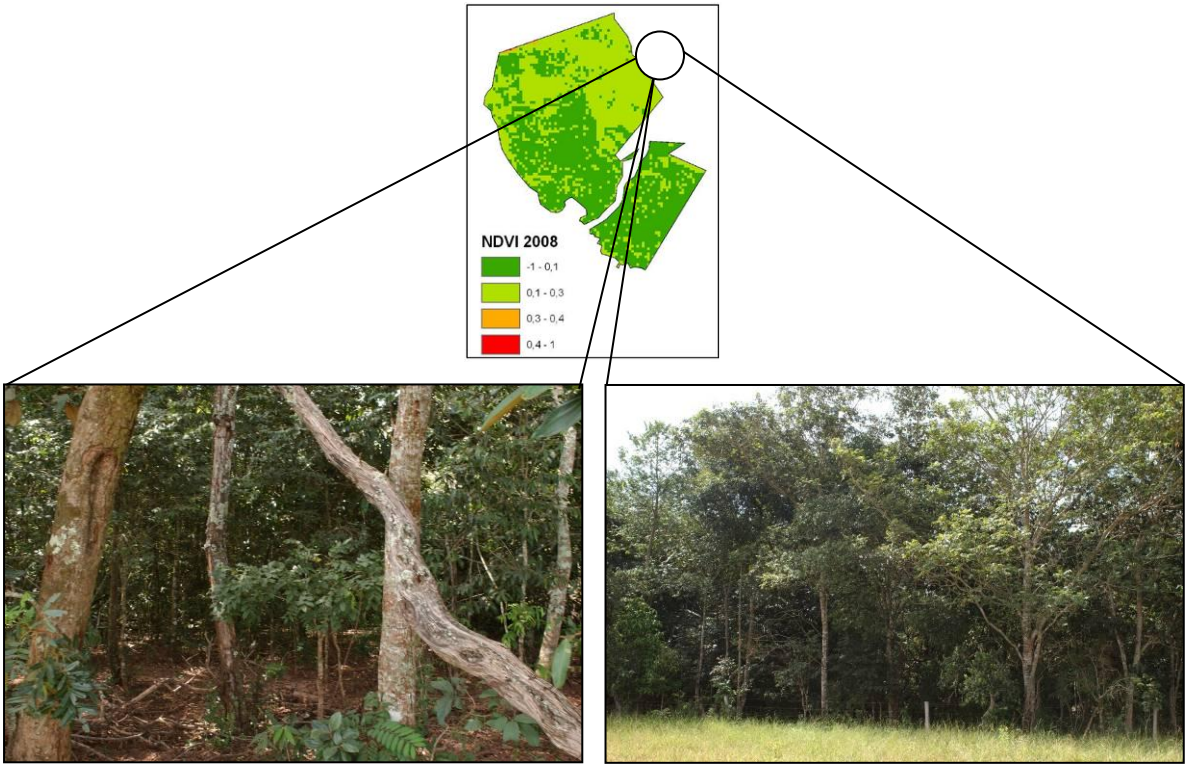


Figure 15: Cerradão physiognomies around the reforestation area belonging to Mr. Vanir Potrich (lots 8, 9 and 10).

In spite of what the area's current landscape may suggest, much of it was once occupied by typical Cerrado forests: the *Cerradão.* Over the past few decades, especially the 1970s and 1980s, agricultural expansion and demand for firewood and charcoal in the project area led to the replacement of forest by pasture, agriculture, and *open cerrado* formations. In some deforested and abandoned areas, it is clear that natural regeneration led to a savanna-like landscape; in other areas, due to competition with exotic grasses and the occurrence of fires, the field appearance remained (*campo cerrado* and *open cerrado*). The secondary formations with a savanna aspect contain low biomass levels, which makes it difficult to identify what used to be occupied by *Cerradão* and what has always been occupied by savanna vegetation.

