FAZENDA NASCENTE DO LUAR AGROFORESTRY PROJECT

Document Prepared By **Carbon Credits Consulting S.r.L.**

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1. PROJECT DETAILS

1.1 Summary Description of the Project

The Fazenda Nascente do Luar Agroforestry Project (**FNL 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 **FNL Project** aims to promote investments in commercial plantations in the Municipality of Costa Rica in the north-eastern part of the state of Mato Grosso do Sul (Brazil). The Project is based on changing the use of land from extensive cattle ranching (of low productivity and which use prescribed 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 (the so called "*Legal Reserve"*, that in each rural property must be over 20% of the land), thus generating a landscape of biological and productive corridors that produce financial, social and environmental services for the region. These impacts include the mitigation of climate change, regulation of water flows, expansion of habitat and conservation of the flora and fauna in the zone. The Project is located in a region that belongs to the *Cerrado* Biome.

The **FNL Project** is developed in a private property, the Fazenda ("Farm") Nascente do Luar that correspond to Project Zone. At the Starting Date (**April 01, 2015**) the farm was composed by areas already reforested with *Eucalyptus spp.* and by areas characterized by degraded grassland (because of the extensive and traditional cattle breeding) and the main activities developed in the farm were 2:

▪ Cattle breeding for meet production (in degraded grassland).

▪ *Eucalyptus* plantations for timber production (even these areas were degraded before the planting).

The areas that corresponded to degraded pasture have become part of Project Area with the beginning of the Project and have been planted with *Eucalyptus* species too.

In the Project Area (and commonly in all other farms of the region) such grasslands have been historically subject to burns that took place with the objective to reduce tree covers, expand grasslands and stimulate the regrowth of tender and nutritious sprouts during the dry season when pasture becomes fibrous in order to develop extensive cattle ranching activities.

The property also conserve remnants of savannah forests and natural areas (Legal Reserve, minimum 20% of the land) but these latter were severely damaged due to the fire practice and the grazing of the animals. Irrational and "extractive" 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.

The **FNL Project** is a typical Afforestation Project and aimed to plant **342.7773 ha** of degraded grassland with the species *Eucalyptus uro-grandis* (hybrid of *E. urophylla* and *E. grandis* species). This 2 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 this timber species. The Project also aimed to recover the remnant natural savanna restauration of the Project Zone. The set of areas planted with *Eucalyptus spp*. and the areas of regenerated savannah is a typical mosaic-shaped landscape that guarantees the protection of the soil and the recovery of biodiversity typical of the Project Zone.

The Crediting Period lasts **30 years** and it runs from **April 01, 2015** to **December 31, 2044**.

The Project is expected to capture **683,920.92 tCO2e in 30 years**, with an average annual GHG emission of **22,797.36 tCO2e.**

Photo 01: One of the planted parcels of the Project.

1.2 Sectoral Scope and Project Type

The **FNL 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.

1.3 Project Eligibility

The **FNL Project** is eligible under the scope of the VCS Program because of his characteristics listed below:

- Th FNL Project is a typical Afforestation Project.
- The baseline scenario was degraded pasture.
- The Project will last 30 years.
- The period between the Starting Date and the day of the Validation is less than 5 years.
- The calculation of GHG emissions was done taking into consideration the LTA.

1.4 Project Design

The **FNL Project** includes a single installation of an activity. This activity includes the plantation of **342.7773 ha** with *Eucalyptus uro-grandis* and was developed in a private property, the Fazenda Nascente do Luar.

1.5 Project Proponent

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Contact person	Andrea Saverio Cornacchia
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1.6 Other Entities Involved in the Project

Organization name	AGROBUSINESS FLORESTAS E PECUARIA Ltda
Role in the project	Project Owner
Contact person	Juliana Scarasati Vignoli
Title	Partner and Manager
Address	Calçadas Da Primaveras 10, Sala 03, Bairro Alphaville, Cep: 06453-046, Barueri (SP) - Brazil.
Telephone	+55 11 94726-4453
Email	juliana.vignoli@gmail.com

1.7 Ownership

As explained above the Project is developed in a private property. This private property is represented by a farm called Fazenda Nascente do Luar, with an extension of 3,248.4620 ha. Nowadays the right of ownership on the land of the farm is exercised by the **Vignoli family** (**Land Owner**). The property is divided among the family members as follows:

- Alberto Eduardo Nogueira Barreto (50,00%). He is Juliana father-in-low.
- Juliana Scarasati Vinholi (16,66%).
- Leandra Cristina Scarasati Vinholi (16,66%).
- Marco Antonio Scarasati Vinholi (16,66%).

The extension of the property and the ownership is demonstrated by the Cadastral Parcel of the Fazenda Nascente do Luar - Appendix 01. The Land Owners rent the farm to the enterprise **Agrobusiness Floresta e Pecuária Ltda** (see Appendix 02 and 03) . This enterprise is nowadays the **Project Owner** and is composed by:

- Alberto Eduardo Nogueira Barreto (50,00%). He is also Land Owner.
- Juliana Scarasati Vinholi (50.00%). She is also Land Owner.

Agrobusiness Floresta e Pecuária Ltda is now managing all the planted forests.

Photo 02: Entrance of the Fazenda Nascente do Luar.

1.8 Project Start Date

The Project Start Date is defined on **April 01, 2015**; on this date also started the Crediting Period.

1.9 Project Crediting Period

The Crediting Period will be of **30 years and 0 months**. This period starts on **April 01, 2015** and ends on **December 31, 2044**. The beginning of the Crediting Period coincide with the Project Start Date.

Follows a graphic representation of the crediting period per Stratum (Table 01).

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Stratum 01	P																													
Stratum 02	P																													
Credit ing Period	S					VA																								

Table 01: Project Start Date, Crediting Period and Cut Cycle.

Photo 03: Plantation of *Eucaliptus uro-grandis* of 4 years inside the Fazenda Nascente do Luar.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2015	22,917.46
2016	22,917.46
2017	22,917.46
2018	22,917.46
2019	22,917.46
2020	22,917.46
2021	22,917.46
2022	22,917.46
2023	22,917.46
2024	22,917.46
2025	22,917.46
2026	22,917.46
2027	22,917.46
2028	22,917.46
2029	22,917.46
2030	22,917.46
2031	22,917.46
2032	22,917.46
2033	22,917.46
2034	22,917.46
2035	22,557.18
2036	22,557.18
2037	22,557.18
2038	22,557.18
2039	22,557.18
2040	22,557.18
2041	22,557.18
2042	22,557.18
2043	22,557.18
2044	22,557.18
Total estimated ERs	683,920.92

Total number of crediting years	30
Average annual ERs	22,797.36

Table 02: Estimated GHG emission reductions during the Project Period.

1.11 Description of the Project Activity

1.11.1 Planted Areas

The Afforestation Project developed in the FNL Project relates to a total area of **342.7773 ha.** This area correspond to the Project Area and is divided in **21 planted parcels** of different extensions. All the planted parcels are listed in the Table 03 below. In this table are present information about:

- The code of each parcel.
- The extension of each parcel.
- The month when have begun the plantation activities.
- The number of trees par ha.
- The cultivars planted.

Parcel Code	Extension	Plantation Month	N° of trees/ha	Cultivar
47	33,3962	Apr 2015	1.250	H13
48	31,9208	Sep 2015	1.250	H13
49	13,0142	Sep 2015	1.250	H13
50	11,5311	Sep 2015	1.250	H13
51	9,4589	Sep 2015	1.250	H13
52	23,7904	May 2015	1.250	H13
53	8,7046	May 2015	1.250	H13
54	13,7896	May 2015	1.250	H13
55	8,7570	Nov 2015	1.250	H13
56	14,3079	May 2015	1.250	H13
57	10,5404	May 2015	1.250	H13
58	5,4611	Nov 2015	1.250	H13
59	22,4010	May 2015	1.250	H13
60	12,4440	Apr 2015	1.250	H13
61	28,0273	Nov 2015	1.250	H13
62	20,5176	Dec 2015	1.250	H13
63	20,8392	Dec 2015	1.250	H13
64	5,3104	Nov 2015	1.250	H13
67	15,4270	Nov 2015	1.250	H13
68	14,4813	Nov 2015	1.250	H13
69	18,6573	Nov 2015	1.250	H13
TOTAL	**342,7773**			

Table 03: List of the planted parcels.

All the parcels was planted in 2015, **from April to December.** Before the beginning of the plantation all these parcels were characterized by soil degradation with moderated erosions due to the extensive cattle breading (Photo 04 and 05).

Photo 04: Areas with degraded pasture before the planting.

Photo 05: Erosion were present in some parcels before planting.

All the area was planted with *E. uro-grandis* species, Cultivar H13 with an 3,60x2,20 mt spacing (1,250 plants/ha). The plantlets have been bought by a brazilian company specialized on produce monoclonal plantlets of *Eucalyptus spp*. The plantlets have been stored in the Fazenda (Plant nursery) and irrigated before the planting (Photo 06 and 07).

Photo 06: Plant nursery before the planting.

Photo 07: Seedlings in their plastic tubes.

A semi-mechanized planter was used (Photo 08 and 09). Precision fertilization based on NPK formula was applied (1° fertilization) directly in the furrows. During the plantation each plantlet received also a sufficient quantity of water.

Photo 08: Semi-mechanized planting.

Photo 09: Semi-mechanized planting.

After the planting operations a field checking was carried out to find and replace dead seedlings. The replantation involved less than 5% of the plantlets. After the replantation the following activities were carried out in each parcel:

▪ Cleaning of the plantlets (elimination of weeds): this is important to reduce the competition for sunlight and soil nutrients.

▪ Leaf-cutting ants control: this activity has an enormous importance, these kind of pests could kill 100% of the plantlets in few weeks.

▪ Second and third fertilization (pulverization on the ground with tractor and fertilizer) with a specific NPK formula.

All these activities are described also in the following § 1.11.3 - Silvicultural activities.

Photo 10: Plantlets with 2 month of age.

Photo 11: Plants with 6 months.

Photo 12: Trees with 1year of age.

Photo 13: Trees of about 3,5 years.

Photo 14: Trees with 4,5 years of age

Photo 15: Trees of about 4,5 years of age

1.11.2 Planted Species

The objective of the first instance was to establish forest plantations with high carbon capture species. It has been used 1 species of genus *Eucalyptus*, because of the high adaptability to the soil and climate condition that characterized the region of the Project and because of its very rapid growth and big potential as carbon sinks. This species was *Eucalyptus uro-grandis* (Photo 10).

Photo 16: Plantlet of *Eucalyptus uro-grandis* in its plastic tube that protect the young root system.

Characteristics of *Eucalyptus uro-grandis*

Eucalyptus uro-grandis is an hybrid plant developed in Brazil through the cross between two highly productive species, *E. urophylla* and *E. grandis* (RUY, 1998) [1]. 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. This interspecific combination results into a vigorous tree, resistant to various diseases, which today is widely used in commercial

1

RUY, O. F. Variação da qualidade da madeira em clones de Eucalyptus urophylla S. T. Blake da Ilha de Flores, Indonésia. Piracicaba, 1998. 69 f. (Mestrado em Ciência e Tecnologia da Madeira)- “Luiz de Queiroz”. Universidade de São Paulo, São-Paulo.

plantations for the production of raw materials such as cellulose, charcoal and sawmill timber (PALUDZYSZYN et AL., 2004) [2]. Clone can be defined as a population of cells or individuals originating from an asexual division starting from a cell or individual (RAVEN, 2007) [3].

According to XAVIER and DA SILVA (2010) [4] "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 et AL., 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. uro-grandis* stands out as the most common variety (BRAGA, 2008 [5]). *Eucalyptus* farming in Brazil has a high average productivity of about 45-60 m³ / ha / year (MORA and GARCIA, 2000) [6] and is mainly represented by *E. uro-grandis* clonal forests (ALFENAS et Al., 2004 [7]). The first *E. uro-*

2 PALUDZYSZYN E.; RODRIGUES, A.; CORDEIRO, D., Estrategia para o melhoramento de eucaliptos tropicais na embrapa. Paraná: EMBRAPA. 2004.

3 RAVEN, P. H., EVERT, R. F., EICHHORN, S. E. Biologia vegetal. Rio de Janeiro: Guanabara Koogan, 2007. 830p.

4 XAVIER, A.; DA SILVA, R. L. Evolução da silvicultura clonal de *Eucalyptus* no Brasil. Agronomia Costarricense, v.34, n.1, jun., 2010.

5 BRAGA , JOSÉ LUCIO PEREIRA, Estabilidade fenotípica de clone de eucalyptus urograndis, na Fazenda Bom Jardim - Aparecida – SP, 2008.

6 MORA, A. L.; GARCIA, C. H. A cultura do eucalipto no Brazil. Verso e Reverso Comunicações. São Paulo, 2000, 112 p.

7 ALFENAS, A. C., ZAUZA, E. A. V., MAFIA, R. G., ASSIS, T. F. Clonagem e doenças do eucalipto. Viçosa: UFV, 2004.442p.

grandis 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, 2011) [8].

8 COSTA, J. A. Qualidade da Madeira de Eucalyptus urograndis, Plantados no Distrito Federal, para Produção de Celulose Kraft. 2011. 86 p. Dissertação (Mestrado em Ciências Florestais) - Universidade de Brasília. Brasília, 2011.

Carbon capture potential of the *Eucalyptus* genus

The species belonging to the genus *Eucalyptus* are among the highest-potential carbon capture trees in the world, as shown by the following data in this chapter. In addition, these species have been genetically selected, cross-breeded and the most productive ones have undergone cloning processes. These improved clones and cultivar in Brazil have been able to express all of their potential, much more than in their home country (Australia) and much more than other Countries both in temperate and tropical regions, thanks to the long photoperiod and the abundance of rains present in Brasil.

According to the publication "*Guia do Eucalipto*" (2008) of *Conselho de Informações sobre Biotecnologia* [9] "The genus *Eucalyptus* found in Brazil an ideal condition for growth. The productivity of these plantations in brazilian lands is up to ten times greater than in countries such as Finland, Portugal and the United States. In some of brazilian forest enterprises, which produced an average of 20 m³/ha/year in the 1970s, it is now possible to reach 40 m³/ha/year to 50 m³/ha/year with the use of improved genetic material and technologies currently available. It is no longer surprising to see, in Brazil, areas producing around 70 m³/ha/year.

Even compared to Australia, the country of origin of the species, Brazil's productivity is much higher, which is attributed to our climatic conditions and to investments in genetic improvement and forestry technologies" (Diagram 01). Productions of 40-50-70 m³/ha/year of timber, applying the IPCC conversion rates used in this PDD for the calculation of the emission reductions, mean capture potential of **71-88-124 t/ha of CO2-e.**

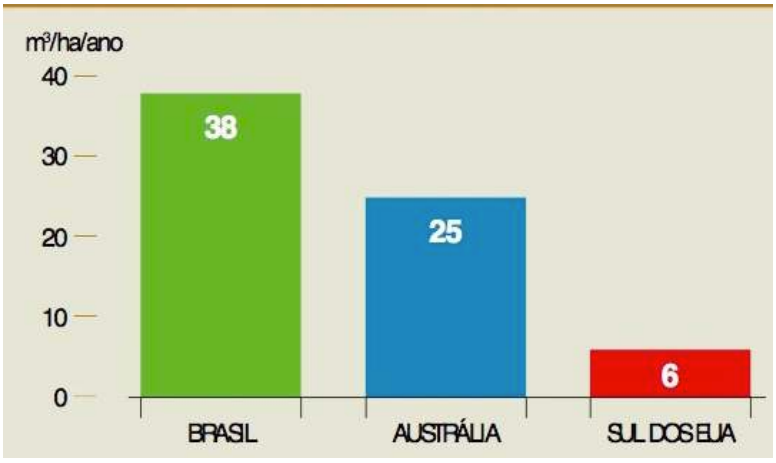


Diagram 01: Comparison between the productivity averages of Brazil, Australia and Southern USA. [10]

9 http://cib.org.br/wp-content/uploads/2011/10/Guia_do_Eucalipto_junho_2008.pdf

10 http://cib.org.br/wp-content/uploads/2011/10/Guia_do_Eucalipto_junho_2008.pdf

The publication of Poyry 2015 [11] "The Pulp And Paper Industry In Brazi" shows that from 1970 to present the productivity of the plantations of *Eucalyptus spp*. is practically tripled, reaching today averages of 45-50 m³/ha/year of timber (Diagram 02), which applying the IPCC conversion values used in this PDD for the calculation of emission reductions corresponds to carbon capture of **80-90 ton/ha/year of CO2-e.**

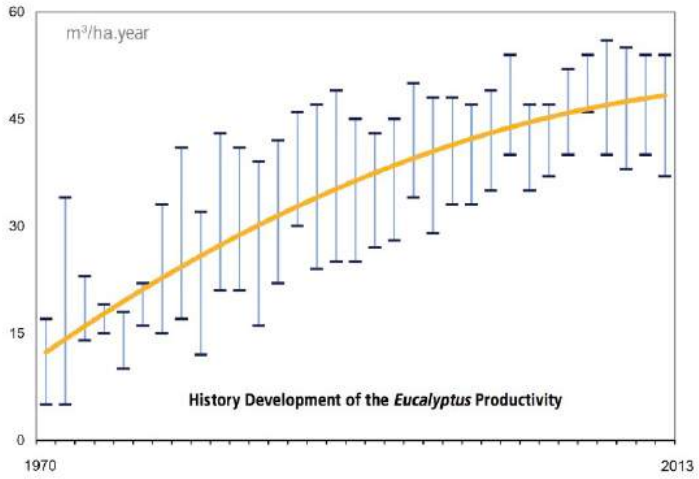


Diagram 02: Development of *Eucalyptus spp*. plantations productivity in Brazil from 1970 to 2013 (Poyry, 2015).

In a study conducted by Ferreira in 2012[12] in Campo Grande, Mato Grosso do Sul, 390 km far from the Project Zone, in a cow breeding/forestry integration system with a spacing of 14x2 (357 plants / ha) 20.09 t/ha/ year of Carbon was established, corresponding to **72.32 t/ha/year of CO2-e**.

A research carried out by Arco Verde[13] in 2003 in the state of Roraima, Brasil, with an average annual pluviometry of 1,900 mm/year, on clones plantations of *E. uro-grandis*, cultivars 1270 and 1232, yielded timber production of 97.42 m³/ha/year and 61.17 m3/ha/year. These data, applying the IPCC conversion values used in this PDD for the calculation of emission reductions, lead to potential carbon capture of more than **100 t/ha/year of CO2-e**.

11 PÖYRY. THE PULP AND PAPER INDUSTRY IN BRAZIL, 2015. http://www.eucalyptus.com.br/artigos/2015_ABTCP_PP_Segment.pdf

12 Ferreira et Al., 2012. Arranjos espaciais sobre a produtividade e o potencial de prestação de serviços ambientais do eucalipto em sistemas integrados.

13 ARCO VERDE, 2003. Avaliação Silvicultural De Espécies Florestais No Estado De Roraima. http://www2.pucpr.br/reol/pb/index.php/academica?dd1=906&dd99=view&dd98=pb

Criticism about *Eucalyptus* commercial plantations

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)[14], 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 03, whose data come from the *Departamento de Solos* of *Universidade Federal de 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 (VITAL, 2007).

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 0,30 and 0,35 tons of crop residues is returned to the ground (VITAL, 2007).

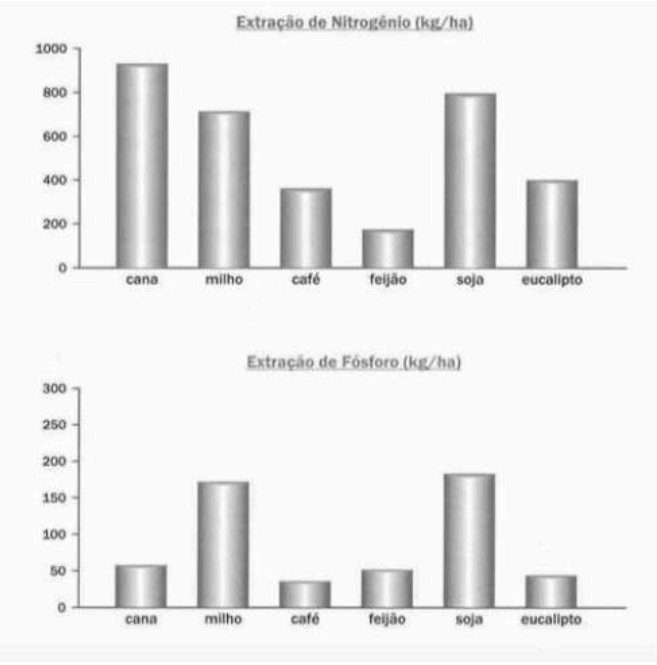


Diagram 03: nutrient uptake (Nitrogen and Phosphorus) rates of various crops in an 8 year-long period (VITAL, 2007).

