REFLORESTAMENTO DE IMPACTO NO BRASIL PROJECT

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CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Project

Investancia Group B.V., based in the Netherlands, has a local affiliate Investancia Brasil Ltda with offices at Rua Treze de Junho, 816, 79.280-000 Porto Murtinho, MS, Brazil. Investancia Brasil Ltda (Investancia) is undertaking a Verified Carbon Standard (VCS) grouped reforestation project, known as Reflorestamento de Impacto no Brasil Project. The Project is planting pongamia (*Pongamia pinnata*), acrocomia (*Acrocomia spp.*), and native tree species in degraded pastures across areas in Brazil that were cleared of native vegetation more than ten years prior to the projects' start date.

Investancia is developing a business model to establish pongamia and acrocomia as a commodity in regions where cattle ranching is the dominant land use. The focus of Investancia's business is four-fold:

1) Sequestering carbon dioxide in the pongamia/acrocomia trees (i.e., generate carbon offset credits);
2) Maintaining cattle or hay on silvopastoral lands with improved pastures;
3) Production of reforestation oil; and
4) Providing protein (i.e., feed) for cattle from pongamia and acrocomia seedcakes.

To date, Investancia has started a nursery, explored the suitability of pongamia/acrocomia in the region, developed protocols, assessed various genetic strains of pongamia, and spoken with numerous local landowners about leasing and buying land. The Reflorestamento de Impacto no Brasil Project will sequester carbon dioxide and generate GHG emission removals in the planted trees and in the soil following the reforestation of degraded pasture.

1.2 Sectoral Scope and Project Type

This Project is to be registered under the Verified Carbon Standard (VCS) as an Afforestation, Reforestation and Revegetation (ARR) project under sectoral scope 14, and is being developed in compliance with the Verified Carbon Standard (version 4.4),[1] which contains all the Agriculture, Forestry and Other Land Use (AFOLU) specific requirements. The Project is being designed as a grouped project.

1.3 Project Eligibility

Eligibility as an ARR project was determined with reference to the VCS Standard. Project implementation did not lead to the conversion of any native ecosystems (within the 10 years prior to planting) and does not lead to the violation of any law. Further, no project activities drained native ecosystems or degraded hydrological functions of native ecosystems to generate GHG credits. Both the

[1] Verra. 2022. Verified Carbon Standard. Version 4.4, 21 December 2022. Verra, Washington, D.C.

lack of conversion and drainage of native ecosystems is demonstrated using the following steps in Google Earth Engine:

1- Load the parcel boundaries to the Google Earth Engine platform;

2- Filter the Landsat 5 TOA collection by the parcel boundaries and the period of interest;

3- Order by date and select the last in the period of interest (i.e., prior to 2013); and

4- Create visualization parameters for Landsat 5 and add the layer to the map.

Both of the above processes can be used to document that project lands were cleared of native ecosystems a minimum of 10 years prior to planting.

1.4 Project Design

Reflorestamento de Impacto no Brasil Project has been designed as a grouped project. Grouped projects provide for the inclusion of new project instances subsequent to initial validation of the project.

Eligibility Criteria

The process for project expansion under the grouped project is as follows: First, Investancia will put an agreement in place allowing the development of a forest carbon offset project on a specified parcel(s) of land, whereby the VCUs generated from the project are transferred to Investancia. Next, this identified land(s) will be assessed by Climate Investment Partners to ensure the land will meet all of the requirements of Section 1.4, as listed below. After signing this agreement and after the initial assessment, site preparation and reforestation will then be performed on the property and methodologically-compliant GHG accounting will be undertaken.

Further, new project instances will demonstrate compliance with the following criteria:

1) of methodology AR-ACM0003 (Version 2.0), and conditions permitting accounting for soil carbon using the CDM "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities":

   a. The grouped project instance area was not cleared of native ecosystems within the 10-year period prior to the project start date.

   b. The grouped project instance area was not forested at the time of planting.

   c. Implementation of the grouped project instance activity does not violate any law.

   d. Clear title and rights to carbon are demonstrated for each grouped project instance.

   e. The grouped project instance activity involves planting with or without site preparation.

   f. Encroachment of natural tree vegetation that leads to the establishment of forests in the baseline is not expected to occur in the baseline.

   g. Project instances will not use flooding irrigation as part of the project activity.

   h. Project instance will not be located on organic soils.

i. Project instance will not fall into the wetland category.

j. Organic litter from vegetation will remain on site.

k. Any site preparation involving ploughing/ripping/scarification, implemented as part of the grouped project instance activity, will:

i. Be done in accordance with appropriate soil conservation practices (e.g., follows the land contour);

ii. Be limited to the first five years from the year of initial site preparation;

iii. Not be repeated, if at all, within a period of 20 years; and

iv. Not cover more than 10 per cent of area in each of the following types of land:

1. Land containing organic soils; and

2. Land which, in the baseline, is subjected to land-use and management practices and receives inputs as listed in appendices 1 and 2 of AR-ACM0003 methodology.

2) New instances will undergo the same boundary delineation process as outlined in Section 4.1. Namely, that "the project area has been delineated to exclude existing trees by drawing the planting boundaries along the edges of the lands cleared for pasture using aerial imagery. In cases, where not all baseline trees were cleared and these trees are in clumps of forest, these clumps will not be included in the project area."

3) The pre-existing land use of the grouped project instance area is pasture and ranching.

4) Face investment and/or technological barriers to reforestation, demonstrated through a barriers analysis.

5) If new project instances are added which use biomass burning during the course of site preparation or as a forest management activity, emissions from biomass burning will be accounted for appropriately using the CDM Tool "Estimation of non-CO_2 greenhouse gas (GHG) emissions resulting from burning of biomass attributable to an A/R CDM project activity".

1.5 Project Proponent

Organization name	Investancia Brasil Ltda.
Role in project	Lead Project Proponent
Contact person	Marcel van Heesewijk
Title	CEO

Address	Rua Treze de Junho, 816, 79.280-000 Porto Murtinho, MS, Brazil;
Telephone	+33 648 581 288
Email	Marcel.van.Heesewijk@investancia.com

Organization name	Climate Investment Partners
Role in project	Project Proponent and implementation partner responsible for VCS project development and ongoing monitoring, reporting and verification of the project over the crediting period.
Contact person	James Eaton
Title	CEO
Address	PO Box 153 Scottsville, Virginia, 24590 – United States
Telephone	+1 708-703-2552
Email	James.Eaton@climateinvestmentpartners.com

1.6 Other Entities Involved in the Project

No other entities have been identified at this time.

1.7 Ownership

All of the reforestation sites are on privately owned property and Investancia has entered into a reforestation lease agreement with these private landowners, which includes the location of the property and proof of ownership (i.e., land titles). Land ownership documentation is in compliance with both MMA (Ministério do Meio Ambiente e Mudança do Clima, or Ministry of Environment and Climate Change) and IMASUL (Instituto de Meio Ambiente de Mato Grosso do Sul, or Institute of the Environment of Mato Grosso do Sul), Brazilian government entities that originally allowed the clearing of each project instance over 10 years ago.

The Lead Project Proponent has reserved the rights to forest carbon in the Project area through purchasing the land themselves or through landowner Agreements between Investancia and the landowners.[2] A copy of each Landowner agreement and title for each project property can be found in the project database. The structure of the landowner contract is in compliance with national laws.

1.8 Project Start Date

[2] The owners of each project instance are identified in Table 1.1.

The grouped project has a project start date of January 1, 2023, marking the date of the scaling up of site preparation in anticipation of planting.

1.9 Project Crediting Period

The Project has an initial crediting period of 40 years, starting January 1, 2023 and ending December 31, 2062.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The Project is expected to generate approximately 8,602 tCO_2e (i.e., 8,602 Verified Carbon Units or carbon offset credits) over the 40-year crediting period or approximately 215 tCO_2e per year, for the initial project instance plantings. This project is not currently a large-scale project. While the Project Proponents expects this grouped project to plant additional areas, only when the planted project area reaches approximately 22,000 ha will the project reach the "Large Project" threshold of 300,000 tCO_2e per year.

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2023	119
2024	320
2025	320
2026	320
2027	320
2028	320
2029	320
2030	320
2031	320
2032	320
2033	320
2034	320
2035	320
2036	320
2037	320
2038	320
2039	320
2040	320
2041	320
2042	320
2043	239
2044	239
2045	239

2046	239
2047	239
2048	239
2049	239
2050	239
2051	239
2052	239
2053	0
2054	0
2055	0
2056	0
2057	0
2058	0
2059	0
2060	0
2061	0
2062	0
Total estimated ERs	8,602
Total number of crediting years	40
Average annual ERs	215

1.11 Description of the Project Activity

Investancia Group B.V., based in the Netherlands, has a local affiliate Investancia Brazil Ltda that is based at Estancia Dona Elsa in Porto Murtinho, Mato Grosso do Sul, Brazil. Investancia Brazil Ltda (Investancia) is undertaking a Verified Carbon Standard (VCS) grouped reforestation project, known as the Reflorestamento de Impacto no Brasil Project. The Project is planting pongamia (*Pongamia pinnata*), *Acrocomia spp.* (i.e., the macaúba palm), and other native tree species throughout areas of Brazil that were cleared of native vegetation more than ten years prior to the projects' start date. While the first project instance is in the state of Mato Grosso do Sul, in the future Investancia is likely to expand its reforestation activities into other states in Brazil.

Investancia is developing a business model to establish reforestation oil as a commodity in regions where cattle ranching is the dominant land use. The focus of Investancia's business is four-fold: 1) establishing pongamia and acrocomia forest for reforestation oil; 2) maintaining cattle or hay with improved pastures in a silvopastoral system; 3) provide protein (i.e., feed) for cattle from the pongamia seedcake/acrocomia pulp; and 4) sequestering carbon dioxide in pongamia/acrocomia trees (i.e., generate carbon offset credits). To date, Investancia has started a nursery, explored the suitability of pongamia/acrocomia in the region, developed protocols, assessed various genetic strains of pongamia, and spoken with numerous local landowners about leasing and buying land. Reflorestamento de Impacto no Brasil Project will sequester carbon dioxide and generate GHG emission removals in the planted trees and in the soil following the reforestation of degraded pasture. Thus, the Project's climate objective is to sequester carbon dioxide emissions. The annual average and total GHG emission

removals to be generated by the Project is estimated at approximately 8,602 tCO_2e (tonnes of carbon dioxide equivalent) over the 40-year crediting period or approximately 215 tCO_2e per year, for the initial project instance plantings.

In addition, the Project aims to increase tree cover and wildlife corridors by connecting forest reserves, forest corridors, and establishing canopy cover on open cattle grazing areas. By reforesting the cattle pastures with pongamia, acrocomia, and native trees, native forest areas of the corridors and forest reserves are being reconnected, which will enhance biodiversity and wildlife. Increasing rural employment will be accomplished through providing employment opportunities, raising project awareness, establishing the nursery, propagating trees, undertaking the reforestation activities, and establishing a project headquarters.

Investancia plans to initially reforest several thousand hectares of land with the goal of scaling this model up as more landowners see the benefits of the silvopastoral system.

The main project activities are to:

- Establish nursery, propagate trees, and undertake reforestation activities;
- Increase forest canopy and expand wildlife corridors
- Raise project awareness
- Provide employment opportunities; and
- Establish a project headquarters

Investancia Brazil Ltda manages this project from their nursery and headquarters at Estancia Dona Elsa, Porto Murtinho, Mato Grosso do Sul, Brazil. Investancia's Reflorestamento de Impacto no Brasil Project aims to plant trees on vast areas of degraded pasture lands by partnering with local landowners or purchasing the land directly. In this model, Investancia leases land for 40 years and gives landowners a portion of the revenue derived from the sale of reforestation oil, or purchases land to reforest. In addition, Investancia has demonstrated better quality forage in the understory of planted forests when compared to a baseline of unimproved tropical degraded pasture. As such, this project will not displace the baseline land use, pasture/ranching, but rather add value to agricultural enterprises.

Investancia has started a nursery, explored the suitability of pongamia in the region, developed protocols, assessed various genetic strains of pongamia, and recruited numerous local landowners interested in leasing their land of Investancia.

With respect to propagation, pongamia trees can be propagated through sexual or asexual techniques. Sexual propagation is performed by sowing the seeds collected from mother-trees and the siblings will present uneven traits due to the combination of its parents' genome. Asexual propagation can be performed by a greater number of options. Currently, Investancia exclusively uses the micro-cutting propagation technique, which consists of generating new plants as clones from a matrix of mother trees with the desired characteristics. Thus, the resulting plantlets are a copy of the genome from the mother tree.

The general process of Investancia's reforestation activities entail:

- Identify lands for reforestation;
- Select best elite tree varieties;
- Plan and certify reforestation work;
- Use planting protocols;
- Undertake direct planting of young trees (i.e., saplings are generally 9-12 months old when planted);
- Undertake tree and land management;
- Manage the planted forest for weeds and pests should they arise;
- Expand planted forest and reintroduce cattle;
- Harvest pongamia pods and acrocomia fruits mechanically or manually; and
- Manage planted forest into the future.

Initially, the project anticipates planting several thousand hectares of land before scaling up to have a regional impact with thousands of hectares of grazing lands converted to a silvopastoral forest which produces reforestation oil. The Project areas tend to be seasonally very dry or very wet which poses a significant challenge to forest establishment using traditional planting techniques. Investancia prepares land prior to planting by disking the degraded pasture in the same manner as the baseline clearing of shrubs from the land. Further, Investancia uses a back blade and tractor to prepare shallow ditches every 10 meters to ensure efficient drainage of the agricultural fields.

Investancia raises pongamia seedlings for 3 months in its greenhouses from improved genetic root stock. Investancia then rusticates these saplings in their outdoor nursery for an additional 6 months prior to planting containerized trees on land it has leased/purchased and prepared for planting. While trees start blossoming/producing pods after 3-4 years, Investancia will start harvesting pongamia pods when economically viable after 4-5 years. After harvesting, these pods are de-shelled, and the bean is processed for pongamia oil. The resulting seedcake is then a source of protein for animals. The shell or remaining pod will be spread as organic material within the project area.

Acrocomia fruits will be collected in the field from native trees and germinated in the laboratory, after which they are sent to a greenhouse for 3 months and later hardened in a nursery for 7 to 9 months. Investancia will start harvesting acrocomia fruits after roughly five years in a process similar to pongamia.

No trees will be harvested for timber as part of the Reflorestamento de Impacto no Brasil Project.

While the initial crediting period of this project is 40 years, the project area will continue to be managed as forest land after the initial crediting period because pongamia forests have multiple revenue streams, including oil from pods/fruit, fodder, and carbon credits. The landowners will want to continue to support pongamia/acrocomia forest as the production of pongamia pods/acrocomia fruit lasts for much longer than the initial project term. Further, management of the planted areas has resulted in a silvopastoral system, whereby forest canopy cover has led to increased foraging materials on the ground, as compared to baseline conditions.

1.12 Project Location

All initial project instances identified in Table 1.1 are located in Porto Murtinho, Mato Grosso do Sul state. The geographic boundary for this grouped project will be the states of Acre, Alagoas, Amapá, Amazonas, Bahia, Ceará, Distrito Federal, Espírito Santo, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Paraíba, Pernambuco ,Piauí, Rio de Janeiro, Rio Grande do Norte, Rondônia, Roraima, São Paulo, Sergipe and Tocantinsin Brazil. All additional project instances will be located within this geographic boundary.

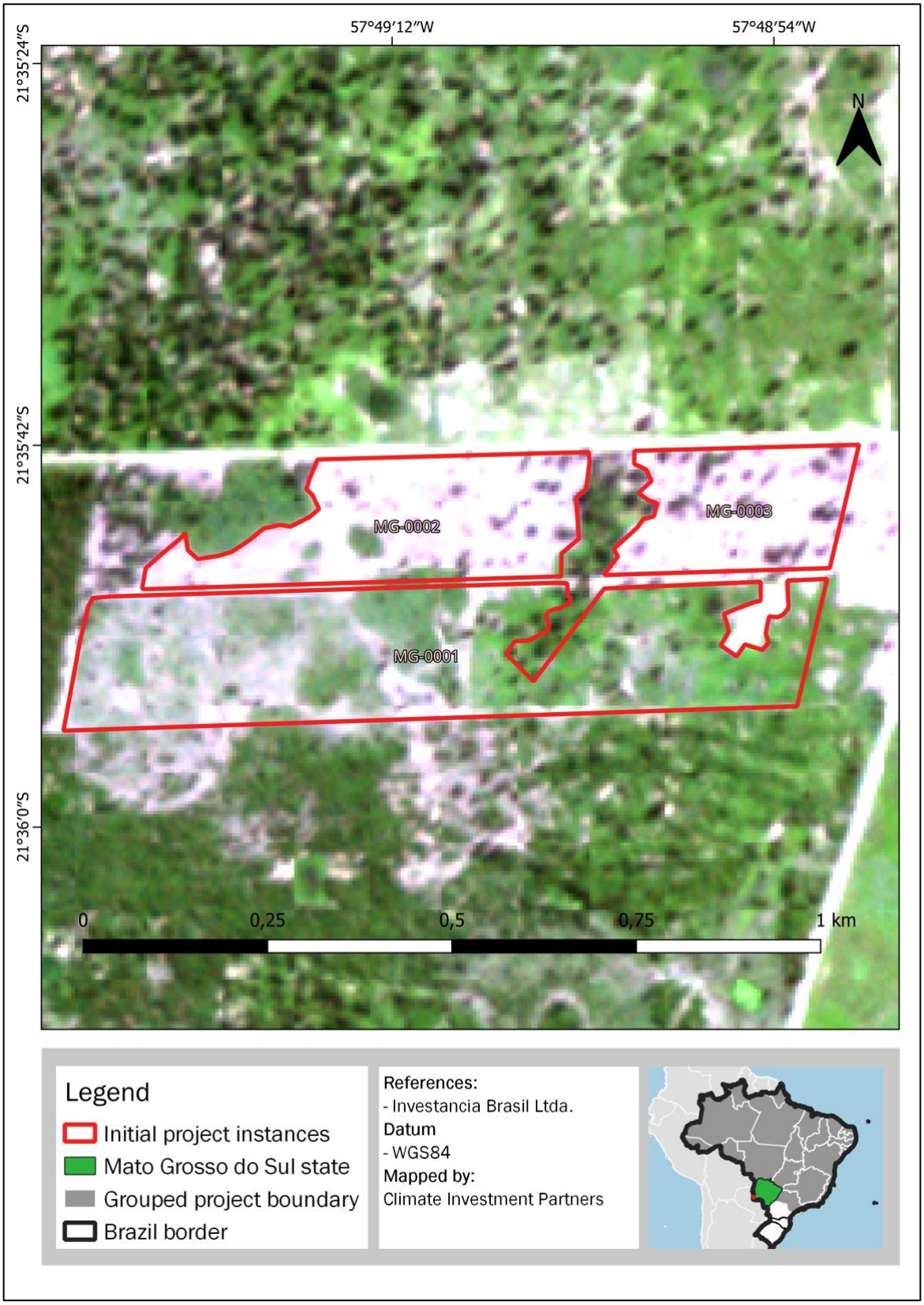
Table 1.1. Project instances information.