The point of this brief analysis is to prove the potential of the project areas to support forest physiognomies with a high biomass concentration, even if the prevailing landscape used to be different. On the other hand, it is noteworthy that, depending on the specific nutritional requirements of the specific area being reforested, the substrate may be unable to provide support to larger forest physiognomies and aerial biomass along the ecological succession process.

The values of carbon stocks in aboveground biomass in tropical savannah are highly variable and depend on the degree of tree cover. Grace et al. (2006) conducted a study compiling data on carbon stocks in different savannah ecosystems, considering the gradient of vegetation in areas of Cerrado in Brazil and other places in other continents. In the aboveground biomass (leaves and stem) the values range from 1.8 to 34 t C/ha (6.6 to 124.78 t CO_2e/ha), while for the belowground biomass (roots) values vary from 4.9 to 52 t C/ha (17.9 to 190.4 t CO_2e/ha). Therefore, the sum of the total stock of carbon in the two compartments would be around 24.5 to 315.62 tonnes of CO_2e/ha. The estimate of this project at the end of the crediting period of 30 years is about 363.81 t CO_2e/ha, more than the study presented here. However, some points should be highlighted for this type of comparison: i) methodological differences adopted; ii) in the survey conducted by Grace et al. (2006) it was not considered any of the forest physiognomies of the biome and in the present project were detected degraded areas that were once occupied by *cerradão*, when looking at areas adjacent to the polygons designed (Figure 14 and 15); iii) some species to be used in reforestation are typical of forest as *cerradão* or riparian forests thus have the potential to achieve higher volume of biomass per individual, compared to species that occur in more open vegetation types (*campo cerrado* and *open cerrado*).

For comparison, the study developed by Salis (2004) to estimate the aboveground biomass in an area of cerradão (woodland savannah) in the Pantanal of Mato Grosso has resulted in the total stock of 198.6 t/ha in the aboveground tree biomass, or 364.43 t CO_2e/ha. This figure meets the estimates of this project, it shows that if taken into consideration only the shoots (trees, shrubs and herbaceous plants), we obtain a value comparable to the ex ante estimates (above and belowground) for the final buildup carbon in the open areas that it is intended to reforest. This analysis shows that the project estimates are conservative and reduce uncertainties of overestimating, since in the potential areas to be reforested for supporting forest formations, one realize that the total amount of carbon calculated to shoots and roots is equivalent to the stock carbon of biomass from a native *cerradão*.

4.4 Quantifying GHG emission reductions and removal enhancements for the GHG project:

The formulas used for ex-ante calculation of net removals by the project activities were quantified according to equation 24:

$$ERAR\ CDM, t = \Delta CPROJ, t - \Delta CBSL, t - GHGPROJ, t - Lt \quad (24)$$

$ER_{AR\ CDM, t}$ = Net anthropogenic GHG removals by sinks (t CO_2-e/year)

$\Delta C_{PROJ, t}$ = Project GHG removals by sinks at time t (t CO_2-e/year)

$\Delta_{BCSL, t}$ = Baseline net GHG removals by sinks (t CO_2-e/year)

$GHG_{PROJ, t}$ = Project emissions (t CO_2-e/year)

Lt = Leakage attributable to the project activity at time t (t CO_2-e/year)

For subsequent crediting periods Lt = 0.

Table 12: Final balance of GHG removals by the project and calculation of VCUs as AFOLU Guidance for VCS.

Parameter	**Calculated volume (t CO_2-e)**	**Comments/Reference**
$\Delta C_{PROJ, t}$	214,244.81	Annex I
$\Delta C_{BSL, t}$	8,130.21	Annex VI
$GHG_{PROJ,t}$	0	Defined by the AR-AMS0001 methodology
$L_t = \Delta C_{ACTUAL, t} * 0.15$	30,917.19	Sections 2.1; 3.1; 3.2.4
ER_{AR} CDM	**206,114.60**	Net anthropogenic removals of GHG resulting from project activities.
Parameter	**Calculated volume (t CO_2-e)**	**Comments/Reference**
Changes in carbon stock	214,244.81	Not permanent
Baseline	8,130.21	Permanent
Net removals	206,114.60	= 214,244.81 – 8,130.21
Total Leakage	30,917.19	= 206,114.60 – 15% (defined by AR-AMS0001)
Total credits	175,197.41	= 206,114.60 – 30,917.19
Buffer	41,222.92	= 206,114.60 – 20%
Total VCUs	**133,974.49**	= 175,197.41 – 41,222.92