14 PALMBERG, C. "Annotated bibliography on environmental, social and eco- nomic impacts of eucalypts". Compilation from English, French and Spanish publications between 1995-1999, set. 2002.

According to other authors, thanks to the 6/7-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 in 1999[15], 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. To conclude, DAVIDSON (1985)[16] 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 water consumption, the impact of *Eucalyptus* on water resources of a given region seems to depend more on the pluviometric characteristics of the region than on the physiological characteristics of the *Eucalyptus.* The water consumption of *Eucalyptus* species is around 800 to 1,200 mm/year. Since most of the brazilian *Eucalyptus* plantations are located in regions with a rainfall volume above 1,200 mm/year, in theory, forests would not tend to cause water deficit in these regions. In regions with a rainfall of less than 400 mm/year, the *Eucalyptus* forests can cause dryness of the soil, using the water stored in its surface layers. The impacts on groundwater must be analyzed on a case-by-case basis, since they depend on the location of the forest in relation to the river basin (VITAL, 2007).

From the point of view of efficiency in biomass production, there are many studies pointing to *Eucalyptus* as one of the most efficient species, that is, *Eucalyptus* produces more biomass per liter of water consumed than other crops (VITAL, 2007). If, on the one hand, the absolute consumption of water by *Eucalyptus* is in fact among the highest (Table 04) due to its rapid growth, the relative consumption of this water (ie the number of liters of water used for the production of 1 kg of biomass) is among the lowest, showing that the species is very efficient in the production of biomass (Table 05).

CULTURA	CONSUMO DE ÁGUA/ANO (mm)
Cana-de-Açúcar	100-2.000
Café	800-1.200
Citrus	600-1.200
Milho	400-800
Feijão	300-600
Eucalipto	800-1.200

Table 04: *Eucalyptus* water consumption, compared with other crop.

15 BOUVET, J. M. “Les plantations d’Eucalyptus: évolutions récents et perpec- tives”. Spécial Eucalyptus, L’association Silva, Paris, 1999.

16 DAVIDSON, J. “Setting aside the idea that eucalyptus are always bad”. UNDP/ FAO project Bangladesh BGD/79/017, 1985 (Working Paper, 10).

CULTURA	EFICIÊNCIA NO USO DA ÁGUA (l/kg)
Batata	2.000
Milho	1.000
Cana-de-Açúcar	500
Cerrado	2.500
Eucalipto	350

Table 05: *Eucalyptus* water efficiency, compared with other crop.

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)[17] 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.

17 CHINNAMANI, S.; GUPTE, S. C. “Afforestation with broom as a nurse crop”. Indian Forester, 91, 1965.

1.11.3 Silvicultural activities

In the Table 06 follows the description of the silvicultural activities implemented in the Project Area. For all these activities was used local labour coming from the city of Costa Rica or from any other settlements in the nearby of the Fazenda Nascente do Luar.

Activity	Description
Land preparation	Delineation of the area, map production. Identification of the protection areas, such as areas with primary forest, forest relicts, biological corridors and water bodies. Analysis of soil samples for accurate fertilization. Ploughing and levelling of eroded areas. Ploughing of areas with greatly compressed soil. Creating soil terraces of different heights every 1,80 m. Division in to 9 areas, separated by corridors of between 10 to 20 m. Fencing the external periphery. Keeping under control the colonies of leaf eating ants. Mechanized cleaning performed to eliminate weeds and grass cover of some areas. Application of 1 ton of dolomite lime per hectare to the soil. This practice allows the correction of soil acidity. Digging of furrow with tractor, with a distance of 3 m between each one.
Sowing	Distribution of seedlings in the lots. 1° fertilization: application of 300 kg of NPK (nitrogen, phosphorus and potassium) fertilizer directly in the grooves to ensure good conditions to the seedlings. Location of the seedlings on land: the seedling bag is removed and the ground cylinder is placed in the hole that is made manually with a specific tool. Distance between each seedling: 2 m. Irrigation of the seedlings with water tank, directly in the hole. The hole is covered and the soil is pushed down to secure the fixing of the seedling.
Fertilization	2° fertilization: performed 9 months after the sowing with an NPK formula. 3° fertilization: performed 18 months after the sowing with an NPK formula. Fertilization should be executed during the wet season to allow the fertilizer to penetrate the soil and reach the roots. A forestry engineer will decide when to stop with the fertilizations according to the soil and foliar analysis results and also depending on the age of the plant and dry matter production.
Weed control	A manual cleaning is performed in the form of a dish with an average diameter of 1 m on each tree in order to ensure that during the fertilizations the resources are efficiently used by the tree and to prevent any suffocation of the plants from the harmful grass and weeds.
Maintenance	Ant control, every week. Fire prevention, especially in dry season.

Table 06: Project Silvicultural Activities.

1.11.4 Stratification of the Project Area

The biomass distribution over the Project Area is not homogeneous. For this reason have been identified 2 *strata.* These 2 *strata*:

- were planted in areas with the same pedological and environmental characteristic;
- were planted with the same species (*E. uro-grandis*) and cultivar (H13).
- were planted with the same number of trees par ha (was realized the same spacing of 3,60x2,20 m (1,250 plants/ha);
- were planted following the same soil management and the same subsequent operations;
- but were planted in different period.

Therefore the stratification for the *ex-ante* estimate is proposed according to the planting moment: the parcels planted in the months of April and May 2015 composed the *stratum* 1, the parcels planted in the months of September, November and December 2015 composed the *stratum* 2, as described in the Table 07.

Stratum	Parcel Code	Extension	Plantation Month	N° of trees/ha	Cultivar
STRATUM 1	47	33,3962	Apr 2015	1.250	H13
	60	12,4440	Apr 2015	1.250	H13
	52	23,7904	May 2015	1.250	H13
	53	8,7046	May 2015	1.250	H13
	54	13,7896	May 2015	1.250	H13
	56	14,3079	May 2015	1.250	H13
	57	10,5404	May 2015	1.250	H13
	59	22,4010	May 2015	1.250	H13
	TOTAL	**139,3741**			
STRATUM 2	48	31,9208	Sep 2015	1.250	H13
	49	13,0142	Sep 2015	1.250	H13
	50	11,5311	Sep 2015	1.250	H13
	51	9,4589	Sep 2015	1.250	H13
	55	8,7570	Nov 2015	1.250	H13
	58	5,4611	Nov 2015	1.250	H13
	61	28,0273	Nov 2015	1.250	H13
	64	5,3104	Nov 2015	1.250	H13
	67	15,4270	Nov 2015	1.250	H13
	68	14,4813	Nov 2015	1.250	H13
	69	18,6573	Nov 2015	1.250	H13
	62	20,5176	Dec 2015	1.250	H13
	63	20,8392	Dec 2015	1.250	H13
	TOTAL	**203,4032**			
	TOTAL	**342,7773**			

Table 07: Stratification of the Project Area.

If, during the *ex-post* estimate, any further inhomogeneous biomass distribution is encountered within one of the 2 *strata* already defined, it will be opportune to divide the inhomogeneous *stratum* in question into further *strata*, in order to achieve homogeneity.

1.12 Project Location

Indicate the project location and geographic boundaries (if applicable) including a set of geodetic coordinates. For grouped and AFOLU projects, coordinates may be submitted separately as a KML file.

1.12.1 Geographic boundaries

The **FNL Project** was developed in a private farm called Fazenda Nascente do Luar. The farm is located in the Costa Rica Municipality, in the State of Mato Grosso do Sul – MS (Map 01), part of the macro-region of West-Central Brazil.[18]

The Costa Rica Municipality (Map 02) has an extension of 4.159,003 km² and is located in the northern part of the Mato Grosso do Sul (extension: 357.145,535 km²), occupying 1.16% of the total area of the State. It is exactly located near the border between the state of Mato Grosso do Sul and the the state of Goias. Its geographical coordinates are: 18º31'38" south latitude and 53º57'42" west longitude. Distances: 390 km from the capital of the state (Campo Grande) and 863 km from the capital of the country (Brasília).[19]

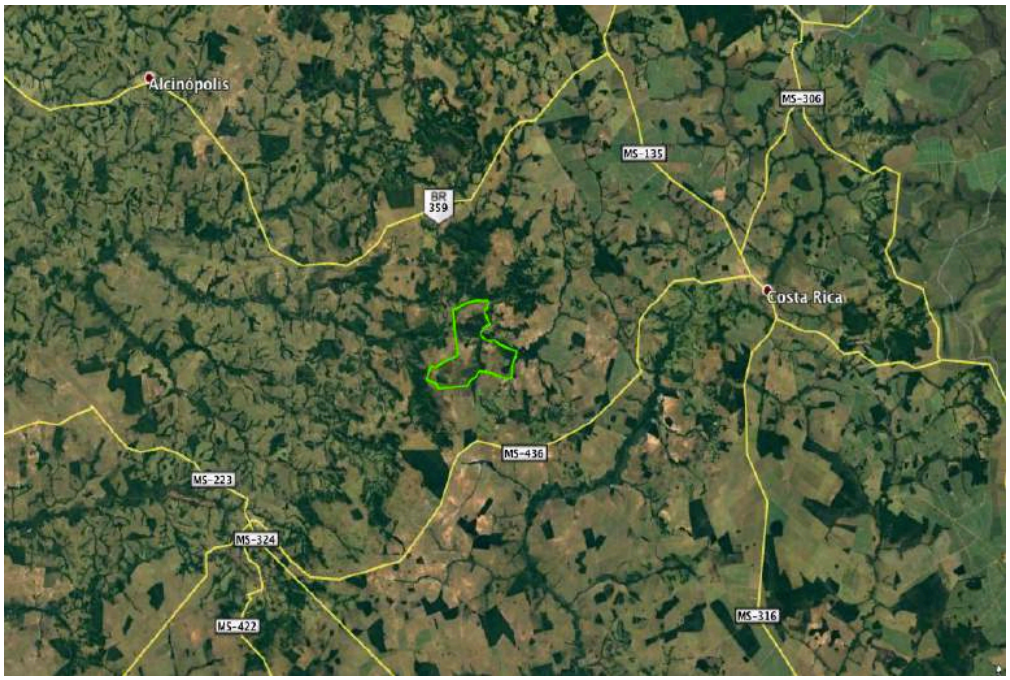
Map 01: Mato Grosso do Sul, (MS), in the West-Central Brazil.

Map 02: Costa Rica Municipality, in the north part of MS.

18 https://www.ibge.gov.br/cidades-e-estados/ms/.html?

19 https://pt.wikipedia.org/wiki/Costa_Rica_(Mato_Grosso_do_Sul)

Map 03: Location of the Project Zone in Mato Grosso do Sul (Source: Google Earth 2003).



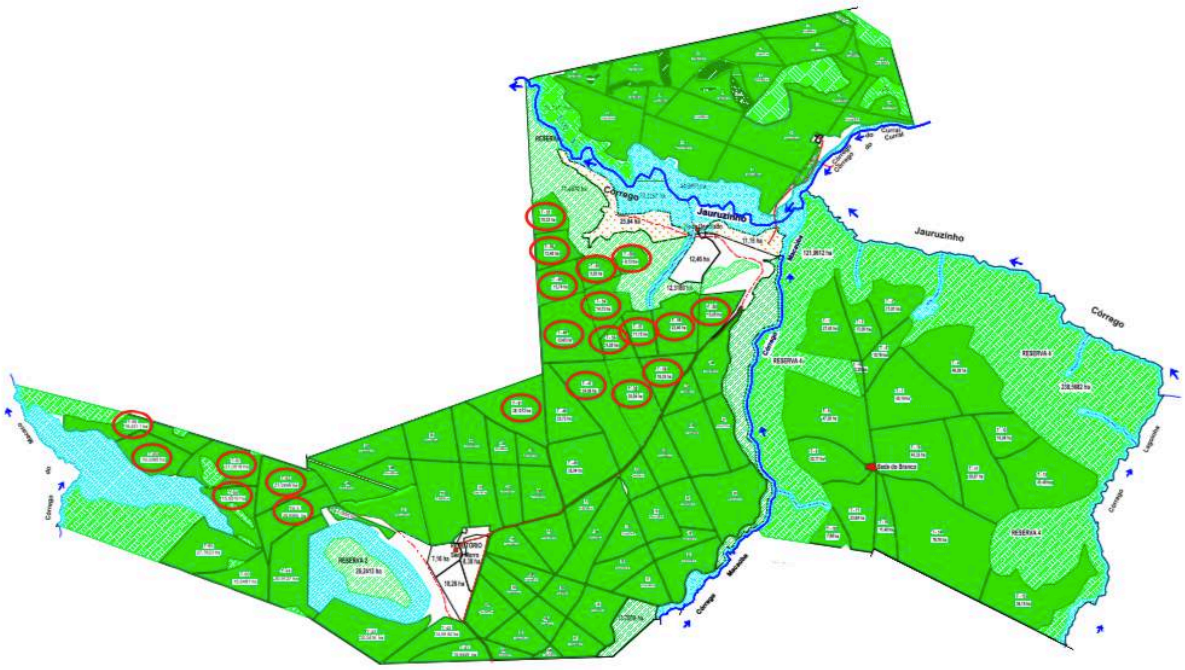
Map 04: Satellite photo of the Project Zone – Fazenda Nascente do Luar (Source: Google Earth, 2003).

The Project Zone is located at about 50 km from the city of Costa Rica (Map 04).

The following Map 05 shows the partition and the characteristics and of the Fazenda Nascente do Luar. The parcels that belongs to Project Area are highlighted with a red circle.

Are visible also the planted areas with *Eucalyptus* species before the Starting Date, some remaining pastures used for milking cows and sheeps, and the savannah areas that compose the Legal Reserve and the Permanent Preservation Areas of the Fazenda Nascente do Luar. The headquarter is located in the middle of the farm (where are located the houses of the workers).

This map is provided as a PDF file in the Appendix 04 – Terrestrial Map.



Map 05: Map of Fazenda Nascente do Luar: (Appendix 04 – Terrestrial Map).

1.12.2 Project Zone

The Project Zone corresponds to the total area of the property Fazenda Nascente do Luar, located in the municipality of Costa Rica (see Appendix 04 – Terrestrial Map and Appendix 05 – KLM Map). Fazenda Nascente do Luar covers a total area of **3,248.4620 ha** and as of today (January 2020), about 4 and half years after the starting of the Project, is divided into:

- **Permanent Preservation Areas: 497.7493 ha (15.32%)**

As defined by Law no. 12,651/2012, Permanent Preservation Area is a protected area, whether or not covered by native vegetation, with the environmental function of preserving water resources, the landscape, geological stability and biodiversity, facilitating the gene flow of fauna and flora, protecting soil and ensure the well-being of human populations.

- **Legal Reserve Areas: 661.3694 ha (20.36%)**

According to Law 12,651/2012, every rural property must maintain an area with native vegetation cover, as a Legal Reserve. It is an area located within a rural property or possession, with the function of ensuring the sustainable economic use of the rural property's natural resources, assisting the conservation and rehabilitation of ecological processes and promoting the conservation of biodiversity, as well as as the shelter and protection of wildlife and native flora. Its minimum size in percentage terms depends on area where the property is located. For example in Mato Grosso do Sul the Legal Reserve correspond to the 20% of the rural property. Legal Reserve Areas of the farm are higher than 20%.

- **Planted Areas: 1,325.31 ha (40.80%)**

This area is composed by the planted areas prior to the Project and the planted areas within the Project (Project Area).

- **Pasture Areas: 756.0213 ha (23.27%)**

In this area dairy cattle breeding is practiced for the Project Owners own consumption and for the Fazenda workers consumption.

- **Headquarters + Sheds + Roads + Corridors: 8.0120 ha (0.25%)**

This area corresponds to: the roads that give access to every part o the Fazenda; the corridors that permit the access to the planted parcels and to the remaining pastures; the headquarter area, where are located the workers houses, the sheds and the the farm offices.

1.12.3 Project Area

The Project Area corresponds to **21 parcels** of the Fazenda that was planted between **April 2015** and **December 2015** and has an extension of **342.7773 ha.** The information necessary to identify the Project location description are presented below:

- Project Zone name: **Fazenda Nascente do Luar**.
- Datuum: **SIRGAS 2000; MC 51°; FUSO 22.**
- Maps of the Project Area: see Appendix 04 - Terrain Map and Appendix 05 - KLM Map.
- Geodetic coordinates (Table 08): below is the list of geodetic coordinates of the central point of the parcels that compose the Project Area:

Stratum	Parcel Code	Extension	Coord E (X)	Coord N (Y)
STRATUM 1	47	33,3962	244046,60	7944853,74
	60	12,4440	245145,20	7945728,30
	52	23,7904	244371,00	7944930,57
	53	8,7046	244207,77	7945446,36
	54	13,7896	244109,48	7945812,75
	56	14,3079	244664,76	7945151,51
	57	10,5404	244435,77	7945545,14
	59	22,4010	244781,93	7945620,62
	TOTAL	**139,3741**		
STRATUM 2	48	31,9208	243744,37	7945556,69
	49	13,0142	243646,24	7946027,21
	50	11,5311	243602,17	7946343,75
	51	9,4589	243559,02	7946668,60
	55	8,7570	244010,74	7946135,93
	58	5,4611	244338,78	7946249,00
	61	28,0273	243251,28	7944816,06
	64	5,3104	240646,04	7943953,04
	67	15,4270	240530,52	7944297,47
	68	14,4813	239729,81	7944587723,00
	69	18,6573	239762,64	7944380,76
	62	20,5176	241004,39	7944099,82
	63	20,8392	241288,44	7943904,77
	TOTAL	**203,4032**		
	TOTAL	**342,7773**		

Table 08: Geodetic coordinates of the central point of the parcels that compose the Project Area.

The KML file to delineate the area *using geodetic polygons* is provided in the Appendix 05 - KLM Map.

1.12.4 Environmental conditions

Below follows a brief description of the environmental conditions of the region in which the Project Area is located, with appropriate information on the climate, hydrology, topography, soils, vegetation and ecosystems.

Altitude:

The average altitude of Costa Rica Municipality is 385 meters above the sea level [20].

Topography:

The Project Zone is characterized by a gently undulating and well-drained low flat relief.

Soil:

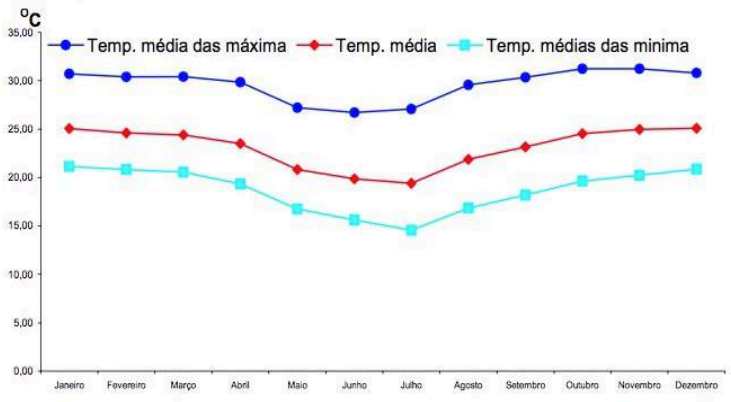
Dark Red Soil and Purple Soil types prevail. They are both deep and well-drained sandy soils. They are suitable for forest and perennial crops if well managed from an agronomic point of view.

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.

Temperature:

Diagram 04 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) [21].



20 https://www.cidade-brasil.com.br/municipio-costa-rica.html

21 PLANURB. Relatório de Avaliação Ambiental (RAA). Programa de Desenvolvimento Integrado e Qualificação Urbana de Campo Grande/MS – Viva Campo Grande. 2007.