Unique Project Identifier	Municipality	Year	Area (ha)	Property	Original Owner	Elevation (m asl)	Precipitation (mm/yr)	Soil type[3]
MG-0001	Porto Murtinho	2023	17.68	Estancia Dona Elsa	Investancia Brazil Ltda.	< 1000	1,432[4]	HAC
MG-0002	Porto Murtinho	2023	7.92	Estancia Dona Elsa	Investancia Brazil Ltda.	< 1000	1,432[4]	HAC
MG-0003	Porto Murtinho	2023	5.06	Estancia Dona Elsa	Investancia Brazil Ltda.	< 1000	1,432[4]	HAC

[3] Batjes, N.H. 2010. IPCC default soil classes derived from the Harmonized World Soil Data Base (Ver. 1.1). Report 2009/02b, Carbon Benefits Project (CBP) and ISRIC- World Soil Information, Wageningen. http://www.isric.org/data/ipcc-default-soil-classes-derived-harmonized-world-soil-data-base-ver-11

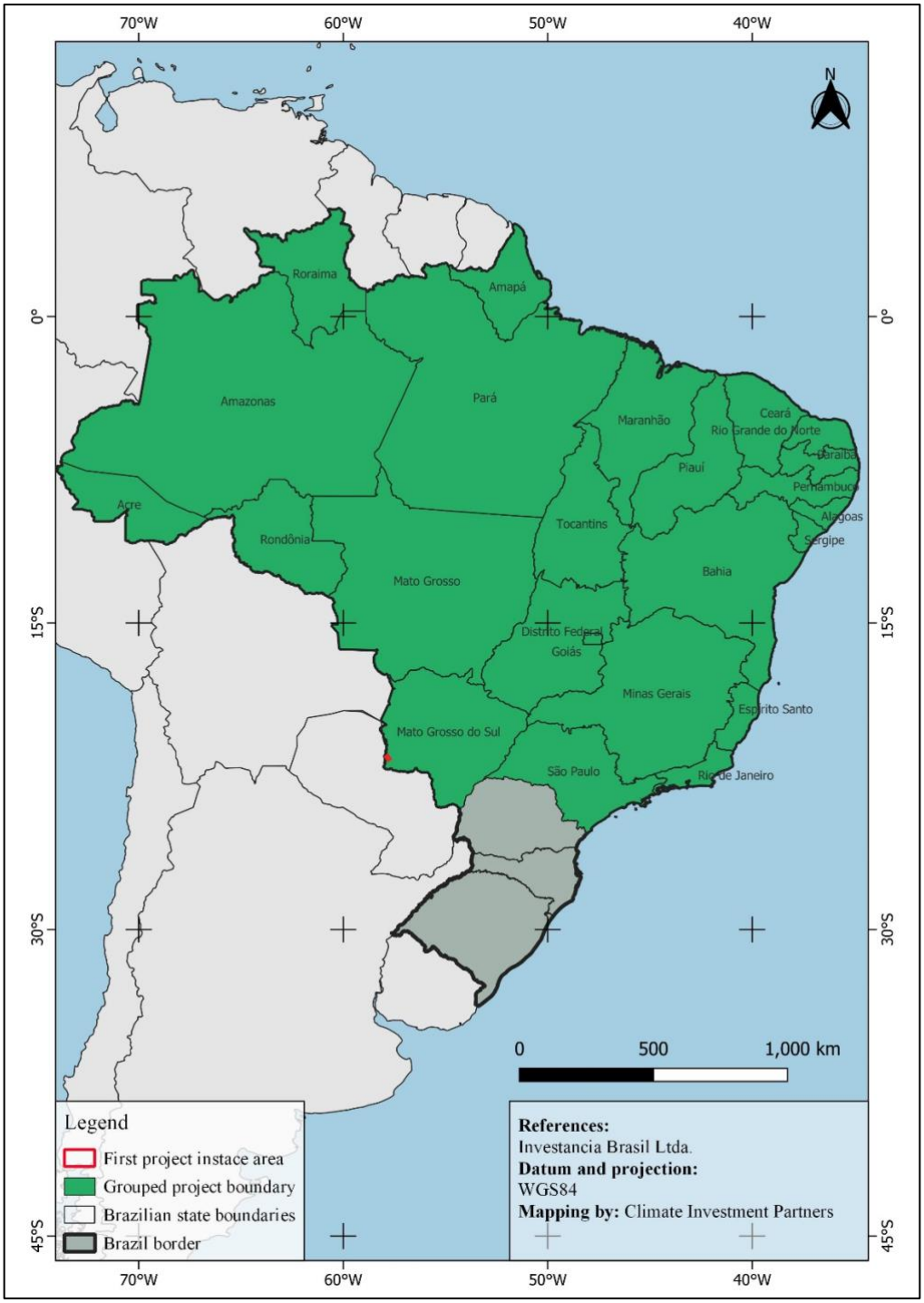
[4] Climate-Data.org, 2023. https://es.climate-data.org/america-del-sur/brasil/mato-grosso-del-sur/porto-murtinho-43479/

Figure 1.1. Map of initial project instance boundaries at Estancia Dona Elsa.



Detailed project instance boundaries for all sites will be archived as GIS files located in the project database. Google Earth files (i.e., KML files) are available for both the project area and grouped project boundary and can be found in the project database. The initial project instances of the Reflorestamento de Impacto no Brasil Project are located in the state of Mato Grosso do Sul, Brazil. Future reforestation activities will take place within the geographic boundary for this grouped project.

Figure 1.2. Geographic boundary of the grouped project.



1.13 Conditions Prior to Project Initiation

The project area is situated in unimproved pasture/ranching lands with degraded soils that are used to raise livestock and produce hay. The region can be classified as degraded using the CDM tool for the identification of degraded lands. Project instances qualify as degraded under Stage 2a and III(c.iv), of the CDM tool due to the clear "reduction in plant cover or productivity due to overgrazing or other land management practices." As the baseline is grassland, there is a clear "reduction in plant cover" due to "land management practices," given that the native vegetation prior to human land management practices was forest from the Pantanal, Cerrado, or Atlantic Forest biomes. Natural regeneration is limited by the baseline land use practices and relatively dry climate.

Topography

The state of Mato Grosso do Sul has three major topographical units: 1) Pantanal, in the west portion, with a drainage network spread over an immense plain of low altitudes between 80 to 200m; 2) Serra de Maracajú, a plateau in the center of the state with altitudes ranging from 300 to over 650m separating the waters of the Paraguay and Paraná river basins; and 3) the Upper Paraná in the east portion, drained by major rivers and with altitudes between 200 and 250m. The initial project instance is in this latter region and its topography is relatively flat.

Soil

According to the resource "Sistematização das Informações sobre Recursos Naturais" (2006), the type of soils in Mato Grosso do Sul are: Argissolos, Chernossolos, Gleissolos, Espodossolos, Latossolos, Luvissolos, Neossolos, Nitossolos, Organossolos, Planossolos, Plintossolos and Vertisolos.[5]

Climate

According to the Köppen Climate Classification, the climate at the initial project instance, Estancia Dona Elsa, is Aw (Tropical Savannah climate).[6] Mean annual precipitation for Porto Murtinho municipality, the location of the initial project instance, is 1,432 mm/yr[7] while mean annual temperature is 25.5 °C,[8] the seasons of the year are well defined in dry and wet periods.

Hydrology

Mato Grosso do Sul is drained by the Paraná river systems (main tributaries: Sucuriú, Verde, Pardo and Ivinhema) to the East, and Paraguay (main tributary: Miranda) to the West. The waters of the Pantanal plain and peripheral lands flow through Paraguay River, responsible for flooding in the plain, and are part of the Platinum Basin, considered the fifth largest drainage system in the world and the second

[5] IBGE 2006. https://geoftp.ibge.gov.br/informacoes_ambientais/pedologia/vetores/brasil_5000_mil/

[6] Rubel, F., and M. Kottek, 2010: Observed and projected climate shifts 1901-2100 depicted by world maps of the Köppen-Geiger climate classification. Meteorol. Z., 19, 135-141. DOI: 10.1127/0941-2948/2010/0430.

[7] Climate-Data.org, 2023. https://es.climate-data.org/america-del-sur/brasil/mato-grosso-del-sur/porto-murtinho-43479/

[8] These values represent the thirty year average. This value was sourced from the World Bank Climate Knowledge Portal Database (https://climateknowledgeportal.worldbank.org/country/Brazil/climate-data-historical, select Variable "Precipitation" and Time Period "1991-2020").

largest in South America, surpassed only by the Amazon Basin[9]. The western border of the Estancia Dona Elsa property is at the bank of the Paraguay River.

Vegetation

The vegetation of Mato Grosso do Sul is composed of the phytogeographic regions of Cerrado, Pantanal and the Atlantic forest, with 62% of the state area covered by the Cerrado biome.[10] The Cerrado biome is the victim of exceptional habitat loss as agriculture in the form of soy and cattle production rapidly replace habitat. Dinerstein et al. 1995 define the Cerrado as a complex of tropical and subtropical grasslands and wooded savannahs,[11] with dominant tree species being *Myrcia splendens*, *Emmotum nitens* and *Qualea parviflora*.[12] The Pantanal covers approximately 27% of the area of Mato Grosso do Sul, and is largely unaltered , with areas that shelter a great variety of plant and aquatic animal species.[13] The third biome is the Atlantic Forest, which encompasses approximately 10% of the state area. The Atlantic Forest is composed of two major vegetation types: the coastal forest or Atlantic Rain Forest and the tropical seasonal forest or Atlantic Semi-deciduous forest.[14]

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

Reflorestamento de Impacto no Brasil Project activities are in compliance with all laws, statues, and regulatory requirements. The local and national government supports the efforts to reforest parts of grouped project boundary. As no project activity is mandated by law and the project activity does not involve the clearing of native ecosystems, the project activities are in compliance with all environmental laws. Compliance can be demonstrated via satellite imagery analysis and via firsthand observations.

It is important to mention that the institutions in charge of executing the environmental laws are the IBAMA at federal level, and at local level each state has its own environmental secretariat or agency that works in coordination with the IBAMA, these local state agencies are in charge of environmental licensing at state level, such as the IMASUL in the case of Mato Grosso do Sul., from which Investancia has already requested and received all due permissions regarding nursery development and boundary cleaning of the property.

[9] Benites et al. 2019. Porto Murtinho, Mato Grosso do Sul, e o Corredor Bioceânico: caminos possíveis para a sustentabilidade socioambiental. Interações (Campo Grande), 20(especial), 267–284. https://doi.org/10.20435/inter.v20iespecial.2413

[10] instituto Brasileiro de Geografia e Estatística (IBGE). Biomas do Brasil 1:250,000. 2019. Available at: https://www.ibge.gov.br/geociencias/informacoes-ambientais/vegetacao/15842-biomas.html

[11] Dinerstein, et al. 1995. A conservation assessment of the terrestrial ecorregion of Latin America and the Caribbean. Washington, DC USA: The World Bank. Available at: https://elibrary.worldbank.org/doi/abs/10.1596/0-8213-3295-3

[12] De Souza et al. 2022. Effects of functional traits on the spatial distribution and hyperdominance of tree species in the Cerrado biome. Biogeosciences and Forestry, 15(5): 339-348.

[13] Iniciativa para o Uso da Terra (INPUT) Brasil. REGIÕES: Mato Grosso do Sul. Available at: https://www.inputbrasil.org/regioes/mato-grosso-do-sul/

[14] Morellato, L. P. C., & Haddad, C. F. B. (2000). Introduction: The Brazilian Atlantic Forest. Biotropica, 32(4b), 786–792. Available at: https://www.jstor.org/stable/2663917

Table 1.2. *National Laws*

Type of law or legal tool	Law	Year	Description
	Law N°6938	1981	Establishes the National Environmental Policy in Brazil, its purposes and mechanisms, constitutes the National Environmental System and establishes the Environmental Defense Registry. Its objective is the preservation, improvement and recovery of environmental quality in the country.
Federal Laws	Law N°7804	1989	Amends the National policy on the environment (Law N° 6938/1981) Law N° 8171/1991: Provides for agricultural policy and modifies environmental legislation in Brazil, establishing policies, bodies and measures for the protection and conservation of the environment and natural resources.
	Law N°8171	1991	Also known as Agricultural Law, provides for agricultural policies. Addresses the agricultural activity (production, processing and commercialization of producers, by-products and derivatives, services and agricultural, livestock, fishing and forestry inputs)
	Law N° 10711	2003	Deals with the National System of Seeds and Seedlings and other measures. The law establishes guidelines and regulations for the production, certification, labeling, storage, transportation, and commercialization of seeds and seedlings. It aims to ensure the quality, safety, and traceability of agricultural seeds and seedlings, promoting the research and development in the use of high-quality materials for agricultural production.
	Law N°12,727	2012	General norms on the protection of the native vegetation, areas of permanent preservation, and areas of legal reserve, as well as biodiversity, soil, water resources, and the integrity of the climate system. The law aims to promote sustainable development and emphasizes the commitment of Brazil to the preservation of its forests, while recognizing the strategic importance of agribusiness and forests for economic growth, quality of life, and national and international markets.
	Law N°12,651	2012	Brazilian Forest Code: General norms on the protection of the vegetation, areas of permanent preservation and areas of legal reserve.
	Decree N° 11075.	2022	This decree establishes procedures for the development of Sectoral Plans for Climate Change Mitigation referred to in Article 11 of Law No. 12.187 of December 29, 2009, and institutes the National System for Greenhouse Gas Emissions Reduction (SINARE). It outlines the roles and responsibilities of the Ministry of the Environment, Ministry of Economy, and related sector ministries in proposing these plans. The plans will include gradual targets for anthropogenic emissions reduction and removals through greenhouse gas sinks, tailored to the specificities of the sectoral agents involved. SINARE is the central registry for emissions, removals, reductions, and compensations of greenhouse gases, as well as the trading, transfer, transaction, and retirement of certified emissions reduction credits. The Ministry of the Environment will be responsible for the operationalization of SINARE, and specific rules

Type of law or legal tool	Law	Year	Description
			will be defined by a joint decree from the Ministry of the Environment and the Ministry of Economy. SINARE will serve as a tool to manage and monitor emissions and will integrate with the international regulated market. It will also recognize additional emissions reductions and removals as certified emissions reduction credits, according to the certification standards set by the system. The decree allows for the registration of carbon footprints, native vegetation carbon, soil carbon, blue carbon, and carbon stock units without the generation of certified emissions reduction credits.
Laws of Mato Grosso do Sul State	Law N° 90	1980	Addresses changes in the environment, establishes regulations on environmental protection and provides other regulations. Furthermore, addresses pollution, considering any alteration in the physical, chemical, or biological properties of the environment caused by human activities, and prohibits the release of substances into water, soil, or air without prior authorization of the INAMB, now IMASUL.
	Law N° 214	1981	Provides for the prohibition of cutting wood, taking of endangered species and other measures. The prohibited species include *Prunus avium* (angelin or cherry tree), *Tabebuia spp* (ipê), *Caesalpinia férrea* (ironwood), *Cedrela fissilis* (cedar), *Paratecoma peroba* (peroba), *Platypodium elegans* (faveiro), *Phillanthus nobilis* (castelo), *Piptadenia spp* (angico), and *Astronium urundeuva* (aroeira).
	Decree N°13977	2014	Deals with the Rural Environmental Registry of Mato Grosso do Sul (CAR-MS); and the Environmental Regularization Program known as Programa MS Mais Sustentável. The decree aims to ensure the protection of natural resources, biodiversity, and the well-being of human populations by regulating various activities and practices, such as agroforestry, ecotourism, and sustainable resource management. Furthermore, provides definitions for various terms, including permanent preservation area (APP and sets out definitions for key terms related to environmental conservation and land use. Some key points: Article 3 of CAR-MS establishes the mandatory administrative registration for all rural properties in Mato Grosso do Sul. Its primary purpose is to regulate and monitor the environmental obligations associated with these properties, with a particular focus on preserving Permanent Preservation Areas (PPAs), Legal Reserve (LR) areas, and Restricted Use Areas. The registration process assigns a unique and permanent sequential alphanumeric code to each rural property, ensuring its traceability and accountability. Furthermore, CAR-MS is designed to be integrated into the Rural Environmental Registry System (SiCAR), in accordance with the provisions outlined in Federal Decree No. 7,830 of 2012. This integration enables the sharing of environmental information

Type of law or legal tool	Law	Year	Description
			concerning rural properties, enhancing coordination and cooperation among stakeholders involved in environmental management. Under Article 4, the State Secretariat for Environment assumes the responsibility for the operation and control of CAR-MS. This ensures that the registry system is effectively implemented and monitored, facilitating compliance with environmental regulations and promoting sustainable land use practices throughout the state of Mato Grosso do Sul. Article 19: Every rural property must maintain an area with native vegetation cover, known as the Legal Reserve, without prejudice to the application of norms regarding Permanent Preservation Areas, observing a minimum percentage of 20% in relation to the property's area. The approval of the Legal Reserve location, after the property's inclusion in the Rural Environmental Registry (CAR), is the responsibility of IMASUL. Chapter VII establishes the Program MS Mais Sustentável in the state of Mato Grosso do Sul, aimed at supporting the environmental regularization of rural properties with environmental liabilities in Permanent Preservation Areas, Legal Reserves, or Restricted Use Areas. The program includes requirements such as the commitment agreement, control mechanisms for regeneration or compensation of liabilities, monitoring of suspension and extinction of penalties, and the use of various instruments. The program provides benefits to participants, including exemption from fines for previous environmental violations, conversion of fines into environmental preservation services, extended deadlines for addressing environmental liabilities, and technical support for vegetation restoration. Chapter VIII addresses the costs associated with the Rural Environmental Registry of Mato Grosso do Sul (CAR-MS), the Environmental Regularization and Compensation Technical Report (TCRAE), and the MS Mais Sustentável program. The costs for analyzing information and issuing CAR-MS and TCRAE are determined based on the size of the rural property.
	Law N° 2257	2001	Guidelines of the state environmental licensing, deadlines for issuance of the Environmental Licenses and Authorizations between others.
	Decree N° 12725	2009	Establishes the Basic Structure and Competence of the Institute of Environment of Mato Grosso do Sul (IMASUL).
	Law N° 4163	2012	The purpose of this law is to regulate the exploitation of forests and other forms of native vegetation, the use of raw forest materials, and the obligation of reforestation.
	Resolution SEMADE N° 9/2015	2015	Establishes norms and procedures for State environmental licensing, and takes other measures.

Type of law or legal tool	Law	Year	Description
	Resolution SEMADE N° 28	2016	Amends and adds provisions to SEMAC Resolution No. 11, of July 15, 2014, which implements and regulates procedures related to the Rural Environmental Registry and the More Sustainable MS Program referred to in State Decree No. 13,977, of June 5, 2014.
	Decree N° 14685	2017	Reorganizes the basic structure of the State Secretariat for the Environment, Economic Development, Production and Family Agriculture (SEMAGRO), and takes other measures.
	IMASUL Ordinance N° 912	2021	Implements the Electronic Environmental Licensing system in the scope of the Environmental Institute of Mato Grosso do Sul (IMASUL).

Table 1.3. Labor laws and regulations

Law or legal instrument	Year	Description
Constitution of the Federal Republic of Brazil, (CFRB)	1988	Establishes worker's rights
Decree Law No. 5452 (DLCLL)	1943	Consolidated Labour Laws
Law No. 7783	1989	Regulates the exercise of the right to strike, defines essential services, and sets out minimum services and other issues (LRSESMS)

International Laws and Regulations

In addition to the aforementioned national laws, Brazil is a party to the United Nations Framework Convention on Climate Change (UNFCCC) and an active member of the International Tropical Timber Organization (ITTO). Brazil has ratified the UNFCCC (1995), the Kyoto Protocol (2005), signed the Paris Agreement (Paris 2015, COP21) and has established a Designated National Authority under the CDM.

Brazil has submitted a Nationally Determined Contribution (NDC) to the UNFCCC, with demonstrate Brazil's commitment to achieve GHG emission reductions and Climate Change mitigation.[15]

As founding member of the International Civil Aviation Organization (ICAO) and also member of the ICAO Council Group I, a group aimed at countries with major importance in the international air transport, Brazil plays a leading role in the ICAO discussions. In October 2022, Brazil signed international commitments to reduce CO_2 in international air transport, and under the terms of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), ICAO's initiative for reducing and offsetting CO_2 emissions from international flights, airlines operating Brazilian routes internationally will have an obligation to offset their emissions—by purchasing carbon credits—starting in 2027.

Investancia is closely following all the developments of Brazil's NDC and Brazil's involvement with ICAO.

1.15 Participation under Other GHG Programs

[15]UNFCCC. NDC Registry. Available at: https://unfccc.int/NDCREG

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The Project has not registered, not is it seeking registration, under any other GHG Programs such as the American Carbon Registry (ACR), the Clean Development Mechanism (CDM), or the Gold Standard.

1.15.2 Projects Rejected by Other GHG Programs

The Project has not been rejected by other GHG Programs such as the American Carbon Registry (ACR), the Clean Development Mechanism (CDM), or the Gold Standard.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The Project is not participating in any other emissions trading program or other mechanism that includes GHG allowance trading. Similarly, the Project is not generating any GHG emission reductions and removals to be used for compliance under any such programs or mechanisms. If an opportunity should arise for the Project to participate in a compliance program, such as under the Carbon Offset and Reduction Scheme for International Aviation (CORSIA) or under Article 6 of the Paris Agreement, then the Project will follow Verra's appropriate procedures.

1.16.2 Other Forms of Environmental Credit

The Project has not sought, nor received, any other GHG-related environmental credits such as Renewable Energy Certificates (RECs), biodiversity offsets, or water credits.

Supply Chain (Scope 3) Emissions

This section is not applicable, because the GHG emission reductions and removals generated from Reflorestamento de Impacto no Brasil Project in Brazil are associated with sequestering carbon in biomass and soils which is not part of a supply chain.

