FAZENDA SÃO PAULO AGROFORESTRY

Document Prepared By
Carbon Credits Consulting S.r.l.

Project Title	FAZENDA SÃO PAULO AGROFORESTRY
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Project Location	Brasil, Municipality of Campo Grande, capital of the State of Mato Grosso do Sul.
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Validation Body	RINA SERVICES SpA, auditor Rita Valoroso, Tel. +39 010 6021711; E-mail: rita.valoroso@rina.org
Project start date	01 January 2013
Project Lifetime	01 January 2013 – 31 December 2037; 25 years lifetime
Brief summary of the project's expected climate, community and biodiversity benefits	The change from the former use of the land based on extensive cattle ranching to a definitively sustainable forest management and production systems, allows to reach the following key benefits. 1) A significant increase of the productivity compared to the previously degraded grassland would ensure the creation of employment, together with a more stable and technically skilled labour force. 2) Overall benefits for the social community arising from a further increase of the services in the region and of related and strictly connected social and productive infrastructures. The results would positively influence the quality of life of the population.

	3) Environmental benefits include the mitigation of climate change, regulation of water flows and the conservation of wildlife and of biodiversity in the relevant region.
GHG Accounting Period	01 January 2013 – 31 December 2037; 25 years lifetime
History of CCB Status	Full validation
Expected verification shedule	

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1 GENERAL

1.1 Summary Description of the Project

The **Fazenda São Paulo Agroforestry – Brazil** project (the 'Project') is a VCS AFOLU (Agriculture, Forestry and Other Land Use) project (scope 14) and, specifically, it falls under the ARR (Afforestation, Reforestation and Revegetation) category.

The project consists in the the reforestation of degraded lands, which would continue to remain degraded in the absence of the project. The Project aims to produce timber for different destinations of use.

The Project is located in Brazil - Municipality of Campo Grande, capital of the State of Mato Grosso do Sul.

The total area of the Project has an extension of 1,055.6736 hectares and it is located inside the Fazenda São Paulo, a private farm. Two species have been specifically chosen for the afforestation project: *Eucalyptus* (*Corimbia*) *citriodora* and *Eucalyptus urograndis* (hybrid of *E. urophylla* e*. grandis* species).

These two species, originating from Australia, have adapted very well to the soil and climate typical of the region of Mato Grosso do Sul, thanks mainly to the high rainfall and the high photoperiod, which ensure a high yield of these timber species.

The planted areas were previously occupied by degraded pasturelands, where extensive cattle farming was practiced with very low livestock loads per hectare (0.6-0.8 Livestock Unit).

'Extractive' and irrational cattle farming, which had been practiced for decades before the start of the project, led to a progressive impoverishment of the soil and to extensive erosion formation, which, together with significant environmental damage, gradually and inexorably compromised even productivity rates and economic returns deriving from livestock farming activities.

Thanks to the characteristics of the two Eucalyptus species that have been planted and that will be able to regenerate when cut, four 6/7-year-long cutting cycles have been envisaged by the project. After each cut, stumps sprout, thereby generating a new plant, which will in turn be cut again at the $6^{th}/7^{th}$ year and so on, up to four 6/7-year-long cycles.

The Crediting Period lasts **25 years** and it runs **from January 1, 2013 to December 31, 2037**.

The project's major climate, community and biodiversity objectives

The change from the former use of the land based on extensive cattle ranching to a definitively sustainable forest management and production systems, allows to reach the following key targets:

- A significant increase of the productivity compared to the previously degraded grassland would ensure the creation of employment, together with a more stable and technically skilled labour force;
- Overall benefits for the social community arising from a further increase of the services in the region and of related and strictly connected social and productive infrastructures. The results would positively influence the quality of life of the population;
- Environmental benefits include the mitigation of climate change, regulation of water flows and the conservation of wildlife and of biodiversity in the relevant region.

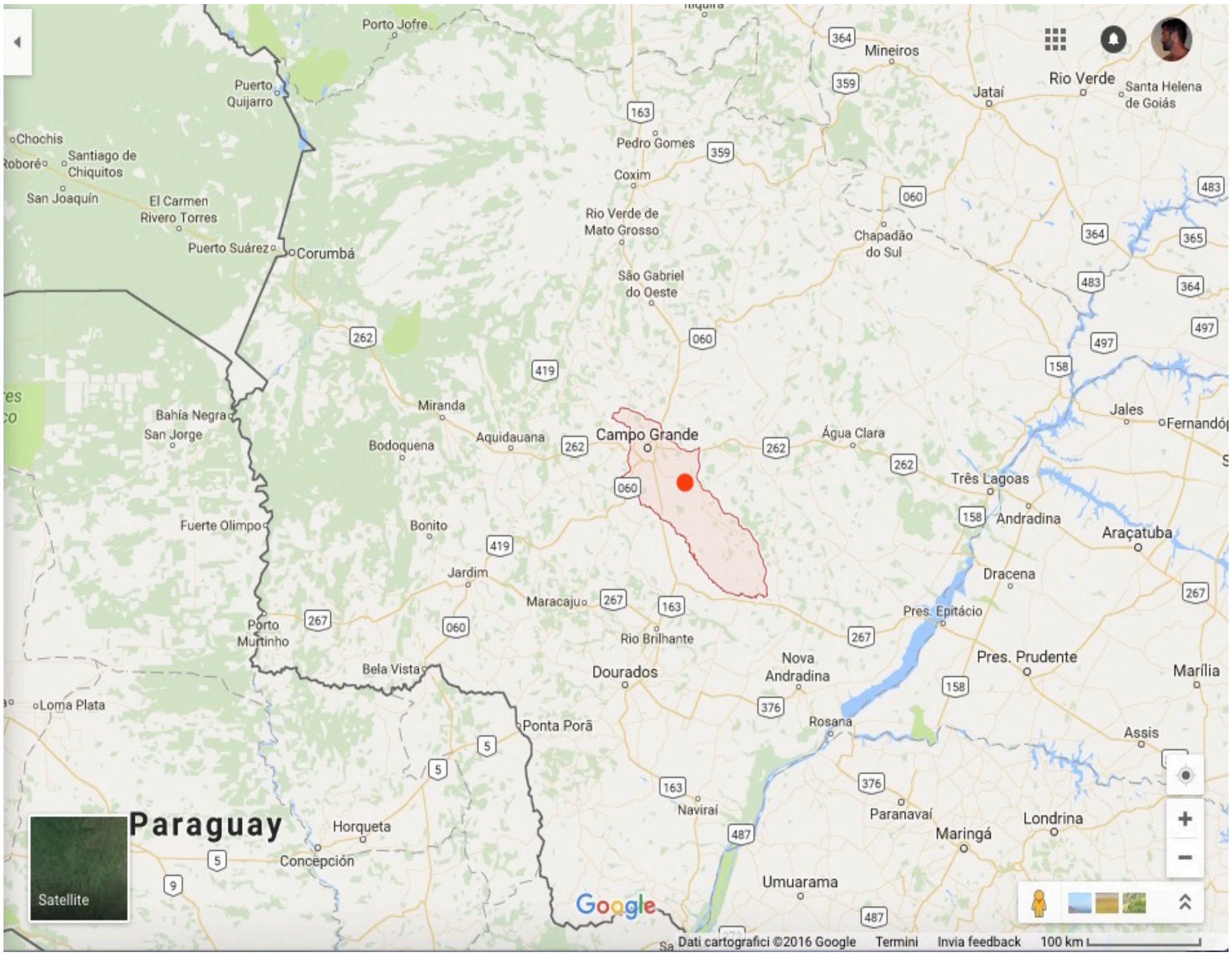
1.2 Project Location

Project location and geographic boundaries

Fazenda São Paulo, the project site, is located in the Campo Grande Municipality, capital of the State of Mato Grosso do Sul, part of the macro-region of West-Central Brazil (Map 01).

Map 01: location of the project (red dot) in the geo-physical map of Brazil (Source Google Maps).

The Campo Grande Municipality (Map 02), 8,096 km², is located in the central portion of the Mato Grosso do Sul, occupying 2.26% of the total area of the State. It is exactly located in the watershed between the Parana and the Paraguay Basin. The geographical coordinates are: 20°26'34" south latitude and 54°38'47" west longitude (PLANURB, 2007).

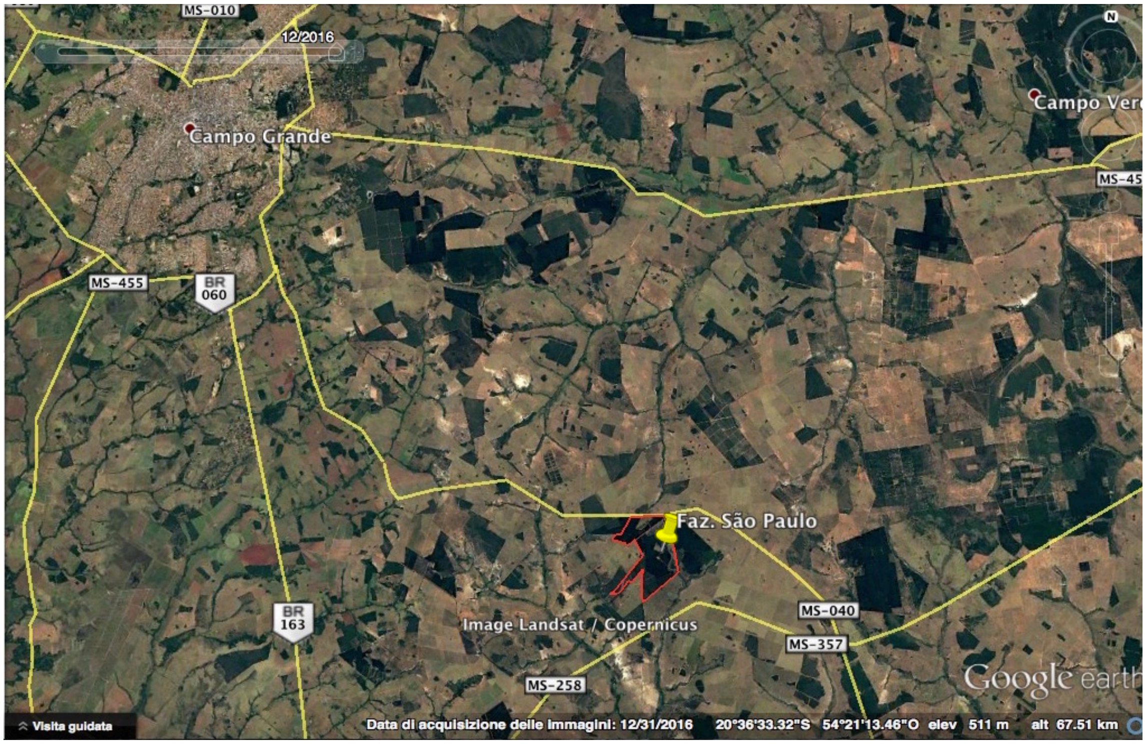


Map 02: location of the project (red dot) in the Campo Grande Municipality (Source Google Maps).

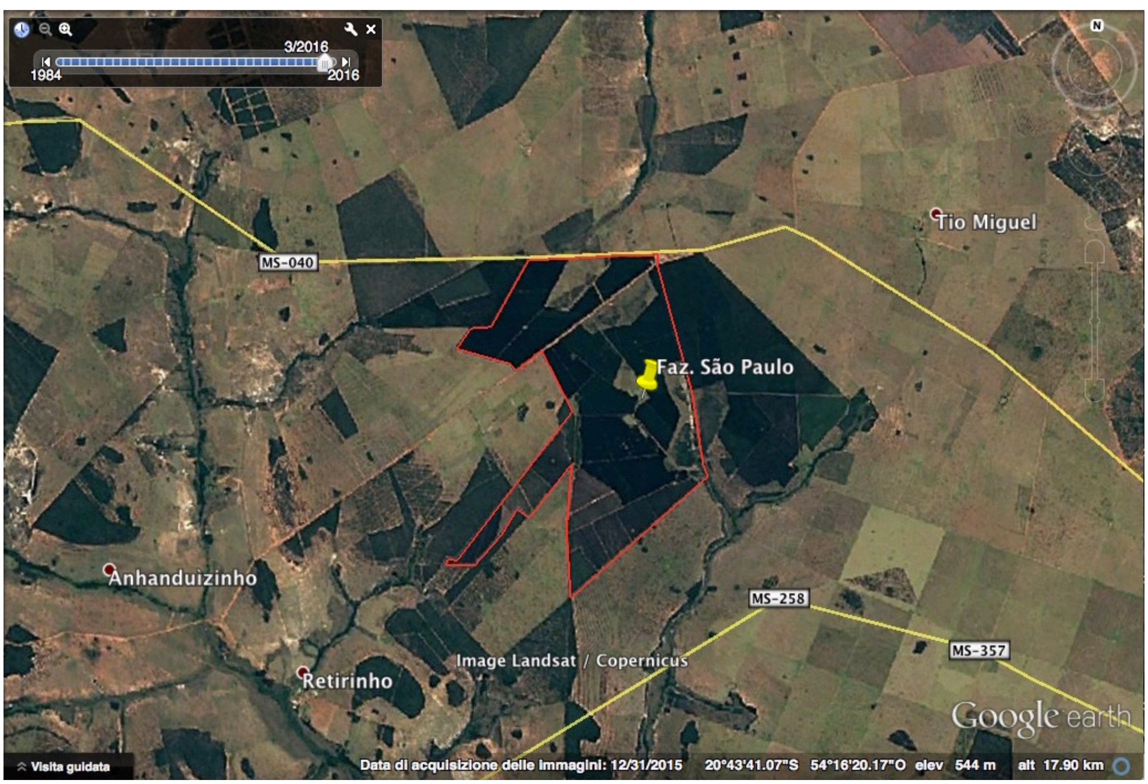
Fazenda São Paulo, site of the Project, is located at about 40 km from the city of Campo Grande (Map 03) in a region crossed by tributary streams of the *Anhanduizinho* and *Anhandui* rivers, including the ***Tres Barras*** stream that the town closest to the Fazenda is name after. All these rivers belong to the Rio Pardo river basin, which in turn is a Rio Parana tributary (*Projeto Tecnico*, Annex 09).

The geographical coordinates of Fazenda São Paulo are reported here below (Map 04 e 05):

- Northernmost point: 20°41'22.62"S – 54°18'20.34"O
- Southernmost point: 20°44'57.15"S – 54°18'19.88"O
- Easternmost point: 20°41'44.40"S – 54°17'40.17"O
- Westernmost point: 20°42'44.32"S – 54°19'38.92"O

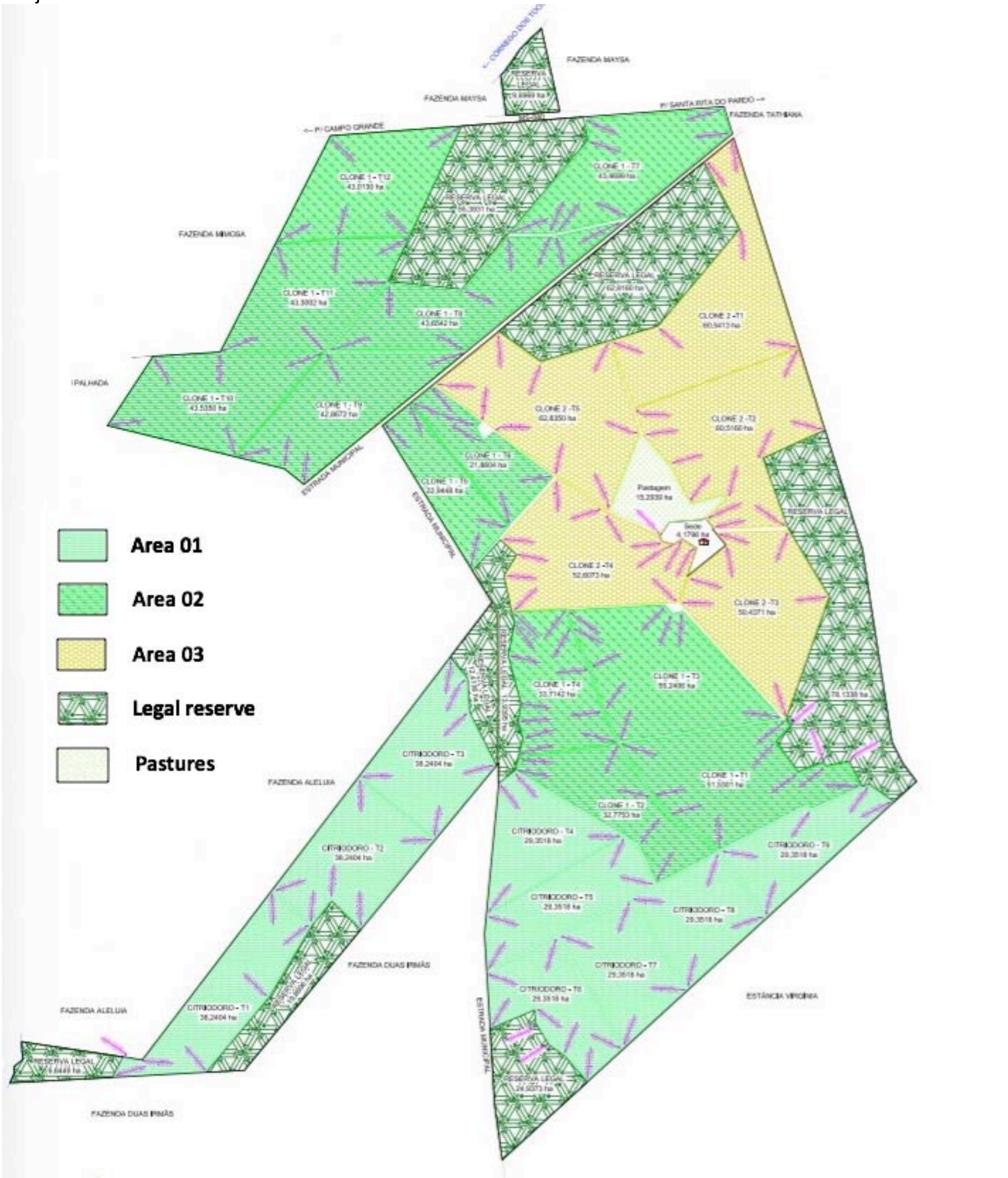


Map 03: location of Fazenda São Paulo and its borders in the territory of Campo Grande (Source Google Earth 2016).



Map 04: borders of Fazenda São Paulo (Source: Google Earth, 2016).

The following Map (Map 05) shows the characteristics and the destinations of the entire area of the Project.



Map 05: Map of Fazenda São Paulo | The three planted areas and the legal reserve area can be clearly identified, toghether with the small remaining area dedicated to pasture and the location of the Fazenda (Annex 19).

Physical parameters

Altitude | The altitude of Campo Grande Municipality varies between 500 and 675 meters (PLANURB 2013-DIOGRANDE DIÁRIO OFICIAL DE CAMPO GRANDE-MS).

Topography | The project area is characterized by a gently undulating, well-drained *low flat relief*, without excess water (*Projeto Tecnico*, Annex 09).

Soil | Dark Red Soil and Purple Soil types prevail. They are both deep and well-drained sandy soils. They are suitable for forest and perennial crops if well managed from an agronomic point of view (*Projeto Tecnico*, Annex 09). Physical (Table 01) and chemical analyses (Table 02) of the soil are reported here below. They have been carried out on a sample taken from a pool of samples harvested from the first planted area (Area 01), prior to pre-Project planting process. The complete analysis findings are listed in Annex 20.

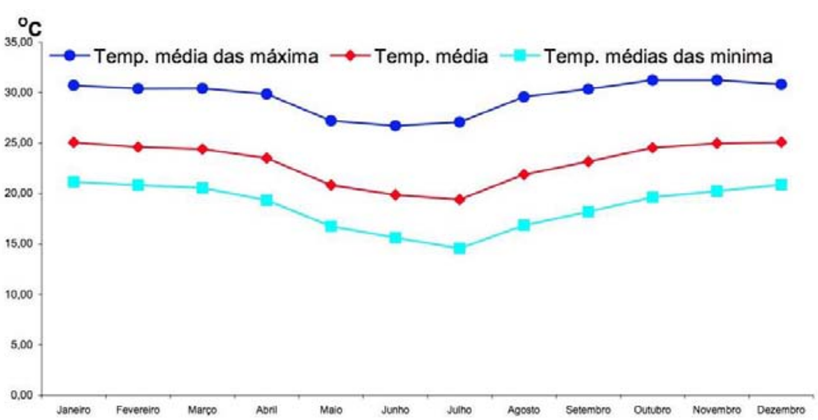
Sample/deep	Argilla	Silte	Sabbia Grossa	Sabbia Fina
Taglione 6-7-8-9	<0,002mm	0,053-0,002mm	2,00-0,210mm	0,210-0,053mm
AM.1 / 0-20	98 gr/kg	12 gr/kg	630 gr/kg	260 gr/kg
AM.2 / 20-40	79 gr/kg	11 gr/kg	270 gr/kg	640 gr/kg

Table 01: Soil physical analysis (Area 01, parcels 6-7-8-9).

Sample/deep	pH	M.O.	P	K	Ca	Mg	H+Al	Al	Soma	CTC	S
Taglione 6-7-8-9		g/dm³	mg/dm³	---------------------------- $mmol_c/dm^3$ ----------------------------							mg/dm³
AM.1 0-20	4,4	11	7	0,5	6	3	25	2	10	35	5
AM.2 20-40	4,2	11	6	0,3	6	2	28	3	8	36	4

Table 02: Soil chemical analysis (Area 01, parcels 6-7-8-9).

Climate | The Mato Grosso do Sul, located in the macro-region of West-Central Brazil, is characterized by tropical climate; hot, humid climate prevails in the central and eastern part of the State (where the Campo Grande Project is located), with at least 3 months of dry season and a longer rainy season, with the highest rainfall concentration (Projeto Tecnico, Annex 09).



Temperature | Diagram 01 shows the average maximum and minimum temperatures recorded throughout the year. The highest average temperatures are recorded in the months of October, November and December (30.80 to 31.25° C), while the lowest temperatures are recorded in July (14.56° C) (PLANURB,2007).

Diagram 01: maximum, medium and minimum temperatures, by months of year (PLANURB, 2007).

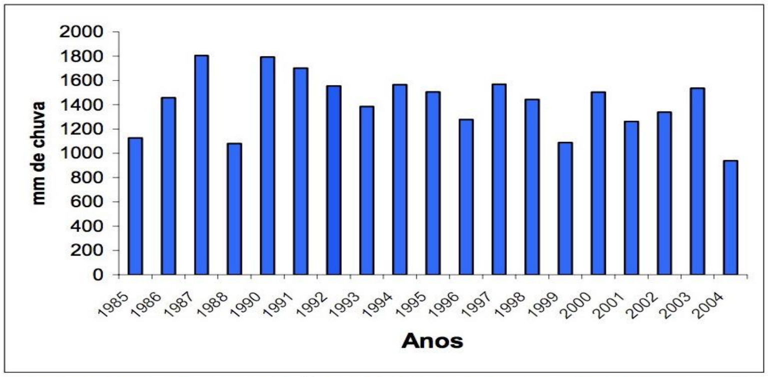


Diagram 02: annual rainfall, from 1985 to 2004 (PLANURB, 2007).

Rainfall **|** The average annual rainfall in the Campo Grande region is about **1,500 mm** (Diagram 02) but its distribution is not uniform, as can be seen in Diagram 03. In the months of June, July, August, the rainfall indices are much lower in comparison with the others (PLANURB, 2007).

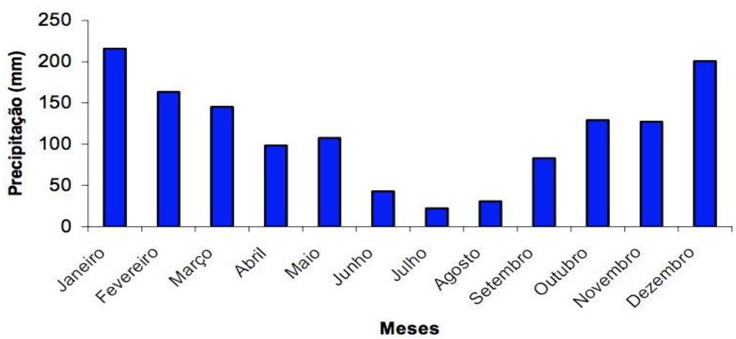


Diagram 03: Monthly rainfall (PLANURB, 2007).