Diagram 04: Maximum, medium and minimum temperatures, by months of year (PLANURB, 2007).

Rainfall:

The average annual rainfall in the Mato Grosso do Sul region is about 1,500 mm (Diagram 05) but its distribution is not uniform, as can be seen in Diagram 06. In the months of June, July, August, the rainfall indices are much lower in comparison with the others (PLANURB, 2007)[22]

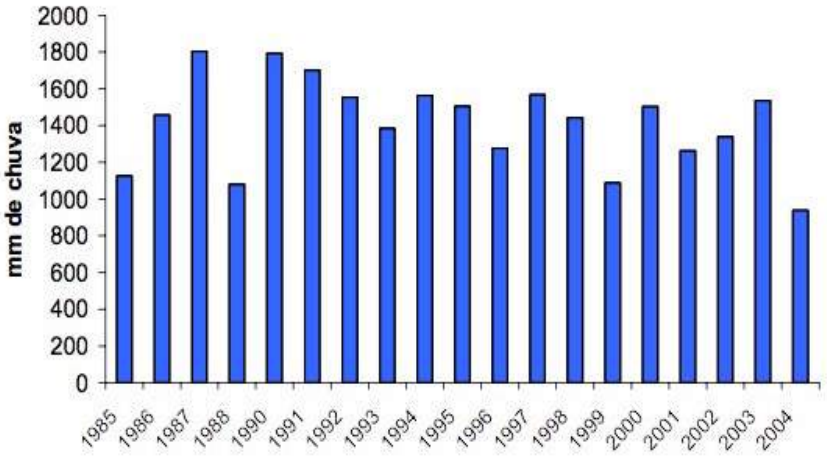


Diagram 05: Annual rainfall, from 1985 to 2004 (PLANURB, 2007).

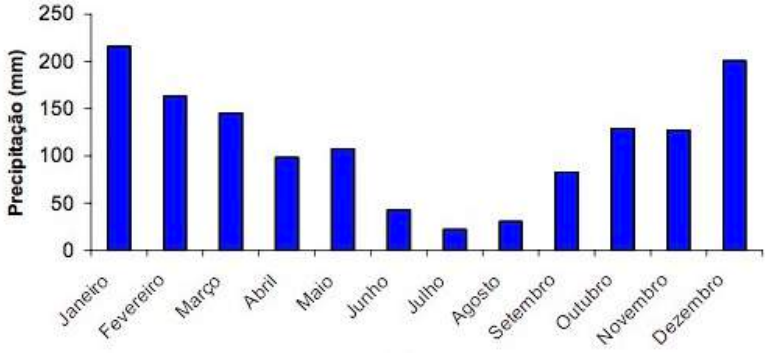


Diagram 06: Monthly rainfall (PLANURB, 2007).

22 PLANURB. Relatório de Avaliação Ambiental (RAA). Programa de Desenvolvimento Integrado e Qualificação Urbana de Campo Grande/MS – Viva Campo Grande. 2007.

Vegetation:

The typical vegetation of the Project Zone and its surroundings is that of the *Cerrado* biome (Savannah). The *Cerrado* is one of the 6 biomes present in the brazilian territory (*Amazon*, *Caatinga, Cerrado, Pantanal, Mata Atlantica* and *Pampa*)[23]. As shown in the Map 06 in Mato Grosso do Sul are present 2 of the 6 brazilian biomes: *Cerrado* biome and *Pantanal* biome.

Map 06: Geographical distribution of the six brazilian biomes:
Amazon, Caatinga, Cerrado, Pantanal, Mata Atlantica and *Pampa* (IBGE, 2004).

In general, the *Cerrado* presents with grassland interspersed with shrubby areas, featuring small woody trees and gallery forest areas. 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"*).

23 IBGE - Instituto Brasileiro de Geografia e Estatística: Mapa de Biomas e de Vegetação, 2004. http://www.ibge.gov.br/home/presidencia/noticias/21052004biomashtml.shtm

Forest Savannah ("*Gran Cerrado*"): is a densely treed Savannah characterized by the presence of *Xeromorphous* tree species (Photo 17), 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 18)*, Andira cuyabensis* (Photo 19)*, 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*[24].

Photo 17: Forest Savannah (*Gran Cerrado*).

24 PEREIRA, Z. V. 2009. Capitulo: Caracterização da Vegetação e Biodiversidade. In: YONAMINE, S. S., (Coord. Geral). ZEE-MS Zoneamento Ecológico-Econômico do Mato Grosso do Sul: Contribuições Técnicas, Teóricas, Jurídicas e Metodológicas.

Photo 18: *Astronium urundeuva.*

Photo 19: *Andira cuyabensis.*

Open Savannah *("Cerrado")*: Open Savannah is characterized by scattered thickets of scrub forest, low, winding, stunted trees, with irregular branching, leathery leaves and thick bark trunks (Photo 20). 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 21), *Kielmeyera coriacea* (Photo 22), *Tabebuia caraiba, Annona crassifólia*[25].

Photo 20: Open Savannah *(Cerrado)*.

Photo 21: *Terminalia argentea.*

Photo 22: *Kielmeyera coriacea.*

25 PEREIRA, 2009.

Park Savannah *(Campo Sujo)*: with typically grassy field vegetation characterized by a layer of grasses interspersed with scattered shrubs (Photo 23). Sometimes tree thickets with the following species can be found: *Curatella americana* (Photo 24), *Tabebuia caraiba*, *Bowdichia virgilioides* (Photo 25). These species mainly grow in the plains that are annually flooded, sometimes turning into an alluvial forest[26].

Photo 23: Park Savannah (*Campo Sujo*).

Photo 24: *Curatella americana.*

Photo 25: *Bowdichia virgilioides.*

26 PEREIRA, 2009.

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 26). 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 27)*, Annona sp.* (Photo 28)*, Erythroxillum suberosum, Aristida pallens* (PEREIRA, 2009).

Photo 26: Gramineous-woody Savannah (*Campo Limpo*).

Photo 27: *Byrsonima intermédia.*

Photo 28: *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)[27].

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 29) is the largest bird in the *Psitaccidae* family and lives mainly in the Chaco of Paraguay and in Pantanal (PEREIRA, 2009). This specie is 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. n addition to this majestic Psitaccidae specimen, other related species are also present, such as *Ara chloropterus* (Photo 30) and *Ara ararauna,* which is listed under CITES Appendix II.

Photo 29*: Anodorhynchus hyacinthinus.*

Photo 30: *Ara chloropterus.*

Several other species protected under brazilian law also live in the area. Among the big cats the Puma (*Puma concolor*) (Photo 31), included in CITES Appendix II, and the Jaguar (*Panthera onca*) (Photo 32), 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.

27 PEREIRA, Z. V. 2009. Capitulo: Caracterização da Vegetação e Biodiversidade. In: YONAMINE, S. S., (Coord. Geral). ZEE-MS Zoneamento Ecológico-Econômico do Mato Grosso do Sul: Contribuições Técnicas, Teóricas, Jurídicas e Metodológicas.

Photo 31: *Puma concolor.*

Photo 32: *Panthera onca.*

The Maned Wolf (*Chrysocyon brachyurus*) (Photo 33) is a canid that lives in the *Cerrado*. Populations of this species have suffered a retraction of their distribution as a result of the ongoing conversion of intact habitat to areas with agriculture and pastures, which in turn leads to increased human persecution due to livestock losses. This species is included on CITES Appendix II. The Giant Armadillo (*Priodontes maximus*) (Photo 34), 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 has a 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.

Photo 33: *Chrysocyon brachyurus.*

Photo 34: *Priodontes maximus.*

The Giant Anteater (*Myrmecophaga tridactyla*) (Photo 35) 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 et Al., 2007)[28]. 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, mainly due to the threats posed by habitat loss and forest fires.

Photo 35: *Myrmecophaga tridactyla.*

Photo 36: *Pteronura braziliensis.*

The Giant Otter (*Pteronura braziliensis*) (Photo 36), 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 CITES and as Endangered according to the IUCN Red List.Protection measures have allowed the partial recovery of the original populations of these species (PEREIRA, 2009). Other mammal species present include the Pampas Deer (*Ozotocerus bezoarticus*) (Photo 37) and the Pantanal Deer (Photo 38) (*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. 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, there are the Capybara (*Hydrochaeris hydrochaeris*) (Photo 39) and the Tapir (*Tapirus terrestris*) (Photo 40) that live both in the Pantanal and in the *Cerrado* areas.

28 MOURÃO, G.; MEDRI, Í. M. (2007). "Activity of a specialized insectivorous mammal (*Myrmecophaga tridactyla*) in the Pantanal of Brazil". *Journal of Zoology.*

Photo 37: *Ozotocerus bezoarticus.*

Photo 38: *Blastocerus dichotomus.*

Photo 39: *Hydrochaeris hydrochaeris.*

Photo 40: *Tapirus terrestris.*

Among reptiles, a population of about 3.7 million Yacaré 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 snake of the world, the Anaconda (*Eunectes murinus)* is also present in this region in high numbers (PEREIRA, 2009).

According to the World Wildlife Fund (WWF)[29] "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.

29 Biodiversity Conservation - CERRADO birthplace of the waters - WWF, 2012.

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, savannas, 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, Parana and Uruguay Rivers. Renowned as the world's 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".

Demography and Land Use:

According to IBGE 2017 [30], the State of Mato Grosso do Sul has a total extension of 357.145 km² (35,71 million hectares) and the resident population amounts to 2,713,147 inhabitants, with a population density of 6.86 inhabitants/km². 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 of Mato Grosso do Sul, also including planted forests. Land Use is summarized in Table 09 [31]

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 09: Land Use of Mato Grosso do Sul.

30 IBGE - *Instituto Brazileiro de Geografia e Estatística*: Síntese por Unidade de Federaçao, 2017. http://www.ibge.gov.br/estadosat/perfil.php?lang=&sigla=ms

31 PEF/MS - Plano Estadual de Florestas de Mato Grosso do Sul, 2009. http://www.pantanalecoturismo.tur.br/fotos/arquivos/916.pdf

1.13 Conditions Prior to Project Initiation

The conditions existing prior to the project initiation perfectly matches the Baseline Scenario (see **§ 3.4 – Baseline Scenario**).

Since the Project is an AFOLU project we provided the environmental conditions of the Project Area yet (see **§ 1.12.4 – Environmental Conditions**).

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

1.14.1 List of National and Local Laws

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 project). Brazil also has recently signed the Paris Agreement (Paris 2015, COP2167).
The Project complies with this regulatory framework, because in the AFOLU scope, Afforestation/Reforestation is one of several mechanisms by which GHG emissions are expected to be reduced.

National Legislation (Federal laws)

A brief overview of the main national laws regulating the forest sector is provided here below.These laws regulate the use and protection of native natural forests and also regulate the management and exploitation of commercial forests derived from reforestation projects.

- **Law n° 12.727 - October 17, 2012.**It establishes general norms on the protection of the vegetation, areas of Permanent Preservation and the areas of Legal Reserve; Logging, supply of forest raw materials, control of the origin of forest products and control and prevention of forest fires, and provides economic and financial instruments to achieve its objectives. *http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12727.htm*

- **Law n° 12.651 - May 25, 2012.** Establishes the New Brazilian Forest Code. *http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm*

- **Law n° 7.804 - July 18, 1989.** Amends Law 6.938, dated August 31, 1981, which provides for the National Policy on the Environment, its purposes and mechanisms for formulation and application, Law 7,735 of February 22, 1989, Law 6803, of July 2, 1980, and makes other provisions. *http://www.planalto.gov.br/ccivil_03/leis/L7804.htm*

Local Legislation

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

- **Law n° 4.163 – January 2, 2012.** Discipline, in the scope of the State of Mato Grosso do Sul, the exploitation of forests and other forms of native vegetation, the use of forest raw material, the obligation of forest replenishment and amendment of the provisions of Law No. 3,480, of December 20, 2007.
http://aacpdappls.net.ms.gov.br/appls/legislacao/secoge/govato.nsf/448b683bce4ca84704256c0b00651e9d/a45f013b3ae076570425797a004685b0

- **Law n° 2.257 – July 9, 2001.** It deals with the guidelines of the state environmental licensing, establishes the deadlines for the issuance of Environmental Licenses and Authorizations, and makes other provisions.
http://aacpdappls.net.ms.gov.br/appls/legislacao/secoge/govato.nsf/1b758e65922af3e904256b220050342a/265b758a8fd1951904256c00005863f1

- **Law n° 1.829 – 1998.** About the merger of *Fundação Terceiro Milênio - Natureza Viva* with Fundação Terceiro Milênio - Pantanal and makes other arrangements.
http://aacpdappls.net.ms.gov.br/appls/legislacao/secoge/govato.nsf/448b683bce4ca84704256c0b00651e9d/e91cb785c328cec204256c0000568e75

- **Law n° 90 - July 2, 1980.** It deals with changes in the environment, establishes standards of environmental protection and provides other measures.
http://aacpdappls.net.ms.gov.br/appls/legislacao/secoge/govato.nsf/1b758e65922af3e904256b220050342a/260c0df88db045f104256e450002e9e4

- **Decree n° 13.432, May 29, 2012.** Repeals Decree No. 7,508 of November 23, 1993, which provides for the environmental licensing of forestry activities.
http://aacpdappls.net.ms.gov.br/appls/legislacao/secoge/govato.nsf/fd8600de8a55c7fc04256b210079ce25/ab5860bc3250f7dd04257a0e00463e73

- **Decree n° 12.230, January 3, 2007.** It provides on the competence and approves the basic structure of the Secretary of State for Environment, Cities, Planning, Science and Technology – SEMAC.
http://aacpdappls.net.ms.gov.br/appls/legislacao/secoge/govato.nsf/fd8600de8a55c7fc04256b210079ce25/33bd0347501ec09904257261003e432d

- **Decree n° 12.231, January 3, 2007.** It deals with the basic structure and competence of the Environment Institute of Mato Grosso do Sul.
http://aacpdappls.net.ms.gov.br/appls/legislacao/secoge/govato.nsf/fd8600de8a55c7fc04256b210079ce25/7930614b4a7899ba04257261003ebfcc

- **Decree n° 7.508, November 23, 1993.** Provides on the Environmental Licensing of Forest Activity. *http://aacpdappls.net.ms.gov.br/appls/legislacao/secoge/govato.nsf/1b758e65922af3e904256b220050342a/1cde637b76b5c46404256e2d0069876f*

- **Resolution SEMADE n° 28, March 22, 2016.** Changes and adds provisions to Resolution SEMAC No. 11 of July 15, 2014, which implements and disciplines procedures related to the Rural Environmental Registry and the Most Sustainable MS Program referred to in State Decree No. 13,977, dated June 5, 2014. *http://www.imasul.ms.gov.br/wp-content/uploads/sites/74/2015/08/resolucao-28.pdf*

- **Resolution SEMAC n° 08 - 2011 – REVOKED for the Resolution SEMADE No 09-2015.** Establishes norms and procedures for the State environmental licensing, and makes other provisions.

- **Resolution SEMAC n° 17 – 2007.** Repeals Resolution SEMAC No. 16, of July 24, 2008, which provides for environmental licensing procedures for Agrarian Reform Settlement Projects in the State of Mato Grosso do Sul and provides other measures. *http://www.imasul.ms.gov.br/wp-content/uploads/sites/74/2015/06/RESOLU%C3%87%C3%83O-SEMAC-N.-17- 2007-compilada.doc*

In addition to this laws and decrees, in 2009 the *Plano Estadual de Desenvolvimento Sustentável de Florestas Plantadas* (PEF/MS)[32] (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 in the forest sector development process (forestry and industry) in order to maximize the economic, social and environmental benefits.

1.14.2 Project Compliance

The FNL Project complies with the law requirements of land use, not affecting natural forests and strategic ecosystems.

As mentioned in laws listed above, in Mato Grosso do Sul to get permission to plant commercial forests in rural areas, it is necessary a Legal Reserve equal or more than 20% of the land and regulate all potential APP – *Areas de Preservação Permanente* (Permanent Preservation Areas). According to Law n° 12,651/2012, all rural property must maintain an area with native vegetation coverage, as a Legal Reserve. This is an area located inside a rural property, with the function of ensuring the sustainable use of the natural resources of the rural property, assisting the conservation and rehabilitation of ecological processes and

32 PEF/MS - Plano Estadual de Florestas de Mato Grosso do Sul, Março 2009 – SEBRAE. http://m.sebrae.com.br/Sebrae/Portal%20Sebrae/UFs/MS/Estudos%20e%20Pesquisas/Plano%20Estadual%20para%20Desenvolvimento%20Economico%20de%20Florestas%20Plantadas.pdf

promoting the conservation of biodiversity, as well as the shelter and protection of wildlife and native flora.

Its minimum size in percentage of to the rural area is dependent on its location, as below (article 12):

▪ 80% in rural properties located in Rain Forest areas in the Legal Amazon;

▪ 35% in properties located in *Cerrado* areas in the Legal Amazon;

▪ 20% in properties located in other forest and fields areas in any region of the country (as in the Project).

Law n° 12,651/2012 envisages the possibility of its sustainable management in the following situations and opportunities:

▪ The collection of non-timber forest products, such as fruits, flowers, vines, leaves, root and seeds, which do not endanger the survival of individuals and of the species collected, is allowed (Article 21).

▪ Sustainable forestry is forbidden for commercial purposes but it's allowed for use in the property, with a maximum limit of 20 cubic meters / year (Article 23) .

▪ It is not allowed cattle farming or any other agricultural activity.

According to the definition of Law n° 12,651 / 2012, APP - Permanent Preservation Area is a protected area, covered or not by native vegetation, with the environmental function of preserving water resources, landscape, geological stability and biodiversity, facilitating the flow of flora and fauna, protect the soil and ensure the well-being of human populations.

Within the APP, the only allowed activities are research and eco-tourism.

By law, all territories with more than 45° slopes must be included in the APP. Also all the rivers, springs and lakes must be included in the APP, which must have vegetation belts with radius that depends on the width of the river or lake.

In the specific case of FNL Agroforestry Project (see Appendix 04 – Terrestrial Map), the Legal Reserve area within the Project borders is complied with and it is larger than the 20% as required by the relevant legislation (it is 661.3694 ha and represents the 20.36% of the farm). In addition to the Legal Reserve in the farm are present more areas of preserved savannah. These areas constitutes the Permanent Preservation Area, composed by areas with more than 45% slope, together with the vegetation areas that preserve the rivers that run trough the property (it is 497.7493 ha and represents the 15.32% of the farm).

Planting authorizations were issued by competent environmental authorities (IMASUL - *Instituto de Meio Ambiente de Mato Grosso do Sul*) upon the planting of all the planted areas present in the farm (see Appendix 06 – Planting Permits).

1.15 Participation under Other GHG Programs

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

Currently the Project does not participate under to any other of GHG Programs.

1.15.2 Projects Rejected by Other GHG Programs

The Project has not been rejected by any other GHG program.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The Project does not reduces GHG emissions from activities included in an emissions trading program or any other mechanism, therefore, reductions and removals generated by this Project will not be used for compliance under any other program or mechanism.

1.16.2 Other Forms of Environmental Credit

The Project has no intention to generate any other form of credits related to reductions or removals under the VCS program.

1.17 Additional Information Relevant to the Project

1.17.1 Leakage Management

The Project activity does not expect any displacement of agricultural activities present in the Project Zone before the beginning of the Project, thus leakage emissions are considered insignificant and hence accounted as zero, as mentioned in the § 4.3 – Leakage.

1.17.2 Commercially Sensitive Information

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

1.17.3 Sustainable Development

The Project Activity promotes reforestation in areas suitable for this purpose and also promote proper handling of the land, contribute to the mitigation of climate change by reducing GHG emissions, generate sustainable development through their activities and generate social, climatic and environmental co-benefits.

- **Social co-benefits:**

Project activities have stimulated an increase in the local workforce employed in the Project Zone: when the unique activity of the Fazenda was the cattle breading only 5 workers were employed in the Fazenda (they were responsible for raising 1,500 to 2,000 beef cattle). Now because of the *Eucalyptus* plantations more than 30 workers are employed. It has also allowed the specialization and qualification of this workforce and thanks to this has produced a wage increase of these workers, with consequent benefits to their families.