Apart from the VCUs generated by the Project, the project also generates a non-edible reforestation oil. This oil is extracted after harvesting the pods of the pongamia tree and fruit of the acrocomia palm. The oil is not accounted for in the sequestered carbon in the biomass and soil of the project. No wood biomass or soil is affected in the harvest of the pongamia pods or acrocomia fruit. The reforestation oil is used to produce a low-CI renewable feedstock utilized for the production of second-generation biofuels such as Sustainable Aviation Fuel and Renewable Diesel/HVO. The carbon intensity (CI) of the reforestation oil feedstock is determined by a Life-cycle Analysis ("LCA") calculation, in which most markets require the CI calculation to exclude the carbon sequestrated in the biomass and soil of the parent trees. All oil feedstock derived from the Project will use a carbon intensity (CI) value which excludes the carbon sequestered by the pongamia trees/acrocomia palms planted as part of the project activities, hence no double counting will occur.

There have been no impacted goods and services for which VCUs have been issued.

1.17 Sustainable Development Contributions

Brazil is a participating state that aims to achieve the 17 Sustainable Development Goals (SDGs). The following SDGs are those that will be achieved by the Project.

1. No poverty – The project is working to increase the communities' incomes by providing access to good paying jobs and registration in the local social security system to gain access to base health insurance.

2. Zero hunger – All employees, such as nursery staff, will be provided with daily, home-cooked meals for free.

3. Good health and well-being – The project is working to provide good paying jobs and nutritious, daily meals which will help improve workers' health and well-being.

4. Quality education – The project will provide training and education to workers about workers' rights and workplace safety, along with the latest techniques in nursery management and improving survivability of plantings. Furthermore, the headquarters will provide important education to stakeholders about the importance of conservation and reforestation measures.

5. Gender equality – The project has hired men and women, with advancement opportunities available to everyone.

6. Clean water and sanitation – Access to clean water and sanitation facilities are provided to all guests and to all workers. In addition, the reforestation activities will reduce erosion and water runoff, including runoff from cattle ranches.

8. Decent work and economic growth – The project is providing work to local communities and is developing a sustainable economic model for the region.

9. Industry, innovation and infrastructure – The project is developing a new, innovative industry for the region and has developed extensive infrastructure (i.e., nurseries, farmhouse headquarters, etc.)

10. Reduced inequalities – The project is seeking to reduce inequalities by providing, amongst many things, good paying jobs and registration in the local social security system to obtain base health insurance.

11. Sustainable cities and communities – The Project is seeking to protect and safeguard an important cultural and natural heritage, as the native vegetation is under grave threat from deforestation.

12. Responsible consumption and production – The Project, as a reforestation project with a sustainable biofuels component, is promoting sustainable management and efficient use of the area's natural resources.

13. Climate action – One of the main goals of the Project is reforestation to sequester carbon dioxide emissions to help mitigate climate change.

14. Life below water – The reforestation activities will reduce erosion and water runoff, including runoff from cattle ranches, which will benefit the adjacent river ecosystems.

15. Life on land – One of the main goals of the Project is to use reforestation activities to reestablish critical wildlife corridors.

16. Peace, justice and strong institutions – The project will encourage strong institutions, including the rule of law.

17. Partnerships for the goals – The project is the result of strong international and domestic partnerships including amongst the Lead Project Proponent, local communities, local landowners, government officials, and Climate Investment Partners.

1.18 Additional Information Relevant to the Project

Leakage Management

Prior to the project, project lands were used to raise livestock, either as pasture to produce hay. The project proponents may choose to continue raising livestock or producing hay in a silvopastoral system as part of the project, but the original landowners of the project lands have agreed that if any animals are displaced by the project activities, these animals can only be "displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land". As no displacement of agricultural production from within the project boundary occurs as a result of the project activities, leakage emissions are considered to be zero for the life of the project.

Commercially Sensitive Information

There is no commercially sensitive information that has been excluded from the public version of the project description.

Further Information

There is no further information to be included.

2 SAFEGUARDS

2.1 No Net Harm

Investancia will use a Participatory Rural Assessment (PRA; also known as a Participatory Rural Appraisal) to help identify and evaluate the stakeholder's perceived impacts (both negative and positive from the Project) along with their perceived costs and risk to participating in the Project.

The Project does not expect to have any negative impacts on the environment, but rather will only have positive impacts on the surrounding area.

2.2 Local Stakeholder Consultation

The Project's full project documentation, including the VCS project description documentation and the ongoing VCS monitoring reports, has been and will continue to be made accessible to communities and other stakeholders throughout the Project Lifetime through the following means:

- The project documents will be posted online at the Verra website, along with on the Investancia website. If possible, the project documents will also be registered and posted on the Brazilian Government's designated website;
- Physical copies of the project documents will also be made available at Investancia's headquarters, located at Estancia Dona Elsa, at: Investancia Brasil Ltda., Rua Treze de Junho, 816, 79.280-000 Porto Murtinho, MS, Brazil; and
- The project documents will be distributed to stakeholders, such as local schools, the mayor's office, etc.

Nevertheless, the summary project documentation and monitoring results will be actively disseminated to communities by Luiz Fudolli of Investancia. Luiz Fudolli will hand-deliver the summary documents to stakeholders. Further, Luiz Fudolli will explain the audit process, solicit public comments, and inform the stakeholders about the upcoming auditor visits. For the onsite audit, the auditors will have direct and independent communication with stakeholders.

In addition, copies of the Summary Project Documents, along with copies of the VCS Project Description and future Monitoring Reports, will be kept at Estancia Dona Elsa. Investancia holds a variety of informational meetings with local stakeholders. Meetings with government officials, such as IMASUL or Ministério do Meio Ambiente e Mudança do Clima, are set up in advance via email or phone calls and oftentimes, an agenda is shared in advance.

Meetings with local landowners (i.e., from whom the potential reforestation sites may be leased) are set up in advance via word-of-mouth, phone calls, WhatsApp messages, or via email.

People interested in working at Estancia Dona Elsa are usually informed about upcoming positions via word-of-mouth or via the local radio station. Upon being hired, there are hiring forms and a safety manual that new hires review, which details the costs, risks, and benefits of working at Estancia Dona Elsa. There are also regular personnel meetings where staff are able to raise issues and concerns. Furthermore, a first aid course is offered to staff and there are safety signs on the walls at Estancia Dona Elsa. The Project Proponents has also held numerous stakeholder consultations with communities and other stakeholders, including several meetings which have influenced the overall project design.

The Project Proponents will continue to communicate and consult with local communities and other stakeholders about the Projects and will utilize an adaptive management approach.

Investancia has used a variety of consultation channels, including but not limited to:

- Extensive in person meetings held in both English and/or Portuguese. This includes in person meetings with investors, local landowners, the nursery staff;

- Information sharing about developments in the carbon markets and reforestation activities via WhatsApp with local landowners;
- Ongoing phone calls and videoconferences via Zoom, Teams, etc., with a wide range of stakeholders from investors to government officials to Verra;
- Announcements of Investancia accomplishments via LinkedIn and Press Releases. This includes links to the Verra Registry, with information about the public comment period and with access to the complete project documents;
- Email communication is regularly used to communicate with stakeholders, including emailing with Verra;
- Periodic announcements are made on local TV and radio stations.

New local nursery staff are recruited via word-of-mouth, are informed about Investancia and its overall mission upon being hired, and receive specific training (i.e., such as in the nursery). Investancia holds a weekly manager meeting, and the managers then hold a weekly meeting with their employees (i.e., the nursery staff).

Investancia has met with Brazilian Government officials. Investancia and Climate Investment Partners, as evidenced by emails, have regularly consulted with Verra.

There are several measures needed and designed to enable the effective participation of the local stakeholders (i.e., the local nursery staff) in a culture- and gender-sensitive manner. This includes:

- Investancia's management team must, and currently does include, several local professionals;
- Investancia will strive to have both a male and female representative present during meetings with local stakeholders to help ensure gender-sensitivity; and
- Investancia will either meet in person with local stakeholders or will provide for their transportation to mitigate the concerns over the lack of transportation.

Furthermore, there are regular personnel meetings with nursery staff every 1-2 weeks.

Investancia assures the Project meets, or exceeds, each of the relevant laws and regulations related to worker's rights in Brazil. Thus, according to the International Labour Organization, there are several relevant laws and regulations related to workers' rights in Brazil as stipulated in the Labor Laws and Regulations in Section 1.14.

The measures needed and taken at the Project to inform workers about their rights includes:

- Providing orientation to new hires;
- Providing a safety manual, which outlines worker's rights; and
- Posting what is required by law on the wall at Estancia Dona Elsa.

Furthermore, phone numbers for emergency services are publicly posted at the nursery.

Some risk and dangers to worker safety that could arise due to project implementation include:

- Snake bites;
- Other wildlife, such as jaguars;
- Contracting a tropical disease, such as Chagas disease;
- Getting lost in the field;
- Road hazards when driving around Porto Murtinho and Mato Grosso do Sul;
- Heat and dehydration related illnesses during fieldwork;
- Working with electrical and water systems at the nursery; and
- The potential use of chemicals or pesticides/herbicides associated with nursery operations.

Snake Bites

Snake bites, particularly several species of coral snakes and vipers, pose a substantial risk to all visitors to the initial project area. Snake anti-venom is stored at the Project's headquarters in Dona Elsa.

Other Wildlife

One potential occupational risk, particularly for biologists, the forest inventory personnel, and the teams undertaking the reforestation activities, is other wildlife, including jaguars. To mitigate the risk of getting hurt by wildlife, all project participants will be encouraged, if not required, to travel with locals who know the region and its biodiversity.

Tropical Diseases

The main tropical diseases in the region include Chagas disease, dengue fever, and Zika virus. The Project Proponents, along with visitors and affiliates, will be encouraged to take precautions by using bug spray, sleeping with mosquito nets, and taking vaccines (if applicable).

Getting Lost

Getting lost in remote areas such the initial project instance is a real concern as navigation apps and mobile phones do not really work well in many parts of these type of areas and some of the forests are quite dense. To mitigate the risk of getting lost, all project participants will be encouraged, if not required, to travel with locals who know the region well.

Driving around and to the project instance areas

Driving at night, driving during flooded conditions, and driving on roads with dust clouds can create potentially hazardous conditions. To mitigate these risks associated with driving, Investancia will only use drivers with extensive knowledge of these local conditions.

Heat and Dehydration Related Illnesses During Fieldwork

It is known that high summer temperatures in the grouped project area can lead to heat and dehydration related illnesses, particularly during fieldwork. To mitigate the risk of heat and dehydration related illnesses, the following measures will be undertaken:

- Fieldwork, including forest inventory work and onsite independent audits, will be prioritized for transition periods during the wet and dry season to minimize the chances of heat-related illnesses;
- Fieldwork will be prioritized for early morning or early evening to avoid the midday sun;
- Supplies, such as water and suntan lotion, will be provided to visitors by Investancia; and
- All visitors to the Project will be informed of these potential risks.

Working with Electrical and Water Systems at the Nursery

To mitigate risks with electrical and water systems at the nursery, Investancia posts signs, conducts trainings, and uses proper safety equipment. In addition to training, Investancia always seeks to work with specific tools in good condition for each situation and always works with the help of another partner, minimizing human errors.

The Potential Use of Chemicals or Pesticides/Herbicides Associated with Nursery Operations

To minimize any risks to workers using chemicals, whether they be pesticides or herbicides, the chemicals are stored in a specific place and under conditions for such, separated from any other material. Investancia employees also work with Personal Protective Equipment (PPE) suitable for this type of operation and application tools are always in good condition, with up-to-date maintenance.

Workers will be informed about these risks during their new hire orientation. These risks, including any future risks identified, will be added to the latest version of the HSE Policy and Procedures manual to help inform workers of the Project's known risks. Investancia has started to offer annual first aid and safety training and has started to maintain safety training logs at Dona Elsa.

Investancia also periodically refills onsite first aid kits and regularly checks whether any supplies are expired. In the future, Investancia will develop a comprehensive safety plan.

2.3 Environmental Impact

No environmental impact assessment is applicable or required for the project activity.

2.4 Public Comments

Due account of any public comments will be taken. All of the Project's project documents, including monitoring results, will be available online at the Verra Registry. Weblinks to the project documents will be publicly distributed during the Public Comment Period and will be available on Investancia's website.

2.5 AFOLU-Specific Safeguards

Local Stakeholder Identification and Background

As previously mentioned, the Project Proponents have conducted a detailed stakeholder identification and engagement process. First, Investancia, with assistance from Climate Investment Partners, brainstormed all of the potential stakeholders related specifically to the initial project instance as well as hypothetical future stakeholders for future project instances. This includes using Investancia's local and national expertise in Brazil, using Climate Investment Partners' extensive experience with forest carbon projects, reviewing other VCS AFOLU projects in Brazil, and by reviewing maps. For the initial project instance, these potential stakeholders were:

- Local community (nursery staff);
- Porto Murtinho community and authorities
- Local landowners;
- IMASUL
- Ministério do Meio Ambiente e Mudança do Clima (Min. of Environment and Climate Change)
- CVH Advocacia law firm;
- Verra;

Stakeholders were then categorized according to Project Proponent(s), Other Entities, Community, Primary Stakeholders, Secondary Stakeholders, and Other Stakeholders based off of CARE's "Relative Influence and Importance of Key Stakeholders" framework. This Framework categorizes stakeholders based off their influence and importance, along with their rights, interests and relevance to the Project.

Table 2.1. Relative Influence and Importance of Key Stakeholders (Credit: CARE 2002)[16]

Influence of Stakeholder	**Importance of Stakeholder to Project Achievement**				
	Unknown	Low	Moderate	Significant	Critical
Low	Other	Other	Other	Secondary	Secondary
Moderate	Other	Other	Other	Secondary	Secondary
Significant	Secondary	Secondary	Secondary	Secondary	Secondary
Highly Influential	Secondary	Secondary	Secondary	Secondary	Primary

[16] Richards, M. 2011. Social and Biodiversity Impact Assessment (SBIA) Manual for REDD+ Projects: Part 2 – Social Impact Assessment Toolbox. Climate, Community & Biodiversity Alliance and Forest Trends with Rainforest Alliance and Fauna & Flora International. Washington, DC. https://www.profor.info/sites/profor.info/files/ForestTrends-SBIA-Part2_0.pdf. Page 29.

Following CARE's "Relative Influence and Importance of Key Stakeholders" framework, the following stakeholder mapping for the initial project instance took place:

- Investancia (Project Proponent / Primary Stakeholder);
- Investancia's Service Providers (i.e., Other Entitles / Primary Stakeholder);
- Local Community (Nursery Staff) (Primary Stakeholder);
- Local Landowner (Other Stakeholder);
- IMASUL (Secondary Stakeholder);
- Ministry of Environment and Climate Change (Secondary Stakeholder);
- CVH Advocacia law firm (Secondary Stakeholder);
- Verra (Secondary Stakeholder);

Further, the following are the stakeholder descriptions as well as their rights, interest and overall relevance to the Project.

Table 2.3. Project Stakeholder Rights, Interest, and Relevance

Stakeholder	Rights, Interest and Overall Relevance to the Project
Local landowners	The Project is directly relevant to the local landowners and the local landowners have a direct interest in the Project as their land is being used for the reforestation activities and in exchange, the local landowners will receive rental income. The local landowners, will be identified using Investancia's local and national expertise. The local landowners are considered an "Other Stakeholder." This said, the local landowners have moderate influence and are moderately important to the project achievement, because the Project structure results in the private lands being assigned to Investancia, which effectively makes Investancia the landowner. Likewise, the landowners only lease out their land for a 30-year period and they do not have any further roles or responsibilities in the Project.
MMA	MMA is the acronym for the Ministério do Meio Ambiente e Mudança do Clima (Ministry of Environment and Climate Change: www.gov.br/mma/pt-br).
MCTIC	The Ministry of Science, Technology, Innovations and Communications (MCTIC) is the focal point for the CDM.[17] The MCTIC may also collaborate with other stakeholders such as government agencies, NGOs, and local communities to ensure the success and sustainability of reforestation projects in Brazil.
IMASUL	IMASUL (Instituto de Meio Ambiente de Mato Grosso do Sul) is a stakeholder for reforestation projects in Mato Grosso do Sul, Brazil. As the state environmental agency, IMASUL is responsible for regulating and supervising

[17] UNFCCC. (n.d.). Designated National Authorities (DNAs) under the Clean Development Mechanism (CDM). Available at: https://cdm.unfccc.int/DNA/index.html.

	environmental issues in the state, including reforestation projects. IMASUL also works with other stakeholders such as landowners, NGOs, and government agencies to promote sustainable land use practices and conservation efforts.
UEMS – Universidade Estadual do Mato Grosso do Sul	The university can offer valuable knowledge and expertise to enhance the implementation of various project activities.
Verra	Verra is the parent nonprofit organization that oversees the Verified Carbon Standard (VCS). The initial project instance and subsequent project instances are being designed, validated and verified to the VCS. The use of the VCS was identified via Climate Investment Partners' extensive experience in the forest carbon industry. The Project's activities associated with validation and ongoing monitoring, reporting and verification are particularly relevant for Verra. With their significant influence and their significant importance, Verra is consider a "Secondary Stakeholder." Further, the Project is directly relevant to Verra as the Project is using its standards.

The main local stakeholder, which will be further described below, is the local community (nursery staff).

Identification of legal or customary tenure/access rights to territories and resources held by local stakeholders

All of the reforestation sites are on privately owned property and all such property rights, including legal or customary tenure/access rights, have been recognized, respected and supported.

Description of the Social, Economic and Cultural Diversity within Local Stakeholder Groups

The region where the reforestation project activities are located is remote and has few local communities. The Project is initially located in the municipality of Porto Murtinho, state of Mato Grosso do Sul, Brazil, which has one of the lowest population density in Brazil (0.87 hab/km^2), and also at state level Mato Grosso do Sul population density is relatively low with only 6.86 hab/km^2.[18] In the MS state most of the population is urban, living areas such the capital, Campo Grande with 97.22 hab/km^2. Other major cities include Dourados, Três Lagoas, and Corumbá. within the geographic grouped project boundary.

The nearest local community to the project area is the city of Porto Murtinho (17km) which has an estimate population of approximately 17,500 people and is located at the banks of the Paraguay River.

From a socio-economic perspective, the Gini Index in Mato Grosso do Sul was around 0.56 in 2010, while in the entire country it was close to 0.53. In relation to poverty itself, Mato Grosso do Sul had lower levels than the national ones. Furthermore, MS had a proportion of poor people lower than the

[18] IBGE. (n.d.). Cidades e Estados. Available at: https://www.ibge.gov.br/cidades-e-estados.html.

national average in 2010, 9.92% and 3.35% against 15.2% and 6.62% of the poor and extreme poor, respectively[19]. The main economic sources of the state are agriculture and livestock, with the area that stands out the most being the Paraná.[20]

From a spiritual/religious perspective, there is a diversity of belief systems. The most widely practiced religion is Christianity, with the majority of the population being Catholic (around 50%) and Evangelical (around 30%). However, with a mixture of Indigenous, European, African, and Asian influences there are also followers of others religions such Candomblé, Spiritism, and Umbanda among several others.[21]

Regarding gender and age, there are roughly an equal proportion of men to women. There are a lot of younger children and there are fewer adults in the third (older) generation.

Further, there have not been any significant community changes in the past.

Location of Territories and Resources which Local Stakeholders Own or to which they have Customary Access

As previously mentioned, all reforestation sites will be implemented on privately owned farms. Further, the project activities do not lead to any involuntary removal or relocation of property rights holders from their lands or territories and does not force rights holders to relocate activities important to their culture or livelihood.

The local community level stakeholders involved in the project primarily work at Estancia Dona Elsa with some of the members living on site and others living in Porto Murtinho, Brazil.

Significant Changes in the Makeup of Local Stakeholders Over Time

Not applicable – there have been no significant changes in the makeup of local stakeholders since the project's start date.

Expected Changes in Well-Being and Other Stakeholder Characteristics Under the Baseline Scenario

The Project is likely to have net well-being impacts for all identified community stakeholders including all of the local nursery staff, compared with their anticipated well-being conditions under the without-project land use scenario.

For the local nursery staff, the direct positive well-being impacts include: the opportunity to earn diversified and increased incomes; to participate in trainings and advancement opportunities; indirect positive well-being impacts include the fact that reforestation activities should help maintain the health of the nearby rivers through reducing soil runoff and siltation

[19] Fernandes, R. F. (2018). Pobreza no mato grosso do sul: uma análise espacial-MS [Master's thesis, Universidade Federal da Grande Dourados]. Repositório Institucional da UFGD. Available at: https://repositorio.ufgd.edu.br/jspui/handle/prefix/4719

[20] Agência de Notícias MS. (n.d.). Institucional. Available at: http://agenciadenoticias.ms.gov.br/institucional/

[21] IBGE (2023). Pesquisa Nacional por Amostra de Domicílios Contínua - PNADC. Retrieved April 28, 2023, from https://cidades.ibge.gov.br/brasil/ms/pesquisa/23/22107

Further, the well-being impacts on the local nursery staff in the with-project scenario are likely to outweigh the anticipated well-being conditions of the local nursery staff in the without-project scenario.