1.3 Conditions Prior to Project Initiation

Vegetation

The typical vegetation of the Project zone is that of the Cerrado biome (Savannah). The Cerrado is one of the 6 biomes present in the Brazilian territory (Map 05). In general, the Cerrado presents with grassland interspersed with shrubby areas, featuring small woody trees and gallery forest areas (Projeto Tecnico, Annex 09). The Cerrado can be subdivided into four formations typical of the region:

- Forest Savannah (Gran Cerrado)
- Open Savannah or Wooded Savannah (Cerrado)
- Park Savannah (Campo Sujo)
- Gramineous-woody Savannah (Campo Limpo)

Map 05: geographical distribution of the six Brazilian biomes: Amazon, Caatinga, Cerrado, Pantanal, Mata Atlantica and Pampa (www.ibge.gov.br).

As highligheted in the 'Technical Project', the area of the Project is mainly characterized by a **Wooded Savannah (Cerrado),** often interspersed with areas more similar to **Park Savannah (Campo Sujo).**

The Forest Savannah (Gran Cerrado or "Cerradão") is a densely treed Savannah characterized by the presence of Xeromorphous tree species (Photo 01), whose trunks with rugged bark do not exceed one meter-wide circumference. It is characterized by a deep tangle of branches, with mostly perennial and leathery leaves. The average plant height is 10 m and the tree canopy closes space preventing light from penetrating into the undergrowth. It can be found on the undulating reliefs and mountain ranges surrounding grassland areas. Most of the species produce valuable timber, used in the construction of homes and as an energy resource. The prevailing species are: *Aspidosperma olivacea, Astronium urundeuva* (Photo 02)*, Andira cuyabensis* (Photo 03)*, Tabebuaia ochracea*. Some trees grow with less twisted branches and higher height, such as *Kielmeyera coriacea, Curatella americana, Qualea grandiflora, Stryphnodendron barbatiman*. Palm trees include *Copernicia australis, Platonia insignis* and *Orbignya oleifera* (Pereira, 2009).

Photo 01: Forest Savannah (Gran Cerrado).

Photo 02: *Astronium urundeuva.*

Photo 03: *Andira cuyabensis.*

Open Savannah (Cerrado): Open Savannah or wooded Savannah (or 'campo cerrado') it is characterized by scattered thickets of scrub forest, low, winding, stunted trees, with irregular branching, leathery leaves and thick bark trunks (Photo 04). The undergrowth is low, scattered, and ready to grow back in case of fire or cutting, often interspersed with a continuous gramineous layer. The plant varieties typical of sandy areas are: Curatella americana, Terminalia argentea (Photo 05), Kielmeyera coriacea (Photo 06), Tabebuia caraiba, Annona crassifólia (Pereira, 2009).

Photo 04: *Open Savannah (Cerrado)*

Photo 05: *Terminalia argentea*

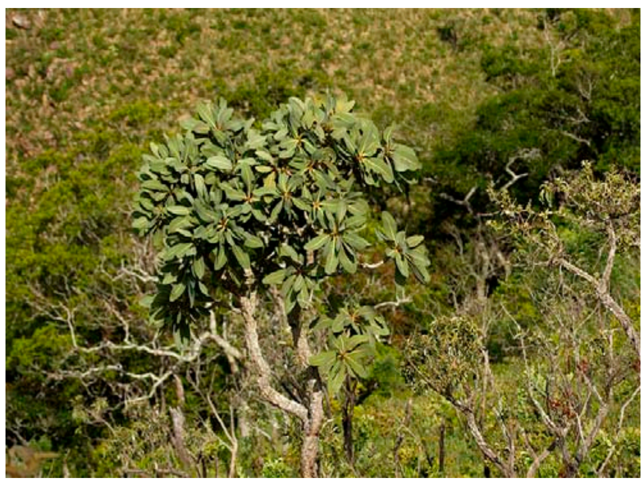


Photo 06: *Kielmeyera coriacea*

Park Savannah (Campo Sujo): with typically grassy field vegetation characterized by a layer of grasses interspersed with scattered shrubs (Photo 07). Sometimes tree thickets with the following species can be found: *Curatella americana*, *Tabebuia caraiba*, *Bowdichia virgilioides*. These species mainly grow in the plains that are annually flooded, sometimes turning into an alluvial forest (Pereira, 2009).

Photo 07: Park Savannah (Campo Sujo).

Photo 08: *Curatella americana.* **Photo 09:** *Bowdichia virgilioides.*

Gramineous-woody Savannah (Campo Limpo): It is strictly an area with a grassy plant formation, with few shrubs and a complete lack of trees (Photo 10). It can be found in different topographic positions, with different degrees of moisture and soil fertility, mainly in the highlands, rocky walls and areas adjacent to gallery forests. Mainly grasses with possible shrubs that reach one meter in height can be found. Among the main species: *Byrsonima intermédia* (Photo 11), *Annona sp.* (Photo 12), *Erythroxillum suberosum, Aristida pallens* (Pereira, 2009).

Photo 10: Gramineous-woody Savannah (Campo Limpo).

Photo 11: *Byrsonima intermédia.*

Photo 12: *Annona cherimola.*

Wildlife

The data referring to the fauna present in the Mato Grosso do Sul come mainly from the Pantanal region, a flood plain of the size of France with a very similar Cerrado biome, but featuring flooded areas in the rainy season. The fauna of that area is very rich, counting 264 species of fish, 652 species of birds, 102 mammals, 177 reptiles and 40 amphibians and 1,100 species of butterflies among insects. This fauna is also typical of the Cerrado, with some Amazonian influences. Many vertebrates typical of the Brazilian fauna live here, which cannot be found in other regions (Pereira, 2009).

HIGH CONSERVATION VALUES (HCVs)

Several High Conservation Values (HCVs) are present in the region. In particular, a significant variety of keystone species lives in the Cerrado and Pantanal areas of Mato Grosso do Sul. The Hyacinth Macaw (*Anodorhynchus hyacinthinus*) (Photo 13) is the largest bird in the Psitaccidae family and lives mainly in the Chaco of Paraguay and in Pantanal (Pereira, 2009). . This speciesis currently listed as Vulnerable in the IUCN (International Union for Conservation of Nature) Red List. The main factors causing the decline of Hyacinth Macaw populations are the illegal trade in the species and habitat loss resulting primarily from cattle ranching and forest fires. The Hyacinth Macaw is currently listed under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) Appendix I and II, protected under Brazilian and Bolivian law and banned from export in all countries of origin.In addition to this majestic Psitaccidae specimen, other related species are also present, such as *Ara chloropterus (*Photo 14) and *Ara ararauna,* which is listed under Cites Appendix II :

Photo 13: *Anodorhynchus hyacinthinus.* **Photo 14:** *Ara chloropterus.*

Several other species protected under Brazilian law also live in the area. Among the big cats: the Puma (*Puma concolor*) (Photo 15), included in CITES Appendix II, and the Jaguar (*Panthera onca*) (Photo 16), included on CITES Appendix I. The latter can be found in a fairly small distribution area, but important populations are still present in sub-regions of the Pantanal.

Photo 15: *Puma concolor.*

Photo 16: *Panthera onca.*

As documented by sightings recorded by the forest maintenance personnel of the Fazenda Sao Paulo, later confirmed by the finding of some footprints, the feline species *Puma concolor* (Puma or American mountain lion) has now started to populate the area inside and outside the Project boundaries. This species typical of the Cerrado region today is considered almost disappeared from the region, probably because of loss of habitat due to human pressure. Sporadic sightings occurred within the Project boundaries prove the presence of this precious and wonderful feline, today still considered in danger of extinction.

Puma concolor footprint found close to the torrent downstream of the Area 01 of Fazenda São Paulo.

The **Maned Wolf (Chrysocyon brachyurus**) is a canid that lives in the Cerrado. Populations of this species have suffered a retraction of their distribution within the Cerrado as a result of the ongoing conversion of intact habitat to areas with agriculture and pastures, which in turn leads to increased human ersecution due to livestock losses. This species is included on CITES Appendix II.

The **Giant Armadillo (*Priodontes maximus*)**, the largest living representative of the order Cingulata, has a preference for open spaces such as Cerrado grasslands. It is listed in Appendix I of CITES, and it is classified as Vulnerable according to the IUCN Red List. This species is considered to be of particular ecological significance, as a number of other species have been found to use the Giant Armadillos' burrows. The local extinction of *Priodontes* may therefore have cascading effects in the mammalian community by impoverishing fossorial habitats.

The **Giant Anteater (*Myrmecophaga tridactyla*)** can be found in a diverse range of habitats. A 2007 study of giant anteaters in the Brazilian Pantanal found the animals generally forage in open areas and rest in forested areas, possibly because forests are warmer than grasslands on cold days and cooler on hot days. (Mourão, G.; Medri, Í. M. (2007). "Activity of a specialized insectivorous mammal (*Myrmecophaga tridactyla*) in the Pantanal of Brazil". *Journal of Zoology)*.This species may therefore benefit from the preservation of landscape-level areas with different contiguous ecosystems. The Giant Anteater is listed on Appendix II of CITES, and is classified as Vulnerable by the IUCN mainly due to the threats posed by habitat loss and forest fires.

The Giant Otter (*Pteronura Braziliensis*) (Photo 19), is also present in these regions, despite having been fiercely hunted in the past due to the quality of its skin. The Giant Otter is listed on Appendix I of the Convention on International Trade in Endangered Species (CITES) and as Endangered according to the IUCN Red List.Protection measures have allowed the partial recovery of the original populations of this species (Pereira, 2009).

Other mammal species present include the Pampas Deer (*Ozotocerus bezoarticus*) (Photo 17) and the Pantanal Deer (Photo 18) (*Blastocerus dichotomus*), both currently included on CITES Appendix I. More in-depth studies and protection are needed in order to ensure the long-term survival of viable populations of these species. The Pantanal Deer is particularly vulnerable due to the conversion of large areas of its reference habitat (open fields), into farmland and pastureland. s. The Pantanal is one of the last areas where the number of specimens is still abundant. (Pereira, 2009). Other native species are present in significant numbers. Among these, the Capybara (*Hydrochaeris hydrochaeris*)) (Photo 20) that lives both in the Pantanal and in the Cerrado areas.

Photo 17: *Ozotocerus bezoarticus* **Photo 18**: *Blastocerus dichotomus*

Photo 19: *Ariranha pteronura Braziliensis* **Photo 20:** *Hydrochaeris hydrochaeris*

Among reptiles, a population of about 3.7 million Yacare Caimans (*Caiman yacare*), which is listed on CITES Appendix II, is estimated to live in the Pantanal. The Broad-Snouted Caiman (*Caiman latirostris*) can be found mainly in the higher areas. This species is listed on CITES Appendix I. The largest ofide of the world, the Anaconda (*Eunectes murinus)* is also present in this region in high numbers (Pereira, 2009).

According to the World Wide Fund for Nature researh (*Biodiversity conservation - CERRADO birthplace of the waters- WWF 2012) '*Deforestation, deliberate burning and uncontrolled fires are extremely harmful to the Cerrado biodiversity. An estimated one in five species to the Cerrado can no longer be found in the protected areas and there are 137 Cerrado animal species and 132 plant species on the Brazilian list of species threatened with extinction. The relatively minuscule area currently under official protection means that urgent measures are needed to create more federal, state, municipal and private protected areas. In addition to nature conservation, protected areas and preserved stretches of Cerrado provide important ecosystem services entirely free of charge, greatly contributing to ecological balance and benefit human activities. Among such services are maintaining the good quality of the air and soil fertility, supplying clean water and impeding floods and erosion processes.

The Cerrado is home to surprisingly beautiful, exotic landscapes and cultures with great economic and tourism potential. The Cerrado also has over 4.000 caves, 6 out of every 10 caves registered for the whole country. The Cerrado is home to a profusion of natural grasslands, savannahs, palm swamps and forests enhanced by many streams and waterfalls with crystal-clear waters. There are vast and impressive tablelands (Chapadas) like the Parecis, Guimaràes, Pacaàs Novos, Vedeiros, Urucuia and Espigào Mestre Chapadas. They form the watershed divides among the basins of the Sao Francisco, Tocantins, Prana and Uruguay Rivers. Renowned as the world's the richest savannah in life forms, the Cerrado is home to 120 species of reptiles, 150 amphibian species, 161 mammalian species, 1.200 fish species, 837 birds species and more than 11.600 kinds of plants have been identified in the region. Among those, more than 5.000 can only be found within the boundaries of this biome. It also contains more than 90.000 insect species of which 13% are butterflies, 35% are bee species and 23% are tropical termite species. When all that rich variety is added together, it means that Cerrado protects 5% of all the species in the world and three out of every ten Brazilian species'.

Land Use

The state of Mato Grosso do Sul has a total extension of 357,145.534 km² (35.7 million hectares). The resident population amounts to 2,449,024 inhabitants and population density is 6.86 inhabitants / km² (IBGE - Instituto Brazileiro de Geografia e Estatística / Brazilian Institute of Geography and Statistics, 2010). The State is divided into 79 Municipalities, including Campo Grande, home to the Project.

Mato Grosso do Sul has a predominantly rural economy. The most significant part is cattle raising. The State ranks third in Brazil by number of cattle (21.8 million heads - 10.9% of all cattle in Brazil). Forests cover 21% of the total area, also including planted forests. Land Use is summarized in Table 03 (IBGE 2006):

Grasslands	70% of the total area
Forests	21% of the total area
Agriculture	4% of the total area
Other uses (cities, lakes, rivers)	5% of the total area

Table 03: Land Use of Mato Grosso do Sul (IBGE 2006).

Communities

According to the IBGE (Instituto Brazileiro de Geografia e Estatística) 49.99% of the population of Mato Grosso do Sul is white, 4.5% of the population is black, 43.9% is mestizo (white with black or white with indians), 0.9% Asian and 0.6% native.

The Campo Grande Municipality has an area of 8096.051 km² and is home, according to IBGE data (2016), to 863,982 inhabitants. Most of the population lives and works in the urban area. The rural area is characterized by the presence of small and medium-sized farms, which employ more or less specialized labourers living in the countryside.

The main activity is cattle breeding, although the proximity to the capital has often stimulated local producers to diversify their production, with the aim to supply the city markets. They produce cassava, legumes, fruit and vegetables, and with regard to livestock production, in addition to cattle, they breed sheep, pigs and chickens.

Throughout the Campo Grande Municipality, and in the district of Tres Barras where the Project Fazenda is located, no conflicts and/or disputes between landowners and natives regarding land ownership are recorded.

1.4 Project Proponent

Project Proponent	CCC - Carbon Credits Consulting S.r.l.
Address	Via Salvatore Quasimodo, 42 Castel Maggiore (BO) Italy
Contact persons	Andrea Saverio Cornacchia - CEO Mobile phone (Italy) +39 392 9050342 Email asc@carboncreditsconsulting.com Davide Rossi - Director Mobile phone (Brazil) +55 67 992543491 Email dr@carboncreditsconsulting.com Web site: www.carboncreditsconsulting.com Tel. Italy: +39 051 6325511

CCC - Carbon Credits Consulting s.r.l. is responsible for the project's design and implementation.

1.5 Other Entities Involved in the Project

Project owners

Name	Ms. Luigina Fioravanti
Role in the project	Owner of the Project land - entire forest. She is the tenant of the Fazenda São Paulo farm
Address	Rua José Mariano, nº 145, CEP 79.003-106 - Campo Grande (MS) – Brazil
Contact details	Mobile phone: +55 67 84485761 Email: vmaronese@terra.com.br

The project proponent team, the owners and forestry team employed by the Fazenda have a relevant experience and appropriate skills to perform the duties related to the planting and management of the selected species. They land owners and the project proponent team have the necessary skills and experience in staff management.

The team of the project development group (Carbon Credits Consulting - CCC) has experience relating to carbon markets and AFOLU projects. CCC, in co-operation with specialized technicians operating in Brazil in the forestry sector, has acquired a longstanding experience in forest ecosystem management in tropical areas, with reference not only to native species but also to non-native species (introduced).

In particular, as regards the Eucalyptus genus, CCC has acquired a specific expertise, gained through project management in Mato Grosso do Sul from 2004 to date.

The experience, gained over the last 13 years, now covers all areas involving forestry, such as planting techniques, soil correction, risk prevention and management of skilled workers teams.

CCC Scientific Director, Luca Casoli, also has direct experience in obtaining Carbon Credits under another VCS Project, having managed the development and implementation of a Jatropha plantation project and other oilseed crops in the Senegalese Republic.

1.6 Project Start Date

In 2012, following an initial trial pre-project period, a clear cutting was made in Area 01, having an extension of 290.8320 ha. That area has been planted with *Eucalyptus citriodora.* Similarly, the Area 02 (478.0349 ha), has been planted with *Eucalyptus urograndis.* The Area 03 with an extension of 286.9367 ha, has been planted with *E. urograndis*.

From 1 January 2013 all the reforested areas of Fazenda São Paulo have been growing. Specifically, the plants growing in the Areas 01 and 02 were sprouting from a previously cut stump, while new seedlings were planted in Area 03 derived from a mother plant by clonal multiplication, all deriving from a mother plant and not from a seed (see 2.2).

The Project Start Date has been consequently identified as 1st January 2013.

1.7 Project Crediting Period

The crediting period runs from January 1, 2013 to December 31, 2037 (25 years).

The VCS AFOLU Project certification refers to the fully planted forest. During the crediting period, four cuts will be made in each one of the 3 areas included in the project.

Thanks to the regenerative properties of the Eucalyptus genus, a growth phase will follow after each cut, leading to the subsequent formation of new trees, which will be cut again after 6-7 year-long cycles.

Area 01 corresponds to a plantation regrowth. In 2012, all plants were fully clear-cut. That action had subsequently given rise to new shoots that have grown into new trees. Given that the production per hectare of a plantation regrowth is equal or even superior to that resulting from a new plantation (Barros et al., 1997; Reis and Reis, 1997; Faria et al., 2002), the crediting period for this area is considered starting from January 2013.

Area 02 refers to a plantation regrowth as well. A full clear-cutting of this area was done in 2012. The fully cut plants have subsequently given rise to new shoots that have grown into new trees. Given that the production per hectare of a plantation regrowth is equal or even superior to that resulting from a new plantation (Barros et al., 1997; Reis and Reis, 1997; Faria et al., 2002), even for this area the crediting period is considered starting from January 2013.

Whereas, Area 03 corresponds to a new planting. Even for this area the crediting period is considered starting from January 1, 2013.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
AREA 01	P							T						T						T						T							T	**32 anni**
AREA 02		P						T						T						T						T							T	**31 anni**
AREA 03								P						T						T						T							T	**25 anni**
CREDITING PERIOD													C																					**25 anni**

Legenda:

P Anno della Piantumazione
T Inizio del taglio
C Anno della certificazione del progetto (2017)

Tab. 03: Cut timeline of the 3 areas included in the Project and crediting period.

2 DESIGN

2.1 Sectoral Scope and Project Type

The Fazenda São Paulo Agroforestry project is a VCS AFOLU (Agriculture, Forestry and Other Land Use) project and, more specifically, it falls under the ARR (Afforestation, Reforestation and Revegetation) category. The project pursues the target to reforest degraded lands, which would have remained degraded in the absence of the project.

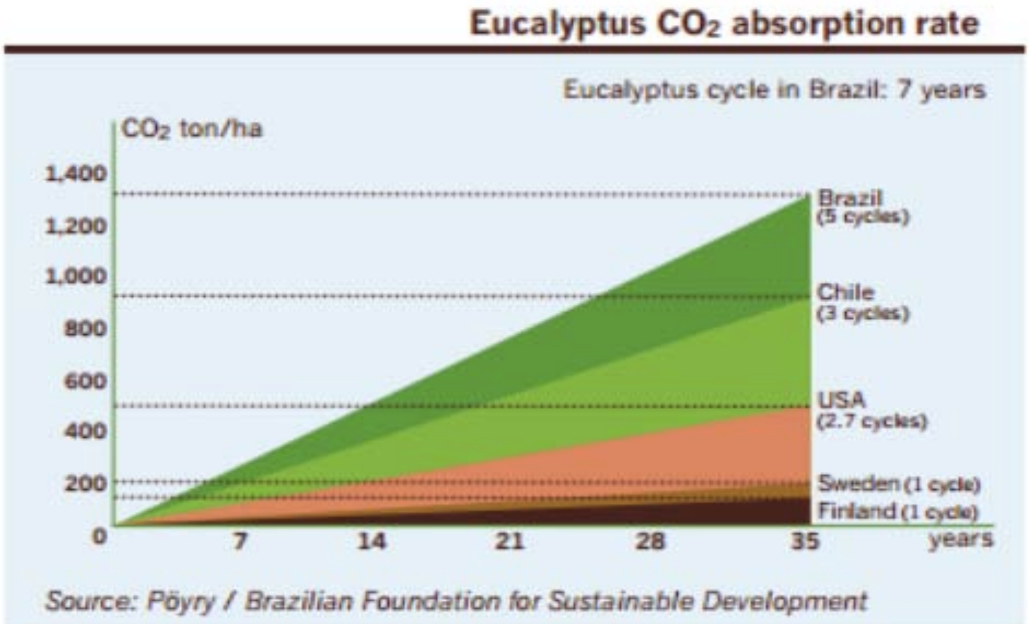
The applied methodology is the AR-ACM003, as disclosed under the United Nations Convention on Climate Change CDM (Clean Development Mechanism) methodologies: *A/R Large-scale Consolidated Methodology Afforestation and reforestation of lands except wetlands* - Version 02.

The Fazenda São Paulo Agroforestry project is not a grouped project.

2.2 Description of the Project Activity

The current consumption of timber in Brazil is 220 million cubic meters, of which 150 million m³ resulting from planted forests, of which 60% eucalyptus timber. The export of products derived from forests in the year 2007 reached 10 billion dollars, of which about 80% originated from reforestation timber (BRAGA, 2008).

Trees absorb most C02 during their growth phase, This explains the large absorption capacity of the planted forests. With the world's shortest and most productive growth cycle, pine and eucalyptus are highly efficient in capturing C02: as soon as one tree is harvested, another parcel is planted in its place, beginning a new absorption cycle (POYRY/ Brazilian Foundation for Sustainable Development 2012)



The reforestation Project developed by Fazenda São Paulo relates to a total area of **1,055.6736** ha (Map 05, Annex 19) and consists of three areas planted in different periods, with different species, but all belonging to the genus *Eucalyptus spp*.

The characteristics of the three different Project areas are described here below.

Area 01

Planted species:	***Eucalyptus (Corymbia) citriodora.***
Planted Area:	**290.8320 ha**
Plants per Ha:	**1,666**

Area 01 was the first area of the Project to be planted. It was the least productive area of the Fazenda, due to the presence of large erosions (Photo 21), of weed species in some areas and, finally, to the scarcity of available grazing land for livestock (*Projeto Tecnico de Reflorestamento da Fazenda São Paulo* (Annex 09).

Eucalyptus* (*Corymbia) citriodora

The history of the genus Eucalyptus reports that "The description of this genus was first made by Charles Louis L'Héritier de Brutelle in 1788 and it was published in Sertum Angelicum, 18, T. 20, Paris" (ANDRADE, 1939).

In 1995, following the analyses carried out on its morphological and molecular characteristics, HILL & JOHNSON, proposed a new classification, by excluding the so-called "*bloodwood*" species from the genus Eucalyptus, thus identifying a new genus, called *Corymbia*. As many as 113 different species, previously all called *Eucalyptus*, were included in this new genus. The old *Eucalyptus citriodora*, now called *Corimbia citriodora* was included in these species (HILL & JHONSON, 1995).

Because of the remarkable similarities between the genera *Corymbia* and *Eucalyptus*, and taking into account the differences of opinions expressed by many authors regarding this classification, Hill and Johnson suggested that both be commonly called ‘Eucalyptus.’ This report uses both nomenclatures.

The *Eucalyptus* (*Corymbia) citriodora* is a species native to Australia, characterized by rapid growth and medium large size, reaching up to 50 meters in height and 1.2 meters in diameter. The wood has a high density (0.99 g / cm3) and for this reason, it is fit for multiple uses (BOLAND et al., 1994).

The species Eucalyptus (Corymbia) citriodora naturally grows only in two large areas of Queensland, Australia. The largest one ranges from Maryborough to Mackay, with an extension of about 400 km, and the smaller one is confined to areas close to Atherton, Herberton and Mount Garnet. Beyond these areas, its spontaneous presence is very limited.

Eucalyptus (*Corymbia) citriodora* is located in hilly areas, including highlands and mountain ranges, thanks to its adaptability to various types of soils. It commonly grows in very poor sandy to clayey soils, with preference for well-drained soils.

The first description of *E. (Corymbia) citriodora* in Brazil dates back to the early twentieth century: "A tall, ornamental tree, with leaves having a lemon fragrance. Excellent, strong and resistant wood employed for the construction of bridges and the manufacture of car and car wheels. It has a very rapid growth. Nine-month-old specimens may reach three meters in height" (LOFGREN, 1906).