- **Climate co-benefits:**

The Project has a positive impact on the micro climate of the region: in fact it contributes to less water evaporation, less soil reflectivity, and a reduction in temperatures. This could, if thought on a large scale, also have significant effects on the climate of the region.

- **Environmental co-benefits:**

Soil: the Project gave a positive impact on the soil; before the starting of the Project the land was characterized by erosions and degraded pasture. Before the plantation the erosions have been recovered, contour lines have been made on all the parcels, to reduce the speed of rainwater on the ground and to increase ground water retention. After the planting the soil improves the characteristics: macro and micro minerals improved due mainly by fertilization.

Also organic matter improved and this increasing is permitted during the growth of the trees that cyclically change/lose branches and leaves that fallows on the ground and remains *in situ*. This wood litter, with natural decomposition, integrates with the soil in the form of organic matter.

Thanks to the Project the soil also reduces its acidity and is enriched with micro and macro elements thanks to periodic fertilization after each cut. The *Eucalyptus* also produces lower soil susceptibility to erosion: in fact, roots contribute to the stability of the soil, the *Eucalyptus* leaf foliage slows down the impact of rain on the soil and the plant material accumulated on the soil slows down the water descend during the rains on the most sloping soils. The arboreal coverage also increases soil moisture, mainly outside the rainy season.

Biodiversity: as for biodiversity in the specific case of the FNL Project different species of birds (including hawks, woodpeckers, snakes-hunter birds and various species of passerines) mammals (including Anteaters, Tapirs, Deer, Foxes, Wild Boars and numerous species of rodents), reptiles and amphibians can be frequently found in the Project Zone. 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 brazilian legislation) and grazing areas that normally are home to an extremely varied fauna. This type of mosaic-shaped crop and environmental diversification fully respects and can even enhance the biodiversity of the region, despite the presence of a monoculture such as the *Eucalyptus* plantation. In the Fazenda Nascente do Luar it is not uncommon to sight species of big predators typical of *Cerrado* region, as the Puma (*Puma concolor*), the Ocelot (*Leopardus pardalis*) and the Manned Wolf (*Chrysocyon brachyurus*). This species nowadays are considered threatened in many countries of Latin America but are present in the Project Zone.

Regarding the flora biodiversity, in the FNL Project some specific plants that make up the undergrowth of the *Eucalyptus* forest, such as *Tabebuia alba*, *Astronium fraxinifolium*, *Astronium urundeuva*, *Anadenanthera peregrina*, *Anadenanthera colubrina*, can commonly be found. 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.

- **Economic progress:**

The timber produced in the farm during the Project lifetime has also allowed and enabled the timber market to grow, with the involvement of various stakeholders, who have also benefited directly and indirectly by the Project. The timber produced by the farm during the life of the Project will be used for various purposes: civil construction, livestock fencing and delimitation of pastures and energy It is interesting to point out that the production of planted forests does reduces considerably the need to extract native timber, thus reducing legal and illegal logging.

1.17.4 Further Information

In order to fortify the activity developed during the Project the Project Proponent and the Project Owner dealt with the **Risk Assessment**. This section focuses on the analysis of the risks that could affect the forest growth and the consequent sequestration of CO2 of the Project in question and, consequently, the loss of the environmental, social and economic benefits that this Project aims to bring to climate, biodiversity and local community.

Seismic Activities:

According to Francisco 2017[33], high intensity earthquakes don't occur in Brazil thanks to the fact that the country is well placed in the South-American tectonic plate. According to the USP (University of São Paulo), they were over 100 earthquakes in Brasil during the 20th century, fortunately, they were all of low intensity and magnitude. Very often their effects were not even perceptible. Earthquakes on the Richter scale with a magnitude higher that 7 and therefore causing damage, have very little possibility of occurring in Brazil, however, these are more frequent in the areas that surround the tectonic plates, that isn't the case with Brazil. According to VACCARI 2016[34], which published data from a study carried out by the USP (University of São Paulo) between 2003 and today, there have been 16 seismic vibrations defined as "tremors" in Mato Grosso do Sul but all of almost insignificant magnitude. None of these occurred in the municipality of Costa Rica.

Most of them were in the Pantanal region in the Municipality of Coxim, Bonito, Aquidauana, Porto Murtinho, Corumba, Paiaguas, Miranda, Ladario, Aparecida do Taboado). The most intense occurrence was in Coxim in 2009 with a magnitude of 4.7 on the Richter scale. All the others which were recorded during the 12 year study were between 2 and 4 on the Richter scale.

Water Risk:

As shown in the § 1.1.2.1 of PDD, in the Mato Grosso do Sul region, the average annual rainfall is 1,500 mm. This often takes place with heavy storm-like episodes which create mainly urban damage which is result of inadequate urban rain drainage structures which are often not kept clean and free of urban waste. Often we can read about the occurrences of

33 FRANCISCO, Wagner de Cerqueria, "Risco de terremotos no Brasil "; Brasil Escola. Disponibile in <http://brasilescola.uol.com.br/brasil/risco-terremotos-no-brasil.htm>. April 22, 2017.

34 VACCARI, Glaucea, "Mato Grosso do Sul teve cinco terremotos confirmados de Janeiro até hoje Disponibile in <http://www.correiodoestado.com.br/cidades/mato-grosso-do-sul-teve-cinco-terremotos-confirmados-de-janeiro-ate/284683/>. Agoust 12, 2016.

urban flooding[35] which take place mainly during the rainy season. As stated in the article below[36] the water risk is limited to the urban areas, due to unauthorized urbanization.

35 O PROGRESO: Chuva deixa 13 cidades de MS em situação crítica, segundo Defesa Civil http://www.progresso.com.br/dia-a-dia/chuva-deixa-13-cidades-de-ms-em-situacao-critica, Aprile 22, 2017.

36 Setorização de Áreas em Alto e Muito Alto Risco Geológico Município de Campo Grande - MS July, 2013.

The Fazenda Nascente do Luar is located in an elevated and hilly region with undulations and hence presents no real risk of flooding. 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 does not exist: the entire area concerned by the Project is crossed only by small streams.

Fire Risk:

From the beginning of the planting the fire risk control was carefully taken into consideration. Indeed all the planted areas have been subdivided into smaller parcels, of various dimensions, with each one separated by anti-fire corridors of between 10 and 20 meters in width. Risk of fires is practically non-existent during the raining season because of the high level of humidity present in both the soil and vegetation which of course prevent risks of development of any fire. During the dry season the fire risk goes up, but this is reduced by a specific management plan for fires. This plan respects the following control measures:

▪ Identification of critical sectors: among these we need to single out the streets with the highest flow of vehicles, walkways, workers homes, areas on the borders with rural habitation, where there is a risk of intentional or accidental fires, possibly even set of by an unextinguished cigarette butt. Other important critical points could be electric cables capable of causing fires simply by a short circuit Break or by simply falling on the ground.

▪ Development of firewall barriers: all the critical sectors are regularly ploughed in order to remove the dry grass carpet which is highly inflammable, so as to eliminate all possibilities of fire risk.

▪ Training the operating staff in preventive measures and how to act quickly when fires occur: every year all the workers are obliged to attend an anti-fire course, divided in 2 both prevention and control. Each member of staff receives a professional certificate at the end of the course.

▪ Provide the right elements such as water tanks, hoses, extinguishers, blankets, etc: All this equipment are always accessible and ready for use in case of any emergency, both during the winter months (dry season) and in the summer months (rainy season).

The practice of starting fires was used regularly in the baseline scenario, in order to burn the dead and fibrous grass during the dry season so as to stimulate the growth of green shoots which are very appreciated by cows. This illegal agricultural practice was not executed under any measure or control. As of result of this practice fire often occurred in the Legal Reserve areas, destroying all the vegetation and forcing the fauna to flee. This increased the degradation of the soil as it lost minerals and porosity.

Pest Infestation

Given the presence of some species of leaf-cutter ants of the genus *Atta* in these *Cerrado* regions, a pest prevention and control plan has been developed and implemented in the planting and growth stages of *Eucalyptus* trees. 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 one of 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

Since **March 2010** (beginning of the planting of the first reforested areas of the Fazenda Nascente do Luar) no *Eucalyptus* infectious diseases have been recorded in any of the reforested areas. A prevention and control plan for diseases has been developed that gives greater priority to biological control, along with organic pesticides used to control outbreaks. Chemical pesticides are also considered but they will be used only if necessary.

Other Natural Risks:

Unusual winds can be present during the dry season, but this does not mean a risk for the planted area. No harms or loss have occurred inside the planted area as a result of an extreme weather during the last 10-years period.

Human-induced Risks:

No human-induced risks have been identified on climate, community and biodiversity, as the forest plantings promote the sequestration of carbon dioxide and other air pollutants and regulate the micro climates of the region. In addition, no communities live inside the project areas or in places surrounding the farm where the Project is developed and the neighbouring farms, therefore there is minimal risk of affecting their wellbeing in a negative way. Biodiversity will only be positively impacted by the plantings as the establishment of forest promotes the creation of natural corridors and the return of previously displaced fauna by the cattle and extensive pastures.

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. Long-term Viability is guaranteed.

2. SAFEGUARDS

2.1 No Net Harm

Starting from a completely degraded land and carrying out the rigorous work done by the Project Owner (already extensively explained in this PDD) on the land, enriched by planting a new forest, is rather difficult and unlikely to highlight any potential negative environment and socio-economic impact. An operation of this type can only issue environmental, social and the biodiversity benefits.

2.2 Local Stakeholder Consultation

The consultation of the local stakeholders started at the beginning of the Project and nowadays is ongoing. This consultation was divided into:

▪ Consultation of the owners of neighbouring farms (farmers);

▪ Consultation of other stakeholders belonging to agro-forestry supply chain (local timber processing companies);

▪ Consultation of forest technicians operating in the forest sector in the Costa Rica region;

▪ Consultation of permanent and temporary workers of Fazenda Nascente do Luar.

During this consultation process is going to be analyzed the possible impacts that the Project on individual or collective actors in terms of economics, social and biodiversity aspects. This analysis is going performed through the use of questions, comments and opinions regarding to the exposed topics. The result of the evaluation will be analyzed and shown in the next Monitoring reports.

To resume the stakeholder perception regarding the Project will be used the fallowing Table 10.

Stakeholder	Sessions	Total participants	Community			Climate			Biodiversity		
			I+	N	I-	I+	N	I-	I+	N	I-
Farmers											
Supply-chain's stockholders											
Technicians											

Permanent workers											
Temporary workers											
TOTAL											

Table 10: Resume of stakeholder perception regarding the Project.

During the local consultation process, all participants will be informed about the mechanisms that generate Carbon Credits and the validation and registry process while pointing out that an external auditor (a validation and verification body) who will visit in February 2020 the Project Area and executes the process, interacts with stakeholders, evaluates the Project informations and issues evaluation reports.

Referring to the Project Owner, Carbon Credits Consulting (as Project Proponent) has maintained constant and direct communication with the Project Owner, in order to give the guidelines and clarity aspects related to the Project cycle, including validation, registration and Project monitoring. We explained to the stakeholders of the FNL Project the process in a comprehensible way giving the exact timing for the visit of the DOE 3 months in advance (November 2019).

The Forest Operations Manager, Mr. Ranieri, took charge of collecting from the workers any kind of questions to be asked to the DOE during the site-visit that is planned the first week on February 2020. Through this local consultation, were assessed the possible impacts of the Project and the perceptions of stakeholders were identified.

The consultation meetings with the different stakeholders (owners of neighboring farms, stakeholders of the agro-forestry supply chain, forest technicians, permanent/temporary workers) were organized in the FNL farm. The invitation to these events was always conducted by telephone.

In addition were involved various governmental and non-governmental organization that we can call “institutional stakeholders”, such as:

▪ IMASUL[37] – *Instituto de Meio Ambiente de Mato Grosso do Sul* where was consulted all the developing staff and also the president, Mr. Ricardo Eboli.

▪ REFLORE[38] where was consulted in particularly his president, Mr. Moacir Reis.

▪ UEMS[39] – *Universidade Estadual do Mato Grosso do Su*l, where we met the Professor Giselle Barbosa, coordinator of bachelor in Agronomy and involved in agroforestry research.

37 https://www.imasul.ms.gov.br

38 https://reflore.com.br

39 http://www.uems.br

The meetings with these institutional stakeholders were organized by means of personal visits. At the beginning of each meeting, participants received a summary sheet of the Project for them to understand the Project. During the meetings aspects related to forest carbon projects, specific project activities and participants were explained. There were question and answer sessions after the talks. The questions of the participants were resolved and all observations were heard and taken into consideration. The information provided, included contacts (phone number and email) of the people in charge of the Project documentation (Project developers), in order to give the attendants, the possibility to permanently communicate their concerns or comments.

Once the Project Design Document is ready, it will be published on the website of VERRA for public comments and on the website of CCC (Project Proponent).

During all the consultation process the aspects of climate change and carbon markets were addressed by providing information and general concepts in simple language that could be understood by all participants. In addition to the topics mentioned above, during the local consultation were analyzed the possible impacts that the Project might have on individual or collective actors in terms of economic, social and biodiversity aspects. This analysis was performed through the use questions, comments and opinions regarding to the exposed topics. The result of the evaluation, assigned to each impact a rating of positive, negative or neutral according to the effect on the quality of life of each participant. During the local consultation, all participants were informed about the validation and registry process while pointing out that an external auditor (a validation and verification body) who visits the area of influence executes this process, interacts with stakeholders, evaluates the Project information and issues a report of the evaluation.

Plans for conflict resolution and training sessions facilitate and promote the understanding and participation of employees. All these measures have been and will continue to be implemented without gender discrimination and respecting the cultural customs of the stakeholders.

The necessary measures to facilitate the participation were:

▪ Local consultations, where the participation of as many people as possible was encouraged. In addition, contact information was provided for future consultations. Participants were allowed to present their comments anonymously, in order to feel free when expressing their disagreements.

▪ The constant monitoring guarantees the participation of communities and the reassessment of goals and objectives during the development of the Project.

▪ Plans for the dissemination of information (design document, monitoring reports, etc.). The publication of the results, allows the stakeholders to remain updated about the Project.

▪ Plans for conflict resolution and training sessions, facilitate and promote the understanding and participation of employees.

All these measures have been and will continue to be implemented without gender discrimination and respecting the cultural customs of the stakeholders.

2.3 Environmental Impact

There is a specific and complete work on *Eucalyptus* commercial plantations called "*Impacto Ambiental de Florestas de Eucalipto* (VITAL, 2007 – Appendix 18)[40], which collects all the articles and works to update the impact of *Eucalyptus* on soil, climate and biodiversity. This work demonstrates how rational management of this kind of forest can have a beneficial effect on the environment in general.

As far as biodiversity is concerned, it is reported that a forest of *Eucalyptus* will never have the benefits of a native forest, but if compared to other crops such as corn, soy, sugar cane, cotton and coffee *Eucalyptus* produces more abundant and differentiated biodiversity.

According to VITAL (2007) 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.

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* plantations, 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[41]).

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)[42] 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

40 http://www.bndes.gov.br/SiteBNDES/export/sites/default/bndes_pt/Galerias/Arquivos/conhecimento/revista/rev2808.pdf

41 ALMEIDA, A. F. "Influência do tipo de vegetação nas populações de aves em uma floresta implantada de *Pinus spp*, na região de Agudos-SP". Ipef, n. 18, jun. 1979.

42 RAJVANSHI, A.; SONI, S.; KUKRET, U. D.; SRIVATAVA, M. M. "A comparative study of undergrowth of Sal forest and Eucalyptus plantation at Golata- Ppar-Dehra Dun during rainy season". Ind. Jr. For. 6(2), p. 117-119, 1983.

radiation and rainwater, thereby explaining the greater plant diversity in its undergrowth.

NERI (2005)[43] 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)[44] 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* (Giant 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)[45] 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. According to VITAL (2007) 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. In general, the fauna and flora biodiversity is lower if compared to natural forests, but it is higher if compared to grazing or farmland. 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)[46] stated that in *Eucalyptus* forests are also home to endangered plant

43 NERI, A V. “Regeneração de espécies nativas lenhosas sob plantio de Eucalyptus em área de Cerrado na Floresta Nacional de Paraopeba, MG, Brazil”, Acta Botanica Brazilica, n. 2, v. 19, jun. 2005.

44 SILVA, E. Avaliação qualitativa de impactos ambientais do reflorestamento no Brasil. Viçosa, MG, UFV, 1994. 309 p. (Tese D. S.).

45 MELLO, H.A. - Posição das florestas artificiais na conservação dos recursos naturais renováveis. In: ARACRUZ FLORESTAL S.A. - O eucalipto e a ecologia. Aracruz, 1975. p.11-4.

46 GABRIEL, V. A.; VASCONCELOS, A. A.; LIMA, E. F.; CASSOLA, H.; BARRETTO, K. D.; BRITO, M. C. A importância das plantações de eucalipto na conservação da biodiversidade. Revista Pesquisa Florestal Brazileira, Colombo, v. 33, n. 74, p. 203-213, abr./jun. 2013.

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 Manned Wolf *(Chrysocyon brachyurus* – Photo 17), the Giant Anteater *(Myrmecophaga tridactyla* - Photo 19*)* and the Tapir *(Tapirus terrestris* – Photo 24*).*

In the specific case of the FNL Project different species of birds (including hawks, woodpeckers, snakes-hunter birds 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 other grazing areas, that normally are home to an extremely varied fauna. This type of "mosaic" landscape 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. Other reason of the increase of wildlife in the Project Zone is the fact that cattle ranching is no longer practiced in the areas within the Project boundary, enabling a significant increase of ungulates (deer and wild boars) in the region, probably because cattle no longer compete for forage with them.

Regarding the flora biodiversity, in the FNL Project can commonly be found some specific plants di that make up the undergrowth of the *Eucaliptus* forest, such as *Tabebuia alba, Astronium fraxinifolium, Astronium urundeuva, Anadenanthera peregrina, Anadenanthera colubrina.* Nowadays these botanical 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.

A further but significant effect on biodiversity derives from the fact that the absence of cattle farming has allowed for 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 of the farm used this practice to stimulate the regrowth of pasture during the dry season.

Nowadays, walking in the *Eucalyptus* plantation it is easy to spot wild ungulates (*Ozotoceros bezoarticus* and *Mazama americana*) giant anteater (*Myrmecophaga tridactyla*) tapirs, foxes and the rare maned wolf (*Chrysocyon brachyurus*). Sometimes even Puma (*Puma concolor*) can be spotted. For this reason we can consider that the Project maintains and enhances any HCVs present in the Project Zone that are very important for conserving biodiversity.

2.4 Public Comments

Public comment period will run from December 16, 2019 to January 15, 2020. Any public comment will be published in this PDD for the validation process.

2.5 AFOLU-Specific Safeguards

2.5.1 Stakeholder identification

Stakeholders were identified with the help of the Project Owner who were responsible for summoning the workers, their families and the other people present on neighbouring farms. However, the population living close to the FNL is limited since most of the people that work in the rural areas are concentrated in the urban area of Costa Rica and Figueirão.

During the beginning of the Project were identified all the commercial stakeholders that were involved with the planting and maintenance of the planted forest regarding the Project Area.

In addition, the institutional (environmental and governmental) entities and organizations that have a potential interest in the Project were also identified.

Actor	Classification	Interests	Pertinence
CCC – Carbon Credits Consulting Srl.	Project Proponent	To coordinate all the aspects related to the project's implementation.	Direct participation in the project activities.
AGROBUSINESS FLORESTA E PECUARIA LTDA	Project Owner and Land Owner	Successfully conclude all project activities and proposals and to fully comply with the objectives set in terms of the climate, biodiversity and communities components.	Direct participation in the project activities.
Workers of the FNL farm	Community	The livelihood of the actors and their families depend directly on the project activities	Direct participation in the project activities. Direct and indirect receivers of impacts of the project on climate, biodiversity and communities.
People present in neighbouring farms (Land Owners, workers, technicians).	Community	New opportunity of business, new opportunity of work. Protect the community's interests about the development of projects that impact directly or indirectly the environmental, economic or social conditions of the area of influence.	Direct and indirect receivers of impacts of the project on climate, biodiversity and communities. To emit opinions concerning the direct or indirect project impacts on the community interests.