4.4.1 Risk analysis for non-permanence and buffer determination

The following analysis is presented in Tables 13 and 14 were based on the Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination from the Voluntary Carbon Standard (VCS).

Table 13: Generic risk factors applicable to all types of projects.

Project risk
Risk of unclear land tenure and potential for disputes
Risk of financial failure
Risk of technical failure
Risk of management failure
Economic risk
Risk of rising land opportunity costs that cause reversal of sequestration and/or protection
Regulatory and social risk
Risk of political instability
Risk of social instability
Natural disturbance risk
Risk of devastating fire
Risk of pest and disease attacks
Risk of extreme weather events (e.g. floods, drought, winds)
Geological risk (e.g. volcanoes, earthquakes, landslides)

Project Risk
All private landowners involved have notarized documentation that ensures the legal ownership of land, to avoid any potential future disputes. In the case of PETN this is a protected area in the public domain under the responsibility of the state of Mato Grosso do Sul, excluding any doubts about the ownership of land.
The project depends on the trading of carbon credits for their installation and maintenance, especially in the early years. To make up for this type of transaction the proponent sees other funding sources such as private companies that want to offset their GHG. Besides, it is being developed by the project proponents dissemination of marketing materials, stressing the social and biodiversity, given the fact that the project will be submitted for certification CCBS (Climate Community and Biodiversity Standard) - CCBS, in order to lure investors and potential buyers of carbon credits. Finally, the project has the full support of Conservation International in conjunction with different actors and voluntary carbon market, technical support, financial and operational for the preparation and implementation.
Technically, the applicant and project partners have extensive experience with practices of reforestation and seedling production and management issue in other conservation projects developed in the Cerrado region (Annex V).

Economic Risk
The areas selected for reforestation are basically Permanent Preservation Area (APP), Legal Reserve (RL) and Conservation Unit (UC), legally protected under the Forestry Code and SNUC (Laws 4771/65 and 9985/00) and meant for conservation; therefore, by definition, they do not compete with other land uses that may cause reversal rates for carbon sequestration. In particular properties that are retrieved multiple use areas (beyond those required by the Forestry Code), the owner's intention is to increase the area of native vegetation on their property where they can get non-timber forest products and generate income, such as fruits, oils, extracts, seeds, fiber, crafts, spices, honey, among others. In this sense, the owner is committed to ensuring the preservation of crops and not to open new areas for relocation of agricultural activities (Annex XV).

Social Risk and Regulatory

Risks of political or social unrest will be minimized as it is being developed under the full knowledge and approval of local authorities (Annex XIII) and consent of the producers (Annex XV). In parallel, the project aims to certification under the criteria required by the CCBS, generating positive social impacts for the improvement of life of local communities benefited. If there are conflicts of social order they could be mitigated by the methodology of Participatory Rural Appraisal - DRP (Annex X), a tool used for the engagement of local actors involved in the project. In addition, the project foresees the creation of an advisory board whose members are owners and community representatives, which will facilitate conflict management and setting solutions. A system of ombudsman to receive criticism, complaints and suggestions concerning the development of the project will be established. The good relationship history of Oréades with both the producers and with communities is a positive factor to help in the speedy resolution of disputes that may arise throughout the duration of the project.