Thus, the Project has a net positive community well-being impact on all identified stakeholders. This net positive well-being impact is likely to occur for the current nursey staff as well as for nursery staff to be hired in the future.

The net impacts on Other Stakeholders (i.e., such as IMASUL, MMA, local organizations and Verra, as Porto Murtinho city), due to the Project's reduction in greenhouse gas emissions and increase in rural employment, along with increasing forest cover and increasing wildlife corridors, is likely to be positive. This net positive impact is also true for the local landowner, who will receive rental income. In contrast, there are no major, specific negative impacts envisioned for Other Stakeholders, including the local landowner. Thus, the overall net impacts on Other Stakeholders are expected to be positive.

The Project is expected to have net positive biodiversity impacts due to the Project's sequestration of carbon dioxide emissions, the Project's increased forest cover within the project areas, and the Project's increasing wildlife corridors by connecting the Project Areas to the nearby green reserves, and green corridors. Further, the Project should improve soil health as pongamia is a nitrogen-fixing species and reforestation activities should reduce topsoil runoff and its associated impact on water quality.

In contrast, without the Project, the likeliest land use scenario would have been maintaining cattle pastures within the initial project areas and possibly expanding forest clearing for cattle ranching in the project region. While some forest areas would remain in the without-project scenario (such as buffers around riparian areas), the impact would still largely be negative for biodiversity in the without-project scenario. For example, white-lipped peccaries are a species that require large, contiguous areas. Other vulnerable or threatened species, such as the lowland tapir (*Tapirus terrestris*),[22] in the absence of protective forest cover and with the introduction of more roads, could become more susceptible to hunting pressures in the open grasslands.

Thus, Project is expected to have net positive biodiversity impacts, will continue to monitor the Project's impact on biodiversity, and will continue to monitor (and address) any negative impacts.

Risks to Local Stakeholders and their Resources due to Project Implementation

According to the feedback received from the nursery staff, there are no community participation risks, except for the potential danger to travel back home by river when there are storms. To address this risk, Investancia provides free bus transportation so that the staff has the option to avoid travel on the river during storms, also it is important to mention that this free bus transportation is available on a daily basis. The weather is regularly monitored to ensure safe travel, and weekly meetings with local nursery staff will enable such staff to raise any participation risks.

[22] IUCN Red List, "Lowland Tapir: Population," Available: https://www.iucnredlist.org/species/21474/45174127#population

As mentioned above, there are unlikely to be any major, negative impacts on Other Stakeholders. This said, general negative impacts might include surrounding land values could go up, or down, as a result of Investancia's reforestation projects. Specific negative impacts, for example, would be:

- The opportunity cost of the local landowner leasing their land for reforestation and being unable to pursue other economic activities;
- Potentially additional work for IMASUL;
- If the Project were to fail, this might negatively impact IMASUL, MMA, CVH Advocacia law firm, and/or Verra. For example, this could lead to reputational risk and/or reduced revenue); and
- There could be competition with local and international organizations for partners and financing.

If any of the aforementioned scenarios occur, Investancia will dedicate more time to understanding the ramifications. This said, the measures needed to mitigate the specific, negative well-being impacts on Other Stakeholders are as follows:

- Investancia has, and will continue to have, a world-class team and external advisors that minimize the risk of project failure through their local expertise (i.e., of local customs, languages, laws, nursery management, etc.) and their deep technical knowledge in all aspects of the carbon markets (i.e., VCS project development, MRV, VER sales, etc.), along with business management, legal and financial expertise. This will reduce the chances of lost revenue (i.e., for Verra and CVH Advocacia law firm) and reduce the chances of any reputational risk (i.e., IMASUL, MMA, CVH Advocacia law firm, and/or Verra);
- Investancia has been and will continue to be regularly in contact with stakeholders for ongoing consultations and dialogue. This earlier dialogue, particularly with local landowners, has helped to minimize opportunity costs. Further, ongoing dialogue will help to better understand any potential negative impacts, such as potential competition issues with local and international organizations working in the sustainable space;
- Investancia will utilize adaptive management to alter the Project design, if necessary;
- Investancia will provide regular updates on the Project by providing ongoing updates and project documentation, such as summary reports and monitoring reports; and
- Investancia will offer to work with private landowners throughout the Project area, assuming they meet the Project's requirements.

Free, Prior and Informed Consent

The Project will take place on private property and will not encroach on the private landowner's property, nor will the Project encroach on community or government lands. Rather, the Lead Project Proponent undertook a Free, Prior, and Informed Consent process with the private landowners.

Free

The Lead Project Proponent presented a reforestation lease agreement to the local landowners. The private landowners are familiar with purchasing and leasing land in Mato Grosso do Sul. Thus, the local landowners were free to join, or to not join, the Project by entering into the agreement.

Prior

The local landowners are given substantial information ahead of time about the project, including the duration of the project, the project activities (i.e., renting their land and reforesting it), the rental payments they will receive, etc., prior to being asked to sign an agreement with Investancia.

Informed

As previously mentioned, the local landowners are given substantial information ahead of time about the project, including the duration of the project, the project activities (i.e., renting their land and reforesting it), and the rental payments they will receive, prior to being asked to sign an agreement with Investancia.

Anti-Discrimination Assurance

The Lead Project Proponent, nor any other entity involved in project design or implementation, are involved in any form of discrimination or sexual harassment. This said, Investancia is proud to be an equal opportunity employer and has an experienced, local team of unrivalled R&D and propagation professionals, including some of the brightest, regional agroforestry talents. Investancia is looking into becoming a certified B corporation, which are "businesses that meet the highest standards of verified social and environmental performance, public transparency, and legal accountability to balance profit and purpose."[23] In the future, anti-discrimination protocols will be filed on the Estancia Dona Elsa office and will be included in the safety manual for new hires.

Thus, the measures needed and designed to ensure that all entities involved in project design and implementation are not involved in, or complicit in, any form of discrimination or sexual harassment with respect to the Project are:

- The tone needs to, and is, set from the top. Thus, senior management at Investancia has made it clear that any form of discrimination is not allowed;
- That discrimination is not allowed amongst any entities involved in project design and implementation must be clearly stated and written down. This has been done in Investancia's new hire onboarding procedures and is contained within Investancia's HSE Policy and Procedures manual;
- Independent assessment should take place. Thus, to help ensure discrimination is not taking place at the Project, Investancia will undertake ongoing independent CCBS audits and if pursued, Investancia will also have ongoing audits to maintain its B Corp certification; and

[23] B. Lab. "About B Corps." Available: https://bcorporation.net/about-b-corps

- There must be a mechanism for any entity who feels they have been discriminated against or been sexually harassed. Thus, the Project has a feedback and grievance redress procedure.

Furthermore, all landowners with suitable lands will be approached and will be considered for participation in the Project.

Communication and Consultation, including Grievance Redress

Investancia is committed to attempt to amicably resolve all grievances, including with local landowners, and provide a written response to the grievances in a manner that is culturally appropriate. The Project is primarily based off reforestation lease agreements between Investancia and private landowners, with each party fully aware of their roles and responsibilities. If a conflict arises, Investancia and the private landowner will seek to resolve the issue. If the two parties are unable to resolve the issue, then mediation will be sought. Mediation will be conducted by a professional mediator. The mediation will be conducted in Portuguese or Spanish, depending on the landowner's language proficiency. The mediation will be initiated within six months of the dispute and the exact time and place will be mutually agreed upon.

If necessary, Investancia will utilize the nationally competent courts, as outlined in Investancia's Agreement with the landowners, as the third stage for any of the grievance processes. This use of the nationally competent courts will be held in with the time and place to be mutually agreed upon. This said, the overall timing will be dependent on the courts. Further, as Brazil is a Portuguese-speaking country, the proceedings would be conducted in Portuguese.

If there are any feedback or grievances with nursery staff at the production hub at Dona Elsa (such as personnel issues), the issue will be initially handled by local Investancia management. If the local manager is unable to address the matter, then the matter will be forwarded to the Administration and HR Manager, and subsequently to the General Manager. Larger issues (i.e., such as investor issues, issues with overall nursery management, issues with local landowners, etc.), which cannot be addressed by the General Manager, will be handled by the CEO of Investancia. This particular feedback and grievance procedure was designed in a participatory manner. Likewise, the nursery staff will be asked as part of the Participatory Rural Assessments (PRAs), "how would you like to provide ongoing feedback about the project?"

In the unlikely scenario where there are any unresolved grievances with a local community or other stakeholder, Investancia and/or the local stakeholder can refer the matter to the Ministério do Meio Ambiente e Mudança do Clima (MMA) or IMASUL, which will act as the Project's third-party ombudsman.

Investancia's feedback and grievance procedure will be publicized and accessible via the Project's VCS Project Description, in the Summary Documents (both English and Portuguese), and in the ongoing VCS Monitoring Reports.

Nursery staff, upon being hired, are made aware of this procedure. As previously stated, in the future, the feedback and grievance procedure will be added as an annex to the new hire paperwork. In

addition, the feedback and grievance procedure will be posted at Dona Elsa once the formal IMASUL or MMA procedure is finalized and any feedback or grievances raised as part of the 30-day public comment period will be publicly posted and included within the independent auditor's validation and verification reports.

Respect for Local Stakeholder Resources

Invasive Species

The Project shall not introduce any invasive species or allow an invasive species to thrive through project implementation. This said, pongamia is not listed as an invasive species on the Global Invasive Species Database (which is being regularly reviewed by the Project).[24]

Non-Native Species

The Project will be planting pongamia (*Pongamia pinnata*), which is a non-native species. Pongamia is being planted because there are relatively few tree species that grow well in the region and more specifically, there are few oilseed tree species that grow well in the region of Brazil. There are also significant financial and technical barriers and it has been demonstrated that reforestation in the project region is not common practice and would not have occurred on privately-owned lands without carbon finance and the pongamia reforestation project.

Thus said, the Project should result in net positive impacts as compared to maintaining the cattle ranches in the without-project scenario by helping to increase rural employment, increase forest cover and to increase wildlife corridors by connecting green reserves, green corridors, and open cattle grazing areas.

Pongamia trees have a superior vigor and reproduction capacity, which can sometimes allow the tree to spread in the wild and this could impact native species. In the case of pongamia commercial plantations, the environmental risk of pongamia spreading to neighboring fields and negatively impacting native species is mitigated by the following factors:

- Current pongamia management practices do not allow seeds to generate or root suckers to grow under planted trees;
- Harvesting practices most often collect in excess of 95% of the pods/seeds produced by the trees;
- Cattle and other animals do not seem to eat the unprocessed pongamia seed pods; and
- Wind dispersion of the pongamia pods is unlikely due to the weight of the pods.

It should be noted that Investancia has received all of the required approvals from the Brazilian Government to import pongamia.

It is planned to have reforestation areas with a certain proportion of natives species along with pongamia so that the biodiversity of native forest is expected to be maintained or improve across the

[24] Global Invasive Species Database. "Search: Pongamia." Available: http://www.iucngisd.org/gisd/

areas in which project instances will be located. Furthermore, the reforestation project will result in higher levels of biodiversity than the traditional cattle pastures in the without-project scenario.

There are also potential concerns about disease introduction or facilitation. To mitigate these concerns, Investancia's main action is to regularly monitor tree health at the reforestation sites for the presence of any disease, invasive species, or pest infestation. Risks of pests and disease in the project region are mitigated by correct land preparation, nursery management when the seedlings are at their greatest risk, and close oversight and management once planted in the project area.

Use of Fertilizers, Chemical Pesticides, Biological Control Agents and Other Inputs

The Project does not currently use inputs such as fertilizers, chemical pesticides, and biological control agents. Inputs, such as fertilizers, herbicides, and fungicides, are currently being tested at the nursery and test plantations for potential use on the pongamia plantations, should they be needed. Investancia will always look for products in the organomineral line (i.e., mixture of organic and minerals).

The use of Personal Protective Equipment (PPE) and specific equipment and the use of application techniques are the primary techniques to minimize negative impacts to the environment and to workers. Investancia employees also work with Personal Protective Equipment (PPE) suitable for this type of operation and application tools are always in good condition, with up-to-date maintenance.

Workers will be informed about these risks during their new hire orientation. These risks, including any future risks identified, will be added to the latest version of the HSE Policy and Procedures manual to help inform workers of the Project's known risks. Investancia has started to offer annual first aid and safety training and has started to maintain safety training logs.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The Project uses the approved Clean Development Mechanism (CDM) afforestation / reforestation methodology AR-ACM0003 "Afforestation and reforestation of lands except wetlands," Version 2.0, together with the following approved CDM tools:

- "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities", Version 1.0;
- "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", Version 4.2;
- "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", Version 3.1;
- "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", Version 1.1.0;
- "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity", Version 2.0;
- "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities", Version 1.0;
- "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity", Version 4.0; and
- "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities", Version 1.0.

3.2 Applicability of Methodology

Demonstrate and justify how the project activity(s) meets each of the applicability conditions of the methodology(s), and tools (where applicable) applied by the project. Address each applicability condition separately.

The grouped Project instances meet the applicability conditions of methodology AR-ACM0003 as demonstrated in Table 3.1.

Table 3.1. Applicability conditions for CDM AR-ACM0003 methodology.

The land subject to the project activity does not fall in wetland category;	The project instance area is not considered to be a wetland as defined by the Intergovernmental Panel on Climate Change[25] or the Verra Program Definitions.[26] The project instance area prior to reforestation was used for agriculture and thus is not considered to be a wetland, as per the IPCC definition. Further, the Tropical and Subtropical Wetlands Distribution Map, version 2[27] indicates there are no wetlands within the initial project instance area.
Soil disturbance attributable to the afforestation and reforestation (A/R) Clean Development Mechanism (CDM) project activity does not cover more than 10 per cent of area in each of the following types of land: (i) Land containing organic soils; (ii) Land which, in the baseline, is subjected to land-use and management practices and receives inputs as listed in appendices 1 and 2 of AR-ACM0003 methodology.	As no project instances involve reforesting land which contain organic soils or restricted baseline management practices and inputs, the soil disturbance requirements are not applicable. A local forest technician familiar with all of Investancia's planted sites has confirmed that "there are no organic soils present in the project area" (Luiz Fadolli, pers. comm). Soil disturbance restrictions are not applicable for tropical grasslands which do not have any fertilizer inputs in the baseline.

The grouped project instances also meet the applicability conditions of the CDM "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" as demonstrated in Table 3.2.

Table 3.2. Conditions for using the CDM "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities."

Applicability condition	Project instances condition
The land does not fall into wetland category.	See justification in Table 3.1.
The area of land does not contain organic soils (e.g., peat-land).	The project instance area does not contain any organic soils.

[25] The IPCC describes a wetland as "land that is covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, cropland, grassland or settlements categories."
[26] Verra. "Program Definitions, v4.3," Available: https://verra.org/wp-content/uploads/2022/12/Program-Definitions_v4.3.pdf
[27] See the Tropical and Subtropical Wetlands Distribution Map, version 2, Available: https://www.cifor.org/knowledge/dataset/0058 as derived from Gumbricht, Thomas, et al. "An expert system model for mapping tropical wetlands and peatlands reveals South America as the largest contributor." Global change biology 23.9 (2017): 3581-3599.

The area of land is not subject to any of the land management practices and application of inputs as listed in the Tables 1 and 2 of the tool.	Table 1 is not applicable as the baseline scenario does not contain cropland. This tool is applicable to grasslands in project region as there are no inputs to grasslands in the baseline case.
Litter shall remain on site and not be removed in the A/R VCS project activity.	No litter will be removed from the project area.
Soil disturbance attributable to the A/R CDM project activity, if any, is: • In accordance with appropriate soil conservation practices, e.g., follows the land contours; • Limited to soil disturbance for site preparation before planting and such disturbance is not repeated in less than twenty years.:	Site preparation is performed in accordance with local soil conservation practices and will not be repeated in less than 20 years. Further, site preparation and planting occur within one year of each other.

Table 3.3. Applicability conditions and justifications for the other modules.

Module	Applicability Condition	Justification
Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities, Version 1.0	• Forestation of the land within the proposed project boundary performed with or without being registered as the A/R CDM project activity shall not lead to violation of any applicable law even if the law is not enforced. • This tool is not applicable to small-scale afforestation and reforestation project activities.	• The project activity is reforesting degraded lands. As no project activity is mandated by law and the project activity does not involve the clearing of native ecosystems, the project activities are in compliance with all laws. See Section 1.14. • This project utilizes the AR-ACM0003 Afforestation and reforestation of lands except wetlands, Version 2.0 Methodology. This is a large “Large-scale Consolidated Methodology” as defined by the CDM.
Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, Version 4.2	This tool has no internal applicability conditions.	Not applicable.

Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities, Version 3.1	This tool has no internal applicability conditions.	Not applicable.
Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity, Version 2.0	This tool is not applicable if the displacement of agricultural activities is expected to cause, directly or indirectly, any drainage of wetlands or peat lands.	This project's approach to leakage is to ensure any displacement of baseline agricultural activities are "displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land". All conversion of forest land for agriculture in the region follows a series of laws enforced by the Ministério do Meio Ambiente e Mudança do Clima (MMA) or IMASUL. See Section 1.14 of the PD for more details. If displacement of agriculture activities did occur, it would not be expected to cause any drainage of wetlands or peat lands.
Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities, Version 1.0	This tool has no internal applicability conditions.	Not applicable.
Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity, Version 4.0	•The tool is applicable to all occurrence of fire within the project boundary. •Non-CO_2 GHG emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party	•While, no burning was involved as part of project implementation, this tool will be applied to all occurrences of fire within the project boundary where the area affected by fires in a given year is ≥5% of the project area.

	for the purpose of defining forest, provided that the accumulated area affected by such fires in a given year is ≥5% of the project area.	
Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities, Version 1.0	This tool has no applicability conditions.	Not applicable

3.3 Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Above-ground biomass	CO_2	Yes	Required. Baseline tree and shrub biomass is subject to periodic cycles of clearing the land every 2-4 years. This baseline practice ensures that crown cover is <5%.
	Below-ground biomass	CO_2	Yes	Required. Baseline tree and shrub biomass is subject to periodic cycles of clearing the land every 2-4 years.
	Dead-wood	CO_2	No	Assumed to be equal to zero for the life of the project.
	Litter	CO_2	No	Assumed to be equal to zero for the life of the project.
	Soil organic carbon	CO_2	No	Soil organic carbon stocks are expected to remain at a steady state or decrease in the baseline scenario.
	Burning of woody biomass	CO_2	No	CO_2 emissions due to burning of biomass are accounted as a change in carbon stock. Inclusion of CH_4 and N_2O emissions are required by the methodology.
		CH_4	Yes	
		N_2O	Yes	
Project	Above-ground biomass	CO_2	Yes	Required. Largest pool affected by project activity.
	Below-ground biomass	CH_4	Yes	Required. Expected to increase due to project activity.
	Dead-wood	N_2O	Yes	This pool is included as it is expected to increase due to project activity.
	Litter	Other	Yes	This pool is included as it is expected to increase due to project activity.

Source		Gas	Included?	Justification/Explanation
	Soil organic carbon	CO_2	Yes	This pool is included and expected to increase due to project activity.
	Burning of woody biomass	CO_2	No	CO2 emissions due to burning of biomass are accounted as a change in carbon stock. Inclusion of CH4 and N2O emissions are required by the methodology.
		CH_4	Yes	
		N_2O	Yes	

As per the methodology AR-ACM0003 Version 2.0:

"GHG emissions resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary, and transportation attributable to the project activity shall be considered insignificant and therefore accounted as zero."

The only emission source that must be included in the project boundary is methane and nitrous oxide emissions resulting from burning of woody biomass (excluding herbaceous biomass). No burning was involved as part of project implementation. Hence, in conformance with the methodology, GHG emission sources included in the project boundary are accounted for as zero.

3.4 Baseline Scenario

The CDM "Combined tool to identify the baseline scenario and demonstrate the additionality in A/R CDM project activities" is applied to identify the baseline scenario and assess additionality. There are five steps to assessing additionality.[28] The project meets all applicability conditions and further, the project activity does not lead to violation of any applicable law and the project follows a large-scale CDM A/R methodology.

STEP 0: Preliminary screening based on the starting date of the project activity

All of Investancia's reforestation planting in Brazil start in 2023 or after, thus meeting the requirement of a start date for the reforestation activity after 31 December 1999.