IMASUL	Other actors	Ensure the sustainable development of their jurisdiction starting from the verification of compliance with existing environmental regulations for the different interventions on ecosystems and associated resources.	Environmental authority in charge of regulate the interventions on associated ecosystems and make sure about the compliance the environmental regulations related to the development of Project.
UEMS – Universidade Estadual do Mato Grosso do Sul	Other actors	Contribute with knowledge and experience in order to improve the implementation of the various project activities	Public Educational institution with presence in the project area that has implemented academic programs consistent with the regional needs

2.5.1 List of all Communities, Community Groups and Other Stakeholders

Communities: workers of the FNL farm , workers families, technicians and experts involved in the Project, people from neighbouring farms (landlords, workers, technicians).

Community Groups: not identified.

Other Stakeholders:

- Direct Stakeholders: Project Owner; Land Owner;
- Institutional Stakeholders: IMASUL - *Instituto de Meio Ambiente de Mato Grosso do Sul*; UEMS - *Universidade Estadual do Mato Grosso do Sul;* REFLORE.
- Commercial Stakeholders.

No ongoing enforcement or disputes have been raised in the past and until now, relating to the protection of the planting area, as there are no communities living close to the Project Zone. In addition the farms are demarcated by fences, and are correctly marked as private land. The staff remains permanently in the Project Area. This limits external risks that could hinder the continuation of the forest when the Project is over.

2.5.1 Grievance redress procedure to resolve any conflicts which may arise between the project proponent and local stakeholders.

The Feedback and Grievance Redness Procedure is manage by the Forest Manager (Mr. Ranieri) who personally delivered to every single stakeholder his business card with the phone and e-mail contacts. For being in constant contact with the community and workers, the Forest Manager is the first responsible for responding to requests from the community.

According to the internal procedures the Forest Manager must climb the observation to the area Project Owner and must address the affected to a discussion room, in order to handle the complaint.

On the other hand, the Forest Manager and the Project Owner maintain constant contact with the institution, in order to verify that externally, the Project operations are not negatively impacting the surrounding communities. It will be done through regular meetings, email and phone calls, allowing them to express their suggestions, recommendations or claims.

The time frames established concerning to the grievance procedures are:
▪ Claims or complaints must be attended within 15 working days of receipt of the request.
▪ Suggestions must be attended within 30 working days of receipt of the request.
▪ However, where it is not possible to provide an answer within the established frame time, the claimant must be formally informed and the reasons for the delay and the new date for reply must be given.

The proposed mechanism will be in constant evaluation and adjustment, according to the recorded dynamics and evaluation of effectiveness. So far, none of the stakeholders has been expressed any kind of grievance.

Expected benefits: climate, community and biodiversity

Activity	Actions	Results	Expected impacts	Expected benefits: climate, community and biodiversity
Reforestation	Training courses, number of trained people, number of used species, number of plants in field, planted area, research on native species.	Revenues from the sale of carbon credits, income from alternative activities, increase of timber stocks, increase of local and regional employment, trained workers in plantation management, publications and / or research activities.	Restored areas with native and introduced tree species.	Climate: CO2 sequestration; Biodiversity: Wildlife increase due to the restoration of landscapes, soil and water conservation; Community: increase of the employment, development of family business, recreation and tourism, revitalization of the economy.
Monitoring	Training courses in the monitoring of climate, communities biodiversity, research on plantations with native and introduced species in the region.	Additional income from the sale of carbon credits, people trained in monitoring climate, community and biodiversity indicators, publications and / or publications resulted from the monitoring's.	Increase of the biodiversity in the project area, improvement of the life quality inside the project area.	Climate: CO2 sequestration; Biodiversity and Communities: quantitative and qualifying studies about changes in the biodiversity, climate and community over the time.
Training and education	Courses / workshops on forest management, environmental education, safety and health at work. Courses / workshops on forest management, environmental education, safety and health at work.	People trained in the proper management of forest plantations, environmental education and implementation of sustainable practices; awareness in occupational safety and health.	People with practical and sustainable actions in the project area. People trained in forest management. Social empowerment.	Climate: CO2 sequestration. Sustainable development of activities; Biodiversity: increase of biodiversity through sustainable practices. Community: People trained on each activity related to sustainable forest management and industrial safety and health to prevent accidents and/or risks to the direct and indirect staff.

Both the Project Proponent and the Project Owner have excellent reputation and are not involved in or complicit in any form of discrimination or sexual harassment with respect to the Project.

The stakeholders involvement in the Project has been inclusive, according to individual capabilities and independent of gender, cultural identity and religion. Recruiting managers have as a principle employ qualified and reliable staff whose skills are in line with the requirements and objectives of the Project, through technical, transparent and non-discriminatory procedures based on merit and excellence.T

he policies and guidelines of the Project Owner and the Project Proponent guarantee that no type of discrimination will be tolerated at any point during the Project development.

3. APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

This is an AFOLU A/R project that aims to reforest degraded lands, which are expected to remain degraded or to continue degraded in the absence of the project.

Title of the methodology: *AR-ACM0003. Afforestation and reforestation of lands except wetlands*. Version 02.0 of 04/10/2013.

The following documents are indispensable for application of this methodology:

(a) Clean Development Mechanism project standard;

(b) A/R methodological tools:

- "*Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities*" (Version 01);
- "*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*".

3.2 Applicability of Methodology

3.2.1 Applicability conditions of the methodology

The methodology is applicable under the following conditions:

The land subject to the project activity does not fall in wetland category.	In Mato Grosso do Sul are presented wetlands but are localized in the Pantanal Region, 150 km far from the Municipality of Campo Grande where the Project is implemented. See Map 02, 03 and 04.
Soil disturbance attributable to the project activity does not cover more than 10% of area in each of the following types of land, when these lands are included within the project boundary: *(a) Land containing organic soils.* *(b) Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 to this methodology.*	(a) The soil within the Project boundaries is not an organic soil as proved by the soil analysis showed in the Table 01: the average of organic matter is barely 11gr/dm³ and the presence of sand reaches nearly 90%, so it is considered a sandy soil. (b) The land within the Project boundaries was a degraded grasslands, without receiving inputs such as listed in appendices 1 and 2 to the methodology AR-ACM003. Such grasslands under tropical conditions have less carbon compared to plantations and forest cover. Therefore, it is expected for soil organic carbon to increase more in the presence of the Project activity relative to the previous land use. In addition during the soil preparation phase at the beginning of the Pre-Project phase, no extensive surface treatments have been carried out with the exception of the closure of the deep erosions, of the digging pits for the plantlets and the ploughed perimeter band to reduce the risk of fire. Soil disturbance attributable to the Project activity does not cover more than 10%. The absence of extended soil processing in unsaturated sandy soils has reduced the losses of organic matter originally present as well as maintaining a natural mulching capable of preserving the soil moisture and favouring the development of natural microbial fauna.

3.2.2 Applicability conditions of the methodology of the methodological tool

The Project applies this methodology and also complies with the applicability conditions of the following methodological tools:

Methodological tool	Applicability conditions	Project compliance
*Combined tool to identify the **baseline** scenario and demonstrate **additionality** in A/R CDM project activities.*	*(a) This tool is applicable for forestation of the land within the proposed project boundary performed with or without being registered as the A/R CDM project activity shall not lead to violation of any applicable law even if the law is not enforced.* *(b) This tool is not applicable to small-scale afforestation and reforestation project activities.*	(a) Forestation of the land will not lead to violation of any applicable law (see **§ 3.5 – Additionality**). (b) The proposed Project is not a small-scale afforestation and reforestation project.
*Estimation of carbon stocks and change in carbon stocks of **trees** and **shrubs** in A/R CDM project activities.*	*This tool has no internal applicability conditions.*	The estimation of change in carbon stocks of trees and shrubs is described and accounted in the **§ 4.4 – Net GHG Emission Reductions and Removals.**
*Estimation of carbon stocks and change in carbon stocks in **dead wood and litter** in A/R CDM project activities.*	*This tool has no internal applicability conditions.* *This tool makes the following assumptions:* *(a) Linearity of change of biomass in dead wood and litter over a period of time: Change of biomass in dead wood and litter may be assumed to proceed, on average, at an approximately constant rate between two points of time at which the biomass is estimated;* *(b) Appropriateness of root-shoot ratios: Root-shoot ratios appropriate for estimation of below-ground biomass from above-ground biomass of living trees are also appropriate for dead trees*	The estimation of change in dead wood and litter is accounted in the **§ 4.4 – Net GHG Emission Reductions and Removals.**

*Tool for estimation of change in **soil organic carbon** stocks due to the implementation of A/R CDM project activities*	*This tool is applicable when the areas of land, the baseline scenario, and the project activity* *meet the following conditions:* *(a) The areas of land to which this tool is applied:* *(i) Do not fall into wetland category;* *(ii) Do not contain organic soils as defined in Annex A: Glossary of the IPCC GPG LULUCF 2003;* *(iii) Are not subject to any of the land management practices and application of inputs as listed in the Tables 1 and 2;* *(b) The A/R CDM project activity meets the following conditions:* *(i) Litter remains on site and is not removed in the A/R CDM project activity;* *(ii) Soil disturbance attributable to the A/R CDM project activity, if any, is:* *· In accordance with appropriate soil conservation practices, e.g.* *follows the land contours;* *· Limited to soil disturbance for site preparation before planting and such disturbance is not repeated in less than twenty years.*	(a) The Project areas of land 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 as listed in the Tables 1 and 2. (b) The litter remain on site and will not be removed in any site. Besides the soil disturbance is done by following appropriate soil conservation practices and it is only for site preparation before planting. The estimation of change in SOC is accounted in the **§ 4.4 – Net GHG Emission Reductions and Removals.**
*Estimation of non-CO2 greenhouse gas (GHG) emissions resulting from **burning of biomass** attributable to an A/R CDM project activity*	*The tool is applicable to all occurrence of fire within the project boundary. Non-CO2 GHG emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party for the purpose of defining forest, provided that the accumulated area affected by such fires in a given year is ≥5% of the project area.*	No burning of biomass is attributable to the Project activity, thus project emissions are accounted as zero *(*see **§ 4.2 – Project Emissions**).

*Estimation of the increase in GHG emissions attributable to **displacement** of pre-project agricultural activities in A/R CDM project activity.*	*This tool is not applicable if the displacement of agricultural activities is expected to cause, directly or indirectly, any drainage of wetlands or peat lands.*	The Project activity does not cause, directly or indirectly, any drainage of wetlands or peat lands and does not expect any displacement of agricultural activities present in the Project Zone before the beginning of the Project Leakage emissions are considered insignificant and hence accounted as zero (see **§ 4.3 – Leakage**).

3.3 Project Boundary

The relevant GHG sources, sinks and reservoirs for the project and baseline scenarios are presenting in the Table 10 below.

Source		Gas	Included?	Justification/Explanation
Baseline	Above and below ground biomass	CO_2	Yes	Above and below ground carbon stock in the baseline is presented in the **isolated trees and grasses**. The trees present in the Project Area before the Project was neither harvested, nor cleared, nor removed. These didn't 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.**
		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	It is expected that carbon stock in these pools **will not decrease** 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.
Project	Above and below ground biomass	CO_2	Yes	Carbon stock in above ground biomass is the **major carbon pool** subjected to Project activity and it is **expected to increase** due to the implementation of the 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		Carbon stock in these pools **may increase** due to implementation of the Project activity.
		CH_4		This is not a requirement of the methodology.
		N_2O		This is not a requirement of the methodology.

Table 10: GHG sources, sinks and reservoirs.

3.4 Baseline Scenario

3.4.1 Identification of the baseline scenario

The baseline scenario will be justified in the next § 3.5 - Additionality, applying the A/R CDM Methodological tool "*Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities*" (Version 01).

3.4.2 Selected baseline scenario: historic use of the land

The baseline scenario of the Project Area corresponds to cattle ranching in degraded pasturelands.

The land within the Project Area boundary before the start of the Project was degraded grassland, occupied by extensive cattle farming, 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 Starting Date (**April 01, 2015**) the land use of the Fazenda Nascente do Luar area (Project Zone) was as follows in the Table 11.

Areas	Extension (ha)
Heaquarters + Streets + Corridors + Sheds	8,0120
Eucalyptus Plantation	982,5327
Legal Reserve	661,3694
Permanent Preservation Area	497,7493
Pasture	1.098,7986
Total Area	**3.248,4620**

Table 11: Land use prior to the Project.

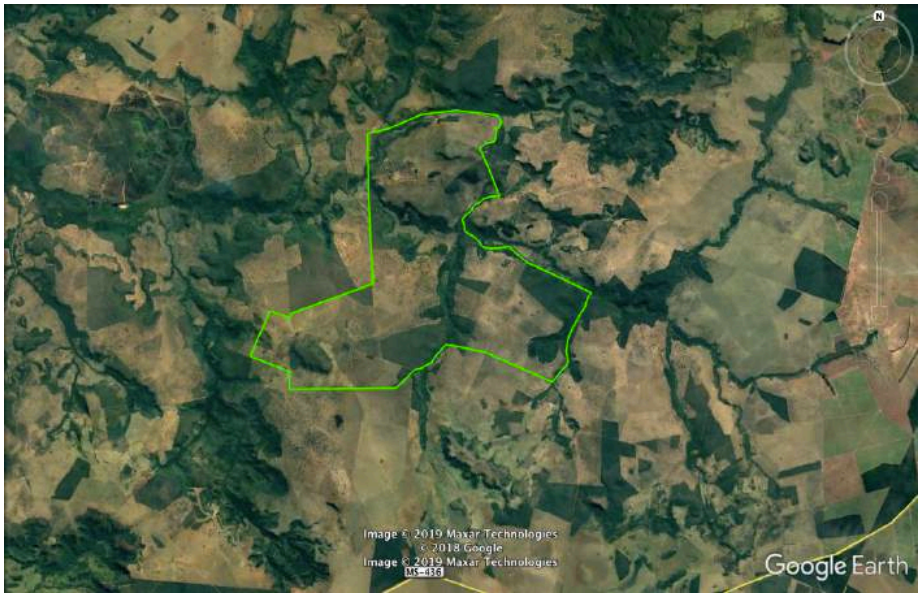
Map 06 shows the Fazenda Nascente do Luar (borders in green) and nearby properties before the start of the Project, exactly in 2014. Are visible:

▪ the planted areas with *Eucalyptus spp.* (dark green due to the thick tree cover);

▪ the remaining degraded pastures;

▪ the Legal Reserve and the Permanents Preservation Areas with native vegetation (light green, due to the scarce plant cover of the soil).

Also in the areas surrounding the Project Zone, corresponding to the nearby farms, it is evident the low vegetal cover, caused by the extensive cattle farming.



Map 06: Baseline scenario of the Project Zone (farm borders in green) (Source: Google Earth, 2014).

Before the start of the Project, the 2 activities present at Fazenda Nascente do Luar were cattle ranching, mainly for meat production, practiced in degraded grassland and *Eucalyptus* plantation for timber production. The grazing area was made up of large areas for grazing, ranging from 30 to 80 ha each, bounded by fences made of iron wires and wooden poles set into the ground. Cattle grazed in that areas permanently, throughout the year, feeding on native and introduced grasses. According to information provided by the current Land Owners, cattle farming had been practiced for several decades. In addition to the grazing areas the property conserved remnants of savannah forest that made up the Legal Reserve of the Fazenda. As stated 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 activity is banned. The vegetation must be preserved in its entirety. Furthermore, a demarcation and fencing obligation applies to these areas.

Over the years, irrational extensive cattle ranching had caused a serious degradation pasture process in the Fazenda Nascente do Luar. The most obvious signs of this process were land erosion patches and reduction in soil fertility (decreased organic matter, decreased macro and micro trace elements). The factors that led to this gradual depletion of pasture and soil were:

- Cattle grazing 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 a 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 pasture production was recorded in the Fazenda Nascente do Luar , with an inevitable reduction of animal load per hectare resulting in a decreased productivity. All this had led to an alarming decline in the economic return of the farm owners.

At the time, pastures present in the Fazenda were so unproductive that in the dry season the owner pushed cattle to graze also in the Legal Reserve areas, thus jeopardizing even the few remaining natural areas, where is prohibited by low 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 to a dangerous decline in biodiversity of the entire region. This landscape corresponded to the land prior to the Project Start Date.

3.4.3 Stratification of the Baseline scenario

The biomass distribution over the Project Area in the baseline scenario was homogeneous, so stratification was not necessary to be carried out. Indeed the areas affected by the Afforestation Project in the baseline scenario was homogeneous in the pedological and environmental characteristics and the land cover was totally represented by pastures for cattle (herbaceous grass meadows) intertwined with few isolated trees.

3.4.4 Conclusion

The degradation, erosion and compacting of the soil in the baseline scenario prevents the natural regeneration of these areas. The few vegetation present in these areas and his economic use in the absence of the Project activity are not sufficient to permit the natural regeneration process of forest cover. If the Project activity were not to occur, the historical uses and the economic determinants of land use would most probably result in a continuation of pastures for cattle.

3.5 Additionality

The assessment and demonstration of additionality and the identification and justification of the baseline scenario are described using the "*Combined tool to identify baseline scenario and demonstrate additionality in A/R CDM project activities* (Version 01)", issued by the CDM executive board at the United Nations, which shall be hereinafter referred to as "additionality tool". The additionality tool is applicable under the following conditions:

• *Forestation of the land within the proposed project boundary performed with or without being registered as the A/R CDM project activity shall not lead to violation of any applicable law even if the law is not enforced.*

• *This tool is not applicable to small-scale afforestation and reforestation project activities.*

According to the additionality tool the following steps have been applied.

STEP 0. Preliminary screening based on the starting date of the A/R project activity

STEP 1. Identification of alternative scenarios

STEP 2. Barrier analysis

STEP 3. Investment analysis (if needed)

STEP 4. Common practice analysis

3.5.1 STEP 0. Preliminary screening based on the starting date of the A/R project activity

The starting date of the Project Fazenda Nascente do Luar is **April 01, 2015**, thus after December 31, 1999.

Provide evidence that the starting date of the A/R CDM project activity was after 31 December 1999.	In the Appendix 3 - Tenancy Agreement is highlighted that the company AGROBUSINESS FLORESTA E PECUARIA LTDA on September 15, 2013 rented the farm Fazenda Nascente do Luar for 20 years, being able to plant by contract 2,200 ha of Eucalyptus plantations. This is subsequent to 31 December 1999.
Provide evidence that the incentive from the planned sale of CERs was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official, legal and/or other corporate) documentation that was available to third parties at, or prior to, the start of the project activity	The evidence that the incentive from the planned sale of CERs was seriously considered in the decision to proceed with the project activity is proved in the Appendix 3 - Tenancy Agreement, where is highlighted that the Land Owners will be payed for the production of wood and for the production of CERs proportional to its shares. This contract was signed on November 28, 2006 and was registered on September 15, 2013.

3.5.2 STEP 1. Identification of alternative land use scenarios to the proposed project activity

This step serves to identify alternative land use scenarios to the proposed CDM project activity that could be the baseline scenario, through the following sub-steps:

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

In the specific area where the Project will focus, the alternative land uses in absence of the VCS forestry proposal are cattle ranching activities and the forestry activities without the VCS component. This two agricultural activities are not attractive for the Land Owners.

Scenario 01: continuation of the pre-project land use: cattle ranching.	The Scenario 01 is the continuation of the pre-project land use and corresponds to the degraded pasture lands with **extensive cattle ranching**. The Mato Grosso do Sul predominant land use is represented by pastures for cattle breeding. According to the data presented in the "*Plano Estadual de Desenvolvimento Sustentável de Florestas Plantadas – PEF/MS* [47]" (2009), the surface of the Mato Grosso do Sul occupied by pastures reaches 70% (Diagram 07). According to IBGE (2015)[48], the state of Mato Grosso do Sul has a total of 21,357,398 bovines and represents 9.92% of the total bovine herd of Brazil (215,2 million of cattle in 2015). For cattle breeding is used natural grasslands and lands, originally occupied by the *Cerrado*, that had suffered a process of deforestation and were transformed into pasturelands. This deforestation process is still exiting throughout Brazil.