Risk of natural disturbances

Natural disturbances caused by fire are very common factor in the Cerrado region and constitute a major threat to the project objectives. However, the occurrence of natural or deliberate fires does not mean total loss of biomass, because the native species of cerrado have adaptive features to survive and are highly resilient, so soon after the passage of fire tend to recover its original features. Furthermore, the increased risk in relation to fire occurs mainly in the early years, because with increasing age of the plantations individual trees are more resilient and even if there may be loss of biomass and carbon emissions after burning, mortality does not occur widely as would occur in other biomes less adapted to this type of extreme event (Hoffmann et al. 2009). Strategies for mitigation and prevention of fire hazards will be developed for this project such as construction and maintenance of firebreaks; division into plots of planted areas within the properties; periodic monitoring of fires during the critical times; combat and control fire-building and training of volunteer fire brigades consisting of employees of enterprises and farms, enabling more effective prevention, partnership with the Volunteer Brigade of Emas National Park and the Fire Brigade of Mineiros.

In the case of attack by pests and diseases that could endanger the health of crops, the technical team that will perform reforestation, will be able to notice any changes and reforestation methodology (Annex IV) also provides for the replacement of seedlings to any losses in case of mortality. Additionally, project partners (landowners, communities, and the Oréades staff) shall conduct periodic visual monitoring, in order to allow for decision-making in time to deal with possible complications in seedling development.

Forecasts for the next century by the IPCC and other studies developed for Cerrado indicate that in the Midwest rains are concentrated in short periods of time, interspersed with dry days or dry spells, with soil erosion could harm agriculture and biodiversity of the Pantanal in Mato Grosso (Marengo, 2007). However, the chance of occurrence of more extreme weather events such as severe droughts, floods and wind storms, for the next 30 years seems unlikely to happen and were never observed in the region so far. The project team is prepared for this kind of situation, on time to take the necessary adaptive measures. It is noteworthy also that native species of cerrado used in the project are also suited to situations of extreme drought (especially when they reach the maturity level) and tolerant to changes in precipitation and temperature, because morphologically they have deep roots and nutrient reserves.

The probability of occurrence of geological hazards (volcanoes, earthquakes, etc.) is virtually null and these events were never reported in the region.

Table 14: Risk Analysis for the Project for the Reforestation of the Emas-Taquari Biodiversity Corridor.

Risk factor	Risk Rating
Project longevity/ Commitment period	
Long-term commitment (i.e., many decades or unlimited) with no harvesting	Low
Long-term commitment with no harvesting in politically unstable countries	Medium
Long-term commitment with harvesting	Medium
Medium-term commitment with harvesting	High
Medium-term commitment (i.e., a few decades) with no harvesting	High
Short-term commitment with or without harvesting	Fail
Ownership type and user rights	
Established NGO or conservation agency owner; or owner-operated private land	Low
Rented or tenant-operated land	Medium
Clear land tenure but disputed land use rights	High
Uncertain tenure but with established user rights	High
Uncertain land tenure and no established user rights	Fail
Technical capability	
Proven technologies and ready access to relevant expertise	Low
Technologies proven to be effective in other regions under similar soil and climate conditions, but lacking local experimental results and having limited access to relevant expertise	Medium
Financial capacity	
Financial backing from established financial institutions, NGOs and/or governments	Low
Long-term project funding not secured	Medium
Management capacity of project developer	
Substantial previous project experience (≥ 5 projects) with on-site management team	Low
Limited project experience (<5 projects) with on-site management team	Medium
Limited project experience (<5 projects) without on-site management team	High
Future income	
Appropriate management plan, and financial analysis demonstrates that likely income stream(s) will finance future management activities (e.g., carbon finance to be used for project management, tending operations, etc.)	Low
Future costs and revenue stream(s) not documented	High
Future/current opportunity costs	
Alternative land uses are unlikely to become attractive in the future	Low
Project is competing with other land uses likely to become more attractive in the future	High
Endorsement of project or land-use activity by local population and local/ national political establishment	
Endorsement given and not likely to change in the future	Low
Endorsement given but may be subject to change in the future	Medium
No endorsement given	High

This is a non-timber project, whose main focus is on biodiversity conservation and which will be implemented in legally protected areas (APP and areas that will be registered as RL, UC of integral protection in the future) The maintenance of other areas (non-timber multiple use) is ensured by the involvement of the producers whose farms are in this situation (Annex XV).