E. (Corymbia) citriodora is probably one of the species of Eucalyptus introduced in Brazil which has best thrived and maintained its original features, since no cross-breeding with other commonly planted native species occurred. The only crossing operation was performed with *E.* (*Corymbia) torelliana* and *Eucalyptus* (*Corymbia) maculata* (PRYOR & JOHNSTON, 1971). These two latter species are widespread in Brazil but not as much as *E.* (*Corymbia) citriodora.* The estimated area planted with *E. (Corymbia) citriodora* in Brazil is 85,000 ha, with the highest concentration is found in the States of Minas Gerais e São Paulo (Kronka et al., 2002).

Photo 21: Area 01 before planting, showing erosion, degraded pasture and weeds.

For this area, two well-defined periods can be identified:

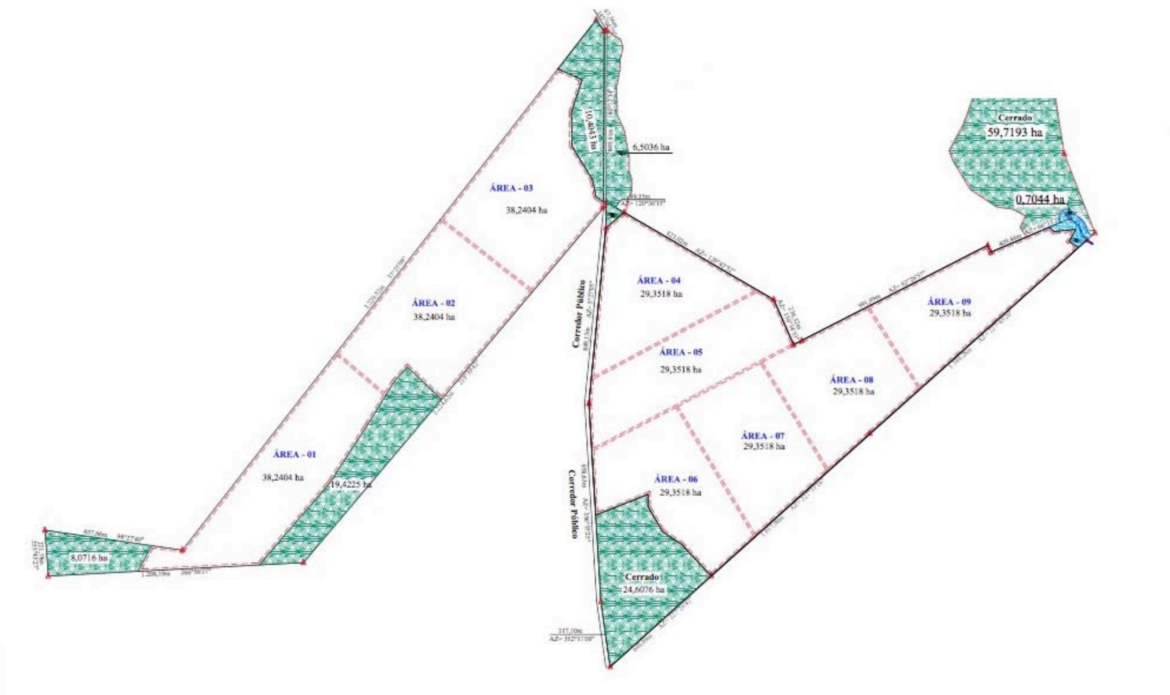
- *Project Preparation Period*: In this period, running from 2005 to 2012 (8 years) the soil preparation, the planting of the area and the plantation maintenance were carried out and finally the first cut, started in 2012 . This period was devoted to the acquisition of all the necessary experience and knowledge in the field of agri-forestry systems.

- *Project Period*: this period, running from 2013 to 2036 (24 years) relates to the project execution itself, with the 4 cyclical cuts of the plantation and the estimation of the carbon uptake.

Project preparation period

The planting of the first area was approved by IBAMA (Instituto Brazileiro do Meio Ambiente) in August 2005. It started in November 2005 and ended in March 2006.

The area was subdivided into nine land lots, also called "parcels", separated from each other by 20 meter-wide firewalls. These corridors are mainly intended to prevent and limit damage deriving from any possible fires (Map 07).



Map 07: Area 01: 290.832 ha wide area planted with *E. (Corimbia) citriodora.*

The nine parcels have the following extension:

Parcel 01: 38.2404 ha
Parcel 02: 38.2404 ha
Parcel 03: 38.2404 ha
Parcel 04: 29.3518 ha
Parcel 05: 29.3518 ha
Parcel 06: 29.3518 ha
Parcel 07: 29.3518 ha
Parcel 08: 29.3518 ha
Parcel 09: 29.3518 ha

The following set of actions according to the following timeline was implemented in the area preparation:

- Seeding of seedlings in the nursery (Photo 22)
- Erosion remedial actions;
- Ploughing of the most degraded areas (less than 5% of the Area);
- Preparation of the contour lines in most sloping areas;
- Preparation of furrows;
- Planting of plantlets in the furrows leaving a 3x2 mt. spacing (i.e. leaving a 3 meter-wide space between one row and the other, and a 2 meter-wide space between one plantlet and the other) (Photo 23 and 24);
- Precision fertilization directly in the furrows;
- Review and replacement of dead plantlets 2 months after planting.

The following maintenance activities were performed in Area 01:

- Manual weeds control of, by means of hoes and sickles (Photo 25);
- Leaf-cutter ant population control (by means of baits).

Photo 22: Area 01: *E. citriodora* seedlings ready to be planted in the ground

Photos 23 e **24:** planting of the Area 01 and detail of a *E. citriodora* seedling

Photo 25: weed manual control Area 01.

Photo 26: Area 01: 1 year-and-a-half old plants.

The extremely rapid growth, characteristic of the species *Eucalyptus citriodora* (Photos 26, 27 and 28), together with the abundant rainfall, the high Photoperiod, typical of tropical latitudes and the precision fertilization, have allowed to carry out the first harvest after 6 and a half years since planting.

Photo 27: Area 01: 4 year-old plants.

Photo 28: Area 01: 5 year-old plants. .

Test cutting in Area 01 began in January 2012, starting from parcel 09 up to 01.

Photo 29: Area 01 (*E. citriodora*): start of the manual cutting (6 year-and-a-half old plants). Please notice the 2.20 m long poles, used for pasture fences.

Photo 30: Area 01 (*E. citriodora*): timber-loading ready to be further processed

The timber deriving from test cutting of Area 01 test was mainly used for two purposes:

- Processing timber (poles for fences (Photos 29 and 30) and civil construction);
- Waste timber (less than 15% was allocated to energy production).

Timbering operations were carried out by local labor, with the employment of more than 30 workers (Photos 29 and 30);

After this first cutting, a large quantity of branches and leaves were left on site to facilitate the regeneration of valuable humus soil (Photo 31).

Project period

This period runs from January 2013 to December 2036 (24 years) and takes place following the clear-cutting of the area started in 2012 (test cut). In fact, thanks to the ability of the genus *Eucalyptus* plants to form new shoots after each cut, new plants have sprouted from the stumps of trees cut in 2012, which have now grown into new adult trees. Thanks to this feature, four 6/7-year-long cutting cycles will be carried out in Area 01 during the project period.

The test cutting, carried out between 5 and 10 cm height above the ground, allows to not jeopardizing the life of the plant itself. In fact, once it has been cut, the plant keeps its root system alive and it sprouts again thanks to chemical and light stimuli.

Photo 31: Area 01 (*C. citriodoro*): regrowth of the plants 2 months after the cut. Please note the abundant organic material left on the ground (branches and leaves, intended to be integrated into the soil).

The plant regrowth is often faster than the original plant, since it exploits an already well developed root system. Furthermore, if the regenerated plants are provided with optimal water, nutrients (fertilizers) and light conditions, yield obtained from subsequent cycles can be equal or even higher than the yield derived from the first cycle (Barros et al., 1997; Reis and Reis, 1997; Faria et al., 2002).

Starting from January 2013 the following forestry strategic Project maintenance operations were carried out:

- Cleaning of the stumps (after cutting many plant residues are left on the soil that can cover shoots sprouting from stumps).
- Soil analysis and precision fertilization
- Replacement of the dead stumps with new seedlings
- Manual pruning of sprouting plants starting from the first year.

After each cut, there may be a small plant loss (estimated between 2 and 5%), due to the death of stumps. To solve this problem, the following techniques have been implemented:

- Planting of new seedlings to replace the dead stumps: these plantlets are planted in the ground at a 30-40 cm distance from the dead stump, always along the same line, and then fertilized.
- Selection of two main stems: since the regrowth of shoots is often faster than the growth of a young seedling, the latter does not generally survive as the neighboring sprouts stifle it. When this happens, at the time of pruning, two main branches are left rather than a single branch, depending on the space left by the dead stump. These two main branches belonging to a single plant when growing back will give rise to two stems that will completely occupy the space left empty by the dead stump, thus compensating for future timber production.

The sprouting of new shoots, branches and stems is also favoured by the permanence of abundant plant material on the ground, derived from branches, leaves and bark, behaving like real mulching. Mulching is an operation practiced in agriculture and gardening, which consists in covering the soil with a layer of plant material, in order to prevent the growth of weeds, retain moisture in the soil, protect the soil from erosion and from the direct impact of driving rain, avoid the formation of so-called surface crust, decrease compaction, keep the soil temperature and structure.

According to the project timeline, the first cut envisaged for Area 01 is scheduled in January 2018.

Area 02:

planted species:	***Eucalyptus urograndis***
Planted Area:	***477.9049 ha***
Plants per Ha:	***1,666***

Eucalyptus urograndis is a hybrid plant developed in Brazil through the cross between two highly productive species, *E. urophylla* and *E grandis.* (Ruy, 1998).

These two species were crossed together to obtain plants with a good growth, a feature of *E grandis*, and a considerable increase in the density of timber, in addition to an improvement of the yield and physical properties of the cellulose, typical characteristics of *E. urophylla*. The interest in crossing *E. grandis* and

E. urophylla also derived from the robustness and resistance to water deficit of *E. urophylla*.

Obviously, being a genetic stock resulting from interspecific hybridization, the entire forestry of this "species" is based on the monoclonal modality with the ultimate goal of retaining its desirable features (AGROTECA Tanabi, 2008).

This interspecific combination results into a vigorous tree, resistant to various diseases, which today is widely used in commercial plantations for the production of raw materials such as cellulose, charcoal and sawmill timber (PALUDZYSZYN, and CORDEIRO RODRIGUES, 2004).

Clone can be defined as a population of cells or individuals originating from an asexual division starting from a cell or individual (RAVEN, 2007). According to SILVA (2005) "clonal forestry" includes the entire process of forming a clonal forest, including the selection of "superior" trees or "mother plants", vegetative propagating material, the evaluation of the selected trees by means of clonal testing, production of seedlings and the planting of the clonal forest.

Vegetative and asexual propagation does not involve genetic recombination. The cloning of "superior" trees deriving from the cross and the large-scale use of this technology were two of the main factors that have enabled Brazil to reach its worldwide reputation in the high quality and low cost eucalyptus production.

The cloning process has brought about the following benefits:

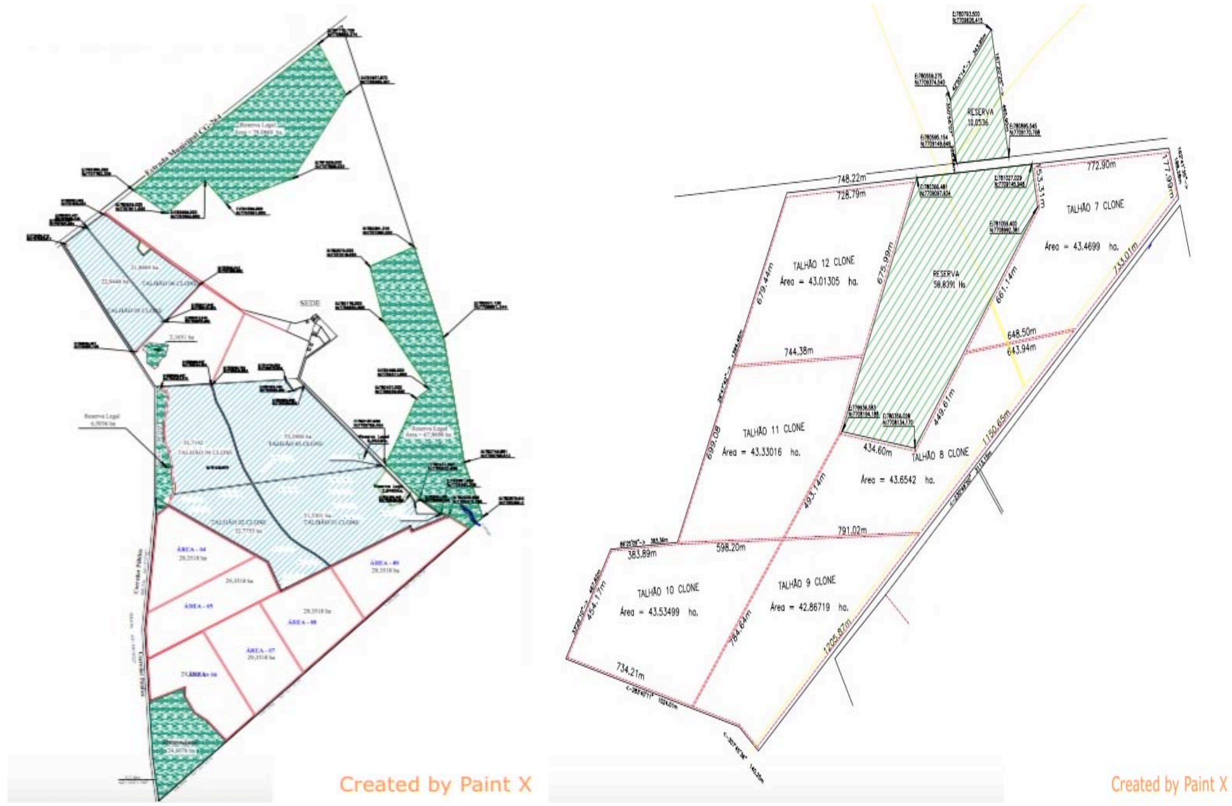
- Total forest productivity increase;
- Better wood quality (density, fiber type, content of lignin and cellulose);
- Greater homogeneity of the raw material for the industry;
- Better performance of (forestry and industrial) operations;
- Better use of marginal (less productive) areas;
- Better planning and prognosis of the final production;
- Significant reduction of production costs and of the environmental impact of the industrial process (PALUDZYSZYN, CORDEIRO E RODRIGUES, 2004).

Eucalyptus cloning has strongly contributed to the technological evolution of the Brazilian national forestry. Today the clonal eucalyptus plantations occupy large areas and are characterized by high productivity, premium quality of wood and high phenotypic stability in production. *E. urograndis* stands out as the most common variety (BRAGA, 2008).

Eucalyptus farming in Brazil has a high average productivity of about 45-60 m³ / ha / year (MORA and GARCIA, 2000) and is mainly represented by *E. urograndis* clonal forests (Alfenas et al., 2004).

The first *E. urograndis* cultivation was made in the State of Espírito Santo in the late '70s. But it is only in the ‘90s when this species prompted the Brazilian forest growth rate (COSTA, J. A., 2011).

Area 02 (Map 08 & 09) was the second project area to be planted. The choice to plant a second area with eucalyptus has resulted from the planting success of Area 01. Extensive cattle ranching was practiced also in this area, pastureland was visibly degraded with some signs of erosion (Photo 32). This area as well was not very productive from the animal husbandry point of view. The annual average of UA (450 kg) per hectare was 0.6-0.8.



Map 08 e 09: Area 02 with an extension of 477,9049 ha, subdivided in 12 parcels, planted with *E. urograndis.*

The pre-project planting activity of Area 02 was approved by SEMA - *Secretaria de Estado de Meio Ambiente* in August 2007 and it started in the same month.

The area was subdivided into 12 parcels, separated from each other by 20 meter-wide firewalls.

Parcels have the following extension (Map 08 and 09):

Parcel 01: 51.5301 ha
Parcel 02: 32.7753 ha
Parcel 03: 55.2406 ha
Parcel 04: 33.7142 ha
Parcel 05: 22.9448 ha
Parcel 06: 21.8604 ha

Parcel 07: 43.4699 ha
Parcel 08: 43.6542 ha
Parcel 09: 42.8672 ha
Parcel 10: 43.5350 ha
Parcel 11: 43.3002 ha
Parcel 12: 43.0130 ha

Photo 32: Area 02 (*E. urograndis*): degraded grazing land.

Planting of plantlets (Photo 33 and 34) occurred leaving a 3x2 spacing (i.e. leaving 3 meter-wide space between one row and the other, and 2 meter-wide space between one plantlet and the other, according to the following timeline:

- Erosion remedial actions;
- Ploughing of the most degraded areas (less than 5% of the Area);
- Preparation of the contour lines in most sloping areas;
- Preparation of furrows;
- Planting of plantlets in the furrows
- Precision fertilization directly in the furrows according to NPK formula + trace elements;
- Review and replacement of dead plantlets 2-3 months after planting.

Similarly, as already done in Area 01, the following forestry non recurring and Project management and conservation activities were carried out:

- Manual weed control (by means of hoes and sickles);
- Ant population chemical control.

Photo 33: Area 02 (*E. urograndis*):
3x2 spacing (1.666 plants per ha).

Photo 34: Area 02 (*E. urograndis*):
Seedling specimen 1 month after planting.

Photo 35: Area 02 with 5 month-old plants.

Photo 36: Area 02 with 10 month-old plants.

Photo 37: Area 02 with 2 year-old plants.

Photo 38: Area 02 with 3 year-old plants.

The cutting permit for the pre-project planting activities was issued by SEMA in September 2012 (Annex 15). The first cut began in October 2012 and ended in February 2013.

The production estimate by SEMA (*Secretaria de Estado de Meio Ambiente*) was 109,798.84 m³ of total planted area of 477.9049 ha, namely 229.75 m³ / ha with a 5-year cycle (45.95 m³ / ha / year). This figure respresents conservative estimation, since the forestry production data have largely exceeded 55 m³ / ha of production with a 5 year cycle.

Photo 38: Area 02 with 3 year-old plants.

Photo 39: Area 02: mechanical cutting of the forest.

Photo 40: Area 02: measurement of cut logs.

Photo 41: Area 02: deposit of cut logs.

Timber harvesting was carried out mechanically (Photos 39, 40 and 41) and lasted just four months. For cutting and harvesting work local labour was used, and more than 40 workers were employed. The harvested timber was entirely sold for cellulose extraction.

Regular cutting operations allow a lot of organic material to be left on the ground (tree tips, twigs and leaves). This organic material derived from cutting and selection of timber contributes to the improvement of organic matter levels in the soil (please notice the previous pictures and in particular Photo 40), for a more effective and proper preparation of the Prohect implementation and management.

Currently, Area 02, thanks to *E. urograndis* plants' ability to regenerate a new plant and the pre-project activies planned and carried-out, features 4-year-old plants. According to the Project, as in Area 01, four 6/7 year-long cycle cuts are envisaged even for this area, The beginning of the next cut is scheduled in 2018.

Area 03

Planted species:	***Eucalyptus urograndis***
Planted Area:	**286.9367 ha**
Plants per Ha:	**1,666**

The planted area is divided into 5 Parcels (Map 10):

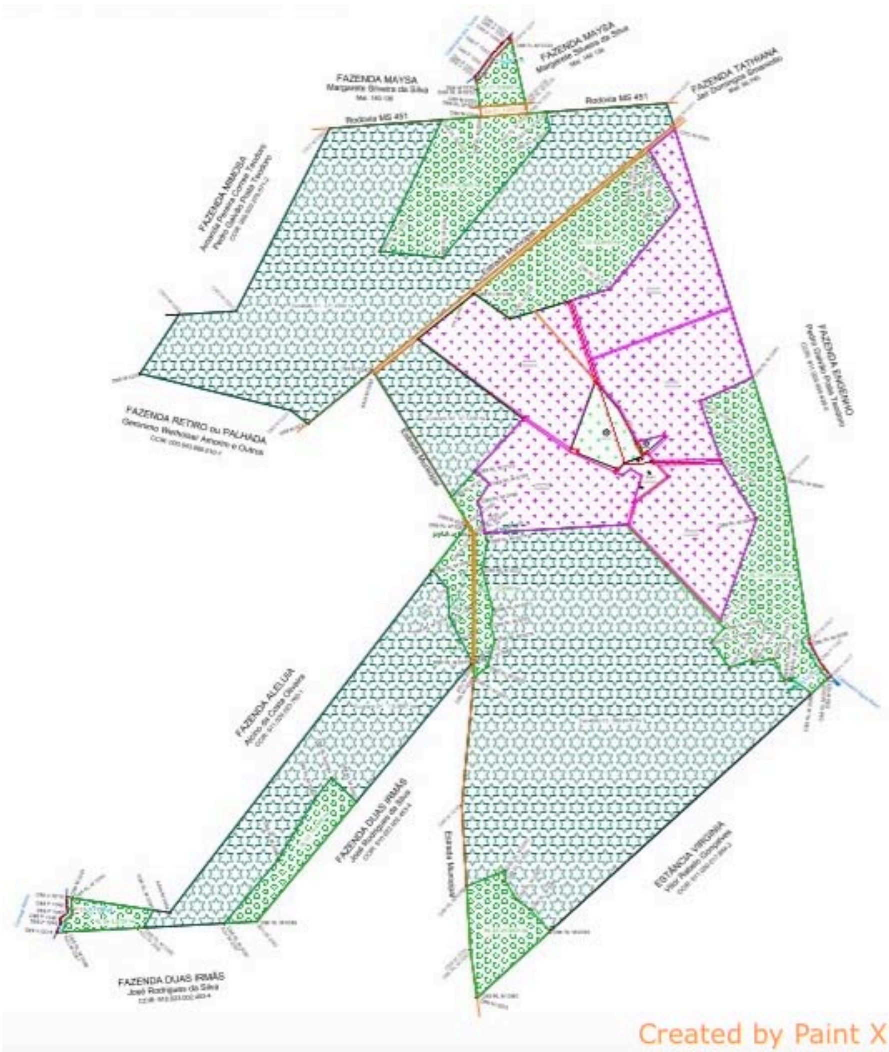
Parcel 01: 60.5413 ha
Parcel 02: 60.5160 ha
Parcel 03: 50.4371 ha
Parcel 04: 52.6073 ha
Parcel 05: 62.8350 ha

SEMA (Secretaria de Estado de Meio Ambiente) environmental authorization for planting was issued in May 2012 (Annex 17). Planting started in July 2012 and ended in November 2012.

This area, similarirly to the previous ones, was not productive. There were many erosions and degraded pastures (Photo 31). As in Area 02 Eucalyptus urograndis was planted with a 3x2 m spacing (1666 plants per hectare).

Planting operations were carried out according to the same timeframe as in Area 02.

Erosion, which was less serious in this area, was remedied to. Furrows were excavated (Photo 35) to plant the Eucalyptus urograndis seedlings. Precision fertilization based on NPK formula was applied and after the planting a review was carried out to replace dead seedlings.



Map 10: Area 03 with an extension of 286,9367 ha (in pink), subdivided in 5 parcels, planted with *E. urograndis.*

For this area a mechanized planter was used, which was much more efficient and faster than the traditional manual planting method (Photo 32). As of January 2017, Area 03 featured on average 4.5 year-old trees. Growth is fast and smooth (Photo 34). The first cut will be made in the second half of 2018. Timber will be harvested and used for the production of cellulose in this area, as well.

Photo 31: Area 03 (*E. urograndis*): degraded grazing land

Photo 32: Area 03 (*E. urograndis*): start of mechanized planting

Photo 33: Area 03 (*E. urograndis*): newly planted seedlings.

Photo 34: Area 03 (*E. urograndis*): 5-month-old seedlings.

In particular, a few specific plants that make up the undergrowth of the native Cerrado (savannah) (bush) can commonly be found in this type of forest, such as:

- Tabebuia alba
- Astronium fraxinifolium
- Astronium urundeuva
- Anadenanthera peregrina
- Anadenanthera colubrina

Today, these species are considered rare and are protected by Brazilian legislation, whereas in the past they were traded illegally together with other types of precious timber.

Finally, the following table (Table 04) provides a description of all the planted areas and the corresponding age and size related information for each parcel as of January 2017.