47 PEF/MS - Plano Estadual de Florestas de Mato Grosso do Sul, Março 2009 – SEBRAE. http://m.sebrae.com.br/Sebrae/Portal%20Sebrae/UFs/MS/Estudos%20e%20Pesquisas/Plano%20Estadual%20para%20Desenvolvimento%20Economico%20de%20Florestas%20Plantadas.pdf

48 IBGE - *Instituto Brazileiro de Geografia e Estatística*: **Censo Pecuario**, 2015. http://www.ibge.gov.br/estadosat/temas.php?sigla=ms&tema=pecuaria2015

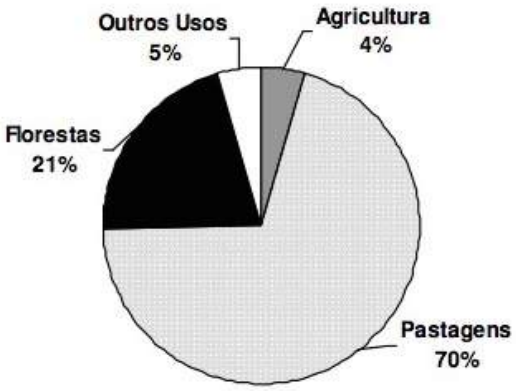


Diagram 07: Land use in Mato Grosso do Sul (*Plano Estadual de Desenvolvimento Sustentável de Florestas Plantadas* (PEF/MS) – *Relatorio Final 2009* [49].

According to Kirby (2005)[50] the annual rate of deforestation in the Brazil has continued to increase from 1990 to recent years because of several factors, both local than international. The removal of *Cerrado*, to make way for cattle ranching, was the leading cause of deforestation and land degradation in the Mato Grosso do Sul region.

Cattle ranching in Mato Grosso do Sul 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.

Under the Deforestation Monitoring Program of the Brazilian Biomes of the Ministry of Environment[51], 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%.

Currently, in some regions of Brazil, deforestation and a form of irrational

49 http://m.sebrae.com.br/Sebrae/Portal%20Sebrae/UFs/MS/Estudos%20e%20Pesquisas/Plano%20Estadual%20para%20Desenvolvimento%20Economico%20de%20Florestas%20Plantadas.pdf

50 KIRBY, K. R., LAURANCE, W. F., ALBERNAZ, A. K., SCHROTH, G., FEARNSIDE, P. M., BERGEN, S., VENTICINQUE, E. M., & DE COSTA, C. (2006). "The future of deforestation in the Brazilian Amazon". Futures. 38 (38): 432–453. doi:10.1016/j.futures.2005.07.011. ISSN 0016-3287.

51 CENTRO DE GESTÃO E ESTUDOS ESTRATÉGICOS - CGEE. Desertificação, degradação da terra e secas no Brazil. Brasília: Centro de Gestão e Estudos Estratégicos, 2016. 252 p. ISBN(9788555691126). http://flegt.info/en/featured/Brazil-2/

	extensive cattle ranching are causing serious desertification phenomena. The recent research work "*Desertificação, degradação da terra e secas no Brazil*[52]", 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". In conclusion cattle ranching is very diffused in Mato Grosso do Sul (and in Brazil as well), it is clearly established in the local economic culture but if managed in an irrational manner may cause serious repercussions on environment, land and climate.
Scenario 02: afforestation of the land within the Project boundary performed without being registered as the A/R CDM project activity.	The Scenario 02 is represented by **afforestation of the land** within the Project boundary performed without being registered as the A/R CDM project activity. Brazil has millions of hectares of planted with reforestation species as *Eucalyptus*, Pine and other species like Acacia (*Acacia mearnsii*), Seringueira (*Hevea spp*.), Teca (*Tectona grandis*), Paricá (*Schizolobium parahyba*), Araucária (*Araucaria angustifólia*) and Álamo (*Populus spp*.), used in the production of pulp, paper, architecture, 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 GHA, as they are natural carbon inventories [53]. 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 favorable 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;

52 https://www.cgee.org.br/documents/10195/734063/DesertificacaoWeb.pdf

53 http://www.florestal.gov.br/snif/recursos-florestais/as-florestas-plantadas

	▪ Shorter production cycles than in temperate climate countries (because of the rapid growth of the plants due to the longer photoperiod and to the abundance of the rain water typical of the humid tropical zones); ▪ Improved product consistency, facilitating all mining and industrial processes. 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 in Brasil as Permanent Preservation Areas (PPA) and Legal Reserves (LR). In Mato Grosso do Sul are present reforestation areas with commercial species and according to the IBGE (*Instituto Brasileiro de Geografia e Estatística*) in Mato Grosso do Sul the total area occupied by forest plantations is approximately 892,000 ha [54]. At state level exists the "*Plano Estadual de Desenvolvimento Sustentável de Florestas Plantadas – PEF/MS*[55] (State Plan for the Sustainable Development of Planted Forests) approved by the Government of Mato Grosso do Sul in 2008, aimed at providing the guidelines for the governmental authorities, businesses and other private entities of the forest sector development process (forestry and industry) in order to maximize the economic, social and environmental benefits. All the commercial plantations in Mato Grosso do Sul are regulated by national and regional laws and decrees presented in the § 1.5.2.1 and up to now doesn't exist other A/R CDM registered projects.

Outcome of Sub-step 1a:

- Cattle ranching.
- Forest plantations (without being registered as a carbon project).

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

According to the information in sub-step 1a all of these alternative land use scenarios are legal and enforced by mandatory applicable laws and regulations taking into account the enforcement in Brazil and Mato Grosso do Sul region.

54 http://g1.globo.com/mato-grosso-do-sul/noticia/2015/11/ms-tem-segunda-maior-area-com-eucalipto-no-pais-diz-ibge.html

55 PEF/MS - Plano Estadual de Florestas de Mato Grosso do Sul, Março 2009 – SEBRAE. http://m.sebrae.com.br/Sebrae/Portal%20Sebrae/UFs/MS/Estudos%20e%20Pesquisas/Plano%20Estadual%20para%20Desenvolvimento%20Economico%20de%20Florestas%20Plantadas.pdf

In summary the alternative land uses scenarios in the Project Area that are in compliance with all mandatory applicable legal and regulatory requirements are:

- Cattle farming: this activity is regulated by the following main laws: Law n° 11,443 - January 5, 2007[56], Law n° 12,727 - October 17, 2012[57], Law n° 12,805, April 29, 2013[58].

- Forest plantations (without being registered as a carbon project): all the laws that regulate the forest plantations in Mato Grosso do Sul are presented in the § 1.5.1.6.

Outcome of Sub-step 1b:

- Cattle ranching.

- Forest plantations (without being registered as a carbon project).

56 http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2007/Lei/L11443.htm

57 http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12727.htm

58 http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2013/lei/l12805.htm

3.5.3 STEP 2. Barrier analysis

This step serves to identify barriers and to assess which of the land use scenarios identified in the sub-step 1b are not prevented by these barriers.

Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenarios.

Investment barrier

The commercial forestry sector is not particularly attractive for professional investors because it has a business-model characterized by unfavorable elements:

- High concentration of costs in the first years of production;
- Long production cycle;
- Long wait for economic returns.

Because of this reason who decides to invest in this specific sector are the big enterprises that belong to the wood supplying chain and that have significant financial availability.

These entities also had and still have greater access to credit lines and incentives at the expense of small and medium-sized rural enterprises. This is exactly what happens in the Mato Grosso do Sul forestry market where nowadays 74% of planted forests is owned barely by 10 big companies[59]. Nowadays the small and medium forestry entrepreneurs are disadvantaged in working in a market become an oligopoly. In addition during the last ten years the forestry sector in Brasil has been facing several market issues that have slowed down the sector's growth. Who has been mostly suffering this changes have been the independent planted forest owners.

The Vinholi family, the Project Owner of the Fazenda the Fazenda Nascente do Luar Project is an independent forest owner that has experienced these barriers, in contrast to the big companies that control the market.

It is clear that a subsidiary of a multinational group may have different access to capital than a local SME company or an individual company as the Project owner case. In particularly today, all the sector, is facing barriers relating to markets, which could be summarized as follows:

- Domestic currency devaluation: in recent years, the devaluation of the Real brazilian currency (Diagram 08) has led to a significant increase in the cost of fertilizers and plant protection products, all these imported products paid in USD. Over the past 7 years, this has led to a 35% increase in fertilizer and other agricultural products costs.

59 PEF/MS - Plano Estadual de Florestas de Mato Grosso do Sul, Março 2009 – SEBRAE. http://m.sebrae.com.br/Sebrae/Portal%20Sebrae/UFs/MS/Estudos%20e%20Pesquisas/Plano%20Estadual%20para%20Desenvolvimento%20Economico%20de%20Florestas%20Plantadas.pdf

Diagram 08: USD/ BRAZILIAN REAL exchange rate (2010-2016 period[60]).

- Increase of the labour cost: in recent years the labour cost has increased as a result of the high inflation rate, as shown in Table 11 (on average by 5-6% per annum)[61].

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

Table 11: IPC inflation rates (2010-2016 period).

- Decrease of the timber sale price: the average sale price per cubic meter of timber has decreased over the last 7 years between 12 - 13% (Table 12). 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 fact that the market is controlled by few big companies as explained above.

Allocation (amounts 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 Chemical treatment	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 12: reduction in the forestry product prices in the 2010-2016 period (Instituto de Economia Agricola - IEA, 2016[62])

60 http://br.advfn.com/bolsa-de-valores/fx/USDBRL/Diagram

61 http://pt.global-rates.com/estatisticas-economicas/inflacao/indice-de-precos-ao-consumidor/ipc/Brazil.aspx

62 ISTITUTO DE ECONOMIA AGRICOLA – Governo do Estado do São Paulo – 'Mercados Florestais em São Paulo, Outubro 2016'. http://www.iea.sp.gov.br/out/florestas.php

▪ Decrease of marginality: this is due to the decrease of the timber sale price while the timber production costs (particularly the labour cost and fertilizer/manure costs) are increasing. 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.

▪ Lack of access to insurance mechanism to protect the future selling price of *Eucalyptus* timber: in Mato Grosso do Sul doesn't exist any insurance company that may cover the timber selling price risk.

▪ Lack of access to credit: 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, averaging around 20-25% per annum for short-term financing to support working capital (Table 13) [63].

		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 13: interest rates applied by brazilian credit institutes in 2016, per month and per year (Banco Do Brazil 2016).

With a so long production/financial cycle, this business itself, it is absolutely not bankable. The plantation business involves very high costs for the preparation of the land and for the plantation and the management of the forest.

The first revenue normally only began after the sale of the timber thus from the 7th year onwards. Usually a bank loan can reach a pre-amortization period of 2 years, therefore

63 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'

absolutely not suitable for this financial-productive cycle of 6/7 years). Even considering a bullet loan (very difficult to obtain within the bank's system), it would still impossible to repay the debt since in Brazil the annual interest rate it is about 25% and this activity has a low margin.

For these reasons, a bank can't take into consideration the possibility of financing a planting activity.Obtaining CERs, the Project Owner can overcome these barriers in a terms of an additional revenue stream that guarantee an adequate return on investment. Also the Project Proponent is remunerated by the Project Owner using these carbon credits.

Social barrier: lack of skilled and/or properly trained labour force

The labour force that inhabit the countryside that surround the Project Area do not have experience in reforestation. Reforestation activities are not part of the traditional economic culture of Mato Grosso do Sul, and institutional and technological support are lacking. Historically, as in many other regions of central Brazil, the principal economic activity has been the extensive, and often with subsistence characteristics, cattle farming. And in general, wood production in the entire Brazil is based on the exploitation of the abundant natural tropical forests.

Today reforestation is not yet consolidated in the country as an economically sustainable venture probably also caused by the difficulty in finding skilled workers. In this way the lack of technical knowledge of the labour force is the main cause of the underdevelopment of the silvicultural sector and represents a loss of great potential.

The local supply of labor with experience in forestry is difficult. Training is costly. Skilled labor must be paid with a higher wage, often to move them from other regions of the State or of the Country. The Project Owners recognize all these obstacles and has to overcome these social/technical barriers. Part of the capacity work could be financed by the income of the carbon credits.

Outcome of Step 2a:

List of barriers that may prevent one or more land use scenarios identified in the Step 1b:

- Investment barrier
- Social barrier

Sub-step 2b. Elimination of land use scenarios that are prevented by the identified barriers Reforestation without carbon revenues faces at least one of the identified barriers. Extensive cattle farming is the only land use alternative that does not face any of the identified barriers. Table 14 shows the List of land use scenarios and the list of the faced barriers.

Project alternative	Barrier Faced
Cattle Farming	No barriers faced

Forest plantations (without being registered as a carbon project).	▪ Investment barrier ▪ Social barrier

Table 14: Summary of barriers faced for alternative use scenarios.

Forest plantations without carbon revenues face the identified barriers. Degraded pasture by extensive livestock is the land use alternative does not face any of the identified barriers. Forest plantation with carbon revenues will alleviate the identified barriers.

Outcome of Sub-step 2b:

List of land use scenarios that are not prevented by any barrier:

- Cattle farming

Sub-step 2c. Determination of baseline scenario (if allowed by the barrier analysis)

Apply the following decision tree to the outcome of sub-step 2b:

Is forestation without being registered as an A/R CDM project activity included in the list of land use scenarios that are not prevented by any barrier? → NO

If NO then: Does the list contain only one land use scenario? → YES

if YES, then the remaining land use is the baseline scenario.

Continue with Step 4: Common practice test

Applying the decision tree presented in the "*Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project* (Version 01)" is concluded that:

- Reforestation without being registered as an A/R VCS Project activity is included in the list of land use scenarios that are prevented by the barriers listed.
- Cattle farming is the baseline scenario.

3.5.4 STEP 4. Common practice analysis

Brazil is the fifth country in the world for total area: over 8.500.000 square kilometers and composed of 26 federated states, each with very different characteristics. We have decided to take into consideration the State of Mato Grosso do Sul (where the project is actually implemented) because it has a multitude of similar characteristics within it that impact on the project but which differ or may differ from other federated states. The main characteristics taken into consideration are the following: climatic, pedological, legislative, rainfall, photoperiod, economic, financial, cost and skilled labor, market related to timber prices, cost of products due to duties that vary from state to state.

In Mato Grosso do Sul there are several reforestation projects but there is only one project registered as A/R VCS Project as evidenced by the VCS database: https://www.vcsprojectdatabase.org/#/project_details/1663 . This Project has been proposed by the same Project Proponente: CCC – Carbon Credits Consulting.

According to IBGE (2015)[64] in Mato Grosso do Sul the total occupied by planted forests is nearly 892,000 ha. And this represent the sixth state of Brazil's largest land area for forestry. The other state are: Minas Gerais (1.7 million hectares), Paraná (1.6 million hectares), Rio Grande do Sul (1.1 million hectares), Santa Catarina (1 million hectares) and São Paulo (1 million hectares).

Planted Forests today in MS represent just 2.5% of the total area of Mato Grosso do Sul.

In Mato Grosso do Sul forest plantations for industrial purposes are usually located in the areas where the industrial activities of pulp, particleboard and sawmill occur. These industries (and these "satellite" forest plantations) are principally located in the department of Tres Lagoas, 435 km far from Costa Rica Municipality where the Project was implemented (8 hours by truck) [65].

As shown in the *"Plano Estadual de Desenvolvimento Sustentável de Florestas Plantadas - PEF/MS, 2008"*, 54% of planted areas belong to a single company, the VCP - Vontorantim Celulose e Papel group, 20% of planted areas belongs to 9 other big companies and finally just 26% belongs to a large number of small and medium-sized producers.

So we can say that about 74% of Mato Grosso do Sul's commercial timber production is now controlled only by 10 big companies. These large forestry companies have close links with the timber processing industries and together they affect almost the entire market. Compared to medium and small timber producers these companies have great advantages, including lower costs due to economies of scale, greater contractual power and easy access to credit.

The main difference between these 2 categories (small-medium size forest and big forest) is the microeconomic prospective and internal context. The tactic of those forest owners (multinational company) is part of an strategic industrial plan which is called vertical integration of the supply chain (upstream integration in this specific case). The client of the forest and the forest owner itself (in the majority of the cases) is the same entity.

Small and medium timber producers (barely 26% according to *"Plano Estadual de Desenvolvimento Sustentável de Florestas Plantadas - PEF/MS, 2008")* are facing the investment and social barriers already widely described in the Sub-step 2a. The Project Owner is one of them.

The main similarities between these small-medium size projects are:

- be in the same State;

- have about the same dimensions;

- be held by small-medium agroforestry entrepreneurs (independent individual entity);

- strongly suffer from the market situation.

64 http://g1.globo.com/mato-grosso-do-sul/noticia/2015/11/ms-tem-segunda-maior-area-com-eucalipto-no-pais-diz-ibge.html

65 https://www.rotamapas.com.br/distancia-entre-tres-lagoas-e-costa-rica

The (small–medium) forest owner is often forced to sell the wood to figures that are lower than the cost generated to produce it. This happens because of a market dominated by a strong presence of a few and huge companies (described above) that control the market along the entire supply chain (from wood to the finished product). Because of this market situation that has become unsustainable for small forest producers, cases are increasingly frequent in which the forest is destroyed to restore cattle breeding (initial condition).

This is the reason why in the Costa Rica Municipality, where the Project is implemented, commercial reforestations are not commonly practiced.

The main difference between the project and similar ones is the possibility of balancing this serious obstacle thanks to the carbon project and the consequent sale of the VCUs, thus maintaining the forest throughout the project period. The same IMASUL (state forestry agency) is looking with particular attention and interest to this project because it could be a resource for small and medium forest projects in the state. VCUs could be the means to ensure the survival of these small projects and the development of new forest projects.

→ If Step 4 is satisfied, i.e. similar activities can be observed and essential distinctions between the proposed CDM project activity and similar activities cannot be made, then the proposed CDM project activity is not additional. Otherwise, the proposed A/R CDM project activity is not the baseline scenario and, hence, it is additional.

Conclusions:

- The Fazenda Nascente do Luar Project activity is not the common practice in the Municipality of Costa Rica.

- The proposed A/R Project activity is not the baseline scenario and it is additional.

By registering the Project under international standards it can generate that investors evaluate positively invest in forestry projects. Financial revenues from carbon sequestration will help investors to offset the risks of investing in the area and the high costs of accessing distant markets for the future sale of timber. The sale of certificates of emission reduction is part of the main sources of additional income to the Project. In addition, the Project seeks to promote the technical development of forestry plantations, by using methods and procedures that allow the well development of the planted area, the inclusion of native species in order to contribute to the sustainable use of the environment and of the landscape and the constant flow of revenues. Therefore, the current initiative will alleviate the common characteristics of the plantations explained before, in order to improve the forestry sector in the area.

3.6 Methodology Deviations

There are not methodology deviations in the current Project Description.

4. QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

According to the *A/R Large-scale Consolidated Methodology, Afforestation and Reforestation of lands except wetlands* (Version 02.0), the baseline estimation is given as follows (equation 1 of the AR-ACM0003 methodology):

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t}$$

where:

$\Delta C_{BSL,t}$	Baseline net GHG removals by sinks in year t; t CO2-e
$\Delta C_{TREE\_BSL,t}$	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 CO2-e
$\Delta C_{SHRUB\_BSL,t}$	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 CO2-e. No shrub is expected in the project activity, thus it is not accounted.
$\Delta C_{DW\_BSL,t}$	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 CO2-e.
$\Delta C_{LI\_BSL,t}$	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 project activities"; t CO2-e

See § **3.4 - Baseline Scenario** for a description of the pre-project conditions that fulfill the criteria presented in the A/R Methodological tool "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*" (Version 04.1) to consider the carbon stock in trees and shrubs in the baseline as zero (Section 5.11 and 5.12 of this tool).

$\Delta C_{TREE\_BSL,t}$ can be accounted as zero due to all of the following conditions:

- The Baseline trees are neither harvested, nor cleared, nor removed throughout the crediting period of the Project activity;
- The Baseline 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;
- The Baseline trees are not inventoried along with the project trees in monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the Project activity.

$\Delta C_{SHRUB\_BSL,t}$ conservatively is assumed to be zero in the baseline scenario, due to the fact that changes in carbon stock of above and below ground biomass of non-tree vegetation of the degraded land in baseline scenario is not possible.

Also $\Delta C_{DW\_BSL,t}$ and $\Delta C_{LI\_BSL,t}$ are assumed to be zero due to the fact that the baseline scenario was degraded pasture, where fire was often used, which did not allow accumulation of dead wood and litter.