The project will be developed on private lands legally constituted and tenure documentation notarized. The reforestation areas shall be noted by way of APP and future RL, which gives them perpetuity even in case of sale of properties. In this sense, the owners pledged to ensure the preservation of the project areas and not open new areas for relocation of agricultural activities.

The project proponent and the project partners already have all the necessary experience and technological framework for the reforestation process and seedling production in the Cerrado.

As this is not a commercially focused project, it depends on the sale of carbon credits for its implementation and maintenance during the first 5 years. Other forms of fund raising will be performed as explained in Table 13 in Section **Risk Project.** According to the budget (Annex XIV) and the financial health of the project (Annex XII), the risk assigned to the financial capacity was assumed to be more conservative.

The project proponent has an 8-project portfolio (Annex V), with similar aims to that proposed in this PD. Additionally, the project also counts on Conservation International and its experience with various initiatives aimed at Cerrado conservation.

Besides the carbon credits, from its 5th year on the project will also rely on several non-timber products that could generate revenue for maintenance of the areas and project activities, such as: fruits, oils, extracts, seeds, fiber, crafts, spices, honey, among others

As described in item **Economic Risk** in Table 13, the areas selected for reforestation are mostly APP, RL and Conservation Unit of full protection; therefore, by definition not competing with other land uses. To support and classify as low risk the future opportunity cost also to the other areas which are enclosed as non-timber multiple use and spatially comprise the smallest portion of the project, the owner's intention is to increase the native area of their property and get income from non-timber forest products. In this sense, the owner is committed to ensuring the preservation of plantations and not to open new areas for relocation of agricultural activities (Annex XV).

Project activities enjoy full support from both state and municipal authorities, as well as from communities and owners in the areas. The project was specially designed to meet the different expectations of the various stakeholders involved.

Table 15: Standard retained buffer percentage according to the "Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination" from the VCS.

ARR Risk Class	Buffer Range
High	40-60%
Medium	20-40%
Low	10-20%

Risk analysis designed for the Reforestation of Biodiversity Corridor Emas-Taquari followed the guidelines of "AFOLU Non-Permanence Risk Analysis and Buffer Determination" as well as "13April2010 VCS Program Update".

From the generic risk analysis of the project (Table 13), it is concluded that the most important risk refers to the occurrence of natural or deliberate fires, very common fact observed in the Cerrado region, but that will have all the preventive measures and mitigation described above. Additionally, the **Project Risk** (Table 13) and the section on **Financial Capacity** (Table 14) are the two most relevant topics to the definition of the buffer that should be retained on the carbon credits to be generated. Of the eight parameters in Table 14, seven were identified as low risk, while one was identified as medium risk. Therefore, the risk factor adopted for this project is **medium,** assuming the buffer of 20% (minimum percentage) as a way to ensure continuity of the climate benefits calculated by the project. A justification for taking this minimum percentage is in arguments about the efforts and strategies for project developers will have to minimize risks and mitigate potential negative effects, as discussed above. Items in **the Project Risk** and **Financial Capacity**, for example, incur different possible ways of raising funds in order to circumvent the financial difficulties for the physical implementation of the project.

5 Environmental Impact:

N/A

6 Stakeholders comments:

6.1 Choice of the communities who shall benefit from the project.

The quilombola and settled communities, as well as the patients from the Therapeutic Center, have been assisted by projects developed by Oréades since 2005. With these communities, Oréades has developed several projects relating to reforestation and the construction of nurseries. In partnership with IBRACE[46], Oréades has developed a socio-economic diagnosis, in order to assist and direct several upcoming activities, such as the reforestation project of the Emas-Taquari Biodiversity Corridor.

[46] Instituto Brasil Central (www.ibracego.org.br).