	Parcel N°	Ha	REGROWTH	Age 1° January 17	1° cut
AREA 1 – *E. citriodora* 290,8320 ha	9	29,3518	JAN 12	60 month	2018
	8	29,3518	MAY 12	56 month	2018
	7	29,3518	SEPT 12	52 month	2018
	6	29,3518	JAN13	48 month	2019
	5	29,3518	MAY 13	44 month	2019
	4	29,3518	SEPT 13	40 month	2019
	3	38,2404	JAN 14	36 month	2020
	2	38,2404	MAY 14	32 month	2020
	1	38,2404	JUNE 16	7 month	2022
AREA 2 – *E. urograndis* 477,9049 ha	Parcel N°	Ha	REGROWTH	Age 1° January 17	1° cut
	1	51,5301	SEPT 12	52 month	2018
	2	32,7753	SEPT 12	52 month	2018
	3	55,2406	SEPT 12	52 month	2018
	4	33,7142	OCT 12	51 month	2018
	5	22,9448	OCT 12	51 month	2018
	6	21,8604	OCT 12	51 month	2018
	7	43,4699	NOV 12	50 month	2018
	8	43,6542	NOV 12	50 month	2018
	9	42,8672	NOV 12	50 month	2019
	10	43,5350	DEC 12	49 month	2019
	11	43,3002	DEC 12	49 month	2019
	12	43,0130	DEC 12	49 month	2019
AREA 3 – *E. urograndis* 286,9367 ha	Parcel N°	Ha	PLANTING	Age 1° January 17	1° cut
	1	60,5413	JULY 2012	54 month	2018
	2	60,5160	AUG 2012	53 month	2018
	3	50,4371	SEPT 2012	52 month	2018
	4	52,6073	OCT 2012	51 month	2018
	5	62,8350	NOV 2012	50 month	2018

Table 04: List of Planted Areas and Parcels, showing the age and size of plants as of January 2017.

As of today, Fazenda São Paulo covers a total area of 1,410.7692 hectares and is divided into:

- **Planted Area**: 1,055.6736 ha (74.83%), which relateds to Area 01, Area 02, Area 03
- **Legal Reserve Area**: 287.0647 ha, (20.35% (pursuant to the law).
- **Site + Roads + Corridors**: 52.7370 ha (3,74%).
- **Pastures**: 15.2939 ha (1.08%); in this area dairy cattle and sheep breeding is practiced for the owner's own consumption and for the workers working on the ranch.

A criticism that is often raised to Eucalyptus forests is related to the soil impoverishment of the regions where they are planted. In agreement with Palmberg (2002), the removal of nutrients from the soil in eucalyptus plantations depends on: (1) the plantation management techniques; (2) harvesting methods.

First of all the consumption of nutrients per eucalyptus tree is not greater than the consumption of nutrients by other agricultural crops. A comparative analysis on nutrient uptake by different cultivated species can be seen in the Diagram, whose data come from the *Departamento de Solos* della *Universidade Federal* di Viçosa (MG-Brazil). It is clear that soybean, corn and sugar cane crops absorb a much larger amount of nutrients (phosphorus and nitrogen) than Eucalyptus tree plantations in an 8 year-long period.

FIGURA 2
Necessidade de Nutrientes de Várias Culturas Durante Oito Anos

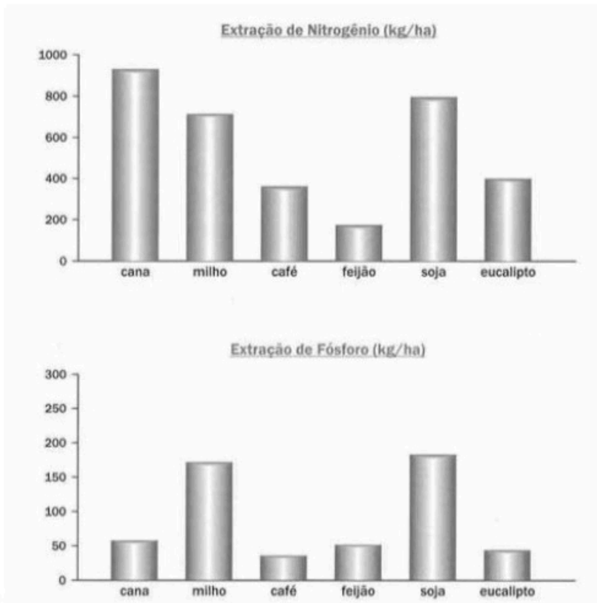


Diagram : nutrient uptake rates of various crops in an 8 year-long period.

The uptake of nutrients contained in different parts of the plant, and the consequent ecosystem depletion, takes place at harvest time, when the biomass, which has been produced, is harvested and withdrawn from the forest. This effect can be mitigated when roots, leaves and bark are left in situ, on the ground, after harvesting. Leaving these organic residues on the ground after timbering most of the nutrients contained in the plants are returned to the soil. It has been estimated that for every ton of timber, which is produced, an amount ranging between 0.3 and 0.35 tons of crop residues is returned to the ground (Vital, 2007).

According to other authors, thanks to the seven-year-long rotation (longer than other crops) the withdrawal of nutrients per unit of time is lower in eucalyptus plantations than in any other agricultural crop. Furthermore, most of the authors consider that the environmental impact of planted forests on the soil depends on the context or even on the "biome" in which the forest is located, or on soil conditions prior to the planting of plantations. Bouvet (1999), for example, stated that Eucalyptus trees, when planted in degraded areas of the savannah, provide a substantial increase in the amount of humus in the ground.

The Photo shown below were taken in Area 01 of Fazenda São Paulo during the first cutting, show the amount of branches, leaves and bark left on the ground after timber harvesting. These plant residues are incorporated into the soil thereby increase the amount of organic matter in the soil.

Area 01 during cutting: after timber harvesting, bark, branches and leaves are left on the ground.

Area 01 after cutting: plant residues left on the ground after harvesting are incorporated into the soil

To conclude, Davidson (1985) stated that, in general, the nutrient uptake per timber product quantity of eucalyptus trees is lower than that of other forest crops, thanks to a more efficient nutrient consumption.

With regard to soil erosion, in accordance with most of the authors, there is little or no experimental evidence that there are differences between the levels of erosion of eucalyptus forests and other types of plantations. Yet, some considerations could be made. First of all, the erosion level of a given ecosystem depends on the amount of water that reaches the ground, the ground slope and the physical characteristics of the soil, such as porosity, water absorption capacity, residue amount in the soil at rainfall (Vital, 2007). Two of these factors (i.e. the quantity of water that reaches the ground and the amount of residues present on the ground) depend on the species planted in that place. In fact the amount of water that reaches the ground depends on the physiological characteristics of the leaves (such as size and inclination), and the amount of residues on the soil depends on the natural fall of dead branches and leaves.

Once again, many authors refer to the environmental conditions prior to planting as a fundamental factor for the measurement of the environmental impact assessment. In agreement with Davidson (1985), replacing native forests with planted forests, a bigger amount of water flowing on the soil with subsequent soil erosion effects can be expected (since the relatively small eucalyptus leaf area index allows more water to flow to the ground).

On the contrary, if eucalyptus trees are planted in the savannah or other areas with degraded soil, with little or no vegetation cover, an improvement in the soil density and aeration capacity, as well as a considerable humus increase can be expected.

Chinnamani (1965) recorded negligible soil losses between of *E. globulus* and *Acacia mollissima* plantations, in an experiment conducted in India, except for moments prior to planting and subsequent to timber cutting and harvesting.

In the case of Fazenda São Paulo, the decrease in the water erosive action following the Eucalyptus plantation was clearly observed, due to a slowdown in the water speed thanks to the abundant residual material left on the ground and thanks to the preventive formation of contour profiles during the planted areas preparation period.

Not all the benefits, including soil and biodiversity benefits, would have occurred in the absence of the project.

2.3 Management of Risks to Project Benefits

This section focuses on the analysis of the risks that could affect the growth, the production of CO2 and the consequent sequestration of CO2 of the Project in question and, consequently, the loss of the economic and social and Community benefits that this Project aims to bring to the local Community. At the same time, these risks could have detrimental consequences on biodiversity, which the Project intends to maintain and preserve.

Natural disasters

Geological risk | *Seismic activities* | The region where the Fazenda São Paulo is located is not characterized by significant seismic activities: no earthquakes, even mild ones, have ever occurred.

Water risk | *Floods and flooding* | Being a hilly region, with moderate altitudes, no floods occur, and even in the presence of heavy prolonged rains, soil, thanks to its texture and slope, is always well drained, avoiding in this way rainwater accumulation. The rivers flooding risk is not significant: the entire area concerned by the Project is crossed only by small streams.

Even the hurricane risk of is extremely low. Since the first planting (2005) no serious events have ever occurred enough to cause significant damage, which could have affected the state of health of trees.

There is no prolonged drought risk: the dry season is relatively short (3-4 months per year) and it is often characterized by rainfall of short duration, bringing benefit to the vegetation.

Fire

Fire risk has been taken into account since the planning of planting of the first area in Fazenda São Paulo, with reference no only to fire potentially caused by natural factors (lightning) but also fire caused by human factors.

To reduce the risk of forest resources loss, each one of the 3 areas that make up the forest has been subdivided into smaller plots, called "parcels", separated from each other by "firewall" corridors having an extension of about 20 meters. These corridors also separate parcels from the roads, from neighboring property and from the Legal Reserve adjacent areas.

All the personnel involved in forest cutting and maintenance operations has received adequate training on fire prevention and fire control techniques. Smoking is forbidden in all forest areas for all the staff. The fire-fighting equipment is always present and available in the planted areas (tractor with tank truck and fire hydrants).

Since 2005 no fires either caused by natural or human factors, have ever occurred in any of the three areas that make up the forest.

Biohazard – pests

Given the presence of some species of leaf-cutter ants of the genus *Atta spp.* in these ‘Cerrado’ regions, a few pest prevention and control plans have been developed and implemented both in the planting and growth stages of eucalyptus trees and of the forest in general. This type of ants originating from Latin America and abundant in the tropical areas, has the habit of cutting pieces of leaves, bringing them into their nests to serve as a substrate on which to grow a fungus (*Leucoagaricus gongylophorus*), which constitutes their exclusive food. In Brazil, they are considered among the most hazardous agricultural pests.

Ant control plans involve the use of Sulfuramide based granulated baits, mainly used in the dry season and scattered throughout the area, and, in case of emergency, Fipronil based powders are directly used on ant nests, once they have been identified.

If not kept under control, these ants can cause huge forest losses, from a delay in the forest growth to the loss of entire forest areas. Today a systematic and periodic ant control plan is implemented with the use of granulated baits in all the three areas of the entire forest. No other pests are present.

Infectious diseases

In the 10 –year period following the planting of the first area, no eucalyptus infectious diseases have been recorded in any of the three forest areas.

In the light of the detailed analyzes that have been made, no major risks have arisen that may cause any loss of benefits for the local community, climate and biodiversity, arising from the Project.

2.4 Measures to Maintain High Conservation Values

According to the Project plan and the local rules, some area will be left without intervention, including savannas. Benefits of these legal reserve zone include the stabilization of the soil to prevent erosion; the filtering of suspended soils, nutrients and harmful or toxic substances; the moderation of water level fluctuations; the providing of essential habitat for cerrado associated wildlife species; the reduction of the potentially adverse human impacts.

This would allow the conservation of habitat for wildlife, a key aspetc to maintain the provision of ecosystem services. These features would attract animal species, positively affecting the biodivesity level.

The forest plantations aim also to maintain the High Conservation Values of the Region. The cover vegetation generated by the plantations, would offer an appropriate environment for endemic, vulnerable or threatened species.

Monoculture tree plantations, associated with good forestry management practices can guarantee the conditions for natural regeneration compared to abandoned pastures. Tree plantations may support biodiversity conservation, playng the role of ‘soft barrier’ for wildlife, providing a suitable habitat for many and also endangered species.

2.5 Project Financing (G3 & G4)

The Project design, implementation and development stage has been financed by own funds by the owners of the area, without resorting to bank loans and/or third party investors, up to the date of the drafting of this document.

The absorption of financial resources invested in the Project implementation, together with significant forestry management costs, make the revenues deriving from the sale of Carbon Credits strategically important. Financial resources derived from this new source of revenue would be able to ensure a total positive cash flow, providing greater robustness and sustainability for the Project and its related benefits for the climate, biodiversity and for the local communities of the Region.

With regard to the financial health of the Project, no member of the management team (Project Participants) is involved in any criminal issues related to corruption offenses.

2.6 Employment Opportunities and Worker Safety (G4)

The Fazenda São Paulo Agroforestry Project started in 2005. Since then, it has employed dozens of people in the region. The local workforce has been largely used for the soil preparation and for the forest planting, fertilizing, cleaning, maintenance and cutting work. Currently the Project has reached a pre-cut stage. Six workers are employed in charge of forestry maintenance.

Since the beginning, Project activities have been performed by local workforce, coming from the nearby city of Campo Grande. Some tasks have been entrusted with third parties, using specialized local companies working in the reforestation sector. The cutting phase is the highest labour intensive stage of the production cycle. Up to 40 workers have been employed in the cutting operations performed in previous periods. Another labour intensive activity is the forest maintenance and management immediately after cutting, and in particular the cleaning of the ‘stalks’. As already disclosed in a previous section, cutting is made just a few centimeters from the ground, leaving a stalk/ stump that is often covered with branches, leaves, bark. To allow the stalks to sprout it is necessary to uncover them from these plant residues. This activity is done manually by means of hoes. After sprouting, a further labour intensive operation is pruning, which is intended to select the strongest shoots, which will generate a new tree in the next cycle. Usually just one main shoot is left in place and all the other shoots of the same stalk are pruned off. Even this operation is done manually, using scythes and pruning hooks. In case of a nearby dead plant, two shoot are left, so that the second shoot can benefit from the space left free by the nearby dead plant.

All employed workers or other companies’ employees hired during the Project life have regularly been ‘registered, fully in compliance with the Brazilian labour law.

The workforce management procedures adopted by the Project manager (owner) are very strict and attach a special importance to training and development of skills and competences. All workers are required to attend appropriate training courses and are provided with personal protective equipment, such as protective boots, gloves, anklets and helmets.

As for the legislation and issues relating to occupational health and safety and hazards, specific training courses are addressed to the employed labour force. Workers in charge of cutting attended specific courses on the use of machinery and equipment to be used for cutting operations. Furthermore, fire control and prevention programs are organized on an annual basis. The Project, besides generating much more employment than the baseline scenario, (before the Project only two people were employed in the farm to tender for about 500-700 cattle heads depending on the season), has also allowed training and the creation of a highly skilled labour, thanks to the several targeted training courses. No gender discrimination has been recorded.

The Fazenda São Paulo provides various accommodation facilities for all teams of workers that have been employed during the Project life. In addition, workers are provided with accommodation and with three meals a day.

2.7 Stakeholders

The following stakeholders have been identified in this Project:

- Workers employed in all the Project phases: they were the first ones to draw direct benefits from the Project, both from an economic point of view (thanks to a regular salary) and from professional point of view (thanks to vocational specialization).

- The families of the workers employed in the Project: they have had a direct economic benefit.

- The owner of Fazenda São Paulo: before the start of the Project, the business situation was very critical, the land was unproductive and animal husbandry, in addition to increasingly more affecting the soil, was no longer as profitable as in the past. Thanks to the Project, the owner reached a higher yield than the one deriving from cattle breeding. In addition, the Project has allowed the recovery of many degraded areas and the enhancement of the soil physical and chemical conditions (soil fertilization and increased organic matter).

- The local timber processing industries: they have benefited from timber production made possible by the Project. Among them the following stakeholders can be mentioned: the cellulose extraction industries (it should be pointed out that all timber extracted from the cut of the Area 02 was intended for cellulose), timber processing industries using autoclaving (most timber derived from the cutting of the Area 01 was intended for this purpose).

- Fertilizer and equipment suppliers, as well as transporters were involved.

During the implementation of the Project no obstacles were encountered by stakeholders. In general, the Project has brought about many economic benefits, in addition to the advantages for the local communities, the climate, air, and biodiversity.

2.8 Commercially Sensitive Information

No commercially sensitive information have been excluded from the public version of the project description.

3 LEGAL STATUS

3.1 Compliance with Laws, Statues, Property Rights and Other Regulatory Frameworks

Regulatory framework

Brazil is a member of the UNFCCC (United Nations Framework Convention on Climate Change) and an active member of the ITTO (International Tropical Timber Organization). The country has ratified the UNFCCC (1995), the Kyoto Protocol (2005), and has established a Designated National Authority under the CDM (currently the country has more than one registered CDM Afforestation/Reforestation project65). Brazil has submitted three National Communications to the UNFCCC (in 2001, 2010 and 2015), and recently, has signed the Paris Agreement (Paris 2015, COP2167).

The project complies with this regulatory framework, because in the AFOLU scope, reforestation is one of several mechanisms by which GHG emissions are expected to be reduced.

National Legislation

A brief overview of the main national laws and decrees regulating the forest sector is provided here below:

- ***Código Florestal*** of **1934** (Decree no 23.793/34) **-** The focus of the Decree is that the preservation of forests and other natural ecosystems concerns the entire society (SOS FLORESTAS, 2011). This approach is a big step towards forests and environment protection in general in Brazil, despite several difficulties encountered in its application. This law was issued as a reaction to the Mata Atlantica deforestation to allocate land for coffee plantations (Castelo, 2015).

- ***Novo Código Florestal*** del **1964** (Lei no 4.771/65). The Forest Code enacted in 1964 provided that forests and other natural forms of vegetation be considered "goods of common interest for all the inhabitants of the country." The forest becomes a good of interest for the population due to its own intrinsic value, and not only for its usefulness (AHRENS, 2003). The new code was a big change since it introduced four types of protected areas: the National Park, the National Forest, the Permanent Preservation Area (APP) and the Legal Reserve (RL) (MEDEIROS, 2006). This code also introduced the requirement of maintaining 50% of the Legal Reserve in the Amazon region and 20% in the rest of Brazil.

- ***Novo Código Florestal*** del **2012** (Lei 12.651/2012). This code currently in force unfortunately threatens to undermine the various achievements in environmental protection. In particular, the reduction of the Legal Reserve in the Amazon from 80% to 50% should be underlined (MIRANDA et al., 2008).

These laws and decrees mainly regulate the use and protection of native natural forests. As for planted forests, various laws have so far been enacted regulating and promoting forestation / reforestation projects. The Federal Law 5106 of 1966 introduced a tax incentive policy. Being of great importance for the entire forestry sector, this law has enabled natural and legal persons to benefit from deduction up to a maximum of 50% of income tax for use in forestation and reforestation projects (SILVA and SOUZA, 1994). The adoption of this policy has led to a large increase in areas planted in Brazil (from

400 thousand hectares in 1966 to about 6 million hectares in 1988), and also to the development of the industrial forest sector (PASSOS, 1996).

Since 1967, various provisions concerning the forestry sector have been issued. The most representative ones are reported here below:

- **Decreto-lei no. 1.134/1970 (Law Decree) –** It confirms the tax benefits for legal persons investing in forestry projects approved by the *Instituto Brazileiro de Desenvolvimento Florestal - IBDF*. This Institute was originally entrusted with this responsibility that was previously directly held by the *Ministério da Agricultura*.

- **Lei no. 8.171/1991 (Law)** – It provides for the national agricultural policy actions and instruments to be used in agriculture, animal husbandry, forestry, fish ponds and agro-industrial activities.

- **Lei Federal n° 33/1996 (Federal Law)** - It has laid down the basis of the national forest policy and sets forth that "the use, storage, conversion and expansion of forests are of public interest, regardless of the legal property system" and that it is up to the State to set the standards for the use of natural resources, in harmony and with the active participation of all producers and users of forestry goods and services and associated natural systems.

- **Lei no. 11.284/2006 (Law)** – It lays down provisions for public forest management for sustainable production and it has establishing the *Serviço Florestal Brazileiro - SFB*, del *Ministério do Meio Ambiente* and the *Fundo Nacional de Desenvolvimento Florestal – FNDF.*

Local Legislation

The main laws governing the forestry sector in the State of Mato Grosso do Sul are:

- **Lei no. 1.458/1993 (Law)** – It regulates forest repositioning.

- **Lei no. 3.480/2007 (Law)** - It sets the taxation on forestry products.

- **Decree no. 13.777/2013 (Law Decree) -** It sets the mechanisms for the recognition of sustainable development programs aimed at the preservation of native forests, associated with the encouragement of agricultural production, livestock husbandry and forestry, being able of generating voluntary bonds of social, environmental and cultural compensation.

In 2008, the ***Plano Estadual de Desenvolvimento Sustentável de Florestas Plantadas*** (PEF/MS) (***State Plan for the Sustainable Development of Planted Forests***) was also approved by the Government of Mato Grosso do Sul aimed at providing the guidelines for the governmental authorities, businesses and other private entities ((SEBRAE/MS, REFLORE/MS, FAMASUL, FIEMS, BANCO DO BRAZIL), in the forest sector development process (forestry and industry) in order to maximize the economic, social and environmental benefits.

In 2008, data present in the same document indicated that the area allocated for planted forests in Mato Grosso do Sul was 284,051 ha (0.79% of the State territory). According to the document, Pinus and Eucalyptus were the most common genera. The Plan was intended to reach 990,000 hectares to be planted with forests by 2030.

Over the past few years, the forestry sector in the State of Mato Grosso do Sul has recorded a very significant development. According to *Instituto Brazileiro de Geografia e Estatística* - IBGE data Mato Grosso do Sul now owns the second largest area cultivated with eucalyptus of Brazil. In 2014 886,300 hectares were planted with this species in the State, accounting for 12.75% in total of the country (6.9 million ha throughout Brazil). These data show that, in Mato Grosso do Sul the Areas planted with Eucalyptus have grown by 312% in just seven years (IBGE 2014).

The entities that have mainly had greater access to credit lines and incentives have, however, been large groups and industries in the sector, at the expense of small and medium-sized rural enterprises. As shown in the *Plano Estadual de Desenvolvimento Sustentável de Florestas Plantadas* (PEF/MS) nearly 60% of Planted Areas belongs to the group *VCP - Vontorantim Celulose e Papel*, 20% of planted areas belongs to nine other companies and finally just 20% belongs to a large number of small and medium-sized producers.

According to De Souza (2013) national and state forestry development incentive policies are generally not very well known and poorly communicated and financial programs aimed at forestry production often lack continuity because of insufficient available resources.

Please note that the Project has never benefited from any national or regional / or State incentive.

As mentioned above, in Mato Grosso do Sul, as in other States of Brazil, in order to plant forests the Legal Reserve bond (20% in Mato Grosso do Sul) must be complied as well as the APP - Permanent Preservation Areas, including territories with more than 45 ° slope and vegetation belts around rivers and lakes which must have a minimum radius of 30 meters, as described in *Plano Estadual de Desenvolvimento Sustentável de Florestas Plantadas* (2008).

According to the Plan, forest plantations in pastures do not require any EIA (*Estudo de Impacto Ambiental* / Environmental Impact Assessment studies) or RIMA (*Relatorio de Impacto Ambiental* / Environmental Impact Report).

In the specific case of Fazenda São Paulo Agroforestry Project, the Legal Reserve area within the Project borders is complied with (Annex 09) and it is larger than the 20% as required by the relevant legislation. No areas with more than 45% slope are located within the project boundary and all the streams have an APP larger than a 30 meters radius.

Authorizations were issued by competent environmental authorities upon the planting of the 3 project areas (IBAMA for Area 01 and SEMA for Areas 02 and 03). See Annexes 09, 13 and 17.

The Prefect of Campo Grande and SEMA are aware of the project, as demonstrated by the document attached herewith (Attachment ….)

The Fazenda São Paulo Agroforestry project complies with the law requirements of land use, not affecting natural forests and strategic ecosystems.

3.2 Evidence of Right of Use

There are no disputes or conflicts regarding the Project land. Recently the Mato Grosso do Sul has been affected by certain conflicts, but those conflicts are not in the Project Area.

The Project relates to project owners property and the Project will not invade any other private property, any communitarian property or any governmental property. Since plantations are developed in private property, no approval from local communities is needed.

The proof of title documentation ca be found on the attached documents (see Attachment [•]).

3.3 Emissions Trading Programs and Other Binding Limits

Not applicable.

3.4 Participation under Other GHG Programs

The Fazenda São Paulo Agroforestry project has not been registered and is not seeking registration under any other GHG programs.

3.5 Other Forms of Environmental Credit

Not applicable.

3.6 Projects Rejected by Other GHG Programs

Not applicable.

3.7 Respect for Rights and No Involuntary Relocation

As shown in Annex 01, 02 and 03 Fazenda São Paulo is a privately owned farm. As disclosed in the Annexes 05, 06, 07 and 08, the Fazenda São Paulo land has been rented for the planting of tree species belonging to the *Eucalyptus spp*. genus.

Before the start of the Project (2012), no communities were present within the farm boundaries. The only people who lived on the farm were the two employees (and their respective families) charged with livestock breeding by the farm owner and regularly hired based on an open-ended labour agreement.

The project did not require the involuntary relocation of people or of the key activities playing an important role for the livelihoods and culture of the local communities.