That is why the estimated baseline emissions or removals are considered insignificant and hence accounted as zero.

4.2 Project Emissions

Whereas in the baseline scenario burning practice was widely used to burn vegetable litter, to deforest, to stimulate the regrowth of the pasture when become hard and fibrous, since January 2015 no Project activity included use of fire.

Increase in non-CO2 GHG emissions within the Project boundary as a result of the implementation of the A/R VCS project activity, in year t. is estimated in the Annex 31 "*Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"* Version 04.0.0".

Considering equation 1 of this tool:

$$GHG_{E,t} = GHG_{SPF,t} + GHG_{FMF,t} + GHG_{FF,t}$$

where:

$GHG_{E,t}$	=	Emission of non-CO_2 GHGs resulting from burning of biomass and forest fires within the project boundary in year t; t CO_2-e
$GHG_{SPF,t}$	=	Emission of non-CO2 GHGs resulting from use of fire in site preparation in year t; t CO2-e
$GHG_{FMF,t}$	=	Emission of non-CO2 GHGs resulting from use of fire to clear the land of harvest residue prior to replanting of the land or other forest management. in year t; t CO2-e
$GHG_{FF,t}$	=	Emission of non-CO2 GHGs resulting from fire, in year t; t CO2-e.
t	=	1.2.3. … years counted from the start of the project activity

It can be stated that:

- Fire has not been used for the preparation of the Project area and has been used in the area at least once during the period of ten years preceding the start of the A/R CDM Project activity. Thus $GHG_{SPF,t}$ = 0.
- Project lifetime considers activities of harvesting but does not consider the use of fire to clear the land of harvest residue or for other forest management. Thus $GHG_{FMF,t}$ = 0.
- Emission of non-CO GHGs resulting from fire are insignificant. Thus $GHG_{FF,t}$ = 0.

Thus Project Emissions ($GHG_{E,t}$) are accounted as zero.

4.3 Leakage

The Project activity does not expect any displacement of agricultural activities present in the Project Zone before the beginning of the Project, thus leakage emissions are considered insignificant and hence accounted as zero. Whereas in the baseline scenario burning practice was widely used to burn vegetable litter, to deforest and to stimulate the regrowth of the pasture when become hard and fibrous, since April 2015 no Project activity included use of fire.

Increase in non-CO2 GHG emissions within the Project boundary as a result of the implementation of the A/R VCS project activity, in year t. is estimated in the Annex 31 "*Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"* Version 04.0.0".

Considering equation 1 of this tool:

$$GHG_{E,t} = GHG_{SPF,t} + GHG_{FMF,t} + GHG_{FF,t}$$

where:

$GHG_{E,t}$	=	Emission of non-CO_2 GHGs resulting from burning of biomass and forest fires within the project boundary in year t; t CO_2-e
$GHG_{SPF,t}$	=	Emission of non-CO2 GHGs resulting from use of fire in site preparation in year t; t CO2-e
$GHG_{FMF,t}$	=	Emission of non-CO2 GHGs resulting from use of fire to clear the land of harvest residue prior to replanting of the land or other forest management. in year t; t CO2-e
$GHG_{FF,t}$	=	Emission of non-CO2 GHGs resulting from fire, in year t; t CO2-e.
t	=	1.2.3. … years counted from the start of the project activity

It can be stated that:

- Fire has not been used for the preparation of the Project area and has been used in the area at least once during the period of ten years preceding the start of the A/R CDM Project activity. Thus $GHG_{SPF,t}$ = 0.
- Project lifetime considers activities of harvesting but does not consider the use of fire to clear the land of harvest residue or for other forest management. Thus $GHG_{FMF,t}$ = 0.
- Emission of non-CO GHGs resulting from fire are insignificant. Thus $GHG_{FF,t}$ = 0.

Thus Project Emissions ($GHG_{E,t}$) are accounted as zero.

Starting from March 2010 (during this month began the first plantation of the farm) the cattle were gradually sold as they reached maturity for the marketing of the meat. Since April 2015, month of the beginning of the Project until today there are no cattle in the farm, except several milk cows owned by the farm keeper for his self-consumption. Because of that, no leakage management zone was identified.

Also market leakage and activity-shifting leakage is negligible (in the farm were bred 600-800 bovines, that represent the 0,0004% of the brazilian herd, composed by more than 200 million cows).

4.4 Net GHG Emission Reductions and Removals

Stratification

The stratification was defined according to the A/R Large-scale Consolidated Methodology: "*Afforestation and reforestation of lands except wetlands*", Version 02.0, Section 5.2.11.b: "*For actual net GHG removals by sinks the stratification for ex ante estimations is based on the project planting/management plan"* (Table 15).

Stratum	Área (Ha)	Starting Crediting Year
Stratum 1	**139.3741**	**2015**
Stratum 1	**203.4032**	**2015**
Total Area	**342.7773**	

Table 15: Stratification based on Project activities.

Estimating carbon stock in trees at a point of time

To estimate the carbon stock in tree biomass at a point of time, the following tool was used: "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*", AR-TOOL14 (Version 04.1). According to Section 8.2 of this tool, this method is used for ex-ante estimation (projection) of carbon stock in tree biomass.

Step 1: Tree biomass estimation

An equation for *Eucalyptus uro-grandis* derived from age has not been found. The equations available for this species depend on allometric parameters and there is not an available database with allometric parameters that allow us to adjust a time equation to estimate the ex-ante carbon stocks.

Considering this, the annual increment in volume of wood suitable for industrial processing value (I_V) of **36.25 $m^3ha^{-1}year^{-1}$** (trunk biomass volume) was used in combination with other parameters derived from ANNEX 3A.1 "Biomass Default Tables for Section 3.2 Forest Land" of IPCC Good Practice Guidance for LULUCF, to find the total biomass per hectare (Table 16).

Parameter	Value	Source
Annual increment in volume of wood, I_V ($m^3ha^{-1}year^{-1}$)	**36.25**	Source: **IPCC – TABLE 3A.7** of ANNEX 3A.1 "Biomass Default Tables for Section 3.2 Forest Land" of IPCC Good Practice Guidance for LULUCF. **Mean value between I_V values of *E. urophylla* and *E. grandis***
Wood density, D	**0.51**	Source: **IPCC – TABLE 3A.9-2** of ANNEX 3A.1 "Biomass Default Tables for Section 3.2 Forest Land" of IPCC Good Practice Guidance for LULUCF
Biomass Expansion Factor, BEF	**1.50**	Source: **IPCC – TABLE 3A.10** of ANNEX 3A.1 "Biomass Default Tables for Section 3.2 Forest Land" of IPCC Good
Root-shoot-ratio, R	**0.35**	Source: **IPCC – TABLE 3A.8** of ANNEX 3A.1 "Biomass Default Tables for Section 3.2 Forest Land" of IPCC Good Practice Guidance for LULUCF

Table 16: Parameters used to estimate the total biomass (below+above) per hectare per year.

The I_V value used of **36.25 $m^3ha^{-1}year^{-1}$** is the mean value between *E. urophylla* and *E. grandis* I_V values derived from Table 3A.7 of ANNEX 3A.1 "Biomass Default Tables for Section 3.2 Forest Land" of IPCC Good Practice Guidance for LULUCF.

To calculate the above and below-ground biomass we used the equation 3.2.5 of the IPCC "Good Practice Guidance for Land Use, Land-Use Change and Forestry" where G_{TOTAL} is the expansion of annual increment rate of above-ground biomass (GW) to include its below ground part, involving multiplication by the ratio of below-ground biomass to above-ground biomass (often called the root-to-shoot ratio (R)) that applies to increments. This may be achieved directly where GW data are available as in the case of naturally regenerated forests or broad categories of plantation. In case GW data are not available, the increment in volume can be used with biomass expansion factor for conversion of annual net increment to aboveground biomass increment. Equation 3.2.5 shows the relationship:

EQUATION 3.2.5
AVERAGE ANNUAL INCREMENT IN BIOMASS

$G_{TOTAL} = G_W \bullet (1 + R)$ **(A)** In case aboveground biomass increment (dry matter) data are used directly. Otherwise G_W is estimated using equation B or its equivalent

$G_W = I_V \bullet D \bullet BEF_1$ **(B)** In case net volume increment data are used to estimate G_W.

where:

G_{TOTAL} = average annual biomass increment above and below-ground, tonnes d.m. ha^{-1} yr^{-1} ;

G_W = average annual aboveground biomass increment, tonnes d.m. ha^{-1} yr^{-1} ;

R = root-to-shoot ratio appropriate to increments, dimensionless;

I_V = average annual net increment in volume suitable for industrial processing, m^3 ha^{-1} yr^{-1};

D = basic wood density, tonnes d.m. m^{-3} ;

BEF_1 = biomass expansion factor for conversion of annual net increment (including bark) to aboveground tree biomass increment, dimensionless.

In the Table 17 follows the calculation of average annual biomass increments above and below-ground of *E. urophylla* and *E. grandis* and the mean value between them that was used to calculate the carbon stock of the Project (100% of Project plantation is composed by *E. uro-grandis*, a hybrid between *E. urophylla* and *E. grandis*).

Source	Annotations	Increment wood vol (m^3/ha/year) I_v	Wood density D	Biomass Exp Fact BEF_1	Incr. biomass ABOVE (ton/ha/year) $G_w = I_v \bullet D \bullet BEF_1$	Root-shoot ratio R	Incr. Biomass ABOVE+BELOW (ton/ha/year) $G_{TOTAL} = G_w \bullet (1 + R)$
IPCC - TABLE 3A.7	*E. urophylla*	40.00	0.51	1.50	30.60	0.35	41.31
IPCC - TABLE 3A.7	*E. grandis*	32.50	0.51	1.50	24.86	0.35	33.56
PDD mean value between *E. urophylla* and *E. grandis*		**36.25**	**0.51**	**1.50**	27.73	**0.35**	**37.44**

Table 17: Average annual biomass increments above and below-ground of *E. urophylla* and *E. grandis* and the mean value between them.

Step 2: Mean tree biomass estimation

The estimation of the mean tree biomass per hectare in the tree biomass estimation strata was calculated according to the equation 13 of the AR-TOOL14:

$$B_{tree} = A \; x \; b_{tree}$$

where A is the area of each stratum and b_{tree} is the mean tree biomass per hectare, that correspond to G_{TOTAL} calculated above.

Step 3: Mean tree carbon stock in terms of CO_2e

The estimation of the mean carbon stock in trees within the tree biomass estimation strata was calculated according to the equation 12 of the AR-TOOL14:

$$C_{TREE} = \frac{44}{12} \times CF_{TREE} \times B_{TREE}$$

Step 4: SOC - Soil Organic Carbon

Estimations of soil organic carbon (SOC) stocks 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*", Version 1.1.0". As suggested by the tool, 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 Project meets the applicability conditions of this tool in the area managed with *Eucalyptus*: 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 (equation 1 of the tool):

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

$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R CDM Project activity in stratum i of the areas of land; t C 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 ñ normally forest) by climate region and soil type applicable to stratum i of the areas of land; t C 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

i = 1. 2. 3. … strata of areas of land; dimensionless

The values of $SOC_{REF.} . f_{LU.ii}. f_{MG.}. f_{IN.ii}$ are presented in the Table 18.

Parameter	Symbol	Value	Source: SOC estimation tool
Reference SOC (tC/ha)	$SOC_{REF,i}$	47	Table 1 of the tool; Tropical moist, Soils with low activity clay (LAC).
Land use factor	$f_{LU,i}$	1	Table 4 of the tool; All permanent grassland.
Management factor	$f_{MG,i}$	0.70 (Tropical)	Table 4 of the tool; Lands are identified as degraded lands.
Input factor	$f_{IN,i}$	1.11	Table 4 of the tool; Lands are identified as degraded lands.
SOC at the beginning of the Project activity	$SOC_{INITIAL,i}$	32,9	Calculated, with Eq. Above described

Table 18: Parameters used for the estimation of the soil organic carbon (SOC).

Then, the rate of change in SOC stock in Project scenario until the steady-state is reached is estimated as follows (equation 6 of the tool):

$$dSOC_{t,i} = \frac{SOC_{REF,i} - (SOC_{INITIAL,i} - SOC_{LOSS,i})}{20\ years} \quad for\ t_{PREP,i} < t < t_{PREP,i} + 20$$

where:

$dSOC_{t,i}$ = The rate of change in SOC stock in stratum i of the areas of land. in year t; t C ha^{-1} $yr^{-1.}$

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

$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R CDM Project activity in stratum i of the areas of land; t C $ha^{-1.}$

$t_{PREP,i}$ = The year in which first soil disturbance takes place in stratum i of the areas of land.

i = 1. 2. 3. … strata of areas of land; dimensionless.

t = 1. 2. 3. … years elapsed since the start of the A/R CDM Project activity.

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 application of these equations results in an estimated rate of **0.71** t C ha yr^{-1} in soil organic carbon.

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.

$$\Delta SOC_{AL,t} = \frac{44}{12} \, x \, \sum_{i} A_i \, x \, dSOC_{t,i} \, x \, 1year$$

where:

$\Delta SOC_{AL,t} =$ = Change in SOC stock in areas of land meeting the applicability conditions of this tool. in year t; t CO_2-e

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

$dSOC_{t,i}$ = The rate of change in SOC stocks in stratum i of the areas of land; t C ha^{-1} yr^{-1}

i = 1. 2. 3. … strata of areas of land; dimensionless

Step 5: Dead Wood

Estimations were done in accordance with the AR-TOOL12 "*Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities*", Version 03.0". Values of the conservative default-factors expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass was selected according to the guidance provided in the methodological tool.

Project Proponent won't 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, using the default values presented in:

$$C_{DW,i,t} = C_{TREE,i,t} \, x \, DF_{DW}$$

where:

$C_{DW,i,t}$ = Carbon stock in dead wood in stratum i at a given point of time in year t; t CO_2e

$C_{TREE,i,t}$ = Carbon stock in trees biomass in stratum i at a point of time in year t. as calculated in the tool "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*"; t CO_2e

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

i = 1. 2. 3. … biomass estimation strata within the Project boundary

t = 1. 2. 3. … years elapsed since the start of the A/R Project activity

Step 6: 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"* (Version 03.0). Values of the conservative default-factors expressing carbon stock in litter as a percentage of carbon stock in tree biomass was selected according to the guidance provided in the methodological tool.

If the Project proponent will not to make sampling based measurements for estimation of C stock, they will use the default method described in tool.

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, using the default values presented in:

$$C_{LI,i,t} = C_{TREE,i,t} \, x \, DF_{LI}$$

where:

$C_{LI,i,t}$ = Carbon stock in litter in stratum i at a given point of time in year t; t CO_2e.

$C_{TREE,i,t}$ = Carbon stock in trees biomass in stratum i at a point of time in year t. as calculated in tool "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*"; t CO_2e.

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

i = 1. 2. 3. … biomass estimation strata within the Project boundary.

t = 1. 2. 3. … years elapsed since the start of the A/R Project activity.

Parameter	Description	Value	Comments
DF_{DW}	Conservative default factor expressing carbon stock in **dead wood** as a DW percentage of carbon stock in tree biomass.	**1%**	Biome: tropical Elevation: <2,000m Precipitation: 1,000-1,600 mm·yr^{-1}
DF_{LI}	Default factor for the relationship between carbon stock in **litter** and carbon stock in living trees.	**1%**	Biome: tropical Elevation: <2,000m Precipitation: 1,000-1,600 mm·yr^{-1}

Table 19: Conservative default factor expressing carbon stock in dead wood and litter.

Step 7: Change in the carbon stocks in Project

Change in the carbon stocks in Project $\Delta C_{P,t}$, occurring in the selected carbon pools in year t were calculated according to the equation 3 of AR-ACM0003 methodology:

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

where:

$\Delta C_{TREE\_PROJ,t}$	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

Step 8: Actual net GHG removals by sinks

The actual net GHG removals by sinks are calculated using equation 2 of the AR-ACM0003 methodology 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 CO2-e.
$\Delta C_{P,t}$	Change in the carbon stocks in project, occurring in the selected carbon pools, in year t; t CO2-e.
$GHG_{E,t}$	Increase in non-CO2 GHG emissions within the project boundary because of the implementation of the A/R CDM project activity, in year t, as estimated in the tool "*Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity*"; t CO2-e.

Since the Project Emissions are accounted to zero (see § 3.3), $\Delta C_{ACTUAL,t} = \Delta C_{P,t}$.

Step 9: Net Anthropogenic GHG removals by sinks

According to the equation 5 of the AR-ACM0003 methodology, the net anthropogenic GHG removals by sinks shall be calculated as follows:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$$

where:

$\Delta C_{AR-CDM,t}$	**Net Anthropogenic** GHG removals by sinks, in year *t*; t CO2-e
$\Delta C_{ACTUAL,t}$	**Actual** net GHG removals by sinks, in year *t*; t CO2-e
$\Delta C_{BSL,t}$	**Baseline** net GHG removals by sinks, in year *t*; t CO2-e
LK_t	**Leakage** GHG emissions, in year *t*; t CO2-e

Given that $\Delta C_{BSL,t}$ can be considered as zero according to § 3.2 and LK_t can be considered as zero according to § 3.4, then $\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t}$.

The period over which the long-term average GHG benefit is calculated is 30 years.

The total GHG benefit, calculated as the sum of stock changes along the 30-year period, is **683,920.92 tCO2e** (Table 20), with an average annual GHG emission of **22,797.36 tCO2e.**

Year	Estimated **Baseline** emissions or removals (tCO2e)	Estimated **Actual Project** emissions or removals (tCO2e)	Estimated **Leakage** emissions (tCO2e)	Estimated **Net Anthropogenic** GHG emission reductions or removals (tCO2e)
	$\Delta C_{BSL,t}$	$\Delta C_{ACTUAL,t}$	LK_t	$\Delta C_{AR-CDM,t}$
2015	0,00	**22,917.46**	0,00	**22,917.46**
2016	0,00	**22,917.46**	0,00	**22,917.46**
2017	0,00	**22,917.46**	0,00	**22,917.46**
2018	0,00	**22,917.46**	0,00	**22,917.46**
2019	0,00	**22,917.46**	0,00	**22,917.46**
2020	0,00	**22,917.46**	0,00	**22,917.46**
2021	0,00	**22,917.46**	0,00	**22,917.46**
2022	0,00	**22,917.46**	0,00	**22,917.46**
2023	0,00	**22,917.46**	0,00	**22,917.46**
2024	0,00	**22,917.46**	0,00	**22,917.46**
2025	0,00	**22,917.46**	0,00	**22,917.46**
2026	0,00	**22,917.46**	0,00	**22,917.46**
2027	0,00	**22,917.46**	0,00	**22,917.46**
2028	0,00	**22,917.46**	0,00	**22,917.46**
2029	0,00	**22,917.46**	0,00	**22,917.46**
2030	0,00	**22,917.46**	0,00	**22,917.46**
2031	0,00	**22,917.46**	0,00	**22,917.46**
2032	0,00	**22,917.46**	0,00	**22,917.46**
2033	0,00	**22,917.46**	0,00	**22,917.46**
2034	0,00	**22,917.46**	0,00	**22,917.46**
2035	0,00	**22,557.18**	0,00	**22,557.18**
2036	0,00	**22,557.18**	0,00	**22,557.18**
2037	0,00	**22,557.18**	0,00	**22,557.18**
2038	0,00	**22,557.18**	0,00	**22,557.18**
2039	0,00	**22,557.18**	0,00	**22,557.18**
2040	0,00	**22,557.18**	0,00	**22,557.18**
2041	0,00	**22,557.18**	0,00	**22,557.18**
2042	0,00	**22,557.18**	0,00	**22,557.18**
2043	0,00	**22,557.18**	0,00	**22,557.18**
2044	0,00	**22,557.18**	0,00	**22,557.18**
Total:				**683,920.92**

Table 20: Estimated Net Anthropogenic GHG emission reductions or removals (tCO2e) during the 30-years long Crediting Period.

Step 10: Buffer calculation and Annual VCUs

The number of GHG credits issued to the Project is determined by subtracting out the buffer credits from the net GHG emission reductions or removals (including leakage) associated with the Project.

The buffer credits are calculated by multiplying the non-permanence risk rating (as determined by the AFOLU Non-Permanence Risk Tool) times the change in carbon stocks.