These communities are all located around the Emas National Park and the Nascentes do Rio Taquari State Park, and are within the Emas-Taquari Biodiversity Corridor. Therefore, the communities are fundamental to the development of landscape planning by joining conservation and economic activities in order to ensure the sustainable use of natural Cerrado resources.

Much like the communities, the owners of the areas that make up the project have also participated in the activities developed by Oréades in the region. For the development of the Project for the Reforestation of the Emas-Taquari Biodiversity Corridor, meetings were held in which the owners actively participated by asking questions and making suggestions (Figure 16).

Figure 16 - Meeting for introducing the project to the owners.

After meetings, all landowners met individually with the Oréades, Conservation International and Brazil CantorCO_2e teams (Figure 17) to discuss project specific data for each property and determine whether or not to participate in it. After that stage, five owners, as well as the Environment Office of Mato Grosso do Sul, decided to participate in the project by allowing some of their properties and areas to be reforested.

Figure 17 - Meeting with owner César Sandri.

Oréades maintains a good relationship with property owners, so that all are free to ask questions, as well as provide feedback and suggestions during the project design.

6.2. Communication process during the project validation

The landowners, the involved communities, and other project stakeholders such as universities, schools, and local public authorities shall be involved during the project validation process under the VCS and CCBA Standards. They shall all be notified about all processes and results through communication channels established by Oréades, namely: mailing and meetings in person.

6.3. Mediation of conflicts during the development and implementation of the project.

It is expected that all those involved in the project exercise their social control of it, with support of the methodology of Participatory Rural Appraisal (DRP) (Annex X). An independent third party, hired later, will implement such tool. In addition, it will be created an advisory board whose members are owners and community representatives, which will facilitate conflict management and setting solutions. The good relationship history of Oréades with both the producers and with communities is a positive factor to help in the speedy resolution of disputes that may arise throughout the duration of the project.

6.4. Main results expected by the project regarding the social aspect

The Project for the Reforestation of the Emas-Taquari Biodiversity Corridor seeks not only to reforest degraded areas, but also to provide social benefits involving low-income, excluded, and disadvantaged communities. Will be benefited 25 families of settlers, 20 *quilombola* families, a community for recovering drug addicts and agents engaged in the project communities will be trained and temporary contracts to carry out the planting activities. Other social benefits for the

project is to train volunteer brigades to prevent, combat and control of fires, as well as support institutions that already work in these activities: 6th Independent Company of the Military Fire Department of the State of Goiás headquarted in Mineiros (6th CIBM) and staff of Fire Brigade of the Emas National Park (PNE).

It is expected that the settled families and Quilombolas will promote the increase of their income through the production and sale of seedlings during the reforestation process and later by supporting the production of seedlings in the Education Center and Production of Native Plants of the Cerrado, of Oréades. The supply of seedlings is demanded in the area, since it presents an environmental liability of approximately 10.000 hectares that need to be recovered. The project will provide a minimal structure to produce seedlings for the 25 families of the three rural settlements participating in the project and the quilombola community of Buracão. This support would include construction of ponds for each individual family that will have the capacity to 2,000 seedlings in the first year of operation. Depending on the performance of families, this capacity may be expanded in subsequent years. The Cedro community already has a nursery capable of containing 13,000 seedlings; it only needs to expand its medicinal herb beds, some technical assistance, some training, and collective organization.

Families also may recover or enhance their properties with native Cerrado that have social and economic value. The gathering and sale of seeds shall be another source of income generation. It shall meet the needs of nurseries in the region and of other markets.

Considering that the average income of these families is a minimum wage (data from survey conducted by Oréades), and that it is difficult for them to become established productively, the project activities provide an incentive and a source of increased property income, which indirectly prevents rural exodus and loss of their collective identity. Without the project activities, the settled and quilombola families will possibly not have access to these new opportunities for increasing their income through gathering and selling seeds, production and sale of seedlings for the reforested areas, as well as seedling production supported by the Education Center Production of Native Plants of Cerrado nursery of Oréades. Especially in rural settlements, the project will stimulate increased production of baru (*Dipteryx alata*) and its treatment, as families use this product in their day-to-day for the manufacture of foodstuffs. The baru nut is already valuable in the national market and is abundant in the area; it is, therefore, an activity that shall strongly contribute to income diversification in small properties.