3.8 Illegal Activities and Project Benefits

No illegal activities occurred during the project period.

4 APPLICATION OF METHODOLOGY

4.1 Title and Reference of Methodology

The Fazenda São Paulo Agroforestry is a VCS AFOLU (Agriculture, Forestry and Other Land Use) project and, specifically it falls under the ARR (Afforestation, Reforestation and Revegetation) category. The project pursues the target to reforest degraded lands, which would had been degraded in the absence of the project.

The title of the applied methodology is the AR-ACM003, as disclosed under the United Nations Convention on Climate Change CDM (Clean Development Mechanism) methodologies: A/R Large-scale Consolidated Methodology Afforestation and reforestation of lands except wetlands - Version 02.

The above-mentioned methodology requires the following A/R tools:

- Tool for the demonstration and assessment of additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) project activities - VT0001 - Version 3.0 – Sectoral scope 14. This tool has been adapted from the CDM ‘Tool for the Demonstration and Assessment of Additionality in A/R CDM Project Activities’ (Version 02);
- Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities;
- Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities;
- Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities;
- Estimation of non-CO2 greenhouse gas (GHG) emissions resulting from burning of biomass attributable to an A/R CDM project activity;
- Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity.

4.2 Applicability of Methodology

The Fazenda São Paulo Agroforestry Project aims to promote investments new commercial forest plantations in Campo Grande Municipality. The project is based on changing the use of land from extensive cattle ranching (of low productivity and which use prescribed occasionally burns to encourage the regrowth of degraded grassland) to sustainable forest production systems, based on good forestry practices, which will increase the forest cover in the project region and promote remnant natural forest restauration, thus generating a typical patchwork landscape formed by biological and productive areas that produce financial, social and environmental services for the region. The project reforested 1055ha with commercial plantations, using the species *Eucalyptus citriodora* and *Eucalyptus urograndis.*

4.3 Methodology Deviations

Not applicable. There are no Methodology deviations.

4.4 Project Boundary

Project boundary

The project boundary is described in section 1.2

GHG sources, sinks and reservoirs

The relevant GHG sources, sinks and reservoirs for the project and baseline scenarios are presenting below.

Source		Gas	Included?	Justification/Explanation
Baseline	Above and below ground biomass	CO2	Yes	Above and below ground carbon stock in the baseline scenario is presented in the isolated trees and grasses. The pre-project trees are neither harvested, nor cleared, nor removed. These do not suffer mortality because of competition from trees planted in the project, or damage because of implementation of the project activity and they are not inventoried along with the project trees in monitoring of carbon stocks throughout the crediting period of the project activity. Therefore, carbon stock in the baseline can be accounted as zero.
		CH4	No	This is not a requirement of the methodology
		N2O	No	This is not a requirement of the methodology
	Dead wood, Litter and Soil Organic Carbon	CO2	Yes	It is expected that carbon stock in these pools will not decrease due to the implementation of the project

Source		Gas	Included?	Justification/Explanation
				activity
		CH_4	No	This is not a requirement of the methodology
		N_2O	No	
Project	Above and below ground biomass	CO_2	Yes	Carbon stock in above ground biomass is the major carbon pool subjected to project activity. Carbon stock in below ground biomass is expected to increase due to the implementation of the project activity.
		CH_4	No	This is not a requirement of the methodology
		N_2O	No	This is not a requirement of the methodology
	Dead wood, Litter and Soil Organic Carbon	CO_2	Yes	Carbon stock in these pools may increase due to implementation of the project activity.
		CH_4	No	This is not a requirement of the methodology
		N_2O	No	This is not a requirement of the methodology

Regarding to dead wood and litter in baseline carbon pools, it is expected that whose will not show a permanent net increase.

Moreover, since carbon stock in SOC (Soil Organic Carbon) is unlikely to increase in the baseline, the change in carbon stock in SOC (Soil Organic Carbon) may be conservatively assumed to be zero.

Historically cattle grazing have been the main land use in the Project area and selected as the baseline scenario.

According to this and in agreement with IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry (2003) the net GHG removals by sinks in the baseline equals zero.

4.5 Baseline Scenario

The baseline scenario corresponds to the degraded pasturelands, mostly by extensive cattle ranching, which would be accompanied by occasional burning of grasses.

The land within the project boundary was degraded grassland, as occurs in the same department and municipality. Such grasslands have historically been subject to burning activities that took place with the objective to reduce tree covers and expand grasslands in order to develop extensive cattle ranching activities.

Before the start of the Project, the only activity present in Fazenda São Paulo was extensive cattle ranching, mainly for meat production. The whole farm was made up of large areas for grazing, ranging from 30 to 90ha each, bounded by fences made of iron wires and wooden poles set into the ground.

Cattle grazed in the farmland permanently, throughout the year, feeding on native and introduced grasses. According to information provided by the current owner of the farm, cattle raising had been practiced for several decades.

However, the property conserved remnants of savannah forest and natural areas that made up the Legal Reserve of the Fazenda. As provided by law, in fact, in the State of Mato Grosso do Sul each rural property is required to maintain a minimum of 20% of the land to be used as a Legal Reserve. In these permanent reserve areas, any kind of activities is banned. The vegetation must be preserved in its entirety. Furthermore, a demarcation and fencing obligation applies to these areas.

Before the Project, the Fazenda São Paulo area (total extension: 1,410.7692 ha) was occupied by:

- **Pastures**: 1,070.9675 ha; cattle breeding was practiced in this area.
- **Legal Reserve**: 287.0647 ha, accounting for 20.35% of the farm (by law).
- **Site + Roads + Corridors**: 52.7370 ha

Map 11 (Source: Google Maps, 2003) shows the Fazenda São Paulo and nearby properties before the start of the Project: degraded pastures interspersed with small plots of land covered with native vegetation (Legal Reserve) are visible. Among all properties, Fazenda São Paulo appeared to be the one with the poorest turf and with the smallest Legal Reserve areas.

Map 11: baseline scenario, consisting of degraded pastures and small areas of native savannah (Legal Reserve).

Over the years, irrational extensive cattle ranching had caused a serious degradation pasture process in the Fazenda São Paulo.

The most obvious signs of this process were:

- turf deterioration;
- minor land erosion patches;
- reduction in soil fertility (decreased macro and micro trace elements and organic matter);

The factors that led to this gradual depletion of pasture and soil were:

- cattle feed pressure: grazing cattle ingest large quantities of green fodder, which contain nutrients derived from the soil.
- lack of rational fertilization: this practice is necessary to replenish the nutrients extracted from the soil by grazing cattle;
- cattle trampling: this phenomenon, mainly impacting the areas where pasture rotation is not practiced, leads to a reduced vegetation cover, exposing the soil to rainfall and subsequent erosion and depletion of surface fertile layer;
- shrinking of the original tree cover: the arboreal plants present in the pastures are seen as competitors for light, nutrients and water of forage. For this reason there is a tendency to eliminate them, reducing soil resistance to erosion, also by increasing the evaporation of water present in the soil.

Before the start of the Project, year after year, a decline in crop production was recorded in the Fazenda São Paulo, with an inevitable reduction of animal load per hectare resulting into a decreased productivity of the Fazenda. All this had led to an alarming decline in the economic return of the farm owner.

At the time, pastures were so unproductive that in the dry season the owner pushed cattle to graze also in the Legal Reserve areas, where law, thus jeopardizing even the few remaining natural areas, prohibits any livestock presence. Moreover, in the dry season, when fodder plants are in their state of vegetative rest, thus reducing the pasture nutritional quality, the owner occasionally lit a fire to stimulate grasses to grow back (in fact, the new shoots sprouting after a fire are much more nutritious and palatable for the cattle than mature fibrous fodder plants typical of the dry season).

This form of extensive and irrational cattle breeding did not only lead to a soil impoverishment and to a serious decrease in productivity of the Fazenda, but it was also a threat towards a dangerous decline in biodiversity of the entire region.This landscape corresponded to the land prior to the project start date.

4.6 Additionality

The additionally of the project was analyzed according to the VCS tool: 'VT0001 - Tool for the Demonstration and Assessment of Additionally in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities' - Version 3.0 – 1 February 2012 – Sectoral Scope 14. The Fazenda São

Paulo Agroforestry Project is consistent with the conditions required by VCS Standards, and the Tool is consequently applicable.

All the activities proposed on the land within the project boundary performed with or without being registered as the VCS AFOLU project don't lead to violation of any applicable law even if the law is not enforced.

The baseline methodology provides a stepwise approach, justifying the determination of the most plausible baseline scenario, as requested by the Tool applied to determine additionality requires.

In accordance with the VT0001 VCS Tool, the next following steps have been developed:

STEP 1. Identification of alternative land use scenarios to the AFOLU project activity;

STEP 2. Investment analysis to determine that the proposed project activity is not the most economically or financially attractive of the identified land use scenarios; or

STEP 3. Barriers analysis; and

STEP 4. Common practice analysis.

STEP 1 Identification of alternative land use scenarios to the proposed VCS AFOLU project activity

Sub-step 1a. Identify credible alternative land use scenarios to the proposed VCS AFOLU project activity

Scenario 1: Continuation of the pre-project land use: cattle ranching.

The Mato Grosso do Sul predominant land use is represented by pastures. The Scenario 1 is the continuation of the pre-project land use and corresponds to the degraded pasture lands, mostly by extensive cattle ranching.

The annual rate of deforestation in the Brazil, including the State of Mato Grosso do Sul, has continued to increase from 1990 to recent years because of several factors, both local than international. The removal of forest, and specifically, of the local vast Savannah region, named 'Cerrado', to make way for cattle ranching, was the leading cause of deforestation and land degradation in the Brazilian Mato Grosso do Sul region. Cattle ranching in Mato Grosso do Sul in Brazil has resulted in massive deforestation and it is regarded as one of the main causes of fragmentation and land degradation, affecting the supply of ecosystem services and biodiversity conservation. In addition, there are significant evidences of erosions and structural degradation (Kirbi, 2006).

Under the Deforestation Monitoring Program of the Brazilian Biomes of the Ministry of Environment, the current situation of deforestation in the Cerrado has been mapped (2012), based on the comparison of satellite images. According to this mapping, between 2002 and 2010, the Cerrado or Savannah had its cover removed by 92,710 km², which is approximately 11.588 km² deforested annually during this period. The percentage of deforested areas in 2002 was 55.7% and in 2010, rose to 60.2% (Source: http://flegt.info/en/featured/Brazil-2/).

Currently, in some regions of Brazil, deforestation and a form of irrational extensive cattle ranching are causing serious desertification phenomena. The recent research work *"Desertificação, degradação da terra e secas no Brazil",* conducted by CGEE (2016) states that "the climate is not responsible for the extreme soil impoverishment", which already characterizes many regions of Brazil. It also points out that "while drought is a climatic phenomenon, desertification is a human phenomenon." The same document has also highlighted that "the deforestation of primary forests for the use of timber and the subsequent allocation of pastures for livestock rearing, associated with the lack of measures to curb soil erosion, inexorably lead to the soil impoverishment down to its ultimate 'collapse'.

Without the Fazenda São Paulo Agroforestry Project, the landowner would have continued to allocate land to pasture, through extensive cattle ranching, which would have doomed the farm to a progressively declining profitability, due to the increasing soil impoverishment and erosion already present in several areas of the farm. Over the years, the extensive cattle ranching practice resulted into a decline in the quantity and quality of pasture and a consequent reduction in livestock production. The decrease of the surface used for grazing purposes results into a lower overall available vegetation and forage growth. The consequence is a lower meat production per hectare and lower income. The continuation of extensive cattle ranching activities practiced before the Project development would have led to a further deterioration of soil conditions and to a non-economically sustainable income generating capacity.

Scenario 2: Alternative land use scenario: agriculture

Agriculture is one of the project alternative scenarios. Currently, only 4% of the territory of Mato Grosso do Sul is allocated to farming activities (IBGE 2006). Agriculture is practiced in the Campo Grande region but it is characterized by a strong dependence on the soil fertility.

Crops, such as corn and soybeans, grown in some areas of the region (Brazil is currently the second-largest global producer of soybeans after the United States, mostly for livestock feed) require a significantly higher level of soil fertility than cattle breeding and eucalyptus. For this reason, agriculture is limited to the best farmland.

In the Fazenda São Paulo, farming was not practiced due to the following reasons:

- The soil physical and chemical characteristics of the Region may allow agricultural production but they cannot be considered the best agricultural practices (the most limiting factor is the low clay content).
- Livestock farming practiced for decades has further reduced soil fertility.
- Agriculture would be possible only after extensive and expensive restoration and fertilizing of the soil.
- Agriculture would have required large investments in machinery and agricultural equipment.

At the beginning of the project, the owner of the farm did not have sufficient resources to choose this risky alternative (high investments, uncertainty of results). Furthermore, no third farms were interested in leasing their land for agronomic purposes.

Scenario 3: Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project

Brazil has millions of hectares of planted Eucalyptus, Pine and other species like Acacia (*Acacia mearnsii*), Seringueira (*Hevea spp.*), Teca (*Tectona grandis*), Paricá (Schizolobium parahyba), Araucária (*Araucaria angustifólia*) and Álamo (*Populus sp.*), used in the production of pulp, paper, furniture, energy and biomass. In addition, planted trees play an important role preventing deforestation of native forests, protecting biodiversity and preserving the soil and springs. They recover degraded areas and they contribute to reducing greenhouse gases, as they are natural carbon inventories.

Today these planted forests occur mostly in monoculture systems and rarely associated in two or more species. In recent years, major progress has been made by research on these agroforestry systems and it has shown many favourable results in all respects, from an economic, environmental and social point of view. Some important functions of planted forests are:

- Decreased pressure on native forests;
- Restoration of degraded lands due to agriculture and livestock breeding;
- Carbon Sequestration;
- Soil and water protection;
- Shorter production cycles than in temperate climate countries
- Improved product consistency, facilitating all mining and industrial processes (http://www.florestal.gov.br/snif/recursos-florestais/as-florestas-plantadas)

Planting activity is managed in accordance with sustainable forestry management principles, aiming to reduce environmental impacts and pursuing the goal to promote economic and social development of the communities surrounding the plantations. In general, these lands are initially degraded, but they suit the needs of the plantations. The plantations also allow preserving extensive areas of natural resources in places named as: permanent preservation areas and legal reserves.

The farm owner's decision to rent the entire surface of Fazenda São Paulo for the Eucalyptus plantation and reforestation Project was dictated by three main reasons:

- Cattle ranching was no longer economically viable because of the damage caused by poor pasture and soil management. The recovery of the areas would have required significant investments and the landowner would not be able to sustain the significant long-term costs
- The rental of the farm for Eucalyptus plantation would guarantee a sure income, higher than the decreasing income deriving from Cattle ranching.
- The planting of Eucalyptus trees would guarantee the recovery of degraded areas of the farm, thanks to the remedial actions aimed at mitigating erosion, leveling and fertilizing soil. All these costs would be borne not by the land owner, but directly by the tenant, also resulting into an increase of the land value at the end of the rental period

At the beginning of the planting there were very few of reforestation projects in the area. This Project can be considered one of the pilot projects of the Campo Grande region.

The issue and sale of carbon credits were among the initial objectives pursued by the Project intended to cover the plantation maintenance costs in the interval between one cut and the next. The lack of information about this option as well as the lack of specialized technicians in Brazil did not allow matching the start of the planting with the PDD preparation. As of the date of the drafting of this document, the Fazenda São Paulo Agroforestry Project covers a plantation made up of 3 Areas, with different degrees of development, in relation to the planting stages.

The first area (Area 01) was planted with the species *Eucalyptus citryodora* aimed at meeting the growing need for timber needed for the construction of cattle pasture fences (processing timber). Over the past few years fences were built using timber harvested in the farms themselves, cutting down native species, often belonging to the reserve areas. This practice, which has never been accompanied by the planting of new plants, has led to a serious shortage of timber. *Eucalyptus citryodora*, when subject to heat and chemical processing in an autoclave, acquires high resistance to climatic and organic impact and is highly suited for the manufacturing of fencing poles.

The second area (Area 02) was planted with a different species, *Eucalyptus urograndis*. At that time the goal was to produce sawmill timber, but following the opening of cellulose extraction plants, such as Eldorado Brazil (2010) and Fibria (2012) in the East region of Mato Grosso do Sul, timber was mainly intended to be used as raw material for the paper industry.

The third area (area 03) was planted with *Eucalyptus urograndis*, also meant for the production of timber for cellulose extraction.

Eucalyptus was chosen because of its high yield and adaptability le to the geo-climatic characteristics of the region. Eucalyptus requires a lot of water, but the rainfall in Campo Grande region, which reaches 1,500 mm/year (PLANURB, 2007), ensures the amount of water necessary for the development of this species. In addition, the (deep and moderately fertile) regional soil characteristics are an optimal condition for this type of trees.

At present, other forestation projects based on different Eucalyptus species are implemented in the State of Mato Grosso do Sud, but there are no other VCS + CBB projects.

This project is developed under a voluntary mechanism by initiative of the private sector to reduce carbon emissions.

In order to sustain the costs for the project, the Forest Owner should obtain additional financial resources. For this purpose, the Project Proponent is pleading to include this Project Activity in a Carbon Market platform. The proposed Project Activity is now not financially feasible without carbon credits potential revenue. Those additional sources of revenue are vital to the forest landscape restoration scheme.

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

Eucalyptus *plantations in Mato Grosso do Sul are subject to no specific legislation. These plantations are thus considered in a similar way as other monocultures practiced in the region, such as corn and soybeans*.

Mato Grosso do Sul State approved a legislation to establish regulatory standards to the harvesting and extraction of forestry products. It is intended to regulate these activities, both in plantation and natural forests. They pay a great attention to the plantations themselves, not just to the forest companies, which own plants in the State, but also motivating rural farmers, since forest plantation is an alternative to diversify their business.

All the alternative land use scenarios outcome of the sub-step 1a are legal and fully in compliance with the applicable laws and regulations in Mato Grosso do Sul State | Brazil.

Step 2: Investment analysis

The barrier analysis was applied instead of the investment analysis. Reference should be made to the following Step 3.

Step 3: Barrier analysis

This section shows how the proposed project activity faces barriers that prevent it to be implemented without the revenue from the sale of GHG (Greenhouse Gas) emission reduction credits. Other than investment barriers (economic point of view) there are also certain noneconomic barriers that render the Fazenda São Paulo Agroforestry project implementation more difficult without carbon credits.

Sub-step 3a. Identify barriers that would prevent the implementation of the type of proposed project activity

Investment barriers

The business forestry segment of *Eucalyptus* planted forests in Mato Grosso do Sul has a significant social and economic importance to the regional economy. The Brazilian pulp industry offers advantages compared to the other worldwide market players. In the late 1990s Brazilians introduced a fast-growing eucalyptus variety that can be harvested after just seven years, compared with the two decades or more it takes to grow pine, the main source of cellulose pulp in the northern hemisphere. The industry plants are located in the forest region, allowing ready access to its raw material. The local companies (like Fibria and Eldorado), which export most of their production, does not suffer the heavy Brazilian economic turmoil and the deep devaluation of local currency.

Source: http://www.economist.com/news/business/21695530-brazils-economy-crumbling-its-giant-pulp-firms-are-booming-money-grows-trees).

The conditions are substantially different for local and independent Eucalyptus planted forest owners. They are facing significant investment barriers, which could be summarized as follows:

- The Brazilian economy has been characterized by the heavy local currency devaluation compared to the USD and other worldwide main currencies.

- Decrease of marginality: steady products sale price, but the costs of products sold (particularly the personnel cost and fertilizer | manure costs) are increasing, while the forest maintenance costs is high.

- Lack of access to credit: debt funding is difficult to obtain and the interest rate are very high. Very limited access to the international capital markets.

In recent years, the devaluation of the Real Brazilian currency (Diagram 4) has led to a significant increase in the cost of fertilizers and plant protection products, all imported products paid in USD. Over the past 7 years, this has led to a 35% increase in fertilizer costs.

Diagram 4: USD/ BRAZILIAN REAL exchange rate (2010-2016 period).
Source: *http://br.advfn.com/bolsa-de-valores/fx/USDBRL/Diagram*

In recent years the labour cost has increased as a result of the high inflation rate, as shown in Table 05 (on average by 5-6% per annum).

Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Inflation %	5.909	6.502	5.839	5.911	6.409	10.672	5.780

Table 05: IPC inflation rates (2010-2016 period).
Source: http://pt.global-rates.com/estatisticas-economicas/inflacao/indice-de-precos-ao-consumidor/ipc/Brazil.aspx

In addition, the average sale price per cubic meter of timber has decreased over the last seven years by 12 -13% (Table 06). The present value loss of forest products seems to be due to the current crisis that has affected Brazil, but it may also be a consequence of the excess of plantations developed in recent years that has led to a supply greater than demand. This situation is expected to last still a few years (Istitudo de Economia Agricola, 2016).

Allocation (amounts in R$/m³)	**Jan 2010**	**Jan 2011**	**Jan 2012**	**Jan 2013**	**Jan 2014**	**Jan 2015**	**Jan 2016**
Timber for Energy purposes	54,12	54,86	52,09	47,20	46,20	47,44	42,84
Timber for processing purposes	77,65	76,33	73,52	66,94	64,44	67,95	67,71
Timber for sawmills	126,02	125,70	120,52	125,56	115,80	112,86	112,14

Table 06: reduction in the forestry product prices in the 2010-2016 period. Source: *http://www.iea.sp.gov.br/out/florestas.php*

All these factors have led to a sharp reduction in returns from the sale of Eucalyptus timber, estimated around 50 - 60%. This has resulted into a strong pressure on the availability of resources allocated for plantation maintenance.

The Fazenda São Paulo reforestation Project envisages four 6/7-year-long cutting cycles, reaching a total duration of 30 years. This timeframe can only be guaranteed through a careful plantation maintenance work, through proper fertilizing, pruning and weed control. Such activity requires a significant amount of skilled labour and high operating costs.

This reduction in return deriving from the sale of timber and the increase in forest maintenance costs, without any additional revenue rising from carbon credits certificates has further been exacerbated, involving the risk of an early conclusion of the Project, without completing all the planned 4 cycles.

A further and significant investment barrier is the difficulty in accessing to credit. The Brazilian economic situation and high inflation rates have led to very high interest rates on bank loans are, averaging around 20-25% per annum for short-term financing to support working capital (Table 07).

		Taxas de juros	
Posição	**Instituição**	**% a.m.**	**% a.a.**
1	BCO RABOBANK INTL BRASIL S.A.	1,29	16,57
2	INTESA SANPAOLO BRASIL S.A. BM	1,32	17,02
3	BCO SUMITOMO MITSUI BRASIL S.A.	1,34	17,38
4	BCO SANTANDER (BRASIL) S.A.	1,44	18,73
5	BCO CITIBANK S.A.	1,44	18,77
6	ITAÚ UNIBANCO BM S.A.	1,45	18,88
7	BCO CCB BRASIL S.A.	1,53	20,02
8	BCO BNP PARIBAS BRASIL S A	1,60	21,05
9	BCO ABC BRASIL S.A.	1,61	21,07
10	BCO DO ESTADO DO RS S.A.	1,64	21,58
11	BCO INDUSVAL S.A.	1,73	22,78
12	BCO SAFRA S.A.	1,76	23,25
13	BCO BRADESCO S.A.	1,76	23,28
14	BCO DO BRASIL S.A.	1,83	24,29
15	BCO PAULISTA S.A.	1,84	24,50
16	BCO PINE S.A.	1,88	25,01
17	BCO BANESTES S.A.	1,99	26,64
18	BCO SOFISA S.A.	2,07	27,86
19	BCO RENDIMENTO S.A.	2,10	28,29
20	BCO DAYCOVAL S.A	2,10	28,29
21	BANCO BONSUCESSO S.A.	2,14	28,85
22	BCO GUANABARA S.A.	2,28	31,00
23	BCO FIBRA S.A.	2,32	31,62
24	BANCO SEMEAR	2,54	35,07
25	DEUTSCHE BANK S.A.BCO ALEMAO	2,76	38,57
26	BCO VOTORANTIM S.A.	3,02	42,88

Table 07: interest rates applied by Brazilian credit institutes in 2016, per month and per year.

Source Banco Do Brazil 2016:
http://www.bcb.gov.br/ptbr/#!/r/txjuros/?path=conteudo%2Ftxcred%2FReports%2FTaxasCredito-Consolidadas-porTaxasAnuais.rdl&nome=Pessoa%20jur%C3%ADdica%20%20Capital%20de%20giro%20com%20prazo%20até%20365%20dias&parametros='tipopessoa:2;modalidade:210;encargo:204'

The approval of the Fazenda São Paulo Agroforestry Project, through additional revenue arising from carbon credits certificates sale, would adequately support the Project. The resources necessary to deal with all the forest maintenance work and, consequently, to ensure the maintenance of the entire workforce employed in forestry related activities and all future timber harvesting operations and trade would in fact be guaranteed.