Further, it is clear in the lease agreement between Investancia and each landowner, that the reforestation project would not have taken place without the transfer of carbon rights to Investancia.

STEP 1: Identification of alternatives land use scenarios to the project activity

Sub-step 1a: Identify credible alternative land use scenarios to the proposed CDM project activity:

1. Continuation of the pre-project land use – pasture and ranching;
2. Conversion of pasture and ranching land to agricultural crops; and

[28] Clean Development Mechanism, "A/R Methodological tool: Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities," (Version 01), Available: https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf

3. Pongamia/acrocomia/native reforestation without incentives from carbon offset credits.

None of the above identified land use scenarios are mandated by law. Section 1.14 provides an overview of the pertinent laws affecting forestry (and land use) in the region. Other land use conversions from pasture while possible are highly unlikely. Conversion from pasture and ranching to development/infrastructure is highly unlikely given the remoteness of the project areas. Conversion from pasture and ranching to productive agricultural land, including cropland and improved pasture, is extremely uncommon given the climate in the region and current land use trends in the region.

Sub-step 1b: Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations:

None of the above identified land use scenarios are illegal, and hence all are considered here as plausible alternatives for consideration. Section 1.14 provides an overview of the pertinent laws affecting forestry (and land use) in the region.

3.5 Additionality

Additionality is demonstrated for the grouped project instances using the approved CDM "Combined tool to identify the baseline scenario and demonstrate the additionality in A/R CDM project activities" as cited in the CDM methodology AR-ACM0003.

Following the identification of the alternative land use scenarios (see Steps 0 and 1 above in Section 3.4) a barriers analysis was performed. Step 2 of the tool identifies several barriers preventing the alternative land use scenarios. As Step 2 of the analysis has resulted in only one land use scenario, no investment analysis is warranted, and step 3 can be omitted. Finally, it is demonstrated that reforestation in the project region is not common practice (Step 4) and would not have occurred on these privately-owned lands without carbon finance and the pongamia reforestation project.

STEP 2: Barriers analysis

Continuation of the pre-project land use – pasture and ranching

No barriers exist to continued operating of pasture and ranching activities. This is the most common land use in the region.

Conversion of pasture and ranching land to agricultural crops

Conversion of pasture and ranching land to agricultural crops while possible is highly unlikely due to several barriers limiting the expansion of cropland in region. These barriers include: investment barriers, barriers due to prevailing practice, and barriers due to local ecological conditions.

Conversion of land in the region to productive agricultural land is cost prohibitive in many cases due to an investment barrier whereby landowners lack of access to the private capital necessary for land development due to the risks associated with cropland farming. There is a further barrier related to the prevailing perception of cattle ranching in the region as the only alternative to the native land use.

Finally, the most dominant barriers are barriers due to local ecological conditions including: degraded soils and unfavorable meteorological conditions, namely the highly seasonal precipitation and high dry season temperatures.

Reforestation without incentives from carbon offset credits

Reforestation in the form of this project with or without incentives from carbon offset credits is extremely unlikely due to both technological barriers and barriers due to prevailing practices. Investancia alone has been able to overcome these barriers by developing pongamia specifically for reforesting the project region. Investancia has the technical knowhow to propagate pongamia and is the first of its kind in the region to establish pongamia forest. Investors in pongamia technology are interested in its multiple benefits including its ability to sequester carbon and generate carbon credits.

Results

It follows that only credible baseline scenario is continued operating of pasture and ranching activities.

STEP 3. Investment analysis

No investment analysis is warranted as Step 2 demonstrated there is only one credible alternative land use.

STEP 4. Common practice analysis

There is no reforestation activity similar to the proposed project activity in Brazil. Before Investancia, there were no pongamia tree planting operations in the region due to the large capital investments required to develop regionally appropriate pongamia plants, establish of a nursery, and engage local landowners to plant pongamia on a large scale.

3.6 Methodology Deviations

There are no methodology deviations applied to this grouped project.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline net GHG removals by sinks ($\Delta C_{BSL,t}$) equals the sum of changes in carbon stocks in tree biomass, shrub biomass, dead wood, and litter using Equation 4.1, below.

$$\Delta CBSL,t = \Delta CTREE\_BSL,t + \Delta CSHRUB\_BSL,t + \Delta CDW\_BSL,t + \Delta CLI\_BSL,t \quad \text{Equation 4.1}$$

Where:

$\Delta CBSL,t$ = Baseline net GHG removals by sink in year t; t CO_2-e

$\Delta CTREE\_BSL,t$ = Change in carbon stock in baseline tree biomass within the project boundary in year t

$\Delta CSHRUB\_BSL,t$ = Change in carbon stock in baseline shrub biomass within the project boundary, in year t

$\Delta CDW\_BSL,t$ = Change in carbon stock in baseline dead wood biomass within the project boundary, in year t

$\Delta CLI\_BSL,t$ = Change in carbon stock in baseline litter biomass within the project boundary, in in year t

In cases where not all trees in the baseline land use scenario were cleared and these trees are in clumps of forest, these clumps will not be included in the project area. Further, the land in the baseline is "cleaned" of small woody vegetation every 2 to 4 years in the baseline to encourage quality forage and ensure the area remains open for grazing. This effectively ensures tree and shrub cover is minimal and thus biomass oscillates between a minimum and a maximum value in the baseline. In line with section 5 of the CDM tool AR-TOOL14, changes in carbon stocks in trees and shrubs in the baseline may be accounted as zero because:

> Land is subjected to periodic cycles (e.g., slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;

The initial baseline stocks in tree biomass, shrub biomass, dead wood, and litter are estimated using the approaches outlined below.

Baseline emissions and removals were estimated using the following approved CDM tools:

- AR-TOOL14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", Version 4.2; and

- AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", Version 3.1.

Baseline tree biomass carbon stocks

Pre-project tree biomass carbon stocks are calculated using the equation below.

$$C_{TREE\_BSL} = \sum_{i=1}^{M} C_{TREE\_BSL,i}$$

Equation 4.2

Carbon stock in trees in the baseline are accounted as zero when the following conditions are met:

a) The pre-project trees are neither harvested, nor cleared, nor removed throughout the crediting period of the project activity;

b) The pre-project trees do not suffer mortality because of competition from trees planted in the project, or damage because of implementation of the project activity, at any time during the crediting period of the project activity;

c) The pre-project trees are not inventoried along with the project trees in monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the project activity.

In all cases where the project does not clear trees (i.e., stems > 10 cm dbh) during the course of site preparation, CTREE_BSL,t = 0.

The following approach is only used where baseline trees are cleared during site preparation prior to planting and the initial baseline tree biomass cannot be accounted as zero in line with the methodology (see Section 5, Step 11a). Section 8.3. of AR-TOOL14 set out an approach to estimating pre-project tree biomass carbon stocks using pre-project tree crown cover (see Equation 4.3). This method is applicable where the mean pre-project tree crown cover is less than 20 percent of the threshold tree crown cover reported by the host Party. The forest thresholds for Brazil are 30% crown cover, 1ha area, and 2-5 m minimum tree height.[29] This approach is therefore applicable where pre-project tree crown cover is less than 5% (i.e., 20% of 30%).

$$C_{TREE\_BSL,i} = \frac{44}{12} \times CF_{TREE} \times b_{FOREST} \times (1 + R_{TREE}) \times CC_{TREE\_BSL,i} \times A_i$$

Equation 4.3

Where:

$C_{TREEBSL}$ = Carbon stock in pre-project tree biomass; t CO_2e

[29] https://cdm.unfccc.int/DNA/DNA/ARDNA.html?CID=168, Accessed 12 September 2022.

$C_{TREE\_BSL,i}$ = Carbon stock in pre-project tree biomass in stratum i; t CO_2e

CF_{TREE} = Carbon fraction of tree biomass; t C (t dm),

b_{FOREST} = Mean above-ground biomass in forest in the region or country, t dm ha,

R_{TREE} = Root-shoot ratio for trees in the baseline, dimensionless

$CC_{TREE\_BSL,i}$ = Crown cover of trees in baseline stratum i

A_i = Area of baseline stratum i, delineated on the basis of tree crown cover at the start of the A/R CDM project activity; ha

Table 4.1. Estimate of pre-project tree biomass carbon stocks.

Year	CF_{TREE} (t C/ t dm)	b_{FOREST} (t dm/ha)	R_{TREE}	CC_{TREE_BSL}	A_i (ha)	$CTREE\_BSL,t$ (t CO_2e)
2023	0.47	60.46	0.25	0.0	0	0.00
2024	0.47	60.46	0.25		0.00	0.00
2025	0.47	60.46	0.25		0.00	0.00
2026	0.47	60.46	0.25		0.00	0.00
2027	0.47	60.46	0.25		0.00	0.00
2028	0.47	60.46	0.25		0.00	0.00
2029	0.47	60.46	0.25		0.00	0.00
2030	0.47	60.46	0.25		0.00	0.00
2031	0.47	60.46	0.25		0.00	0.00
2032	0.47	60.46	0.25		0.00	0.00
2033	0.47	60.46	0.25		0.00	0.00
2034	0.47	60.46	0.25		0.00	0.00
2035	0.47	60.46	0.25		0.00	0.00
2036	0.47	60.46	0.25		0.00	0.00
2037	0.47	60.46	0.25		0.00	0.00
2038	0.47	60.46	0.25		0.00	0.00
2039	0.47	60.46	0.25		0.00	0.00
2040	0.47	60.46	0.25		0.00	0.00
2041	0.47	60.46	0.25		0.00	0.00
2042	0.47	60.46	0.25		0.00	0.00
2043	0.47	60.46	0.25		0.00	0.00
2044	0.47	60.46	0.25		0.00	0.00
2045	0.47	60.46	0.25		0.00	0.00
2046	0.47	60.46	0.25		0.00	0.00
2047	0.47	60.46	0.25		0.00	0.00
2048	0.47	60.46	0.25		0.00	0.00
2049	0.47	60.46	0.25		0.00	0.00
2050	0.47	60.46	0.25		0.00	0.00
2051	0.47	60.46	0.25		0.00	0.00
2052	0.47	60.46	0.25		0.00	0.00

Baseline shrub biomass carbon stocks

Section 11 of AR-TOOL14 sets out an approach to estimating shrub biomass carbon stocks on the basis of shrub crown cover. The area within the project boundary may be stratified by shrub crown cover.

In line with the AR-TOOL14, areas with shrub crown cover less than 5 per cent are treated as a single stratum and the shrub biomass in this stratum may be estimated as zero.

In all other cases pre-project shrub biomass carbon stocks are calculated using the Equations 4.4 and 4.5, below. As stipulated in AR-TOOL14 data/parameter Table 2, when land is subjected to periodic cycles (e.g., slash-and-burn, or clearing-regrowing cycles) so that the shrub crown cover oscillates between a minimum and maximum values in the baseline, an average shrub crown cover equal to 0.5 is used.

$$C_{SHRUB,t} = \frac{44}{12} \times CF_s \times (1 + R_s) \times \sum_i A_{SHRUB,i} \times b_{SHRUB,i}$$

Equation 4.4

$$b_{SHRUB,i} = BDR_{SF} \times b_{FOREST} \times CC_{SHRUB,i}$$

Equation 4.5

Where:

$C_{SHRUB,t}$ = Carbon stock in shrubs within the project boundary at a given point of time in year t; t CO_2e

CF_S = Carbon fraction of shrub biomass; t C (t dm),

R_S = Root-shoot ratio for shrubs, dimensionless

A_{SHRUBi} = Area of shrub biomass estimation stratum i; ha

$b_{SHRUB,i}$ = Shrub biomass per hectare in shrub biomass estimation stratum i; ha,

BDR_{SF} = Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0 (i.e., 100 per cent) and the default above-ground biomass content per hectare in forest in the region/country where the A/R CDM project activity is located; dimensionless.

b_{FOREST} = Mean above-ground biomass in forest in the region or country, t dm ha,

$CC_{SHRUB,i}$ = Crown cover of trees in baseline stratum i

Table 4.2. Estimate of shrub biomass carbon stocks at the start of the project.

Year	CF_S (t C/ t dm)	R_S	A_{SHRUBi} (ha)	BDR_{SF}	b_{FOREST} (t dm/ha)	CC_{SHRUB_BSL}	$C_{SHRUB\_BSL,t}$ (t CO_2e)
2023	0.47	0.40	30.66	0.10	60.46	0.50	223.62
2024	0.47	0.40	0.00	0.10	60.46		0.00
2025	0.47	0.40	0.00	0.10	60.46		0.00
2026	0.47	0.40	0.00	0.10	60.46		0.00
2027	0.47	0.40	0.00	0.10	60.46		0.00
2028	0.47	0.40	0.00	0.10	60.46		0.00
2029	0.47	0.40	0.00	0.10	60.46		0.00
2030	0.47	0.40	0.00	0.10	60.46		0.00
2031	0.47	0.40	0.00	0.10	60.46		0.00
2032	0.47	0.40	0.00	0.10	60.46		0.00
2033	0.47	0.40	0.00	0.10	60.46		0.00
2034	0.47	0.40	0.00	0.10	60.46		0.00
2035	0.47	0.40	0.00	0.10	60.46		0.00
2036	0.47	0.40	0.00	0.10	60.46		0.00
2037	0.47	0.40	0.00	0.10	60.46		0.00
2038	0.47	0.40	0.00	0.10	60.46		0.00
2039	0.47	0.40	0.00	0.10	60.46		0.00

2040	0.47	0.40	0.00	0.10	60.46		0.00
2041	0.47	0.40	0.00	0.10	60.46		0.00
2042	0.47	0.40	0.00	0.10	60.46		0.00
2043	0.47	0.40	0.00	0.10	60.46		0.00
2044	0.47	0.40	0.00	0.10	60.46		0.00
2045	0.47	0.40	0.00	0.10	60.46		0.00
2046	0.47	0.40	0.00	0.10	60.46		0.00
2047	0.47	0.40	0.00	0.10	60.46		0.00
2048	0.47	0.40	0.00	0.10	60.46		0.00
2049	0.47	0.40	0.00	0.10	60.46		0.00
2050	0.47	0.40	0.00	0.10	60.46		0.00
2051	0.47	0.40	0.00	0.10	60.46		0.00
2052	0.47	0.40	0.00	0.10	60.46		0.00
2053	0.47	0.40	0.00	0.10	60.46		0.00
2054	0.47	0.40	0.00	0.10	60.46		0.00
2055	0.47	0.40	0.00	0.10	60.46		0.00
2056	0.47	0.40	0.00	0.10	60.46		0.00
2057	0.47	0.40	0.00	0.10	60.46		0.00
2058	0.47	0.40	0.00	0.10	60.46		0.00
2059	0.47	0.40	0.00	0.10	60.46		0.00
2060	0.47	0.40	0.00	0.10	60.46		0.00
2061	0.47	0.40	0.00	0.10	60.46		0.00
2062	0.47	0.40	0.00	0.10	60.46		0.00

Baseline dead wood carbon stocks

Similar to the with-project approach, dead wood carbon stocks, Table 4.3, are calculated using the conservative default-factor based method and the equation below,

$C_{DW} = C_{TREE} \times DF_{DW}$ Equation 4.6

Where:

C_{DW} = Carbon stock in dead wood; t CO_2e

C_{TREE} = Carbon stock in trees biomass; t CO_2e

DF_{DW} = Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass; %

The conservative default factor for the project region (DF_{DW} = 1%) was determined using Section 8 of CDM AR-TOOL12 for the tropical biome with an elevation less than 2000m and precipitation between 1000-1600mm/yr.

Baseline litter biomass carbon stocks

Similar to the with-project approach, litter biomass carbon stocks, Table 4.3, are calculated using the conservative default-factor based method and the equation below,

$C_{LI} = C_{TREE} \times DF_{LI}$ Equation 4.7

Where:

C_{LI} = Carbon stock in litter; t CO_2e

C_{TREE} = Carbon stock in trees biomass; t CO_2e

DF_{LI} = Conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass; %

The conservative default factor for the project region (DF_{LI} = 1%) was determined using Section 8 of CDM AR-TOOL12 for the tropical biome with an elevation less than 2000m and precipitation between 1000-1600mm/yr.

Estimated baseline emissions

Table 4.3. Baseline net GHG removals by sinks.

Year	ΔCTREE_BSL,t (t CO_2e/ha)	ΔCSHRUB_BSL,t (t CO_2e/ha)	ΔCDW_BSL,t (t CO_2e/ha)	ΔCLI_BSL,t (t CO_2e/ha)	ΔCBSL,t (t CO_2e/ha)
2023	0.00	223.62	0.00	0.00	223.62
2024	0.00	0.00	0.00	0.00	0.00
2025	0.00	0.00	0.00	0.00	0.00
2026	0.00	0.00	0.00	0.00	0.00
2027	0.00	0.00	0.00	0.00	0.00
2028	0.00	0.00	0.00	0.00	0.00
2029	0.00	0.00	0.00	0.00	0.00
2030	0.00	0.00	0.00	0.00	0.00
2031	0.00	0.00	0.00	0.00	0.00
2032	0.00	0.00	0.00	0.00	0.00
2033	0.00	0.00	0.00	0.00	0.00
2034	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00
2036	0.00	0.00	0.00	0.00	0.00
2037	0.00	0.00	0.00	0.00	0.00
2038	0.00	0.00	0.00	0.00	0.00
2039	0.00	0.00	0.00	0.00	0.00
2040	0.00	0.00	0.00	0.00	0.00
2041	0.00	0.00	0.00	0.00	0.00
2042	0.00	0.00	0.00	0.00	0.00
2043	0.00	0.00	0.00	0.00	0.00
2044	0.00	0.00	0.00	0.00	0.00
2045	0.00	0.00	0.00	0.00	0.00
2046	0.00	0.00	0.00	0.00	0.00
2047	0.00	0.00	0.00	0.00	0.00
2048	0.00	0.00	0.00	0.00	0.00
2049	0.00	0.00	0.00	0.00	0.00
2050	0.00	0.00	0.00	0.00	0.00
2051	0.00	0.00	0.00	0.00	0.00

2052	0.00	0.00	0.00	0.00	0.00
2053	0.00	0.00	0.00	0.00	0.00
2054	0.00	0.00	0.00	0.00	0.00
2055	0.00	0.00	0.00	0.00	0.00
2056	0.00	0.00	0.00	0.00	0.00
2057	0.00	0.00	0.00	0.00	0.00
2058	0.00	0.00	0.00	0.00	0.00
2059	0.00	0.00	0.00	0.00	0.00
2060	0.00	0.00	0.00	0.00	0.00
2061	0.00	0.00	0.00	0.00	0.00
2062	0.00	0.00	0.00	0.00	0.00

4.2 Project Emissions

Both ex-ante and ex-post estimates of carbon sequestered will use the following equations derived from the CDM AR-ACM0003 methodology. For the purpose of both ex-ante and ex-post estimates of carbon sequestered, emissions removals and reduction accounting starts at the time of the project start date or when the trees are planted onsite, whichever is later. Any removals prior to the project start date or when the trees are planted onsite are considered de minimis as planted trees do not meet the minimum monitoring threshold of 5 cm dbh.

Actual net GHG removals by sinks (ΔC_{ACTUAL}) is calculated using Equation 4.8, below.

$$\Delta C_{ACTUAL} = \Delta C_P - GHG_E \quad \text{Equation 4.8}$$

where:

ΔC_{ACTUAL} Actual net GHG removals by sinks; t CO_2-e

ΔC_P Changes the carbon stock in project, occurring in the selected carbon pools; t CO_2-e

GHG_E Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity; t CO_2-e

Please note that the increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity (GHG_E) equals zero for the life of the project as justified in Section 3.

The change in carbon stock in all selected carbon pools (ΔC_t) is calculated using Equation 4.9, below.

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t} \quad \text{Equation 4.9}$$

where:

$\Delta C_{P,t}$ Change in carbon stock in project, occurring in all selected carbon pools, in year t; t CO_2-e

$\Delta C_{TREE\_PROJ,t}$ Change in carbon stock in tree biomass in project, in year t; t CO_2-e

$\Delta C_{SHRUB\_PROJ,t}$	Change in carbon stock in shrub biomass in project, in year t, t CO_2-e
$\Delta C_{DW\_PROJ,t}$	Change in carbon stock in dead wood biomass in project, in year t; t CO_2-e
$\Delta C_{LI\_PROJ,t}$	Change in carbon stock in litter biomass in project, in year t; t CO_2-e
$\Delta C_{SOC\_AL,t}$	Change in carbon stock in SOC in project, in year t; t CO_2-e

Please note that the change in carbon stock in shrub biomass ($\Delta C_{SHRUB\_PROJ,t}$) equals zero as all planted species are managed as trees, as such shrub biomass ($\Delta C_{SHRUB\_PROJ,t}$) has not included in the with-project case.