The project tends to show paths to sustainability for small properties, seeking diversity of supply of natural resources, their management and use for income generation, since land ownership does not always guarantee permanence in rural areas, and families to use the land to support themselves.

The project shall stimulate the production of herbal medicines in the Cedro community by supporting the expansion of the community medicinal herb garden, in order to increase supply and security of raw material for herbal medicine production in the Cedro Community's Medicinal Plants Center. To strengthen these families, the project shall introduce training processes that allow for increased self-esteem, knowledge exchange and improved social, economic, and environmental development of the community.

Another public to be benefited with the project is the Nova Esperança Therapeutic Community, whose public served are young and male adults with addiction problems. This community has had support from Oréades and now has a nursery

with a capacity of 50,000 seedlings per year. The free care for drug addicts at the Nova Esperança Therapeutic Community is made possible partly by the sale of seedlings grown in nurseries. Without the project activity will not occur technical skills that can contribute to the qualification of the inmates, guarantying the continuity of the free treatment offered and enabling the Centre does not only depend on donations for the exercise of their work. The estimate is that such support shall bring opportunities of social integration through professional training and increased employment opportunities.

For the planting and management of reforested areas and for seedling production, will be temporarily hired some workers prioritizing members of settled and *quilombola* communities involved in the project. This group shall be hired according to the CLT (Labor Laws Consolidation) for 3 years; they shall be trained for their respective tasks. At the end of this period this group shall be trained to re-enter the labor market, with both experience and certificates qualifying them further.

For fire control, the project foresees the training of the Volunteer Brigade of Emas National Park. Forming volunteer brigades through the training of company and farm employees shall allow for a better management of fire fighting and controlling in the project areas and neighbouring regions The project activity will have as a monitoring mechanism and communication between stakeholders the methodology of Participatory Rural Appraisal (DRP), whose scope of application is described in Annex X.

7 Schedule:

Table 16: Quarterly schedule of activities throughout the duration of the project (Annex XI).

SCHEDULE OF ACTIVITIES DETAILED																						
	1st YEAR		2nd YEAR		3rd YEAR		4th YEAR		5th YEAR		6th to 10th YEAR					11th to 15th					16 to 20	21 ° 30 °
BREAKDOWN	1st S	2nd S	1st S	2nd S	1st S	2nd S	1st S	2nd S	1st S	2nd S	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16 to 20	21 to 30
Goal 1 - To stimulate the local economy through the strengthening of sustainable and exemplary businesses in terms of social and environmental responsibility, associated with ecological restoration and native seedling production.																						
1.1 - Estimated calculation of the demand for native seedlings within 36 months and associated costs.																						
1.2 - Formalize partnerships with four nurseries in the region, which shall produce seedlings for the reforestation process.																						
1.3 - Expand the model nursery in the Oréades area and building a training and Environmental Education center.																						
1.4 - Reforest 588.9 hectares in the Emas-Taquari Biodiversity Corridor area.																						
1.5 - Management of the reforested areas for 5 years.																						
1.6 - Management of the reforested areas.																						
Goal 2 - Encouraging the involvement of excluded or disadvantaged communities in the reforestation process, increasing their income and quality of life.																						