The sale of the credits would also stimulate the forest owner to make further investment in the purchase of degraded and deforested areas, thereby also increasing the demand for labour intended primarily for local communities.

Barriers due to prevailing practice

The project activity is "the first of its kind". No project activity of this type is currently operational in the region. Today, the Fazenda São Paulo Agroforestry Project is a highly innovative project and acts as a pioneer in a growing sector such as planted forests. The Project has requested a lot of study and research work and its success could be decisive for the development of similar projects throughout Brazil.

Sub-step 3B. Show that the identified barriers would not prevent the implementation of at least one of the alternative land use scenarios (except the proposed project activity).

The identified barriers above are sufficient grounds for demonstration of additionality, as they would prevent the Project Proponent from managing the Project Activity if it was not expected to be registered as a VCS AFOLU project. Forest plantations without carbon revenues face all the identified barriers.

On the other hands, degraded pasture by extensive livestock and agricultural crops are the land use alternative that would continue ‘as is’. The identified barriers would not preventing the implementation of at least one of those alternative land use scenarios.

Step 4. Common practice analysis

According to the applied ‘Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities’, the previous steps are complemented with an analysis of the extent to which similar activities have already diffused in the geographical area of the proposed VCS AFOLU project activity. This test is a credibility check to demonstrate additionality that complements the barrier analysis (Step 3).

This analysis involved a survey of similar activities in the region of the proposed Project Activity, according to the following characteristics in a same project (large-scale operations). Based on the analysis carried out there are similar projects in the region. Although there are other commercial plantations in the Region, no planting is registered under voluntary carbon markets.

The financial resources secured from the sales of carbon credits would be a key component of the operation today and years to come. The sale of certificates of emission reduction is part of the main sources of additional income to the project. Without carbon revenues, the A/R project is not economically attractive as compared to the baseline scenario. Thus, the proposed VCS AFOLU project activity is additional.

The sale of emission reduction certificates may greatly stimulate the development of new reforested areas, with different, native or introduced, species throughout the Campo Grande region and in other regions of Mato Grosso do Sul thereby exponentially increasing the uptake of GHG, fixing CO2 in the timber product and massively reducing the deforestation trend and improving biodiversity in the various regions, thanks to the introduction of timber on the market.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS (CLIMATE)

5.1 Project Scale and Estimated GHG Emission Reductions or Removals

Project	
Large project	**X**

Years	Estimated GHG emission reductions or removals (tCO2e)
2013	10,079
2014	24,444
2015	38,503
2016	50,724
2017	64,555
2018	65,106
2019	65,106
2020	62,901
2021	65,106
2022	64,878
2023	64,908
2024	65,007
2025	65,007
2026	65,106
2027	62,901
2028	65,106
2029	64,878
2030	64,908
2031	65,106
2032	65,106
2033	65,106
2034	65,106
2035	65,106
2036	65,106
2037	65,106
Total estimated ERs	1,484,968
Total number of crediting years	25
Average annual ERs	59,399

5.2 Leakage Management

The proposed project aims to reduce the vulnerability of agricultural activities (for example, the fight against soil degradation, depletion of soil organic matter content), to encourage land development and productive investment, to increase and diversify farm income, to diversify energy sources and technologies, and to fight desertification.

In conditions of applicability of this methodology to the only emissions that may occur are the greenhouse gas emissions deriving from the minimum processing activities and no emissions related to the change / displacement of pre-project agricultural activities were recorded. Each phase of the project activities will be conducted with special attention to limit any potential losses.

5.3 Baseline Emissions

According to the A/R Large-scale ConsolidatedMethodology, Afforestation and reforestation of landsexceptwetlands, Version 02.0, the baseline estimationisgivenasfollows:

$\Delta CBSL$,=$\Delta CTREE\_BSL$,+$\Delta CSHRUB\_BSL$,+ΔCDW_BSL,+ΔCLI_BSL,

Where:

$\Delta CBSL$,= Baseline net GHG removals by sinks in year$t$; t CO2e

$\Delta CTREE\_BSL$,= Change in carbon stock in baseline tree biomass within the project boundary 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”; t CO2e

$\Delta CSHRUB\_BSL$,= Change in carbon stock in baseline shrub biomass within the project boundary 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”; t CO2e

ΔCDW_BSL,= Change in carbon stock in baseline dead wood biomass within the project boundary, in year$t$, as estimated in the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”; t CO2e

ΔCLI_BSL,= Change in carbon stock in baseline litter biomass within the project boundary, in year$t$, as estimated in the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM projecta ctivities”; t CO2e

$\Delta CTREE\_BSL$ can be accounted as zero due to all of 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 continue dexistence, consistent with the baseline scenario, is monitored throughout the crediting period of the project activity. $\Delta CSHRUB\_BSL$, conservatively is assumed to be zero in the baseline scenario, due to changes in carbon stock of above- and below-ground biomass of non-tree vegetation of the degraded land in baseline scenario, is not possible.

5.4 Project Emissions

Not applicable.

5.5 Leakage

Not applicable.

5.6 Summary of GHG Emission Reductions and Removals

Actual net GHG removals by sinks were calculated as follows:

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t}$$

Where:

$\Delta C_{ACTUAL,t}$ Actual net GHG removals by sinks, in year t; t CO 2- e

$\Delta C_{P,t}$ Change in the carbon stocks in project, occurring in the selected carbon pools, in year t; t CO2-e

$GHG_{E,t}$ Emission of non-CO2 GHGs resulting from burning of biomass and forest fires within the project boundary in year t; t CO2-e

And,

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

$\Delta C_{TREE\_PROJ,t}$ = 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'; t CO2-e.

$\Delta C_{SHRUB\_PROJ,t}$ = 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"; t CO2-e.

$\Delta C_{DW\_PROJ,t}$ = Change in carbon stock in dead wood in project in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO2-e.

$\Delta C_{LI\_PROJ,t}$ = Change in carbon stock in litter in project in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO2-e.

$\Delta SOC_{AL,t}$ = Change in carbon stock in SOC in project in year t, in areas of land meeting the applicability conditions of the tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", as estimated in the same tool; t CO2-e.

Information regarding the growth of the species Brasil

Trees: Eucalyptus spp.	***Value***	***Source***
Annual growth rate of the plant (t dry wt ha-1)	21,28	Mean value of the *total wood weight* (ton / year) among the species *E. grandis* and *E. urophylla*, since the forest in question is made up by 70% of hybrids deriving from these species from a *(E. uro-grandis)* and by 30% of a very similar species (*E. cytriodora*) whose bibliography is still very poor. The value was calculated using the production data of a forest with 3x2 spacing (as in our project) and a 7-year cycle (as in our project) - Source of data: ***Crescimento e produçao de madeira de Eucalipto***, Pag 12 (Simoes et al. 1980), Publ. IPEF n.20 June 1980
Stem volume (m3), V	48,49	Mean value between the species the species *E. grandis* and *E. urophylla*, converted into M3 / ha / year starting from m3 steres (conversion value: 1,2) The source of data: Crescimento e produçao de madeira de Eucalipto - Simoes et al. 1980 Publ. IPEF n.20 June 1980
Wood density; D	0,515	Mean value between the extremes shown in the bibliography - Ref. Bibliography Viabilidade de um projeto florestal de Eucalyptus grandis considerando o sequestro de carbono - Maestri e al. 2004 -

		Publ. Floresta 34(3), Set/Dez 2014 Curitiba PR
Biomass Expansion Factor, BEF_2	2,225	Source of data 1: FATOR DE EXPANSÃO DE BIOMASSA, RAZÃO DE RAÍZES-PARTE AÉREA E MODELOS PARA CARBONO PARA Eucalyptus grandis PLANTADOS NO SUL - Ana Paula Dalla Corte - ENCICLOPÉDIA BIOSFERA, Centro Científico Conhecer - Goiânia, v.11 n.21; p. 2015 - Source of data 2: TABLE 3A.1.10 of IPCC Good Practice Guidance for LULUCF
Root-shoot-ratio, R	0,35	Source: TABLE 3A.1.8 of IPCC Good Practice Guidance for LULUCF
Carbon Fraction	0,5	

Information regarding Eucalyptus Agroforestry Brasil project

AREA OF EACH STRATUM AND NUMBER OF TREES TO BE PLANTED				N° Trees	Trees/ha
Stratum 1	852,8970	ha	Trees planted in 2012	1420926	1666
Stratum 2	88,0554	ha	Trees planted in 2013	146700	1666
Stratum 3	76,4808	ha	Trees planted in 2014	127417	1666
Stratum 4	0,0000	ha	Trees planted in 2015	0	1666
Stratum 5	38,2404	ha	Trees planted in 2016	63709	1666
Total area	1055,6736	ha	Toltal number of planted trees	1758752	

Soil organic Carbon

Estimations of soil organic carbon (SOC) stocks will be accounted for the stand models with the species H. brasiliensis, P. caribaea and native species, due to these species have a rotation period longer than 20 years.

Estimations were done in accordance to the “Tool for the estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activity”. As suggested by the guidance, it is assumed that the implementation of the project activity increases the SOC content of the lands from the pre-project level to the level that is equal to the steady-state SOC content under native vegetation. The increase in SOC content in the project scenario takes place at a constant rate over a period of 20 years from the year of planting.

The areas of land to which the tool is applied do not fall into wetland category, do not contain organic soils and are not subject to any of the land management practices and application of inputs listed in Tables 1 and 2 of the tool.

The initial SOC stock at the start of the Project is estimated as follows:

$$SOC_{INITIAL,i} = SOC_{REF,i} * f_{LU,i} * f_{MG,i} * f_{IN,i}$$

Where,

$SOC_{INITIAL,i}$= SOC stock at the beginning of the A/R project activity in stratum i of the areas of land; tC ha^{-1}

$SOC_{REF,i}$ =Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation – normally forest) by climate region and soil type applicable to stratum i of the areas of land; tC ha^{-1}

$f_{LU,i}$ = Relative stock change factor for baseline land-use in stratum i of the areas of land; dimensionless

$f_{MG,i}$ = Relative stock change factor for baseline management regime in stratum i of the areas of land; dimensionless

$f_{IN,i}$= Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum i of the areas of land; dimensionless

The values of $SOC_{REF,i}, f_{LU,i}, f_{MG,i}, f_{IN,i}$ are presented in the following table | ***Parameters used for the estimation of the soil organic carbon (SOC)***

Parameter	***Symbol***	***Value***	***Source (SOC estimation tool, V01.1.0)***
Reference SOC (tC/ha)	*SOCREF,*	47	Table 1 of the tool; Tropical moist, Soils with low activity clay (LAC)
Land use factor	*fLU ,i*	1	Table 4 of the tool; All permanent grassland
Management factor	*f MG,i*	0,7	Table 4 of the tool; Lands are identified as degraded lands.
Input factor	*fIN,i*	1	Table 4of the tool; Lands are identified as degraded lands.
SOC at the beginning of the project activity	*SOCinitial,i*	32,9	Calculated, with Eq. above described

Then, the rate of change in SOC stock in project scenario until the steady state is reached is estimated as follows

$$dSOC_{t,i} = \frac{SOC_{REF,i} - (SOC_{INITIAL,i} - SOC_{LOSS,i})}{20\ years}$$

$dSOC_{t,i}$ = Change in carbon stock in trees within the project boundary in year t; tCO2e

$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R project activity in stratum i of the areas of land; tC ha^{-1}

$SOC_{REF,i}$ =Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation normally forest) by climate region and soil type applicable to stratum i of the areas of land; tC ha^{-1}

$SOC_{LOSS,i}$= Loss of SOC caused by soil disturbance attribuible to the A/R project in stratum i of the areas of land; tC ha^{-1}

In the case of the soil disturbance attributable to project activity and for which the total area disturbed, over and above the area is less than 10% of the area of the stratum. Then the carbon loss is assumed as zero. The resultant value applying the equation above, is *dSOCt,i* = 0.71

The change in SOC stock for all the strata of the areas of land, in year t, is calculated as indicated in equation 8 of the tool.

$$\Delta SOC_{AL,t} = \frac{44}{12} * \sum Ai * dSOC_{t,i} * 1\ year$$

$\Delta SOC_{AL,t}$ = Change in SOC stock in areas of land meeting the applicability conditions of the tool, in year t;

tCO2e A_i = The area of stratum i of the areas of land; ha

$dSOC_{t,i}$= Change in carbon stock in trees within the project boundary in year t; tCO2e

Dead Wood and Litter

Estimations were done in accordance with the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”. Values of the conservative default-factors expressing carbon stock in litter and dead wood as a percentage of carbon stock in tree biomass was selected according to the guidance provided in the methodological tool.

Conservative default-factor based method for estimation of carbon stock in dead Wood (CDW)

Project proponent will not make sampling based measurements for estimation of C stock in dead wood for all strata to which this default method is applied, the carbon stock in dead wood was estimated as is indicated in equation 9 of the tool:

$$C_{DW,i,t} = C_{TREE,t,i} * DF_{DW}$$

$C_{DW,i,t}$ = Carbon stock in dead wood in stratum i at a given point of time in year t; tCO2e

$C_{TREE,t,i}$ = Carbon stock in tree biomass in stratum i at a given point of time in year t; tCO2e

DF_{DW} = Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass; percentage Value of the conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass (DFDW) was selected according to the guidance provided in the relevant table in Section III of the tool.

The rate of change of dead wood biomass over a period was calculated assuming a linear change. Therefore, the rate of change in carbon stock in dead wood over a period was calculated as is indicated in equation 10 of the tool. Then, change in carbon stock in dead wood within the project boundary in year is given by equation 11 of the tool.

Conservative default-factor based method for estimation of carbon stock in litter (CLI)

For all strata to which this default method is applied, the carbon stock in litter will be estimated as is indicated in equation 15 of the tool.

Value of the conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass (DF) has been selected according to the guidance provided in the tool.

The rate of change of litter biomass over a period was calculated assuming a linear change. Therefore, the rate of change in carbon stock in litter over a period of time is calculated as is indicated in equation 16 of the tool. Then, change in carbon stock in litter within the project boundary in year is given by equation 16 of the tool.

Next table summarize the conservative default factors expressing carbon stock in dead wood and litter.

Conservative default factor expressing carbon stock in dead wood and litter

Parameter	***Description***	***%***	***Comments***
DFDW	Conservative default factor expressing carbon stock in dead wood as a DW percentage of carbon stock in tree biomass	1	Biome: tropical Elevation: <2000m Precipitation: 1000 - 1600 mmyr-1
DF_u	Default factor for the relationship between carbon stock in litter and carbon stock inliving trees	1	Biome: tropical Elevation: <2000m Precipitation: 1000 - 1600 mmyr-1

Total estimated net GHG emission reductions

Years	**Age of**	**Estimated baseline emissions or**	**Estimated project emissions or**	**Estimated leakage**	**Estimated net GHG emission**

	Project	removals (tCO2e)	removals (tCO2e)	emissions (tCO2e)	reductions or removals (tCO2e)
2013	1	-	-	-	10,079
2014	2	-	-	-	24,444
2015	3	-	-	-	38,503
2016	4	-	-	-	50,724
2017	5	-	-	-	64,555
2018	6	-	-	-	65,106
2019	7	-	-	-	65,106
2020	8	-	-	-	62,901
2021	9	-	-	-	65,106
2022	10	-	-	-	64,878
2023	11	-	-	-	64,908
2024	12	-	-	-	65,007
2025	13	-	-	-	65,007
2026	14	-	-	-	65,106
2027	15	-	-	-	62,901
2028	16	-	-	-	65,106
2029	17	-	-	-	64,878
2030	18	-	-	-	64,908
2031	19	-	-	-	65,106
2032	20	-	-	-	65,106
2033	21	-	-	-	65,106
2034	22	-	-	-	65,106
2035	23	-	-	-	65,106
2036	24	-	-	-	65,106
2037	25	-	-	-	65,106
Total		**0**	**0**	**0**	1,484,968

5.7 Climate Change Adaptation Benefit

The Eucalyptus plantation has also generated positive effects on climate and microclimate, which can also benefit the entire local community.

Vital (2007) stated that eucalyptus effects on climate do not differ substantially from the effects of any other forest cover. Obviously, if Eucalyptus trees were planted in areas where there previously was no forest cover, they would alter the soil reflectivity degree, in addition to wind speed, thereby engendering an increase in humidity and a lowering in temperature. In this sense, a eucalyptus plantation might have some impact on climate.

The same author also stated that there is no empirical evidence or obvious conclusions about the effect that eucalyptus plantations might have on climate. If the climate impact can be considered negligible, the impact of plantations on local microclimate is much more noticeable. As stated by Poore and Fries (1985), eucalyptus forests produce a microclimate characterized by high humidity, less sunlight, lower temperatures, and moderate temperature excursions.

Considering that in all the three areas where eucalyptus plantations were introduced, only degraded pasture was present, it can be stated that the current eucalyptus plantations present today in the Fazenda São Paulo have positively influenced the microclimate of that area.

The local community also receives indirect benefits from the positive effect of the forest on the air.

In fact, similarly to other forest covers, the Eucalyptus forest uses not only water, soil nutrients, solar energy and CO_2 for Photosynthesis (daytime), but also oxygen in respiration (Nighttime), in its growth process, thereby returning water and CO_2. Growing forests anyway absorb more CO_2 than the quantity of CO_2 returned at night to the atmosphere through respiration. Indeed, as stated by Hall et al. (1980), the Photosynthesis rate in growing forests is thirty times greater than the respiration rate, as opposed to "mature forests", which during respiration release back into the atmosphere all the CO_2 absorbed in the Photosynthesis process. This CO_2 absorption from the atmosphere is called "carbon sequestration". Since CO_2 is considered one of the main greenhouse gases, Eucalyptus plantations can indeed act as real CO_2 "absorbent", thus working as an efficient mechanism to combat global warming (Vital, 2007).

6 COMMUNITY

6.1 Net Positive Community Impacts

The reforestation Project development has resulted into an increase of all agricultural and business activities of the Fazenda, with a consequent increase of employment: Before the Project, only two people in charge of livestock breeding worked in the Fazenda. Currently, the forest maintenance and timber harvesting operations employ 8 to 40 workers, depending on the time of year, the stage of the life cycle of plants and the particular job to be done. Both workers and their families have directly benefited from the Project. For this reason, it can be stated that the Project has had a positive impact on the local community.

Not all the benefits, including climate and community benefits, would have occurred in the absence of the project.

6.2 Negative Offsite Stakeholder impacts

The Fazenda São Paulo Agroforestry Project has no negative effect on the community. In some regions of Brazil, the dispute over the ownership of the land among landowners and local natives is particularly lively and topical.

We would like to express all our understanding towards such an important and sensitive subject. The Fazenda São Paulo Agroforestry Project is located in a region (*Tres Barras*) where there is no dispute or confrontation between indigenous tribes and ranchers.

Pending conflicts between the indigenous Guarani/Kayowa ethnical group and "fazendeiros" are still ongoing and no permanent solutions have been found yet. They also concern the south of Mato Grosso do Sul, in the border areas with Paraguay, mainly in the Caarapó, Amambai and Ponta Porã municipalities (Source: http://portalctb.org.br/site/noticias/Brazil/29517-conflito-por-terras-indigenas-se-intensifica-no-mato-grosso-do-sul).

No such disputes are under way in the region where the Project is implemented.

6.3 Exceptional Community Benefits

There are no exceptional community benefits.

7 BIODIVERSITY

7.1 Net Positive Biodiversity Impacts

The impact of eucalyptus plantations on water, soil and biodiversity depends on the conditions prior to the planting of the forest: if planted in degraded areas or in areas previously used for pasture and other crops, an increase of flora and fauna biodiversity can be recorded (Vital, 2007).

A monoculture can never offer the same diversity of the original products and benefits of native forests. In fact, the replacement of the original vegetation cover composed of different plant species with a single monoculture, be it native or exotic, is mostly detrimental to biodiversity. Yet, in the case of eucalyptus monoculture, due to the characteristics of the forest, a greater flora and fauna variety can be observed than in other forms of monoculture (Davidson, 1985).

Reforestation with monoculture plantations can serve as shelter for a diversified fauna, provided that rational techniques are implemented, for example by maintaining native vegetation belts (biological corridors) or planting fruit trees, shrubs and grasses, they can meet the food requirements of wild fauna throughout the year (Almeida, 1979).

Vital (2007) stated that, despite the more reduced variety of species observed in the eucalyptus forests compared to native forests, a wide variety of mammals, birds, and insects can be observed in planted forests.

Rajvanshi (1983) compared the undergrowth of a natural forest (*Sal Forest*) in the Golatappar-Dehra Dun region, in India, with a *Eucalyptus spp* plantation, attributing the differences in species composition to different types of openings in the tree canopy. The more wide-open foliage of the eucalyptus plantation allows greater penetration of sun radiation and rainwater, thereby explaining the greater plant diversity in its undergrowth.

Neri (2005) published a study on the flora present in the undergrowth of a eucalyptus forest, showing that the undergrowth regeneration in homogeneous plantations heavily depends on the species present in the neighboring native forests. In this study, 47 species were observed, including some tree species producing precious wood.

Silva (2002) carried out a study intended to analyze the richness of diversity of mammal species living in a planted area characterized by patches of *Eucalyptus saligna* plantations close to remaining *Mata Atlantica* forests*.* As many as 47 species of mammals, including some endangered species, such as *Puma concolor* (puma) and *Myrmecophaga trydactyla* (anteater) were observed in the study area. The species biodiversity is similar to the one recorded in the native forest patches, although it is lower in *E. saligna* plantations. The author also stated that the eucalyptus plantations, if well managed, could play an important role for the protection of species of non-flying mammals, as these areas are abundantly inhabited by these species.

Silveira (2005) stated that, despite the fauna biodiversity in planted forests is less than the one observed in native forests, the undergrowth present in these homogenous forests can provide food, shelter and an environment conducive to animal growth.

Mello (1975) stated that biodiversity is proportional to the size of the forest and becomes greater as the number of existing native areas interspersed with planted areas increases.

Biodiversity in eucalyptus forests is much greater than that found in other crops such as soybeans, corn, sugar cane and coffee. This is because eucalyptus forests can serve as a shelter, home and nesting sites to several species of birds, which would not be possible instead in crops with a lowest height, such as soybeans, coffee, sugar cane and other monoculture crops (Vital, 2007).

In general, the fauna and flora biodiversity is lower if compared to natural forests, but it is higher if compared to grazing or farmland (Vital, 2007). The same author claimed that the "green desert" nickname attributed to eucalyptus is incorrect. As already pointed out, eucalyptus forests are able to provide safe habitats to a wide range of species, both birds and mammals, and to provide a rich plant development through their "undergrowth".

Gabriel et al. (2013) stated that in eucalyptus forests are also home to endangered plant species threatened with extinction, such as *Araucaria angustifolia, Couratari asterotricha, Buchenavia hoehneana, Dalbergia nigra, Ocotea catharinensis and Ocotea porosa.* Animal species threatened with extinction included the Grey Eagle *(Urubitinga coronata),* the Chaua Parrot *(Amazona rhodochorytha),* the Guarà Wolf *(Chrysocyon brachyurus), the Tamanduá* anteater *(Myrmecophaga tridactyla)* and the tapir *(Tapirus terrestris).*

In the specific case of the Fazenda São Paulo Agroforestry project different species of birds (including hawks, woodpeckers, snakes and various species of passerines) and mammals (including anteaters, tapirs, deer, foxes, wild boars, ocelots and numerous species of rodents) can be frequently found. This is mainly due to the fact that the planted forest areas are interspersed with Legal Reserve areas (which must account for at least 20% of the Fazenda land according to the Brazilian legislation) and grazing areas normally are home to an extremely varied fauna. This type of mosaic-shaped crop and geographical diversification fully respects and can even enhance the biodiversity of the region, despite the presence of a monoculture such as the Eucalyptus plantation.

The fact that cattle ranching is no longer practiced in the areas within the project boundary has enabled a significant increase of ungulates (deer and wild boars) in the region, probably because cattle no longer compete for forage.

A further significant effect on biodiversity derives from the absence of cattle farming, which has allowed the full restoration of Legal Reserve area within the Fazenda boundaries. In the past, when cattle ranching was practiced, the Legal Reserve areas were almost systematically used for cattle grazing during the dry season, when pastures were poor, thus breaking the law and jeopardizing the native savannah. These areas were also often burned, since the owner used this practice to stimulate the regrowth of pasture during the dry season.

As for GMOs, none of the species planted within the Project area is classified as GMOs.

Typical "mosaic" landscape of the areas planted with eucalyptus in the framework of the Project. Parcels are often interspersed with pastures and native savannah areas that make up the Legal Reserve

Typical "mosaic" landscape of the areas planted with eucalyptus in the framework of the Project.