Ex-ante estimates of aboveground and belowground biomass

Ex-ante estimates of the GHG removal enhancements in the Project are derived from measurements of *Pongamia pinnata* stands covering a range of ages.[30] The final estimated above-ground and below-ground biomass per hectare is displayed in Table 4.4, with maximum above and belowground biomass carbon stock of 69.6 t C/ha. These ex-ante estimates are thought to be conservative as the planting density in with with-project cases are greater than those in the sequestration study.

Table 4.4. Ex ante estimates of cumulative carbon sequestered per ha.

Stand age	Live aboveground and belowground tree biomass (tC/ha)[30]
0	0.0
1	2.3
2	4.6
3	7.0
4	9.3
5	11.6
6	13.9
7	16.2
8	18.6
9	20.9
10	23.2
11	25.5
12	27.8
13	30.2
14	32.5
15	34.8
16	37.1
17	39.4
18	41.8
19	44.1
20	46.4

[30] Live aboveground and belowground carbon estimates are derived from James Eaton and Brian McFarland. 2019. Pongamia in Florida: A Rapid Assessment of CO2 Sequestration Potential. Report prepared for Investancia Group B.V

21	48.7
22	51.0
23	53.4
24	55.7
25	58.0
26	60.3
27	62.7
28	65.0
29	67.3
30	69.6
31	69.6
32	69.6
33	69.6
34	69.6
35	69.6
36	69.6
37	69.6
38	69.6
39	69.6
40	69.6

Ex-ante estimates of carbon stocks in deadwood and litter

The project proponents decided to use the conservative default-factor based method to estimate both ex-ante and ex-post estimates of carbon stocks in deadwood ($\Delta C_{DW\_PROJ,t}$) and litter ($\Delta C_{LI\_PROJ,t}$). This approach is described in the CDM AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", Version 3.1 uses Equation 4.10 and 4.11 below.

$C_{DW} = C_{TREE} \times DF_{DW}$ Equation 4.10

Where:

C_{DW} = Carbon stock in dead wood; t CO_2e

C_{TREE} = Carbon stock in trees biomass; t CO_2e

DF_{DW} = Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass; %

$C_{LI} = C_{TREE} \times DF_{LI}$ Equation 4.11

Where:

C_{LI} = Carbon stock in litter; t CO_2e

C_{TREE} = Carbon stock in trees biomass; t CO_2e

DF_{LI} = Conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass; %

DF_{DW} = 1%, for the project region. This was determine using Section 8 of CDM AR-TOOL12 for the tropical biome with an elevation less than 2000m and precipitation between 1000-1600mm/yr.

DF_{LI} = 1%, for the project region. This was determine using Section 8 of CDM AR-TOOL12 for the tropical biome with an elevation less than 2000m and precipitation between 1000-1600mm/yr.

Litter carbon (tC/ha) and deadwood carbon (tC/ha) stocks on a per hectare basis are in Table 4.5.

Table 4.5. Ex-ante deadwood and litters estimates for the initial project instances per ha.

Stand age	Litter carbon (tC/ha)	Deadwood carbon (tC/ha)
0	0.0	0.0
1	0.0	0.0
2	0.0	0.0
3	0.1	0.1
4	0.1	0.1
5	0.1	0.1
6	0.1	0.1
7	0.2	0.2
8	0.2	0.2
9	0.2	0.2
10	0.2	0.2
11	0.3	0.3
12	0.3	0.3
13	0.3	0.3
14	0.3	0.3
15	0.3	0.3
16	0.4	0.4
17	0.4	0.4
18	0.4	0.4
19	0.4	0.4
20	0.5	0.5
21	0.5	0.5
22	0.5	0.5
23	0.5	0.5
24	0.6	0.6
25	0.6	0.6
26	0.6	0.6
27	0.6	0.6
28	0.6	0.6
29	0.7	0.7
30	0.7	0.7
31	0.7	0.7
32	0.7	0.7
33	0.7	0.7

34	0.7	0.7
35	0.7	0.7
36	0.7	0.7
37	0.7	0.7
38	0.7	0.7
39	0.7	0.7
40	0.7	0.7

No trees will with be harvested for timber as part of the Impact Reforestation of Degraded Areas in Brazil project, hence the project did not calculate the long-term average GHG benefit maintained by the project.

Ex-ante estimates of soil carbon stocks

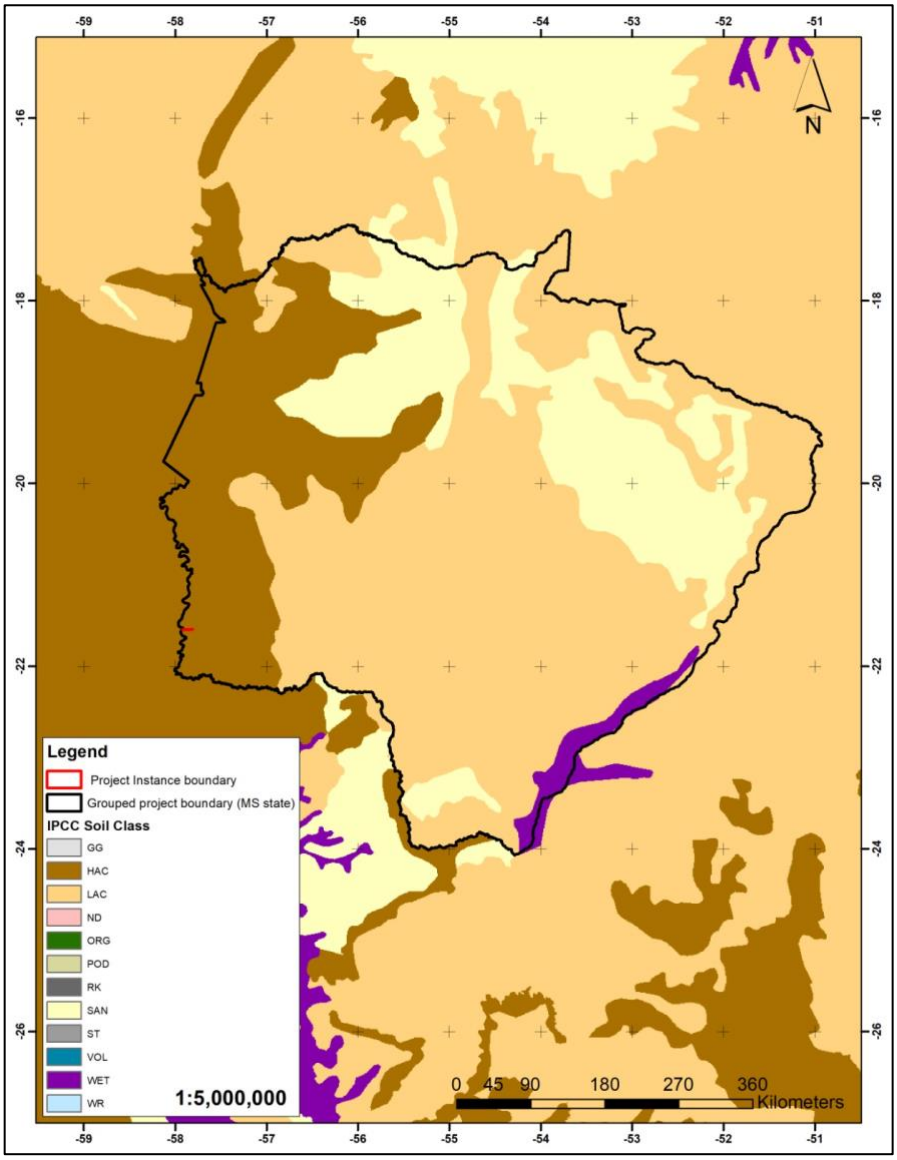
Ex-ante estimates of soil carbon stocks ($\Delta C_{SOC\_AL,t}$) were generated using the CDM "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".

According to the Harmonized World Soil Database,[31] the grouped project area/region is dominated by the following soil types: Solonetz, Fluvisols, Regosols, and Cambisols. Each of these soil types can be classified as High Activity Clays (HACs) using the default IPCC soil types.[32] IPCC default soil classes were derived using GIS by overlaying the project region over a spatially explicit map of IPCC soil types (See Figure 4.1).

[31] Batjes NH 2009. IPCC default soil classes derived from the Harmonized World Soil Data Base (Ver. 1.0). Report 2009/02, Carbon Benefits Project (CBP) and ISRIC – World Soil Information, Wageningen (with dataset).

[32] Batjes, N.H. 2010. IPCC default soil classes derived from the Harmonized World Soil Data Base (Ver. 1.1). Report 2009/02b, Carbon Benefits Project (CBP) and ISRIC- World Soil Information, Wageningen. http://www.isric.org/data/ipcc-default-soil-classes-derived-harmonized-world-soil-data-base-ver-11

Figure 4.1. Map of Mato Grosso do Sul, Brazil, and the IPCC default soil classes



The rate of soil organic carbon accumulation (d_{SOC}) has been calculated using Equations 4.12, 4.13, and 4.14 for high activity clay soil in the project area. Ex-ante estimates of soil carbon accumulation use the value calculated for high activity clay soils, below.

$$SOC_{initial} = SOC_{reference} * f_{LU} * f_{MG} * f_{IN} \quad \text{Equation 4.12}$$

$$SOC_{loss} = SOC_{initial} * 0.1 \quad \text{Equation 4.13}$$

$$d_{SOC} = (SOC_{referen-e} - (SOC_{initial} - SOC_{loss}))/20 \text{ years} \quad \text{Equation 4.14}$$

The terms in the above equations are defined as follows:

$SOC_{initial}$, SOC stock at the beginning of an ARR VCS project activity; t C ha^{-1},

$SOC_{reference}$, Reference SOC stock corresponding to reference condition in native lands; t C ha^{-1},

SOC_{loss}, Loss of SOC caused by soil disturbance attributable the ARR project activity; t C ha^{-1},

f_{LU}, Stock change factor for land-use; dimensionless,

f_{MG}, Stock change factor for management; dimensionless,

f_{IN}, Stock change factor for input of organic matter; dimensionless, and

d_{SOC}, The rate of change in SOC stock; t C ha^{-1} yr^{-1}.

Ex-ante estimates of soil carbon stocks in high activity clay soils

Using Equation 3.12, $SOC_{initial}$ is calculated for grasslands with high activity clay soils as = 65.0 t C ha^{-1} * 1.0 * 0.7 * 1.0 = 45.5 t C ha^{-1}.

As per the CDM, "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" the below parameters have been defined.

$SOC_{reference}$ = 65.0 t C ha^{-1}. This value is the default SOC stocks referenced for high activity clay soils in the moist tropical climatic region in the default reference table in the above tool.

f_{LU} = 1.0, as all grassland is assigned a land-use factor of 1;

f_{MG} = 0.7, as project grasslands are considered severely degraded;

$f_{IN,}$ = 1.0, as these grasslands had no (i.e., low) input of fertilizers.

Using Equation 4.13, SOC_{loss} = 45.5 t C ha^{-1} * 0.1 = 4.5 t C ha^{-1}

Using Equation 4.14, d_{SOC} = (65.0 t C ha^{-1} – (45.5 t C ha^{-1} - 4.5 t C ha^{-1}))/20 years = 1.203 t C ha^{-1}.

Using this tool, the soil carbon accumulation rate was calculated to be 1.203 t C ha^{-1} yr^{-1}. In accordance with the tool, this approach allows for reporting a maximum of 0.80 tons C per hectare per year for 20 years for grassland with high activity clay soils in the project boundary. Soil organic carbon stocks are assumed to be at a steady state after 20 years.

Carbon sequestered

Ex-ante estimates on a per unit area basis are detailed in Table 4.6 below.

Table 4.6. Ex-ante estimates of cumulative carbon sequestered per ha on project lands.

Stand age	Live aboveground and belowground tree biomass (tC/ha)	Litter carbon (tC/ha)	Deadwood carbon (tC/ha)	Soil carbon (tC/ha)	Total carbon density (tC/ha)	Metric tons of CO_2 (t CO_2e/ha)
0	0.0	0.0	0.0	0.0	0.0	0.0
1	2.3	0.0	0.0	0.8	3.2	11.6
2	4.6	0.0	0.0	1.6	6.3	23.2
3	7.0	0.1	0.1	2.4	9.5	34.8

4	9.3	0.1	0.1	3.2	12.7	46.4
5	11.6	0.1	0.1	4.0	15.8	58.1
6	13.9	0.1	0.1	4.8	19.0	69.7
7	16.2	0.2	0.2	5.6	22.2	81.3
8	18.6	0.2	0.2	6.4	25.3	92.9
9	20.9	0.2	0.2	7.2	28.5	104.5
10	23.2	0.2	0.2	8.0	31.7	116.1
11	25.5	0.3	0.3	8.8	34.8	127.7
12	27.8	0.3	0.3	9.6	38.0	139.3
13	30.2	0.3	0.3	10.4	41.2	151.0
14	32.5	0.3	0.3	11.2	44.3	162.6
15	34.8	0.3	0.3	12.0	47.5	174.2
16	37.1	0.4	0.4	12.8	50.7	185.8
17	39.4	0.4	0.4	13.6	53.8	197.4
18	41.8	0.4	0.4	14.4	57.0	209.0
19	44.1	0.4	0.4	15.2	60.2	220.6
20	46.4	0.5	0.5	16.0	63.3	232.2
21	48.7	0.5	0.5	16.0	65.7	240.9
22	51.0	0.5	0.5	16.0	68.1	249.6
23	53.4	0.5	0.5	16.0	70.4	258.3
24	55.7	0.6	0.6	16.0	72.8	266.9
25	58.0	0.6	0.6	16.0	75.2	275.6
26	60.3	0.6	0.6	16.0	77.5	284.3
27	62.7	0.6	0.6	16.0	79.9	293.0
28	65.0	0.6	0.6	16.0	82.3	301.7
29	67.3	0.7	0.7	16.0	84.6	310.3
30	69.6	0.7	0.7	16.0	87.0	319.0
31	69.6	0.7	0.7	16.0	87.0	319.0
32	69.6	0.7	0.7	16.0	87.0	319.0
33	69.6	0.7	0.7	16.0	87.0	319.0
34	69.6	0.7	0.7	16.0	87.0	319.0
35	69.6	0.7	0.7	16.0	87.0	319.0
36	69.6	0.7	0.7	16.0	87.0	319.0
37	69.6	0.7	0.7	16.0	87.0	319.0
38	69.6	0.7	0.7	16.0	87.0	319.0
39	69.6	0.7	0.7	16.0	87.0	319.0
40	69.6	0.7	0.7	16.0	87.0	319.0

4.3 Leakage

Leakage emissions were estimated using the following approved CDM tool:

- AR-TOOL15 "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity", Version 2.0.

This tool defines leakage emissions as those "attributable to the displacement of agricultural activities due to implementation of an A/R CDM project activity". Further, Section 10 of the tools states

> "Leakage emission attributable to the displacement of grazing activities under the following conditions is considered insignificant and hence accounted as zero) Animals are displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land;"

Prior to the project, project lands were used to raise livestock. Project lands were either pasture or used to produce hay. The project proponents may choose to continue raising livestock or producing hay in a silvopastoral system as part of the project, but the original landowners of the project lands have agreed that if any animals are displaced by the project activities, these animals can only be "displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land." As no displacement of agricultural production from within the project boundary occurs as a result of the project activities, leakage emissions are considered to be zero for the life of the project:

$LK_t = 0$ t CO_2e ha^{-1}

4.4 Net GHG Emission Reductions and Removals

Emission reductions are calculated (see Equation 4.15) by subtracting the baseline carbon stocks and leakage from the with-project emission reductions (for both the ex-ante and ex-post case), and then subtracting the non-permanence risk buffer (see the project's Non-Permanence Risk Report for risk buffer determination).

$$ER = \Delta C_{ACTUAL} - \Delta C_{BSL} - LK - Buffer_{VCS} \quad \text{Equation 4.15}$$

Where:

ER	Net anthropogenic GHG removals by sinks; t CO_2-e
ΔC_{ACTUAL}	Actual net GHG removals by sinks; t CO_2-e
ΔC_{BSL}	Baseline net GHG removals by sinks; t CO_2-e
LK	GHG emissions due to leakage; t CO_2-e
$Buffer_{VCS}$	VCS buffer credits; t CO_2-e

Over the 40-year crediting period, the initial grouped project instances are expected to generate 8,602 t CO_2-e net emissions reductions (Table 4.7).

The number of VCUs at time t_2 (the date of verification) is estimated using Equation 4.16.

$VCUs = ER_{t2} - ER_{t1}$ Equation 4.16

Where:

VCUs Number of Verified Carbon Units

ER_{t2} Emission reductions (net anthropogenic GHG removals by sinks) for time t_2; t CO_2- e

ER_{t1} Emission reductions (net anthropogenic GHG removals by sinks) for time t_1 (the previous verification); t CO_2- e

Note that $ER_{t1} = 0$ for the first verification.

Table 4.7. Ex-ante estimates of net emission reductions for the initial grouped project instances.

Year	Estimated project emissions or removals (tCO_2e)	Estimated baseline emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Non-permanence Risk deduction (t CO_2)	Estimated net GHG emission reductions or removals (tCO_2e)	Cumulative estimates of net emission reductions (tCO_2)
2023	356	224	0	13.2	119	119
2024	356	0	0	35.6	320	440
2025	356	0	0	35.6	320	760
2026	356	0	0	35.6	320	1,080
2027	356	0	0	35.6	320	1,401
2028	356	0	0	35.6	320	1,721
2029	356	0	0	35.6	320	2,042
2030	356	0	0	35.6	320	2,362
2031	356	0	0	35.6	320	2,682
2032	356	0	0	35.6	320	3,003
2033	356	0	0	35.6	320	3,323
2034	356	0	0	35.6	320	3,644
2035	356	0	0	35.6	320	3,964
2036	356	0	0	35.6	320	4,285
2037	356	0	0	35.6	320	4,605
2038	356	0	0	35.6	320	4,925
2039	356	0	0	35.6	320	5,246
2040	356	0	0	35.6	320	5,566
2041	356	0	0	35.6	320	5,887
2042	356	0	0	35.6	320	6,207
2043	266	0	0	26.6	239	6,446
2044	266	0	0	26.6	239	6,686
2045	266	0	0	26.6	239	6,925
2046	266	0	0	26.6	239	7,165
2047	266	0	0	26.6	239	7,404
2048	266	0	0	26.6	239	7,644
2049	266	0	0	26.6	239	7,883
2050	266	0	0	26.6	239	8,123
2051	266	0	0	26.6	239	8,362
2052	266	0	0	26.6	239	8,602
2053	0	0	0	0.0	0	8,602
2054	0	0	0	0.0	0	8,602
2055	0	0	0	0.0	0	8,602

2056	0	0	0	0.0	0	8,602
2057	0	0	0	0.0	0	8,602
2058	0	0	0	0.0	0	8,602
2059	0	0	0	0.0	0	8,602
2060	0	0	0	0.0	0	8,602
2061	0	0	0	0.0	0	8,602
2062	0	0	0	0.0	0	8,602
Total	**9,781**	**224**	**0**	**956**	**8,602**	

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	GHG_E
Data unit	t CO_2-e
Description	Increase in non-CO2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity
Source of data	AR-ACM0003 "Afforestation and reforestation of lands except wetlands," Version 2.0
Value applied	0 t CO_2-e
Justification of choice of data or description of measurement methods and procedures applied	The non-CO2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity (GHG_E) equals zero for the life of the project as justified in Section 3.
Purpose of data	This parameter is used for the following: Calculation of project emissions
Comments	None

Data / Parameter	DF_{DW}
Data unit	%
Description	Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass
Source of data	CDM AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", v 3.1
Value applied	1-7% depending on elevation and precipitation of instance
Justification of choice of data or description of measurement methods and procedures applied	This value was determine using Section 8 of CDM AR-TOOL12 for the tropical biome with an elevation less than 2000m and precipitation between 1000-1600mm/yr.
Purpose of data	This parameter is used for the following: Calculation of baseline emissions Calculation of project emissions
Comments	None

Data / Parameter	DF_{LI}
Data unit	%
Description	Conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass
Source of data	CDM AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", v 3.1
Value applied	1-4% depending on elevation and precipitation of instance

Justification of choice of data or description of measurement methods and procedures applied	This value was determine using Section 8 of CDM AR-TOOL12 for the tropical biome with an elevation less than 2000 and precipitation between 1000-1600mm/yr.
Purpose of data	This parameter is used for the following: Calculation of baseline emissions Calculation of project emissions
Comments	None