2.1 - Increase alternative income sources for 45 quilombola and settled families in the region by creating a network for gathering and selling Cerrado seeds.																							
2.2 - Increasing alternative sources of income for 45 quilombola and settled families in the region through the production and sale of seedlings for the reforested areas.																							
2.3 - Increase alternative sources of income using the nursery from the Nova Esperança Therapeutic Community, enabling free treatment of drug addicts and alcoholics.																							
Goal 3 - Strengthen businesses that encourage or promote the preservation or restoration of the Cerrado, competitively opposing businesses that destroy the Cerrado.																							
3.1 - Build, along with the involved families, a value-added supply chain for the production and sale of seedlings and gathering of seeds.																							
3.2 - Technical and financial support for the production of medicinal Cerrado plants in the Medicinal Plants Center of the Cedro quilombola community.																							
3.3 - Technical and financial support for the processing of the Baru and other existing natural resources.																							
Goal 4 - Involving local institutions in actions for recovery of the Cerrado.																							
4.1- Formalize partnerships with higher education institutions for research in the areas of carbon sequestration and conservation biology.																							
4.2 - Formalize a partnership with the Emas National Park for the prevention of forest fires in reforested areas, through the Fire Brigade.																							

4.3 - Formalize a partnership with the Mineiros Fire Department.																							
Goal 5 - Training and creating opportunities for social inclusion of people who are disadvantaged or at risk																							
5.1 - Technical training for 45 involved families in gathering seeds and producing native Cerrado seedlings.																							
5.2 - Technical training regarding the production of seedlings of native Cerrado species for the patients at the Nova Esperança Therapeutic Community.																							
5.3 - Courses on mobilization, communication, and leadership for 45 involved families.																							
5.4 - Train teachers and students on topics regarding the local reality and appreciation of the Cerrado.																							
5.4 - Course on cooperativism for 40 families.																							
5.5 - Course on Financial Education for the involved families.																							
5.6 - Train brigade members																							
Goal 6 - Promote communication as a means of ensuring transparency and equal opportunities of access to information.																							
6.1 - Organize events in the towns within the Emas-Taquari Biodiversity Corridor for presenting experiences with sustainable business.																							
6.2 - Organizie a week of environmental videos, produced with the community.																							
Goal 7 - Structuring and Project Operations																							
7.1 Coordinator (01) - for 5 years																							
7.2 - Environmental Educator (01) - for five years																							
7.3 - Technicians (4) - for 5 years																							

7.4 - Administrator (01) - for 5 years																							
7.5 - Nurseries (3) planting and management of areas - for 3 years																							
7.6 - Secretary (01) - for 5 years																							
7.7 - Interns (3)																							
7.8 - Life Insurance																							
7.9 - Exams (admission / dismissal)																							
7.10 - Vehicle																							
7:11 - Tractor and implements.																							
7.12 - Air conditioning																							
7.13 - Box to save seeds																							
7.14 - Artesian Well																							
7.15 - 10 PC's and peripherals.																							
7.16 - Notebook																							
7.17 - 50 Chairs																							
7.18 - 11 Tables																							
7.19 - 01 Video camera																							
7.20 - Data show																							
7.21 -02 Steel Cabinets																							
7.22 - Area to build the nursery																						-	
7:23 - Administrative headquarters.																							
7:24 - Structure of existing nursery																							
7.25 - Databse																							
Goal 8 - Developing other PDD																							
8.1 - Consulting services																							
8.2 - Validation																							
Goal 9 – Monitoring																							
9.1 - Monitoring large vertebrates (year 0, 5,10,15, 20, 25 and 30)																							
9.2 - Monitoring birds (year 0, 5,10,15, 20, 25 and 30)																							
9.3 - Monitoring invertebrates (year 0, 5,10,15, 20, 25 and 30)																							
9.4 - Monitoring socio environmental (year 0, 5,10,15, 20, 25 and 30)																							

9.5 - Monitoring/verification of plantations (year 5,10,15, 25 and 30)																						

8 Ownership:

8.1 Proof of Title:

Annex XIII - Letter of consent issued by official organs containing the documents formalizing the partnership and involvement of all organs entities in the project.

Annex XV - Statement of Commitment and Promise of Donation concluded between the Oréades Núcleo de Geoprocessamento and each of the landowners involved in the project, as well as the term of Technical Cooperation between the Oréades and Environment Institute of Mato Grosso do Sul (IMASUL) in relation to participation in the Nascentes do Rio Taquari State Park in the project.

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