7.2 Negative Offsite Biodiversity Impacts

The Project has had no negative impact on the biodiversity of the region. As described and shown in the previous section, the development of the undergrowth after the planting of the eucalyptus forest has become a source of food and shelter for the wildlife. The typical ‘mosaic’ structure of the plantation, where the Eucalyptus areas are interspersed with grassland and savannah areas, has allowed an increase in (both fauna and flora) biodiversity in the region.

7.3 Exceptional Biodiversity Benefits

There are no exceptional Biodiversity Benefits.

8 MONITORING

8.1 Description of the Monitoring Plan

Monitoring Plan Approach

This monitoring plan considers the standard operating procedures and guidelines in order to meet the requirements based on reliable data with the aim of reaching a reliable project performance assessment and the reduction of anthropogenic emissions of greenhouse gases.

The monitoring plan defines the control procedures indicated in the e-ARACM0003 project document and it outlines a few specific permanent test areas.

In particular, a few specific areas have been identified that will allow to monitor changes in the carbon content of the aboveground and belowground biomass, in different periods of forestry activities (ie soil preparation, fertilization, thinning, harvesting and enrichment).

The project areas are appropriately numbered, geo-referenced and shown in detail in the maps. The monitoring was performed by experts specialized in the field with a deep knowledge of the various spatial, agri-climate and environmental aspects.

<u>Davide Rossi</u>
Italian nationality
Veterinary doctor, PhD in Epidemiology
Operating in Brazil since 2004.
Expert in agricultural, zootechnical and forestry production in tropical setting.

<u>Vittorio Maronese</u>
Italian nationality
zootechnician, expert in livestock production
Operating in Brazil since 1997.
Operating in Brazil since 1997.
Expert in forestry and Eucalyptus farming

Data management and storage

The collected data was processed using specifically designed forms and reported on paper and digital format.

The collected data, the calculations and the related outputs are stored with dedicated backup in multiple copies.

The variations observed by the field staff are monitored again, thus becoming the subject of new processing and reporting activities.

Monitoring intervals and frequency

The monitoring periods and frequency comply with the predetermined intervals over a five year timeframe. This period may, however, vary depending on any further in-depth analysis needs and other project requirements.

Monitoring operational procedures

All personnel involved in the survey uses standard operating procedures (SOP) as well as specific scientific literature reported in the bibliography.

All measurements, estimates of variations as well as forestry operations related to the project plantations as well as any changes in the areas subject to preparation, management and planting are properly recorded. This is done using regularly checked and calibrated dedicated tools.

In order to reduce sampling and assessment uncertainties, the proper operation of the devices was preliminarily checked according to specific procedures

Measurement and estimation of carbon content changes

Only aboveground and belowground biomass of trees established in the project will be monitored.

Therefore, only monitor individual growth of each tree in the plots. This value shall be estimated from the increase in the determined stem in each monitoring. The changes of carbon content in other components of the biomass (branches and leaves) and aboveground (roots) of trees of each plot will be estimated by the Method of Biomass Expansion Factors (Biomass Expansion Factor Method-BEF).

The carbon content in dead wood, litter and soil attributable to project activities, will not be monitored.

These ones will be estimated by using default values and suggested methods in the tools Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities and Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities.

Stratification

The strata defined will be monitored in a database that lists species, area, plot, date of planting, etc. This database will be stored both in physical and digital format. This database will be additionally supported by the respective cartography. An annual update of the project areas is suggested, due to the gradual process of intervention, as this allows a permanent control and monitoring of the areas per stratum.

The areas will be periodically monitored in accordance with the criteria established for the monitoring of project boundaries, seeking to identify changes in the parameters of the initially established areas, a nd promoting the unification of strata considered as dissimilar in the ex ante phase. According to changes in the accumulation of carbon in each monitoring period, a new stratification that would group stands with similar accumulations and other aspects in common. If a pre-sampling is conducted before the first monitoring, the results will allow a re-stratification to be made, according to the following parameters:

- Age
- Silviculture management
- Carbon capture
- Cost-effectiveness of the monitoring process
- Disturbances (plagues, fire, pathologies, etc.)
- Others

Plot size

Permanent sample plots (PSPs) will be used for sampling over time to measure and monitor changes of the relevant carbon stocks. Permanent plots will be installed prior to the first verification. The sample plots are used to take measurements such as tree height (H), diameter at breast height (DBH) and species type. For all trees, the DBH measurement will be taken at a height of 1.3 m. The field forms for every PSP shall be recorded and kept in the PSP file.

The survey areas will be defined within the plot boundary according to the guidelines.

Number of sample plots

The sample size (number of sample plots to be established and measured) can be estimated as fol lows:

$$n = \left(\frac{t_\alpha}{E}\right)^2 * \left(\sum_{i=1}^{I} W_i * s_i * \sqrt{C_i}\right) * \left(\sum_{i=1}^{I} W_i * \frac{s_i}{\sqrt{C_i}}\right)$$

Where:

N Sample size (number of sample plots required for monitoring)

ta t value for a si gnificance level of a (0.05) or confidence level of 95%

Ni Number of sample units for stratum i, calculated by dividing the area of stratum i

by the area of each plot

N Total number of sample units of all stratum levels , N = ∑Ni si Standard deviation of stratum i

E Allowable error (±10% of the mean)

Ci Cost to select a plot of the stratum i

I Stratum i (total number of strata I)

Wi Ni/N

The number of plots will be allocated among the strata as per the equation below:

$$n_i = n * \frac{W_i * \frac{s_i}{\sqrt{C_i}}}{\sum_{i=1}^{I} W_i * \frac{s_i}{\sqrt{C_i}}}$$

Where:

ni Number of sample units (permanent sample plots) per stratum, that are allocated proportion to Wh* si/vCi

Ci Cost to select a plot of the stratum i

N Sample size (number of sample plots required for monitoring)

si Standard deviation of stratum i

I Stratum i (total number of strata I)

Wi Ni/N

When no information on costs is available or the costs may be assumed as constant for all strata, then:

$$n = \frac{\left[\sum_{i=1}^{I} N_i * s_i\right]^2}{\left(N * \frac{E}{t_\alpha}\right)^2 + \sum_{i=1}^{I} N_i * (s_i)^2}$$

where:

N Sample size (number of sample plots required for monitoring)

ta t value for a significance level of a (0.05) or confidence level of 95%

Ni Number of sample units for stratum i, calculated by dividing the area of stratum i by the area of each plot

N Total number of sample units of all stratum levels , N = ∑Ni

si Standard deviation of stratum i

E Allowable error (±10% of the mean)

I Stratum i (total number of strata I)

The number of plots will be allocated among the strata as per the equation below:

$$n_i = \frac{\sum_{i=1}^{I} N_i * s_i}{\left(N * \frac{E}{t_\alpha}\right)^2 + \sum_{i=1}^{I} N_i * (s_i)^2} * N_i * s_i$$

where:

ni Number of sample units (permanent sample plots) per stratum, that are allocated proportion to Wh* si/vCi

Ni Number of sample units for stratum i, calculated by dividing the area of stratum i by the area of each plot

si Standard deviation of stratum i

N Total number of sample units of all stratum levels , N = ∑Ni

E Allowable error (±10% of the mean)

ta t value for a si gnificance level of a (0.05) or confidence level of 95%

I Stratum i (total number of strata I)

Standard operating procedure SOP:

SOP Establishment of Plots will be used to establish all plots. The plots will be systematically located with a random start in each stratum to avoid subjective choice of plot locations (plot centers, plot reference points, movement of plot centers to more “convenient” positions). The plot locations will be identified with the help of a GPS device in the field. For each plot the geographic position (GPS coordinate), administrative location and compartment series number will be recorded and archived. The PSPs will be established before the first monitoring takes place and measured for each monitoring event. In the case of special circumstances (e.g., forest fires, uneven growth) additional PSPs may be laid out.

Data Collection

Each pool will be measured following the methodology procedures and IPCC Good Practice Guidance for LULUCF (2003). Carbon stocks in above and below ground biomass of trees are estimated by applying the BEF method. Stem volume, will be calculated applying a manual of procedures developed for local conditions, based on DBH and height measurement in each plot. Stem volume of trees is converted to above-ground and below-ground tree biomass using basic wood density (D), biomass expansion factor

(BEF) and root-to-shoot ratio (R), Default carbon fraction (CF) value will be used in order to estimate the carbon stock.

Deadwood, litter and soil carbon will be calculated according to the tools Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities and Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities; the conservative default approach might be selected.

Forest and tree inventory data is exclusively collected within the limits of the project boundary. Data is collected through observations and measurements within a sample plot.

Fieldwork

This part includes a description of the Standard Operation Procedures to prepare and carry out fieldwork activities. The fieldwork, together with guidance on the data collection techniques, is described step by step for a sample plot.

Overview of data collection process

Data are collected by the field crews for plots in different strata. The main information sources for the inventory area:

- Desktop-based planning;
- Field measurements and observations.
- Interviews with local people, owners or land users, the key external reporting, as foresters responsible for the area in which lies the sampling area.

The data collection procedures are divided into three phases:

- The first phase is the field crew formation;
- The second phase is the preparation of the fieldwork (bibliographic research, contacts with locals, preparation of the field forms, preparation of the maps and access itinerary, material preparation)
- The third phase is the actual field work: field measurements and observations (access the first plot, plot marking, variable measurements, and access to the next plot).

Fieldwork organization

- Setting up field crews;
- Conducting training for field crews;

- Organizing and planning fieldwork, in particular mobilization and preparation of necessary resources and equipment, such as vehicles, and allocation of plots by field crews;
- Monitoring and backstopping fieldwork, including technical and logistic support to field crews, in order to ensure data quality and homogeneity among field crews;
- Controlling and validating field forms;
- Controlling data and evaluating its quality;
- Compiling databases; and
- Reporting and disseminating results.
- Field crews will be responsible for collection of data in the field.

Field crew composition

A forest inventory field crew, taking into account the amount of information to be collected and the tasks of each individual, is composed by at least two members. Additional people may be included to improve performance of the field crews when conditions require greater resources.

It is intended that some of the field crews are hired locally and act as guides in the field. One of the crew members must be experienced in tree species identification.

The responsibilities of each crew member must be clearly defined and their tasks are as follows:

- The crew leader is responsible for organizing all the phases of the fieldwork, from the preparation to the data collection. He/she has the responsibility of contacting and maintaining good relationships with local stakeholders and has a good overview of the progress achieved in the fieldwork. He/she will specifically:
- Prepare the fieldwork by carrying out bibliographic research, preparing field forms and maps;
- Plan the work for the crew;
- Contact local stakeholders (e.g. authorities) to introduce the survey objectives and the work plan, and request their assistance if needed;
- Administer the location of plots;
- Take care of logistics of the crew by organizing and obtaining information on accommodation facilities, recruiting local workers, organizing access to the strata;
- Ensure that field forms are properly filled in and that collected data are reliable;

- Organize meetings after fieldwork in order to sum up daily activities; and
- Organize the fieldworks safety.
- The assistant of the crew leader will:
- Help the crew leader to carry out his/her task;
- Take necessary measurements and observations;
- Make sure that the equipment of the crew is always complete and operational; and
- Supervise and orient workers.
- The workers are assigned the following tasks, according to their skills and knowledge of local species and practices:
- Help to measure distances;
- Open ways to facilitate access and visibility to technicians;
- Provide the common/local name of forest species;
- Inform about access to the strata;
- Provide information about the forest uses and management; and
- Carry the equipment.
- Training of the crews on the survey methodology is undertaken at the beginning of the fieldwork in theoretical and practical sessions where techniques of different forest and tree measurements are explained and practiced.

Preparation of the fieldwork

In forest inventories, auxiliary information is necessary to prepare the field survey. Existing reports on forest inventory have to be studied to enable the crew members to understand and to build better knowledge on the local realities.

Contacts

Each field crew, through its leader, starts its work by contacting local stakeholders to introduce the field crew and its programme of work in the area. Authorities may provide information about access conditions to the site. Field crews may also inform the local people about the project.

Preparation of the field forms

The technical unit of the project will prepare and print, for each crew, the necessary field forms to cover the strata assigned to it. One field form per plot is needed. The form is described in the following section.

Some information will be filled-in before going out to the field: sections for identification of the strata and plots (header of each page), general information related to strata location, coordinates of the plot.

The crew leader must ensure that enough forms are available to carry out the planned field data collection.

Preparation of maps

Maps covering the study area will be prepared to help the orientation in the field. These may be enlarged and reproduced, if necessary.

The strata limits and plot locations will be delineated on topographic maps and, if available, on aerial photographs/satellite images. The plots in the strata are to be indicated, together with their respective coordinates, in decimal degrees (latitude and longitude) traceable in GPS. The point coordinates of the plots are entered into the GPS receiver.

The plot order for data collection will vary according to conditions of accessibility. It is determined during the preparation phase. The plots will have unique IDs following: # (=Stratum number) + # (=Plot number).

Field equipment per crew

- The equipment needed to carry out the inventory is composed of:
- Compass (360°);
- GPS receiver (Geographic Positioning System) and extra batteries;
- 2 self-rolling measuring tapes 10-30 m (metric);
- 2 diameter tapes or calliper (metric);
- Tree height and land slope measuring equipment: an Haga and aluminum rods
- 50m measuring tape or wire rope of 50 meters, marked every 5 meters
- Wooden stakes (50 cm long) for plot marking;
- Waterproof bags to protect measurement instruments and forms;
- Yellow paint;
- Brushes;
- Mobile phone (discretionary);

- Digital camera;
- Waterproof boots and outfits;
- Machetes;
- Emergency kit;
- Topographic maps;
- Supporting board to take notes;
- Data collections forms;
- Field manual;
- Permanent markers and pens;
- Flora and species list (common and scientific names);

Data collection in the field

- Introduction of the project to the local people

The crew must establish contacts with local people and onarrival to the site, meet with contacted persons and others such as village representatives and people living closest to the strata area. It will be necessary to contact the local population before visiting the area in order to inform them about the visit and request information about current conditions (e.g. accessibility due to weather conditions or conflicts).

The crew must briefly introduce and explain the aim of the visit and study. The aim of the forest inventory must also be clearly introduced to avoid misunderstandings or raise false expectations. Cooperation and support from local people are essential to carry out the fieldwork.

- Access to plot

The plots will be located with the help of the topographic maps (and aerial photographs/satellite images, if available), where the plots have been delineated. Some reference points that facilitate the orientation in the field will also be identified on the maps. A local guide will be useful to access the plots more easily. Orientation in the field will be assured with the help of a GPS where the central points of each plot have been registered as waypoints. To get to a well defined point, an average position is taken with the GPS when its reading indicates that the point is within a few meters (>10m). Then, the compass and measuring tape might be used for the last few meters instead of the GPS.The order of the plots for data collection, decided during the preparatory phase, should be followed and the plot code and orientation must be respected.

While accessing the first plot, the form must be filled in. The coordinates of the departure location on foot towards the first plot must be read on GPS (or on the map, if the GPS does not capture a signal). The coordinates of each reference point are read on the GPS and reference photography will be taken. Then, the photograph codes will be reported in the form.

- Establishment of permanent plot

When arriving to the point of the plot, a permanent marker (a wooden stake and marked on the bottom with yellow paint the plot number). The marker must be placed exactly on the position of the point of the plot. In cases where obstacles obstruct such exact location (due to tree, rock, river, etc.) the permanent marker will be placed as close as possible to the starting point of the plot. Marker location data must be collected together with a starting point description of the plot in order to enable relocation in the future.

The coordinates of plot marker position are determined, with the help of GPS, as average position. An ID will be assigned to name each one of the points identified by the GPS. The distance and direction (compass bearing in degrees, 360°) of the plot's starting point, measured from the marker location, must be measured in case that these two positions do not coincide; these indications are recorded in the form under observations. Markers will be positioned at the central point of all plots.

Data collection in the plot

The data collection starts at the plot starting point and continues in predefined direction. From the plot centre the northern bearing will be identified (0°) and then trees will be measured in clockwise direction.

Variables are collected in the plot where large trees are measured (Dbh ≥10 cm, or also ≤10 cm and ≥ 2.5 cm if the plantation is ≤5 years old). These data must be recorded in the form (one for each plot).

- Tree measurements

All trees over 10 cm (also ≤10 cm and ≥ 2.5 cm if the plantation is ≤5 years old) of DBH are measured, and these data is recorded in a field form. Trees located at the border of the plot will be considered as being inside the plot if at least half of the stem diameter is inside at breast height. Data collected include the species identification (common and scientific name), height and diameter. Tree diameter and height measurement methods are crucial for the accurate reporting of data.

- Tree (DBH) measurement

Tree diameter is measured over bark, at 1.3 m breast height above ground with the exception of particular cases mentioned below (see Figures below). Measurement may be carried out with the help of a diameter tape (tape whose diameter unit is in centimetres) or with the use of a calliper. In order to avoid overestimation of the volume and to compensate measurement errors, diameter is measured in cm and adjusted in a decreasing sense (example: 16.8 cm become 16 cm).

Figure - Position for diameter measurement at breast height in flat terrain

Some preventive measures must be taken into account:

Measurement instruments are kept in a position that perpendicularly cuts the tree axe at 1.3 m.

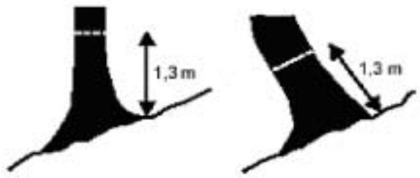


Figure - Dbh measurement position for a tree on steep terrain

If the diametric tape is used, make sure it is not twisted and is well stretched around the tree in a perpendicular position to the stem. Nothing must prevent a direct contract between the tape and the bark of the tree to be measured.

On inclined terrain, DBH tree measurement at 1.3 m is taken from an uphill position.

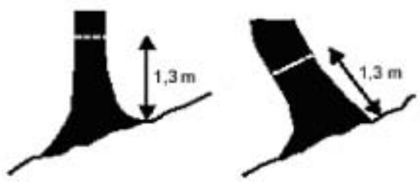


Figure - Dbh measurement position for a tree on steep terrain

Fork tree: several cases exist, according to the point where the fork divides the stem.

If the fork begins (the point where the core is divided) below 1.3 m height, each stem having the diameter required (≥10 cm in the whole plot, ≤10cm and ≥ 2.5 cm for plantations ≤5 years old) will be considered as a tree and will be measured. Diameter measurement of each stem will be taken at 1.3m height. If the fork begins between 0.3 and 1.3 m, each stem will be considered as separate tree and will be measured. The diameter measurement will be taken at 1 meter above the fork origin.

If the fork begins at 1.3 m or a little higher, the tree will be counted as a single tree. The diameter measurement is thus carried out below the fork intersection point, just below the bugle that could influence the Dbh.

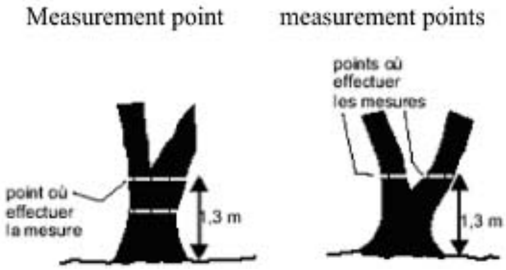


Figure - Measurement points at fork trees

Trees with irregular stem at 1.3 m: trees with bulges, wound, hollows and branches, etc. at breast height, are to be measured just above the irregular point, there where the irregular shape does not affect the stem.

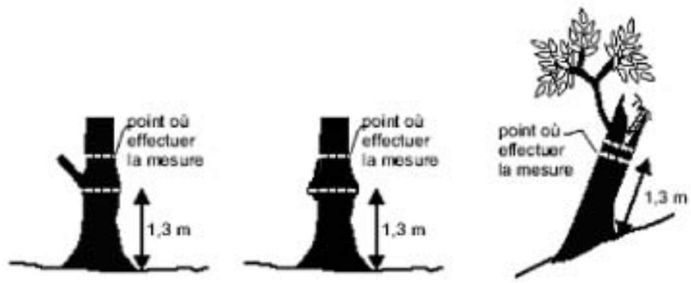


Figure - DBH measurement position for a tree with branch enlargement at 1.3 m and for other trees

Inclined trees: diameter measurement is done at 1.3 m. The stem height is measured where the steam base and the ground meet forming an angle.

Figure - DBH measurement position for an inclined tree. The scale to measure the CBH or DBH is 1 cm.

- Tree height measurement. It is done in several stages:
- To avoid measurement errors the tree distance (at 15, 20, 30 or 40 metres) when taking the measurement must be equivalent to the tree height.
- Observation of the tree crown.
- Observation of the tree base.
- Addition or subtraction of the two observation results according to the case:
- Addition if the operator is standing uphill (see Figure) in relation to the tree;
- Subtraction if the operator is standing downhill (see Figure) in relation to the tree.
- Slope correction.

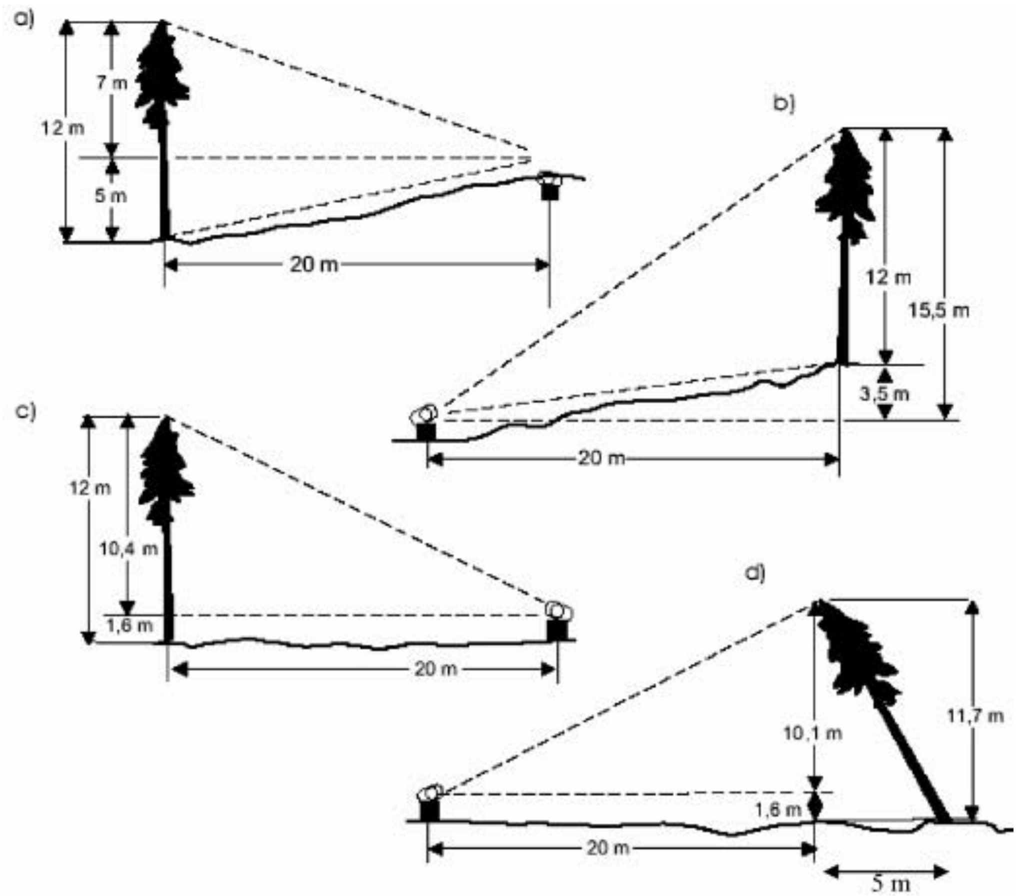


Figure - Tree height calculation

Tree height measurement may be carried out by means of several instruments such as a Haga.

- Observation angles: in order to measure the height of a tree, the operator tries two observation angles. The first one at the top level and a second one at the base of the tree.
- Determining the height: after each sighting, the operator reads the measure indicated on the scale which corresponds to the landmark chosen in the rod and then adds the results of the two measurements. The result of this addition corresponds to the height of the tree.
- For the new model, the operator will read the measurements after the second sighting because each pendulum allows the determining of a separate measurement.

On inclined terrain:

- The operator carries out the same operations indicated above, with the exception of the height calculation. If the operator is standing uphill, the results of the two measurements are added. If the operator is standing downhill, the sighting will be directed to the base of the tree and the result will be subtracted from the one directed at the top of the tree.

- Apply a slope coefficient to the height result.
- Carry out the observation of a tree point located at the same height where the operators' eye is positioned in relation to the ground.
- Check the angle's measurement in the appropriate scale.
- Then check the table located on one side of the instrument, on top of which a coefficient table is placed that helps in making the necessary corrections.
- Apply such coefficient following the formula: h' = h – hk; in which h' is the real height, h is the measured height and k the correction coefficient.