Data / Parameter	$SOC_{reference}$
Data unit	t C ha^{-1}
Description	Reference SOC stock corresponding to the reference condition in native lands
Source of data	CDM "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".
Value applied	Climate region / HAC soils / LAC soils / SAN soils Tropical dry / 38 t C ha / 35 t C ha / 31 t C ha Tropical moist / 65 t C ha / 47 t C ha / 39 t C ha Tropical wet / 44 t C ha / 60 t C ha / 66 t C ha
Justification of choice of data or description of measurement methods and procedures applied	The value used for the first instance is the default SOC stock referenced for high activity clay soils in the moist tropical climatic region in the default reference table in the above tool.
Purpose of data	This parameter is used for the following: Calculation of project emissions
Comments	None

Data / Parameter	fLU
Data unit	dimensionless
Description	Stock change factor for land-use
Source of data	CDM "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".
Value applied	1.0
Justification of choice of data or description of measurement methods and procedures applied	All grassland is assigned a land-use factor of 1
Purpose of data	This parameter is used for the following: Calculation of project emissions
Comments	None

Data / Parameter	f_{MG}
Data unit	dimensionless
Description	Stock change factor for management
Source of data	CDM "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".
Value applied	0.7

Justification of choice of data or description of measurement methods and procedures applied	f_{MG} = 0.7, as project grasslands/pasture in the baseline project area considered severely degraded
Purpose of data	This parameter is used for the following: Calculation of project emissions
Comments	None

Data / Parameter	f_{IN}
Data unit	dimensionless
Description	Stock change factor for input of organic matter
Source of data	CDM "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".
Value applied	1.0
Justification of choice of data or description of measurement methods and procedures applied	$f_{IN,}$ = 1.0, as project grasslands/pasture in the baseline project area had no (i.e., low) input of fertilizers.
Purpose of data	This parameter is used for the following: Calculation of project emissions
Comments	None

Data / Parameter	LK_t
Data unit	t CO_2e ha^{-1}
Description	GHG emissions due to leakage
Source of data	AR-TOOL15 "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity", Version 2.0.
Value applied	0 t CO_2e ha^{-1}
Justification of choice of data or description of measurement methods and procedures applied	Prior to the project, project lands were used to raise livestock. Projects lands were either pasture or used to produce hay. The project proponents may choose to continue raising livestock or producing hay in a silvopastoral system as part of the project, but the original landowners of the project lands have agreed that if any animals are displaced by the project activities, these animals can only be "displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land". As no displacement of agricultural production from within the project boundary occurs as a result of the project activities, leakage emissions are considered to be zero for the life of the project.
Purpose of data	This parameter is used for the following: Calculation of leakage emissions

Comments	None

Data / Parameter	SG
Data unit	g/cm^3
Description	Wood specific gravity
Source of data	Rajput SS, Shukla NK and VK Gupta, 1985. "Specific gravity of Indian timbers." Journal of Timber Development Association of India, XXXI(3), 12-41.
Value applied	0.609
Justification of choice of data or description of measurement methods and procedures applied	The specific gravity of P. pinnata, 0.609, is derived from Rajput et al.
Purpose of data	This parameter is used for the following: Calculation of project emissions
Comments	None

Data / Parameter	R_{TREE}
Data unit	dimensionless
Description	Root-shoot ratio for trees
Source of data	AR-TOOL14 Estimation of carbon stocks of trees and shrubs and K Mokany, RJ Raison, and AS Prokushkin. 2006. "Critical analysis of root: shoot ratios in terrestrial biomes." Global Change Biology.
Value applied	0.25 for baseline or: 0.205 in moist biomes where biomass is <125 tons/ha 0.235 in moist biomes where biomass is >125 tons/ha 0.563 in dry biomes where biomass is <20 tons/ha 0.275 in dry biomes where biomass is >20 tons/ha
Justification of choice of data or description of measurement methods and procedures applied	A root-shoot ratio developed by Mokany et al. 2006 is used in project instances depending on the biome and biomass measured
Purpose of data	This parameter is used for the following: Calculation of baseline emissions Calculation of project emissions
Comments	None

Data / Parameter	RS
Data unit	dimensionless
Description	Root-shoot ratio for shrubs
Source of data	AR-TOOL14
Value applied	0.40
Justification of choice of data or description of measurement methods and procedures applied	Default value as provided in AR-TOOL14.

Purpose of data	This parameter is used for the following: Calculation of baseline emissions Calculation of project emissions
Comments	None

Data / Parameter	$f(x_1)$
Data unit	kg
Description	Above-ground biomass of the tree returned by the allometric equation for species j relating the measurements of tree l to the above-ground biomass of the tree
Source of data	Chave, J., Andalo, C., Brown, S., Cairns, M.A., Chambers, J.Q., Eamus, D., Folster, H., Fromard, F., Higuchi, N., Kira, T., Lescure, J.P., Nelson, B.W., Ogawa, B., Puig, H., Riera, B. and T. Yamakura. 2005. "Tree allometry and improved estimation of carbon stocks and balance in tropical forests." Oecologia 145:87-99.
Value applied	aboveground biomass (kg) = SG*EXP(-0.667+1.784*LN(dbh)+0.207*(LN(dbh))^2-0.0281*(LN(dbh))^3)
Justification of choice of data or description of measurement methods and procedures applied	As per the CDM tool "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities". The above equation is appropriate for ex-post estimation of tree biomass because it is a an allometric equation derived from trees growing in edapho-climatic conditions similar to those in the project area. Further, it satisfies the condition that: (c) The equation was derived from a data set of at least 30 sample trees, and the value of coefficient of determination (R2) obtained was not less than 0.85. This allometric equation meets the requirements of the methodology because it is an equation for dry forest with less than 1,500 mm of precipitation per year. Further, the equation is based on a large number of samples (n=420) and has an r^2=0.996.
Purpose of data	This parameter is used for the following: Calculation of project emissions
Comments	None

Data / Parameter	CF_{TREE}
Data unit	t C $(t.d.m.)^{-1}$
Description	Carbon fraction of tree biomass
Source of data	AR-Tool 14, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Value applied	0.47 t C $(t.d.m.)^{-1}$
Justification of choice of data or description of measurement methods and procedures applied	A default value is used.
Purpose of data	This parameter is used for the following:

	Calculation of baseline emissions Calculation of project emissions
Comments	None

Data / Parameter	CF_S
Data unit	t C $(t.d.m.)^{-1}$
Description	Carbon fraction of shrub biomass
Source of data	AR-Tool 14, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Value applied	0.47 t C $(t.d.m.)^{-1}$
Justification of choice of data or description of measurement methods and procedures applied	A default value is used.
Purpose of data	This parameter is used for the following: Calculation of baseline emissions Calculation of project emissions
Comments	None

Data / Parameter	b_{FOREST}
Data unit	tons d.m./ha
Description	Mean above-ground biomass in the forest in the region
Source of data	FAO Global Forest Resources Assessment 2020 Report for Brazil (https://www.fao.org/forest-resources-assessment/fra-2020/country-reports/en/) and Brazilian Institute of Geography and Statistics / Instituto Brasileiro de Geografia e Estatísticas – IBGE (https://www.ibge.gov.br/geociencias/downloads-geociencias.html)
Value applied	60.46 in first instance
Justification of choice of data or description of measurement methods and procedures applied	Biomass stock of relevant region in Brazil according to the national forest inventory of December 2018 as reported in the FAO 2020 FRA for Brazil. The first project instance falls in the Pantanal biome, and Savana-Estépica Florestada (Td) subcategory.
Purpose of data	This parameter is used for the following: Calculation of baseline emissions
Comments	None

Data / Parameter	BDR_{SF}
Data unit	dimensionless
Description	Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0 (i.e., 100 per cent) and the default above-ground biomass content per hectare in forest in the region/country where the A/R CDM project activity is located
Source of data	AR-Tool 14, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"

Value applied	0.10
Justification of choice of data or description of measurement methods and procedures applied	Default value as stipulated in AR-Tool 14, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities
Purpose of data	This parameter is used for the following: Calculation of baseline emissions
Comments	None

5.2 Data and Parameters Monitored

Data / Parameter	Ai
Data unit	Ha
Description	a) Area of tree biomass stratum i; b) Area of SOC stratum i of the land meeting the applicability conditions of the SOC tool
Source of data	GIS
Description of measurement methods and procedures to be applied	The project area will be delineated and tracked using a GIS. The GIS planting boundary (i.e., the project area) is confirmed with a GPS in the field. This process ensures all planted trees fall within the project area.
Frequency of monitoring/recording	The project area for each project instance is fixed at the time of planting. This parameter will continue to increase as new project instances are added to the project.
Value applied	See project database.
Monitoring equipment	GIS
QA/QC procedures to be applied	The delineated project areas will align with the leased hectarages from landowner contracts.
Purpose of data	The project area is used for: Calculation of baseline emissions Calculation of project emissions Calculation of leakage
Calculation method	GIS
Comments	None

Data / Parameter	ASHRUBi
Data unit	Ha
Description	Area of shrub biomass estimation stratum i;
Source of data	GIS
Description of measurement methods and procedures to be applied	The project area will be delineated and tracked using a GIS. The GIS planting boundary (i.e., the project area) is confirmed with a GPS in the field.
Frequency of monitoring/recording	The project area for each project instance is fixed at the time of planting. This parameter will continue to increase as new project instances are added to the project.
Value applied	See project database.

Monitoring equipment	GIS
QA/QC procedures to be applied	The delineated project areas will align with the leased hectarages from landowner contracts.
Purpose of data	The project area is used for: Calculation of baseline emissions Calculation of project emissions
Calculation method	GIS
Comments	None

Data / Parameter	dbh
Data unit	cm
Description	Diameter at breast height of a tree.
Source of data	Monitored during the course of each forest inventory
Description of measurement methods and procedures to be applied	Detailed procedures provided in the Standard Operating Procedures found in Section 5.3. Monitoring responsibilities are listed in section 5.3, below.
Frequency of monitoring/recording	Every 5 years after first verification
Value applied	See project database.
Monitoring equipment	Measuring tape.
QA/QC procedures to be applied	Detailed procedures are provided below under monitoring plan description
Purpose of data	Used to calculation of project emissions reductions
Calculation method	Not applicable
Comments	None

Data / Parameter	$A_{PLOT,i}$;
Data unit	Ha
Description	Area of a sample plot
Source of data	Field measurement
Description of measurement methods and procedures to be applied	AR-Tool 14, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities".
Frequency of monitoring/recording	At every verification
Value applied	See project database.
Monitoring equipment	Measuring tape.
QA/QC procedures to be applied	Detailed procedures are provided below under monitoring plan description
Purpose of data	Used to calculation of project emissions reductions
Calculation method	Not applicable
Comments	None

Data / Parameter	$\Delta CLI,t$ and $\Delta CLI\_BSL,t$

Data unit	t CO_2e
Description	Change in carbon stock in litter within the project boundary in year t
Source of data	Calculated
Description of measurement methods and procedures to be applied	AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", Version 3.1
Frequency of monitoring/recording	At every verification for project emission and at the verification of each new project instance for baseline emissions
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	See Section 3.1 of the project document
Purpose of data	This parameter is used for the following: Calculation of baseline emissions Calculation of project emissions
Calculation method	Equation 17, AR-TOOL12
Comments	Changes in carbon stocks in the baseline may be accounted as zero for those lands for which the project participants can demonstrate…Land is subjected to periodic cycles (e.g., slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;

Data / Parameter	CLI,t
Data unit	t CO_2e
Description	Carbon stock in litter in stratum i at a given point of time in year t
Source of data	Calculated
Description of measurement methods and procedures to be applied	AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", Version 3.1
Frequency of monitoring/recording	At every verification for project emissions
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	Detailed procedures are provided below under monitoring plan description
Purpose of data	This parameter is used for the following: Calculation of baseline emissions Calculation of project emissions
Calculation method	Equation 15, AR-TOOL12
Comments	None

Data / Parameter	$\Delta CDW,t$ and $\Delta CDW\_BSL,t$
Data unit	t CO_2e
Description	Change in carbon stock in dead wood within the project boundary in

	year t
Source of data	Calculated
Description of measurement methods and procedures to be applied	AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", Version 3.1
Frequency of monitoring/recording	At every verification for project emission and at the verification of each new project instance for baseline emissions
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	See Section 3.1 of the project document
Purpose of data	This parameter is used for the following: Calculation of baseline emissions Calculation of project emissions
Calculation method	Equation 11, AR-TOOL12
Comments	Changes in carbon stocks in the baseline may be accounted as zero for those lands for which the project participants can demonstrate…Land is subjected to periodic cycles (e.g., slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;

Data / Parameter	CDW,t
Data unit	t CO_2e
Description	Carbon stock in dead wood in stratum i at a given point of time in year t
Source of data	Calculated
Description of measurement methods and procedures to be applied	AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", Version 3.1
Frequency of monitoring/recording	At every verification
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	Detailed procedures are provided below under monitoring plan description
Purpose of data	This parameter is used for the following: Calculation of baseline emissions Calculation of project emissions
Calculation method	Equation 9, AR-TOOL12
Comments	None

Data / Parameter	B_{TREE}
Data unit	t d.m.
Description	Tree biomass in the tree biomass estimation strata
Source of data	Calculated

Description of measurement methods and procedures to be applied	AR-Tool 14, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities".
Frequency of monitoring/recording	At every verification
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	Detailed procedures are provided below under monitoring plan description
Purpose of data	This parameter is used for the following: Calculation of project emissions
Calculation method	AR-Tool 14
Comments	None

Data / Parameter	$b_{TREE,i}$
Data unit	t d.m. ha-1
Description	Mean tree biomass per hectare in stratum i
Source of data	Calculated
Description of measurement methods and procedures to be applied	AR-Tool 14, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities".
Frequency of monitoring/recording	At every verification
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	Detailed procedures are provided below under monitoring plan description
Purpose of data	This parameter is used for the following: Calculation of project emissions
Calculation method	AR-Tool 14
Comments	None

Data / Parameter	CTREE
Data unit	t CO_2e
Description	Carbon stock in trees in the tree biomass estimation strata
Source of data	Calculated
Description of measurement methods and procedures to be applied	AR-Tool 14, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities".
Frequency of monitoring/recording	At every verification
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	Detailed procedures are provided below under monitoring plan description

Purpose of data	This parameter is used for the following: Calculation of project emissions
Calculation method	AR-Tool 14
Comments	None

Data / Parameter	$C_{TREEBSL}$
Data unit	t CO_2e
Description	Carbon stock in pre-project tree biomass
Source of data	Calculated
Description of measurement methods and procedures to be applied	AR-Tool 14, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities".
Frequency of monitoring/recording	At every verification where project instances are added
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	Detailed procedures are provided below under monitoring plan description
Purpose of data	This parameter is used for the following: Calculation of baseline emissions
Calculation method	AR-Tool 14
Comments	Only needed when calculating baseline pre-project tree biomass.

Data / Parameter	$b_{SHRUB,i}$
Data unit	tons d.m./ha
Description	Shrub biomass per hectare in shrub biomass estimation stratum i
Source of data	Calculation
Description of measurement methods and procedures to be applied	None
Frequency of monitoring/recording	At every verification where project instances are added
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	None
Purpose of data	This parameter is used for the following: Calculation of baseline emissions
Calculation method	Equation 27, AR-Tool 14
Comments	Only needed when calculating baseline shrub biomass.

Data / Parameter	$C_{SHRUB,t}$
Data unit	t CO2-e
Description	Carbon stock in shrubs within the project boundary at a given point of time in year t
Source of data	Calculation

Description of measurement methods and procedures to be applied	None
Frequency of monitoring/recording	At every verification where project instances are added
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	None
Purpose of data	This parameter is used for the following: Calculation of baseline emissions
Calculation method	Equation 26, AR-Tool 14
Comments	Only needed when calculating baseline shrub biomass. Changes in carbon stocks in the baseline may be accounted as zero for those lands for which the project participants can demonstrate…Land is subjected to periodic cycles (e.g., slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;

Data / Parameter	$\Delta CSHRUB\_PROJ,t$
Data unit	t CO_2-e
Description	Change in carbon stock in shrub biomass in project in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Source of data	Calculation
Description of measurement methods and procedures to be applied	None
Frequency of monitoring/recording	At each verification
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	None
Purpose of data	This parameter is used for the following: Calculation of project emissions
Calculation method	Equation 3, AR-ACM0003
Comments	Expected to be zero in the with-project case

Data / Parameter	$\Delta CSHRUB\_BSL,t$
Data unit	t CO_2-e
Description	Change in carbon stock in baseline shrub biomass within the project boundary, in year t
Source of data	Calculation

Description of measurement methods and procedures to be applied	None
Frequency of monitoring/recording	At every verification where project instances are added
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	None
Purpose of data	This parameter is used for the following: Calculation of baseline emissions
Calculation method	Equation 25, AR-TOOL14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", Version 4.2
Comments	Only needed when calculating baseline shrub biomass. Changes in carbon stocks in the baseline may be accounted as zero for those lands for which the project participants can demonstrate…Land is subjected to periodic cycles (e.g., slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;

Data / Parameter	$\Delta CTREE\_PROJ,t$
Data unit	t CO_2-e
Description	Change in carbon stock in tree biomass in project in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Source of data	Calculation
Description of measurement methods and procedures to be applied	None
Frequency of monitoring/recording	At each verification
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	None
Purpose of data	This parameter is used for the following: Calculation of project emissions
Calculation method	Equation 3, AR-ACM0003
Comments	None

Data / Parameter	$\Delta CTREE\_BSL,t$
Data unit	t CO_2-e
Description	Change in carbon stock in baseline tree biomass within the project boundary in year t
Source of data	Calculation

Description of measurement methods and procedures to be applied	None
Frequency of monitoring/recording	At every verification where project instances are added
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	None
Purpose of data	This parameter is used for the following: Calculation of baseline emissions
Calculation method	Equation 11, AR-TOOL14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", Version 4.2
Comments	Only needed when calculating baseline tree biomass. Changes in carbon stocks in the baseline may be accounted as zero for those lands for which the project participants can demonstrate…Land is subjected to periodic cycles (e.g., slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline

Data / Parameter	$CC_{SHRUB,i}$
Data unit	Dimensionless
Description	Crown cover of shrubs in shrub biomass stratum i
Source of data	Default approach as stipulated AR-TOOL14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", Version 4.2
Description of measurement methods and procedures to be applied	None
Frequency of monitoring/recording	At every verification where project instances are added
Value applied	See project database.
Monitoring equipment	None
QA/QC procedures to be applied	None
Purpose of data	This parameter is used for the following: Calculation of baseline emissions
Calculation method	None
Comments	As the land is subjected to periodic cycles (e.g., slash-and-burn, or clearing-regrowing cycles) so that the shrub crown cover oscillates between a minimum and maximum values in the baseline, an average shrub crown cover equal to 0.5 may be used, as stipulated in the methodology. When less than 5%, stocks may be considered zero.

Data / Parameter	CC_{TREE_BSLi}
Data unit	Dimensionless
Description	Crown cover of trees in the baseline stratum i
Source of data	Imagery based sampling approach
Description of measurement methods and procedures to be applied	See Section 5.3
Frequency of monitoring/recording	At every verification where project instances are added and baseline trees are cleared during site preparation.
Value applied	See project database.
Monitoring equipment	GIS
QA/QC procedures to be applied	See Section 5.3
Purpose of data	This parameter is used for the following: Calculation of baseline emissions
Calculation method	None
Comments	It is unlikely this approach will be used during project implementation. This approach is only used where baseline trees are cleared during site preparation and initial baseline tree biomass cannot be accounted as zero in line with the methodology. CC_{TREE_BSLi} = (#tree canopy cover points in stratum i/# grid point in stratum i)

Data / Parameter	A_{DISP_t}
Data unit	Ha
Description	Area of land from which agricultural activity is being displaced in year t
Source of data	Landowner contract and AR-TOOL15 “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity”, Version 2.0.
Description of measurement methods and procedures to be applied	None
Frequency of monitoring/recording	At every verification
Value applied	0
Monitoring equipment	Not applicable.
QA/QC procedures to be applied	See Section 5.3
Purpose of data	The project area is used for: Calculation of leakage
Calculation method	None
Comments	As stipulated in the leakage tool: “Leakage emission attributable to the displacement of grazing activities under the following conditions is considered insignificant and hence accounted as zero:

	(a) Animals are displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land;" As the original landowners of the project lands have agreed that if any animals are displaced by the project activities, these animals can only be "displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land" both parameters A_{DISP_t} and LKt are considered to be zero for the life of the project.

5.3 Monitoring Plan

Monitoring pre-project tree biomass carbon stocks

This approach is only to be used where baseline trees are cleared during site preparation and initial baseline tree biomass cannot be accounted as zero, in line with the methodology.