Height measurement with a Haga: It is an instrument used for measuring heights, which is the solution of triangles known angle, a distance and their respective calibration. With this device, the observer must be at a chosen distance Di and take two angles α1 and α2, which are replaced by the corresponding H and calibration:

$H1= Di \tan \alpha 1$

$H2= Di \tan \alpha 2$

The scale to measure the height is in meters.

- Then two measurements are needed, one above and one below zero to be added. When both readings are above or below zero are subtracted from the heights. This happens when the observer is outside of the line L equivalent to OH in Fig. Moreover, when not working with horizontal distances is necessary to apply to pending corrections

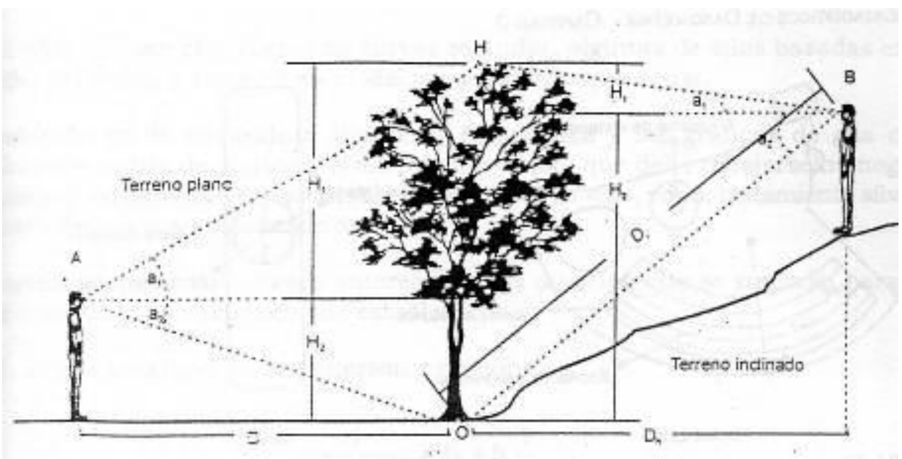


Figure - Items for measuring heights with trigonometric principles on flat and sloping.

End of data collection work in the plot and access to the next plot: Once the work in the first plot is completed, the time is recorded in the form and the crew need to access the second plot. If the forest cover allows it, it is possible to directly access the plot with the help of the GPS. Otherwise, it may be assured by using the compass. If the starting point of the next plot to be reached is not accessible on a straight line, the obstacle must be bypassed using auxiliary methods that allow finding the next plot.

Quality Assurance and Quality Control (QA/QC)

The implementing organization will be responsible for the centralized documentation of all project planning and implementation. QA/QC procedures will be implemented and the use of these procedures monitored to ensure that net anthropogenic GHG removals by sinks are measured and monitored precisely, credibly, verifiably, and transparently.

The project will follow the IPCC GPG of using two types of procedures in order to ensure that the inventory estimates and their contributing data are of high quality Quality assurance (QA) and Quality control (QC). Since a QA/QC plan is fundamental to create credibility, one will be developed that outlines QA/QC activities with a scheduled time frame from preparation to final reporting. The plan will describe specific QC procedures in addition to special QA review procedures. The QA/QC plan is an internal document to organize, plan, and implement QA/QC activities and will be represented here only in a reduced form. Here, some abstract of QA/QC plan features:

a) Standard Operating Procedures (SOP) that will be established for all procedures such as GIS analysis; field measurements; data entry; data documentation, and data storage.

b) Training courses will be held for all relevant personnel on all data collection and analysis procedures.

c) Steps will be taken to control for errors in the sampling and data analysis to develop a credible plan for measuring and monitoring carbon stock change in the project context. The same procedures shall be used during the project life to ensure continuity.

Field data collection

d) The personnel involved in the measurement of carbon pools will be fully trained in field data collection and analysis. SOPs will be developed for each step of the field measurements and followed so that measurements are comparable over time. If different interpretations of the SOPs exist among the field teams, they will be jointly revised to ensure clearer guidance. This procedure will be repeated during the field data collection.

e) To verify that plots have been installed and the measurements taken correctly: A minimum of 10% of randomly selected plots will be re-measured by a supervisor with a team not involved in the initial measurement sampling.

f) The re-measurement data will be compared with the original measurement data. Any errors found will be corrected and recorded. The level of errors recorded will be calculated and reported using this equation:

$$Error(\%) = \frac{(Estimate1 - Estimate2)}{Estimate2} * 100$$

g) The proper entry of data into the data analyses spreadsheets is required to produce reliable carbon estimates. All data sheets will include a “Data recorded by” field. Communication between all personnel involved in measuring and analyzing data will be used to resolve any apparent anomalies before final analysis of the monitoring data can be completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot will not be used in the analysis. Expert judgment and comparison with independent data will be used to ensure data results are in line with expectations. Additionally, field data will be reviewed by a senior member of the monitoring team further ensuring that the data and analysis are realistic.

h) Due to the long length of the project and the speed at which technology changes data archiving will be an essential component. Data will be archived in several forms and copies of all data will be provided to each project participant.

i) Original copies of the field measurement (data sheets and electronic files) and laboratory data will be stored in a secure location.

j) Copies will be stored in a dedicated and safe place (preferably offsite) of all data analysis and models, the final estimate of the amount of carbon sequestered, any GIS products, and the measuring and monitoring reports.

k) Electronic copies of all data and reports will be updated periodically and converted to any new format required by future software or hardware. A project participant involved in the field measurements will be assigned to implement this updating.

l) The data collected shall be archived for a period of at least two years after the end of the last crediting period of the project activity.

Verification and checklist considered to guarantee the quality of the information gathered and its management.

QC activity	**Procedures**
Check that assumptions and criteria for the selection of activity Data, emission factors and other estimation parameters are documented.	Cross-check descriptions of activity data, emission factors and other estimation parameters with information on source and sink categories and ensure that these are properly recorded and archived.
Check for transcription errors in data input and reference.	Confirm that bibliographical data references are properly cited in the internal documentation. Cross-check a sample of input data from each source category (either measurements or parameters used in calculations) for transcription errors.

Check that emissions and removals are calculated correctly.	Reproduce a representative sample of emission or removal calculations. Selectively mimic complex model calculations with abbreviated calculations to judge relative accuracy.

QC activity	Procedures
Check that parameter and units are correctly recorded and that appropriate conversion factors are used.	Check that units are properly labeled in calculation sheets. Check that units are correctly carried through from beginning to end of calculations. Check that conversion factors are correct. Check that temporal and spatial adjustment factors are used correctly.
Check the integrity of database files.	Confirm that the appropriate data processing steps are correctly represented in the database. Confirm that data relationships are correctly represented in the database. Ensure that data fields are properly labeled and have the correct design specifications. Ensure that adequate documentation of database and model structure and operation are archived.
Check for consistency in data between categories.	Identify parameters (e.g., activity data, and constants) that are common to multiple categories of sources and sinks, and confirm that there is consistency in the values used forthese parameters in the emissions calculations.
Check that the movement of inventory data among processing steps is correct	Check that emission and removal data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries. Check that emission and removal data are correctly transcribed between different intermediate products.
Check that uncertainties in emissions and removals are estimated or calculated correctly.	Check that qualifications of individuals providing expert judgment for uncertainty estimates are appropriate. Check that qualifications, assumptions and expert judgments are recorded. Check that calculated uncertainties are complete and calculated correctly. If necessary, duplicate error calculations on a small sample of the probabilitydistributions used by Monte Carlo analyses.
Undertake review of internal documentation	Check that there is detailed internal documentation to support the estimates and enable reproduction of the emission and removal and uncertainty

	estimates. Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review. Check integrity of any data archiving arrange me nts of outside organizations involved in inventory preparation.
Check time series consistency.	Check for temporal consistency in time series input data for each category of sources and sinks. Check for consistency in the algorithm/method used for calculations throughout the time series.
Undertake completeness checks	Confirm that estimates are reported for all categories of sources and sinks and for all years. Check that known data gaps that may result in incomplete emissions estimates are documented and treated in a conservative way.
Compare estimates to previous estimates.	For each category, current inventory estimates should be compared to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain the difference.

Operational and management structure

The project owners in each instance implement the proposed A/R project activity utilizing the locally available and experienced staff. The activities are implemented under the supervision of the technical team. The technical team organizes technical training and consultation, and is responsible for the organization and coordination of measuring and monitoring the actual GHG removals by sinks.

Under the proposed A/R project activity each project proponent will provide technical instruction on reforestation and forest management. They will conduct the specific supervision of the implementation of the proposed A/R project activity, collect specific activity data at routine basis, be responsible for measuring and monitoring of the actual GHG removals by sinks, establish an expert team when necessary (e.g., to address any technical issues), conduct checks, and verify the accuracy of measured and monitored data.

The operational structure and responsibilities for each project owner is divided into three basic departments:

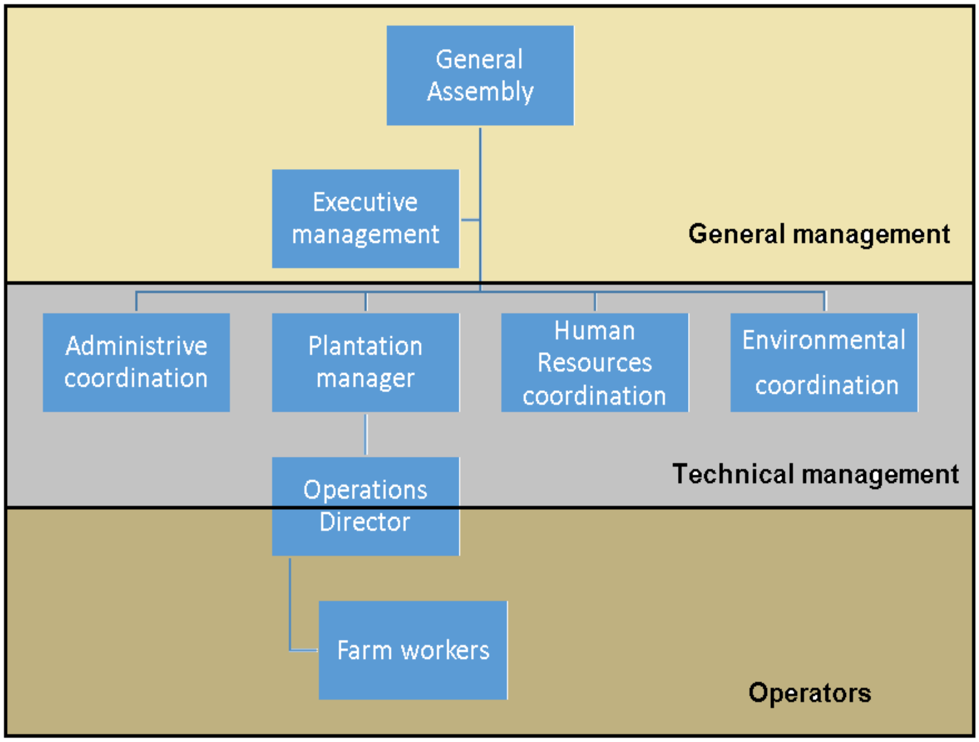


Figure - Operational Structure

The project proponent is committed to act responsibly, to guarantee the quality of the silvicultural activities performed in the field, and also that the environment, industrial safety and occupational health, are in line to the development of all the processes, products and projects. The skills required by the staff in order to work in the project, are as follows:

Specialized staff

This staff is composed by professionals that perform specific technical and administrative tasks and that usually have experience in this type of projects. This group of people is hired by the project owners and many of them belong to the permanent team of workers. The group consists of forestry and agricultural engineers, accountants, business managers, among others.

Qualified staff

Corresponds to the staff who have acquired training and experience in forestry projects through their ongoing work on these projects, and that have specialized in a specific task. The positions held by these personnel are: wholesalers, tractor drivers, mechanics, cooks, and others.

No-qualified staff

Workers engaged to unskilled activities do not require special skills or training to perform their duties. The company will prioritize the inhabitants of the community and other communities in the area where the project is developed.

Uncertainty assessment

The project follows the methods from IPCC GPG for LULUCF, GPG 2003, and the modalities and procedures for A/R project activities to estimate baseline net GHG removal by sinks, leakage, actual net GHG removal by sinks, and net anthropogenic removal by sinks. In the context of this methodology, the major sources of uncertainties related to changes in carbon stock in the living biomass pool include: natural factors such as fire and pest outbreaks; stand variables such as variation in the yield tables, allometric equation, biomass expansion factor (BEF), wood density, carbon fraction; and the errors contributed by the measurement. Estimates of uncertainty will be developed for all land-use categories involved in the inventory part of the monitoring.

Other elements of monitoring plan

Verification of project emissions emissions

The project will quantify and monitor the Non-CO2 GHG emissions resulting from an occurrence of fire (forest fire) within the project boundary, whose accumulated area affected by such fires in a year is ≥5% of the project area. These events will be monitored and the affected area will be recorded.

Emission of non-CO2 GHGs resulting from the loss of aboveground tree biomass due fire will be calculated in each verification period, by using the above ground biomass in trees of relevant strata calculated in the previous verification and the default values for the combustion factor, the emission factors and the global warming potential.

8.2 Data and Parameters Available at Validation

Data Unit / Parameter:	CO2-e
Data unit:	tCO2/tC
Description:	The factor is applied to convert the tree carbon sequestered to tree CO2-e sequestered.
Source of data:	IPCC default value.
Value applied:	3.667 (44/12)
Justification of choice of data or description of measurement methods and procedures applied	Value suggested by the IPCC
Purpose of the data:	Calculation of project emissions removals
Any comment:	-

Data Unit / Parameter:	fN,i
Data unit:	Dimensionless
Description:	Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum i of the areas of land
Source of data:	Tables 6 of "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project" activities
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied	The project meets the applicability conditions laid down in the *Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project*
Purpose of the data:	Calculation of project emissions removals
Any comment:	-

Data Unit / Parameter:	fMG,i
Data unit:	Dimensionless
Description:	Relative stock change factor for baseline management regime in stratum i of the areas of land; dimensionless
Source of data:	Table 6 of "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	The project meets the applicability conditions laid down in the *Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project*
Purpose of the data:	Calculation of project emissions removals
Any comment:	-

Data Unit / Parameter:	SOCREF
Data unit:	t C ha-1
Description:	Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation, normally forest) by climate region and soil type applicable to stratum i of the areas of land
Source of data:	Table 3 of "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project" activities.
Value applied:	47
Justification of choice of data or description of measurement methods and procedures applied	The project meets the applicability conditions laid down in the *Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project*
Purpose of the data:	Calculation of project emissions removals
Any comment:	-

Data Unit / Parameter:	fLU,i
Data unit:	Dimensionless
Description:	Relative stock change factor for baseline land use in stratum i of the areas of land
Source of data:	Tables 6 of "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project" activities
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied	The project meets the applicability conditions laid down in the Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project
Purpose of the data:	Calculation of project emissions removals
Any comment:	-

Data Unit / Parameter:	DF_{DW}
Data unit:	%
Description:	Conservative default factor expressing carbon stock in dead wood as a DW percentage of carbon stock in tree biomass
Source of data:	"Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project" activities
Value applied:	**1**
Justification of choice of data or description of measurement methods and procedures applied	The project meets the applicability conditions laid down in the Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project
Purpose of the data:	Calculation of project emissions removals
Any comment:	-

Data Unit / Parameter:	DF_{LI}
Data unit:	%
Description:	Default factor for the relationship between carbon stock in litter and carbon stock in living trees
Source of data:	"Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project" activities
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied	The project meets the applicability conditions laid down in the *Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project*
Purpose of the data:	Calculation of project emissions removals
Any comment:	-

Data Unit / Parameter:	**Wood density**
Data unit:	
Description:	D; t d.m./m^3
Source of data:	Mean value between the extremes shown in the bibliography - Rif. Bibliografy: Viabilidade de um projeto florestal de Eucalyptus grandis considerando o sequestro de carbono - Maestri e al. 2004 - Publ. Floresta 34(3), Set/Dez 2014 Curitiba PR
Value applied:	0,515
Justification of choice of data or description of measurement methods and procedures applied:	There is no local data information available on wood density for these species.
Any comment:	

Data Unit / Parameter:	Biomass Expansion Factor (BEF_2)
Data unit:	Dimensionless
Description:	The above-ground tree biomass is calculated using the BEF_2
Source of data:	*
Value applied:	2.225
Justification of choice of data or description of measurement methods and procedures applied:	
Purpose of the data:	Data is used for project emission calculation
Any comment:	-

* *Source of data 1: FATOR DE EXPANSÃO DE BIOMASSA, RAZÃO DE RAÍZES-PARTE AÉREA E MODELOS PARA CARBONO PARA Eucalyptus grandis PLANTADOS NO SUL - Ana Paula Dalla Corte - ENCICLOPÉDIA BIOSFERA, Centro Científico Conhecer - Goiânia, v.11 n.21; p. 2015 - Source of data 2: TABLE 3A.1.10 of IPCC Good Practice Guidance for LULUCF*

Data Unit / Parameter:	Biomass Expansion Factor (BEF_1)
Data unit:	Dimensionless
Description:	The above-ground tree biomass is calculated using the BEF_1
Source of data:	
Value applied:	
Justification of choice of data or description of measurement methods and procedures applied:	
Purpose of the data:	
Any comment:	-

Data Unit / Parameter:	Root-Shoot-Ratio (R)
Data unit:	Dimensionless
Description:	
Source of data:	**Source: TABLE 3A.1.8 of IPCC Good Practice Guidance for LULUCF**
Value applied:	**0.35**
Justification of choice of data or description of measurement methods and procedures applied:	
Purpose of the data:	Data is used for project emission calculation
Any comment:	-

Data Unit / Parameter:	A
Data unit:	ha
Description:	Project Area
Source of data:	Monitoring of strata and stand boundaries is done using a Geographical Information System (GIS) which allows for integrating data from different sources (including GPS coordinates and Remote Sensing data)
Value applied:	**1055.7033**
Justification of choice of data or description of measurement methods and procedures applied:	Output of the multitemporal vegetation cover analysis to identify the eligible areas of the project.
Purpose of the data:	Data is used for project emission calculation

Data / Parameter	A_i
Data unit	ha
Description	Area of stratum i
Source of data	Current and projected planting areas
Value applied:	See Table
Justification of choice of data or description of measurement methods and procedures applied:	GPS coordinates and projected planting areas by nucleus and specie
Purpose of data	Calculation of project emissions removals
Comments	

Data Unit / Parameter:	*V* *TREE, j,p,i,t*
Data unit:	m^3
Description:	Steam volume
Source of data:	Average value between the species *E. grandis* and *E. urophylla* converted into M3/ha/year starting from m3 steres (conversion value): 1,2)The source of data: Crescimento e produçao de madeira de Eucalipto - Simoes et al. 1980 Publ. IPEF n.20 jun 1980
Value applied:	48,49
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	

Data Unit / Parameter:	*F (t)*
Data unit:	T d.m.
Description:	Steam volume
Source of data:	
Value applied:	
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	

8.3 Data and Parameters Monitored

Data / Parameter	*A*
Data unit	ha
Description	Project Area
Source of data	Monitoring of strata and stand boundaries is done using a Geographical Information System (GIS) which allows for integrating data from different sources (including GPS coordinates and Remote Sensing data)
Description of measurement methods and procedures to be applied	Field measurement: the area shall be delineated either on the ground using GPS or from georeferenced remote sensing data
Frequency of monitoring/recording	Each time a verification is conducted
Value applied:	**1,055,6736**
Monitoring equipment	GPS coordinates and Remote Sensing data
QA/QC procedures to be applied	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Purpose of data	Calculation of project emissions
Calculation method	measured
Comments	-

Data / Parameter	A_i
Data unit	ha
Description	Area of stratum i
Source of data	Monitoring of strata and stand boundaries is done using a Geographical Information System (GIS) which allows for integrating data from different sources (including GPS coordinates and Remote Sensing data)
Description of measurement methods and procedures to be applied	Field measurement: the area shall be delineated either on the ground using GPS or from georeferenced remote sensing data
Frequency of monitoring/recording	Each time a verification is conducted
Value applied:	**View stratum table**
Monitoring equipment	GPS coordinates and Remote Sensing data
QA/QC procedures to be applied	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied

Data / Parameter	$A_{BURN,i,t}$
Data unit	ha
Description	Area burnt in stratum i in year t
Source of data	Monitoring of strata and stand boundaries is done using a Geographical Information System (GIS) which allows for integrating data from different sources (including GPS coordinates and Remote Sensing data)
Description of measurement methods and procedures to be applied	Field measurement: the area shall be delineated either on the ground using GPS or from georeferenced remote sensing data
Frequency of monitoring/recording	Whenever a fire has occurred
Value applied:	*Ex-post*
Monitoring equipment	GPS or georeferenced remote sensing data
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	Used in Eq. 7, ARAM-tool-08-v4.0.0
Comments	-

Data / Parameter	$A_{p,i}$
Data unit	ha
Description	Area of sample p in stratum *i*
Source of data	Field measurement
Description of measurement methods and procedures to be applied	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In the absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Frequency of monitoring/recording	Each time a verification is conducted
Value applied:	*Ex-post*
Monitoring equipment	Tape measure and GPS
QA/QC procedures to be applied	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	Sample plot location is registered with a GPS and marked on the project map.

Data / Parameter	*DBH*
Data unit	cm
Description	Diameter at Breast Height of the trees
Source of data	Field measurements in sample plots
Description of measurement methods and procedures to be applied	Typically measured 1.3 m above-ground. Measure all the trees above some minimum *DBH* in the permanent sample plots that result in the project activity.
Frequency of monitoring/recording	Each time a verification is conducted
Value applied:	*Ex-post*
Monitoring equipment	Tape measure
QA/QC procedures to be applied	Persons involving in the field measurement work should be fully trained in the field data collection. Field measurements shall be checked by a qualified person to correct any errors in techniques.
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	Section 4.3. (Tree DBH measurement) provide the detailed procedures to be applied.

Data / Parameter	H
Data unit	m
Description	Height of tree
Source of data	Field measurements in sample plots
Description of measurement methods and procedures to be applied	Measure all the trees height in the permanent sample plots that result in the project activity.
Frequency of monitoring/recording	Each time a verification is conducted
Value applied:	*Ex-post*
Monitoring equipment	Hypsometer
QA/QC procedures to be applied	Persons involving in the field measurement work should be fully trained in the field data collection. Field measurements shall be checked by a qualified person to correct any errors in techniques.
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	Section 4.3. (Tree height measurement) provide the detailed procedures to be applied.

Data / Parameter	$V_{TREE,\,j,p,i,t}$
Data unit	m^3
Description	Stem volume of trees of species *j* in sample plot p of stratum *i* at a point of time in year *t* calculated using a volume table or volume equation
Source of data	Field measurements of tree parameters (such as *DBH*, *H*, etc.) measured in sample plot *p* of stratum *i* at a given point of time in year *t*
Description of measurement methods and procedures to be applied	A volume table or volume equation is a table or an equation that predicts tree stem volume based on one or more measurements of a tree. Where the volume table or volume equation predicts under-bark volume (i.e. wood volume, rather than gross stem volume), suitable correction should be applied to estimate the over-bark volume.
Frequency of monitoring/recording	Each time a verification is conducted
Value applied:	Ex post
Monitoring equipment	-
QA/QC procedures to be applied	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	This is used to calculate change in tree biomass in the project scenario, in ex-post

Data / Parameter	F(D, H)
Data unit	t d.m.
Description	Function relating measured tree dimensions (x1, x2, x3, …) to above-ground tree biomass
Source of data	For ex ante estimation the allometric equation applicable to a tree species is a theoretical model derived secondary information. For expost estimation the tools 'Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities' or 'Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A/R CDM project activities' should be applied to prove the appropriateness of the equation.
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Each time a verification is conducted
Value applied:	-
Monitoring equipment	-
QA/QC procedures to be applied	AR-AM-tool-17-v1, AR-AM-tool-18-v1.0.1
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	This is used to calculate change in tree biomass in the project scenario, in ex-post

Data / Parameter	T
Data unit	year
Description	Time period elapsed between two successive estimations of carbon stock in trees and shrubs
Source of data	Verification records
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Each time a verification is conducted
Value applied:	-
Monitoring equipment	-
QA/QC procedures to be applied	AR-AM-tool-17-v1, AR-AM-tool-18-v1.0.1
Purpose of data	Calculation of project emissions
Calculation method	$T = t_2 - t_1$
Comments	If the two successive estimations of carbon stock in trees are carried out at different points of time in year *t2* and t1, (e.g. in the month of April in year *t1* and in the month of September in year *t2*), then a fractional value is assigned to *T*.

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