A baseline tree crown cover analysis will be carried out prior to the inclusion of each project instance in the project, where trees are cleared during site preparation, such that the project is able to estimate pre-project tree biomass carbon stocks according to the default approach provided in Section 8.3 of the CDM tool AR-TOOL 14. This approach will be implemented for project instances, such that for each year in which project instances, where trees are cleared during site preparation, will be added, the following number of 50 m x 50 m sampling plots will be assessed for each strata. It is expected there will be only one sampling strata per planting year.

Sampling Area/ Planted Area (ha)	Number of Sampling Plots
<100	5
100-2000	20
>2000	40

For the purpose of this analysis, a tree was defined as > 3 m height and a dbh >10 cm. For baseline stocks this definition is appropriate as stems < 10 cm would be cleared periodically every 2-4 years to encourage better growth of pasture grasses and thus be unlikely to reach 3 m in height whereby these stems would be considered trees.

This baseline tree crown cover analysis was conducted using a combination of Collect Earth and QGIS software using the steps outline below.

1. The location of each sampling grid was generated at random over the sampling area using the "Collect Earth" platform. The sample design, consisting of a 5 x 5 point grid with 10 m spacing between points, was used to sample pre-project tree crown cover in available imagery from dates prior to the project start. Each sampling grid and sub-plot received its own ID, similar to that found in Figure 5.1.

2. This tree crown cover survey implemented on the Collect Earth Platform and QGIS platforms consisted of labeling each grid point after visual interpretation of high resolution satellite or aerial imagery. The presence or absence of tree canopy cover was recorded for each grid point location (Figure 5.2).

3. For each sampling strata, this data was scaled to tree crown cover by dividing the number of positive tree canopy cover points by the total number of sampling points.

4. For grid points which were allocated outside the project area boundary, these grid points were pushed to the opposite side of the sampling grid thus ensuring each sampling grid contained 25 sampling points (see Figure 5.3a and 5.3b).

Figure 5.1. Tree crown cover plot design in Collect Earth Platform.

Figure 5.2. Example of sampling plot results from Collect Earth Platform. Green point indicate presence of a tree.

Figure 5.3a. Example of sampling plot in QGIS software

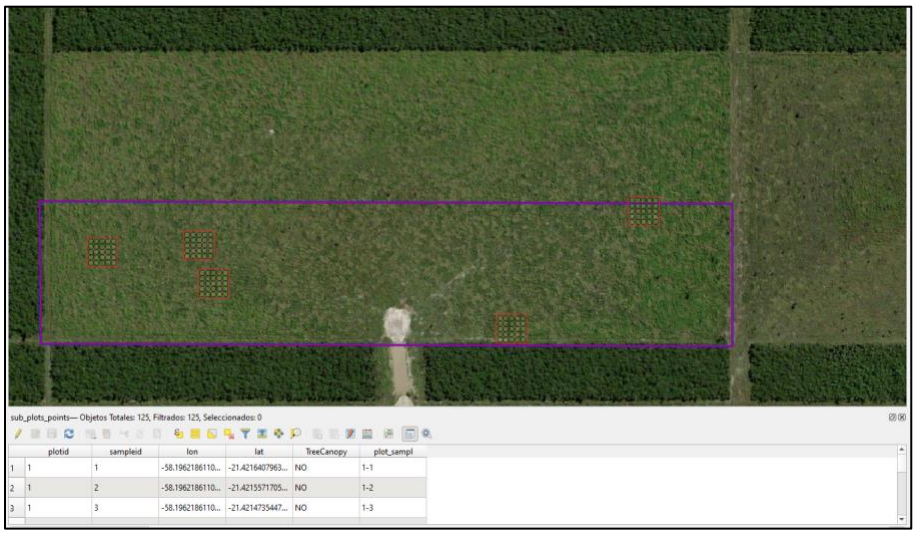


Figure 5.3b. Example of sampling plot in QGIS software, where subplots exceeding boundary limits were pushed to the opponent side of the cluster in which the labels were assigned

Monitoring with-project carbon stocks

Over the life of the project, live aboveground biomass estimates will be derived from direct measurements on permanent plots and thus satisfy the IPCC Tier 3 highest level of accuracy criteria. Tree and shrub carbon stocks are estimated using the CDM tool AR-TOOL14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", Version 4.2. This monitoring section includes the Standard Operating Procedures (SOPs) and the Quality Assurance/Quality Control Procedures (QA/QC) to be implemented as part of each monitoring and verification even.

Deadwood and litter carbon stocks are estimates using a default-factor base method as approved in AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", Version 3.1.

Soil carbon is accounted for using a formulaic approach as devised in the CDM "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".

No monitoring of deadwood, litter, or soil carbon is warranted.

The project monitoring plan conforms with monitoring requirements of methodology AR-ACM0003 and follows general principles of carbon accounting provided in Chapter 4 (AFOLU; Agriculture, Forestry and Other Land-use) of the IPCC 2006 Guidelines for National Greenhouse Gas Inventories and IPCC Good Practice Guidance (IPCC GPG[33] 2003), specifically Chapter 4.3 LULUCF Projects. In conformance with IPCC guidance, the monitoring plan is designed to quantify and control for uncertainty in estimates by employing sufficient sampling intensity and unbiased allocation of measurement plots to produce estimates with a known level of confidence.

Per IPCC 2006GL guidance, the monitoring plan includes a Quality Assurance/Quality Control (QA/QC) plan to control for errors in measurement and data analysis. Application of the QA/QC plan will provide documentation and consistency in data archiving to permit efficient third-party auditing and evaluation against measurement and quantification standards over the life of monitoring.

Investancia is responsible for all monitoring aspects including planning, fieldwork, reporting, and data archiving.

Precision Target

The monitoring plan is designed to produce biomass stock estimates with a precision level of +/-10% of the mean with 90% confidence at the first measurement, with precision expected to improve over time as the stands mature and become more homogeneous. In the event that monitoring of biomass yields a precision of the estimates exceeding ± 10% of the mean at a 90% confidence level, as required by the methodology, an appropriate confidence deduction will be applied.

[33] Penman, Jim, Michael Gytarsky, Taka Hiraishi, Thelma Krug, Dina Kruger, Riitta Pipatti, Leandro Buendia et al. "Good practice guidance for land use, land-use change and forestry." (2003).

Carbon Pools

Project monitoring will measure and quantify carbon stocks in carbon pools including aboveground biomass and belowground biomass. As noted above, deadwood and litter carbon stocks will not be monitored; change in deadwood and litter stocks will be determined using the default-factor base method as approved in AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities", Version 3.1. Soil carbon stocks will not be monitored; change in soil carbon stocks will be determined using the approved CDM "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".

Definition and Delineation of Strata

Stratification reduces overall variability and improves the efficiency in sampling. The project monitoring plan will stratify project lands on the basis of location and/or age cohort.

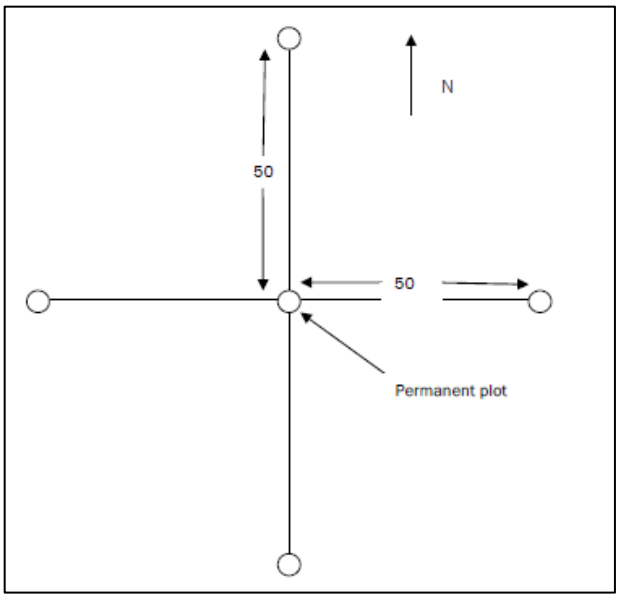
Sampling Design

The project will employ stratified random sampling using permanent 10-meter radius circular (fixed area) plots for live aboveground biomass. Sample size will be determined prior to the monitoring date on the basis of field data.

At young ages when variability is high, cluster sampling may be employed to improve precision. Each cluster sample will be composed of five ten-meter radius plots, arranged in a cross configuration centered on the permanent plot (Figure 5.4), oriented in the cardinal directions. The center plot will be permanently marked and will serve as a Continuous Forest Inventory (CFI) plot to be measured over the life of the project. The four surrounding "satellite" plots will be un-marked temporary plots expanding the sample unit to a cluster. Sample units will be allocated at random within strata using ArcGIS.

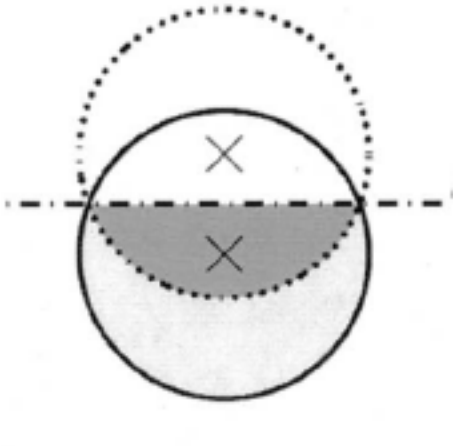
Live aboveground biomass, including aboveground and belowground biomass, will first be monitored, and verified within five years of the project start date.

Figure 5.4. Diagram of cluster monitoring plot design with the permanent Continuous Forest Inventory plot in the middle.



It is expected that issues of boundary overlap will be encountered at some clusters/plots in the field. Plots that overlap the project boundary will be corrected using the mirage method[34, 35] (Figure 5.5). The solid-lined circle is the actual plot border. The portion of the circle above the horizontal line is outside of the forest strata being sampled. After sampling all the trees within the sampling circle within the forest strata (e.g., below the line), the trees within the grey shaded area will then be registered twice on the data sheet to account for the same area which is above the horizontal line and outside the plot.

Figure 5.1. Diagram of mirage method (Avery and Burkhart, 1994)



Where the 50 meter lines of transit from the permanent plot center cross the project boundary prior to terminating, lines will be deflected from the boundary back into the project area using a “ricochet”

[34]Avery, T.E. and H.E. Burkhart. 1994. Forest Measurements. Fourth Edition. McGraw Hill, Boston, Massachusetts, USA. 408pp.

[35]Ducey, M, J. Gove, and H. Valentine. 2004. A Walkthrough Solution to the Boundary Overlap Problem. For Sci, 50:427-435.

method to complete the 50 m, where the line of transit will ricochet back into the project area to the right of the original bearing at a 45 degree angle.

Field Measurement Protocols

Direct field measurements of aboveground biomass will follow standard forest inventory best practices outlined in Avery and Burkhart (1994) and Harmon and Sexton (1996). As allowed under methodology AR-ACM0003, litter and soil organic carbon will not be measured and monitored.

Establishment of Permanent Plots

Once a permanent plot center (i.e., the central plot of a cluster) location is reached, the plot will be marked by hammering a stake into the ground. The stake should be approximately 1.5 meters in length with about 30-60 cm going into the ground. If possible, an aluminum tag, labeled with a unique monitoring plot identification name, should be attached to the PVC pipe for all permanent sampling plots (i.e., the center plot).

Coordinates of each permanent sample plot will be recorded, when altered from original (i.e., allocated) location, with GPS to facilitate future relocation.

Layout of Measurement Plots

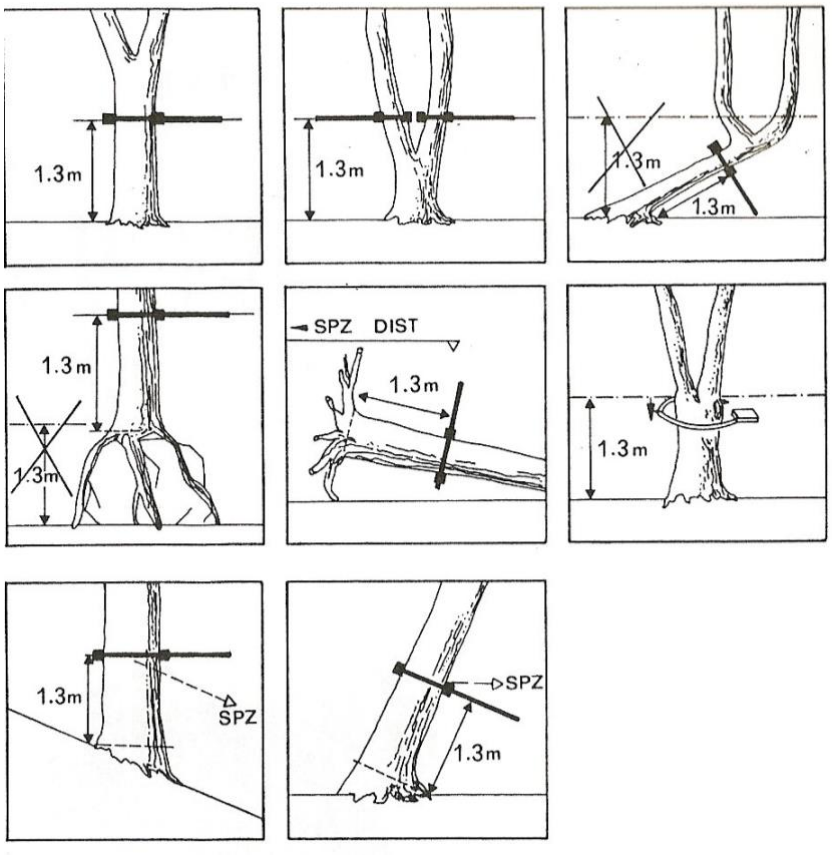
The slope (in %) of each monitoring plot (both permanent and temporary plots) should be taken with a clinometer and recorded. The slope will be recorded so the plot radii in the direction of the slope can later be adjusted to calculate the equivalent horizontal area.

Measurement of Live Trees

Within each sampling plot, the diameter of planted trees will be measured. Diameter of trees will be measured at breast height (1.3 m above ground level, see figure below) only for stems > 5 cm dbh. Diameter of trees with buttresses will be measured directly above the point of termination of the buttress.

To avoid either missed trees or double recording, the point of initiation of measurement will be noted.

Figure 5.2. Point of measurement of diameter at breast height (from Pancel, 1993).[36]



Measuring Distance

If sonic measuring equipment, such as Haglof DMEs, is to be used in the field (to check plot radii and borderline trees) they will be calibrated before each use and allowed 10+ minutes prior to use to equilibrate the unit to ambient conditions.

Data Analysis for Aboveground and Belowground Biomass

Field measurements will be used to estimate biomass stocks in live aboveground and belowground trees using the following equations.

Table 5. Equations for Aboveground and Belowground Biomass Estimation

Biome and Equation	Aboveground biomass (AGB, in kg)	Belowground biomass (BGB, in kg)
Tropical Wet	AGB = D * EXP(-1.239 + 1.980 * LN(dbh) + 0.207 * (LN(dbh))^2 - 0.0281 * (LN(dbh))^3) [38]	BGB = 0.37 * AGB [42]

[36] Pancel, L., ed. 1993. Tropical forestry handbook. Berlin, Germany, Springer-Verlag. Volume 1, 738 pp.

Tropical Moist	AGB = D * EXP(-1.499 + 2.148 * LN(dbh) + 0.207 * (LN(dbh))^2 - 0.0281 * (LN(dbh))^3) [38]	BGB = 0.205 * AGB when AGB <125 tons/ha [41]
		BGB = 0.235 * AGB when AGB >125 tons/ha [41]
Tropical Dry	AGB = D * EXP(-0.667 + 1.784 * LN(dbh) + 0.207 * (LN(dbh))^2 - 0.0281 * (LN(dbh))^3) [38]	BGB = 0.563 * AGB when AGB <20 tons/ha [41]
		BGB = 0.275 * AGB when AGB >20 tons/ha [41]
Pongamia	AGB = 0.609 * EXP(-0.667 + 1.784 * LN(dbh) + 0.207 * (LN(dbh))^2 - 0.0281 * (LN(dbh))^3) [38]	Formula chosen from above options depending on biome and biomass
Live aboveground biomass will be calculated as a function of diameter at breast height (dbh; in cm) using the predictive model for tropical forests developed by Chave et al. 2005.[37] Specific gravity (D; density in g/cm^3) will be sourced from Chave et al. 2006.[38] Following IPCC 2006 guidance,[39] a root-shoot ratio developed by Mokany et al. 2006[40] will be used to estimate belowground biomass in tropical/subtropical moist or dry forest/plantation, while a ratio developed by Fittkau and Klinge 1973[41] will be used to estimate belowground biomass in tropical wet forest. Root-shoot ratios for moist and dry forest depend on certain thresholds of aboveground biomass.		

Specific Gravity

The specific gravity of native species is sourced from Chave et al.[42] The specific gravity of *P. pinnata* used in the above equation, 0.609, stems from Rajput et al.[43]

Quality Control and Data Archiving

Implementation of the monitoring plan will apply QA/QC procedures as outlined here to minimize errors in measurement and data analysis, and to provide documentation and consistency in data archiving. The plan will cover procedures for: (1) collecting reliable field measurements, (2) documenting data entry and analysis techniques and (3) data maintenance and archiving.

[37] Chave et al. 2005. "Tree allometry and improved estimation of carbon stocks and balance in tropical forests." Oeco.145:87-99.

[38] Chave, et al. 2006. "Regional and phylogenetic variation of wood density across 2456 Neotropical tree species." Ecological Applications, 16:2356-2367.

[39] IPCC Guidelines for National Greenhouse Gas Inventories 2006. Table 4.4. in Chapter 4: Forest Land.

[40] Mokany et al. 2006. "Critical analysis of root : shoot ratios in terrestrial biomes." Global Change Biology 12:84-96.

[41] Fittkau, et al. 1973. On biomass and trophic structure of the central Amazonian rainforest ecosystem. Biotropica 5: 2-14.

[42] Chave et al. 2006. "Regional and phylogenetic variation of wood density across 2456 neotropical tree species." Ecological Applications 16:2356-2367.

[43] Rajput et al. 1985. "Specific gravity of Indian timbers." *Journal of Timb. Dev. Assoc of India*, 31(3):12-41.

The grouped project maintains an electronic database of GIS coverages detailing parcel boundaries and will record and archive raw field measurements and analyses to permit independent review of source data over the life of the project.

Field Measurements

Field crews will be fully trained in all aspects of the field data collection and adhere to field measurement protocols. Field crew leaders will be responsible for ensuring that field protocols are followed to ensure accurate and consistent measurement. Pilot sample plots shall be measured before the initiation of formal measurements to appraise field crews and identify and correct any errors in field measurements. During measurement, a consistency check of an opportunistic sample of plots shall be re-measured to determine measurement error. Re-measurement for this purpose shall be done by different field personnel. These internal check cruises will serve to quantify measurement error and allow for the identification and correction of any field measurement issues arising during implementation of the monitoring plan.

All equipment used in the course of field measurements will be calibrated according to the equipment's specifications or national/international standards.

Data Entry

Data will be recorded on field sheets and then transcribed to electronic media. To minimize errors in data entry, where they are not the same, personnel involved in data analysis will consult with personnel involved in measurement to clarify any anomalous values or ambiguities in transcription.

Data Archiving

Because of the long-term objective of the monitoring plan, data archiving is essential. Field measurement data will be recorded on field sheets, which shall be duplicated and archived. Field data will be entered in an electronic database; data entry shall work with photocopies, not originals, to avoid loss of data. Copies of all raw data, reports of analysis, and supporting spreadsheets will be stored in a dedicated long-term electronic archive. All documents and records are kept in a secure and retrievable manner for at least two years after the end of the project crediting period. Given the extended timeframe and the pace of production of updated versions of software and new hardware for storing data, electronic files will be updated periodically or converted to a format accessible to future software applications. Adherence to these procedures will also ensure smooth transitions and maintain “institutional memory” in the event of changes in personnel responsible for the monitoring plan.

Each new grouped project instance will be given a unique identifier and incorporated into the overall project accounting tracking system. The project maintains an electronic database of GIS coverages detailing parcel boundaries and monitoring plot locations (once established), and maps archived in both digital and hard copy form. Original field monitoring data sheets, GIS data layers, reports of analyses and supporting spreadsheets will be stored in digital form at the Investancia Office. Given the extended timeframe and the pace of production of updated versions of software and new hardware for storing data, electronic files will be updated periodically or converted to a format accessible to future

software applications. Adherence to these procedures will ensure smooth transitions and maintain "institutional memory" in the event of changes in personnel responsible for the monitoring plan.