The Non-Permanence Risk rating of the Project is derived from the risk report calculation (Appendix 08 and 09) and corresponds to **12,75%.** The number of GHG credits issued to the Project, considering the buffer credits, is calculated iin the Appendix 10 –Ex-ante ERs Estimation.

Considering the buffer calculation, the total number of VCUs is **596,721.00** in 30 years.

The number of buffer VCUs to be deposited in the AFOLU pooled buffer account is **87,199.92.**

5. MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	**Mean annual Increment in Volume (I_V)**
Data unit	$m^3ha^{-1}yr^{-1}$
Description	It is the average annual net increment in volume suitable for industrial processing and itis used to calculate the average annual above-ground biomass increment (Gw) with the Equation 3.2.5 of IPCC "*Good Practice Guidance for LULUCF*".
Source of data	Table 3A.7 of ANNEX 3A.1 of IPCC "*Good Practice Guidance for LULUCF*".
Value applied	**36,25** This is the mean value between I_V values of *E. urophylla* and *E. grandis.*
Justification of choice of data or description of measurement methods and procedures applied	As the forest plantation has not been measured yet, data reported in the literature was used for estimation of GHG removals. Once the monitoring is developed this value will be replaced for the actual growth of the forest.
Purpose of data	Estimation of GHG Emission Reductions and Removals.
Comments	

Data Unit / Parameter:	**Wood density (D)**
Data unit:	t d.m./m3
Description:	Wood density is used to convert the commercial tree volume into tree biomass.
Source of data:	Table 3A.9-2 of ANNEX 3A.1 of IPCC "*Good Practice Guidance for LULUCF*".
Value applied:	**0.51**
Justification of choice of data or description of measurement methods and procedures applied:	Used the value of *Eucalyptus robusta* in Latin America (the only species os *Eucalyptus* reported in the table).
Purpose of data:	Estimation of GHG Emission Reductions and Removals.
Comments:	

Data / Parameter	**Biomass Expansion Factor (BEF_1)**
Data unit	Dimensionless
Description	Ratio of aboveground oven-dry biomass to oven-dry biomass of the steam.
Source of data	Table 3A.10 of ANNEX 3A.1 of IPCC "*Good Practice Guidance for LULUCF*".
Value applied	**1.5**
Justification of choice of data or description of measurement methods and procedures applied	The above-ground tree biomass is calculated using the BEF_1 in connection to Increment in Volume data using Equation 3.2.5 of the IPCC "*Good Practice Guidance for LULUCF*". The BEF_1 value for Tropical Climatic Zone and Broadleaf Forest Type was used.
Purpose of data	Estimation of GHG Emission Reductions and Removals.
Comments	

Data / Parameter	**Root-Shoot-Ratio (R)**
Data unit	Dimensionless
Description	Ratio of the weight of the roots to the weight of the top of the tree. Used for below-ground tree biomass estimation.
Source of data	Table 3A.8 of ANNEX 3A.1 of IPCC "*Good Practice Guidance for LULUCF*".
Value applied	**0.35**
Justification of choice of data or description of measurement methods and procedures applied	Below-ground biomass is usually estimated with this factor as below-ground sampling is destructive and expensive. The mean value for *Eucalyptus* plantations was used for stands with above-ground biomass, ranging from 50 to 150 t/ha.
Purpose of data	Estimation of GHG Emission Reductions and Removals
Comments	

Data / Parameter	**Carbon Fraction (CF)**
Data unit	tC/t d.m.
Description	Biomass proportion corresponding to carbon. CF is used to convert biomass to carbon.
Source of data	AR-TOOL 14 "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*", Version 04.2.
Value applied	**0.47**
Justification of choice of data or description of measurement methods and procedures applied	The default value from the AR-TOOL 14 was used.
Purpose of data	Estimation of GHG Emission Reductions and Removals
Comments	

Data / Parameter	**CO_2e**
Data unit	tCO_2/tC
Description	Factor applied to convert the tree carbon sequestered to tree CO_2e sequestered.
Source of data	IPCC default value.
Value applied	**44/12**
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value.
Purpose of data	Estimation of GHG Emission Reductions and Removals
Comments	

Data / Parameter	**Reference SOC ($SOC_{REF,i}$)**
Data unit	t C ha^{-1}
Description	Reference Soil Organic Carbon 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*", Version 01.1.0.
Value applied	**47**
Justification of choice of data or description of measurement methods and procedures applied	Default reference of $SOC_{REF,i}$ for Tropical Moist Climate Region and Soils with LAC (Low Activity Clay).
Purpose of data	Estimation of GHG Emission Reductions and Removals
Comments	

Data / Parameter	**Land Use Factor ($f_{LU,i}$)**
Data unit	Dimensionless
Description	Relative stock change factor for baseline land use in stratum i of the areas of land.
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*", Version 01.1.0.
Value applied	**1**
Justification of choice of data or description of measurement methods and procedures applied	Default reference of f $f_{LU,i}$ assigned to all permanent grasslands.
Purpose of data	Estimation of GHG Emission Reductions and Removals
Comments	

Data / Parameter	**Management Factor ($f_{MG,i}$)**
Data unit	Dimensionless
Description	Relative stock change factor for baseline management regime in stratum i of the areas of land;
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*", Version 01.1.0.
Value applied	**0.70**
Justification of choice of data or description of measurement methods and procedures applied	Default reference of $f_{MG,i}$ assigned to lands severely degraded.
Purpose of data	Estimation of GHG Emission Reductions and Removals
Comments	

Data / Parameter	**Input Factor ($f_{IN,i}$)**
Data unit	Dimensionless
Description	Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum i.
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*", Version 01.1.0.
Value applied	**1**
Justification of choice of data or description of measurement methods and procedures applied	Default reference of $f_{IN,i}$ assigned to all grasslands without input of fertilizers.
Purpose of data	Estimation of GHG Emission Reductions and Removals
Comments	

Data / 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	AR-TOOL12 "*Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities,* Version 03.0, Section 8.
Value applied	**1**
Justification of choice of data or description of measurement methods and procedures applied	Default value for Tropical Biome, Elevation < 2000 m, Precipitation 1000-1600 mm yr^{-1}.
Purpose of data	Estimation of GHG Emission Reductions and Removals
Comments	

Data / 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	AR-TOOL12 "*Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities",* Version 03.0, Section 8.
Value applied	**1**
Justification of choice of data or description of measurement methods and procedures applied	Default value for Tropical Biome, elevation < 2000 m, precipitation 1000-1600 mm yr^{-1}.
Purpose of data	Estimation of GHG Emission Reductions and Removals.
Comments	

Data / Parameter	**A**
Data unit	ha
Description	Project Area
Source of data	Monitoring of strata and stand boundaries, using Geographical Information Systems (GIS).
Value applied	**1,055.66**
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of data	Definition of Project spatial boundaries, estimation of GHG Emission Reductions and Removals.
Comments	

Data / Parameter	A_i
Data unit	ha
Description	Area of stratum i
Source of data	Projected planting areas by stratum and specie (see Table 31)
Value applied	see Table 31
Justification of choice of data or description of measurement methods and procedures applied	The stratification for *ex post* estimations is based on the actual implementation of the project planting/management plan. It may even be necessary to evaluate the possibility of re-stratifying the project boundary, according to the development of the stand models. It would enable the merging of several strata in order to optimize the costs and improving the outcomes in forest inventories. New strata could be defined too.
Purpose of data	Estimation of GHG Emission Reductions and Removals.
Comments	

5.2 Data and Parameters Monitored

Data / Parameter	**A**
Data unit	ha
Description	Project Area (planted area).
Source of data	Survey databases of each polygon that is part of the Project and is under the control of the Project participants.
Description of measurement methods and procedures to be applied	Field measurement: the area shall be delineated either on the ground, using GPS or from geo-referenced remote sensing data.
Frequency of monitoring/recording	At the beginning of site preparation, in final establishment of the Project and each time a verification is conducted.
Value applied	**1,055.66**
Monitoring equipment	GPS equipment (precision 1- 5 m) 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	Measurement
Comments	

Data / Parameter	A_i
Data unit	ha
Description	Area of stratum i
Source of data	Monitoring of strata and stand boundaries is done employing Geographical Information Systems (GIS) allowing the integration of 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 geo-referenced remote sensing data.

Frequency of monitoring/recording	Each time a verification is conducted.
Value applied	See Table 31
Monitoring equipment	GPS equipment (precision 1- 5 m) 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. Calculation of Project emissions.
Purpose of data	Calculation of Project emissions.
Calculation method	Measurement
Comments	The stratification for ex post estimations is based on the actual implementation of the project planting/management plan. It may even be necessary to evaluate the possibility of restratification of the project boundary, according to the development of the stand models, as it would enable the merging of several strata in order to optimize the costs and improving the outcomes in forest inventories.

Data / Parameter	$A_{p.i}$
Data unit	m²
Description	Area of sample plot in stratum I.
Source of data	Field measurement
Description of measurement methods and procedures to be applied	Standard Operating Procedures (SOPs) prescribed under the 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 the 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	**n**
Data unit	Dimensionless
Description	Number of plots to be established in the Project area
Source of data	Estimation
Description of measurement methods and procedures to be applied	This value will be estimated based on a pre-sampling developed in the project area before monitoring.
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.
Purpose of data	Estimate the number of plots needed for complying with a sampling error less than 15%.
Calculation method	See § 7.1.1 - Obtaining the data (Number of sample plots)
Comments	

Data / Parameter	**n_h**
Data unit	Dimensionless
Description	Number of plots to be established in each stratum
Source of data	Estimation
Description of measurement methods and procedures to be applied	This value will be estimated using the total number of plots and the area of each stratum
Frequency of	Each time a verification is conducted.

monitoring/recording	
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.
Purpose of data	Estimation of the number of plots needed for each stratum for complying with a sampling error less than 15%.
Calculation method	See § 7.1.1 - Obtaining the data (Number of sample plots)
Comments	

Data / Parameter	**Plot Location**
Data unit	Lat/Long
Description	Localization each sampling plots
Source of data	Data field sampling
Description of measurement methods and procedures to be applied	Measured with GPS
Frequency of monitoring/recording	Each time a verification is conducted
Value applied	
Monitoring equipment	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 from 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 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	§ 7.1.1 - Obtaining the data (Tree (DBH) measurement) provides the detailed procedures to be applied.

Data / Parameter	**H**
Data unit	m
Description	Total height of trees
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	Clinometer, measuring tape.
QA/QC procedures to be applied	Persons involved in the field measurement work should be fully trained in 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	See monitoring plan
Comments	§ 7.1.1 - Obtaining the data (Tree height measurement) provides the detailed procedures to be applied.

Data / Parameter	**T**
Data unit	year
Description	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	See the monitoring plan
Frequency of monitoring/recording	Each time a verification is conducted.
Value applied	Ex-post
Monitoring equipment	NA
QA/QC procedures to be applied	NA
Purpose of data	Calculation of Project emissions
Calculation method	T= t2-t1
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.

5.3 Monitoring Plan

5.3.1 Operational And Management Structure

The operational structure and responsibilities for the Project is divided into three basic departments: General management, Technical management, and Operators (Table 21).

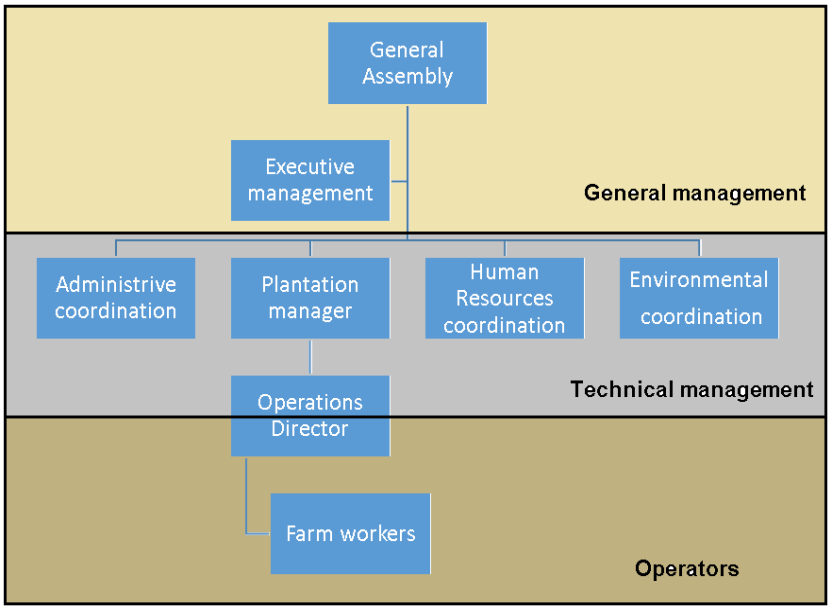


Table 21: Operational and Management Structure.

For monitoring purposes, the **plantation manager** and **human resources coordinator** will be in charge of contracting field crews that will carry out the data collecting for all the parameters mentioned in § 5.2 - Data and Parameters Monitored. The first phase of data collection constitutes the establishment of field crews. For these tasks, locally available experienced staff will be preferred. The Project Proponent is committed to act responsibly to guarantee the quality of the silvicultural activities performed in the field, and also that the environmental, industrial safety and occupational health standards are in line with 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, forestry technicians and farm 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.

Non-qualified staff: workers engaged to unskilled activities that do not require special skills or training to perform their duties. The company will prioritize the inhabitants of the area where the Project is developed.

Once the personal is contracted for monitoring the Project activities, the data collecting process will start. For this component of the Project, permanent plots will be the base of data collecting. Data will be collected by the field crews that will be composed by at least four members. Additional people may be included to improve performance of the field crews when conditions require greater resources. The crew will be composed by three forestry experts (qualified staff), one of them being the crew leader, and one additional person (qualified or not) that is familiarized with the local site, routes, strata, etc. The responsibilities for each crew member are summarized in Table 22.

Crew member	Responsibilities
Forestry expert (crew leader)	Organizing all the phases of the fieldwork, from the preparation to the data collection. This includes: preparing the fieldwork by carrying out bibliographic research, preparing field forms and maps, plan the work for the crew, administer the location of plots, ensure that field forms are properly filled in and that collected data is reliable, organize meetings after fieldwork in order to sum up daily activities, and organize working safety plan. When needed, crew leader will be in charge of training the crew for guarantying the accuracy of the data collection. Additionally, he/she will have to contact and maintain good relationship with the plantation manager and overview the progress achieved in the fieldwork.
Forestry expert (assistant of the crew leader)	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 guide workers.
Forestry expert	Measure DBH, height
Local person	Help to measure distances, facilitate access and visibility to technicians and inform about access to the strata.

Table 22: Crew members' responsibilities.

It is important to emphasize that before the crews start the collecting data process, the crew leader, together with the plantation manager, must prepare field work (bibliographic research, contacts with farm workers, preparation of the field forms, preparation of the maps and access itinerary, field equipment preparation, etc.). In this phase, it is expected that the crew leaders train the field crews, organize and plan mobilization and the preparation of necessary resources and equipment, such as vehicles, maps with plots location, and prepare and print valid field forms (the form is described in the § 5.3.3 - Record of the data.

Regarding this form, some information will be filled-in before going out in the field: sections for identification of the strata and plots (header of each page), general information related to strata location and coordinates of the plot. The crew leader must ensure that enough forms are available to carry out the planned field data collection. Regarding the maps, they must be prepared to help the orientation in the field, so it must contain all the project strata and the location of plots for each one of the strata. 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 must be entered into the GPS receiver.

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

Field equipment per crew will include:

- Compass (360°);
- GPS receiver (Geographic Positioning System) and extra batteries;
- 2 self-rolling measuring tapes 10-30 m (metric);
- 2 diameter tapes or caliper (metric);
- A clinometer;
- 50m measuring tape or wire rope of 50 meters, marked every 5 meters;
- Waterproof bags to protect measurement instruments and forms;
- Mobile phone;
- 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.
- Yellow paint and brushes.

5.3.2 Methods for measuring

Only above-ground and below-ground biomass of trees established in the Project will be monitored. Therefore, only individual growth of each tree in the plots will be monitored. This value shall be estimated from the increase in the determined measured stem and height in each monitoring.

The carbon content in dead wood, litter and soil attributable to Project activities will not be monitored. These 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 data sampling will be designed according to the three strata defined for the project (Table 23). Therefore, the sample plots will be established in each stratum according to its area and variability on their growth.

Stratum	Área (Ha)	Project Activity	Starting Crediting Year
Stratum 1	139.3741	Planted in Apr. and May 2015	2015
Stratum 2	203.4032	Planted in Nov. and Dec. 2015	2015
Total Area	**242.7773**		

Table 23: : Strata for plot sampling.

The 2 strata will be monitored in order to identify different growth patterns inside each stratum that can lead to a unification between strata or a most detailed stratification. An annual update of the Project areas is suggested due to the gradual process of intervention, as it allows for 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 and promoting the consolidation of strata considered dissimilar in the *ex-ante* phase. According to changes in the accumulation of carbon in each monitoring period, a new stratification that groups stands with similar accumulations and other common aspects can be done. The monitoring result will allow a re-stratification for the following monitoring, according to the following parameters:

- Age;
- Silviculture management;
- Carbon capture;
- Disturbances (plagues, fire, pathologies, etc.).

Plot type and size

Permanent sample plots (PSPs) will be used for sampling of carbon stock. The sample plots will be 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. Circular plots with a radius of 8.00 m (= 201.06 m²) were used for collecting data, as this type of plot has proven efficiency regarding sampling error and time invested for *Eucalyptus* species (SOARES et al., 1981[66]).

Number of sample plots

The number of sample plots to be established depends mainly on the desired precision and the standard deviation of the variable to be measured on the inventoried areas. According to PEARSON et al. (2005)[67], the level of precision admissible for forestry inventories is between ±10 and ±20 percent. For this Project, a precision of 15% will be taken. As the standard deviation of the data is needed, a pre-sampling will be carried out in the area before the establishment of the plots for the monitoring. For doing so, 3 permanent circular plots of 500m^2 for each stratum will be established and measured[68]. With the data collected in the pre-sampling, it will be possible to estimate the number of plots needed for meeting the desired precision defined above. Moreover, this data will be included in the database of the monitoring period. For the 3 stratum defined, the plots needed (*n*) will be estimated as follows, according to PEARSON et al. (2005):

$$n = \frac{(\sum_{h=1}^{3} N_h * s_h)^2}{\frac{N^2 * E^2}{t^2} + (\sum_{h=1}^{3} N_h * s_h^2)}$$

where:

E = allowable error or the desired half-width of the confidence interval. Calculated by multiplying the mean carbon stock by the desired precision (that is, mean carbon stock x 0.15);

t = the sample statistic from the t-distribution for the 95% confidence level. *t* is usually set at 2 as sample size is unknown at this stage;

Nh = number of sampling units for stratum *h* (= area of stratum in hectares or area of the plot in hectares);

66 SOARES, V. P., de Paula Neto, F., Brandi, R. M., & Ladeira, H. P. (1981). Eficiência Relativa De Tamanhos E De Formas De Unidades De Amostra Em Plantações De Eucalyptus Granais, De Origem Hí-Brida, Na Região De Bom Despacho, MGi. Revista Arvore, 5(1), 29.

67 PEARSON, T., Walker, S., & Brown, S. (2005). Sourcebook for land use, land-use change and forestry projects. Winrock International and the BioCarbon Fund of the World Bank, 57.

68 According to PEARSON et al. (2005), between 6 to 10 plots is usually sufficient to evaluate standard deviation.

n = number of sampling units in the population (*n* = ∑ *Nh*);

sh = standard deviation of stratum *h.*

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

$$n_h = n * \frac{N_h * s_h}{\sum_{h=1}^{3} N_h * s_h}$$

where:

n = total number of plots;

nh = number of plots in stratum *h*;

N = number of sampling units in the population;

Nh = number of sampling units in stratum *h*;

S = standard deviation;

sh = standard deviation in stratum *h.*

SOP (Standard Operating Procedures) 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). In order to do so, Geographical Information Systems (GIS) tools will be used so the center of the plot could be easily identified in a map for each stratum. The systematic location of plots within each stratum will be achieved by overlaying a grid on the Project map and allocating plots in a regular pattern across the strata. 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 stratum code will be recorded and archived. The plots will be established before any monitoring takes place. In the case of special circumstances (e.g., forest fires, uneven growth) additional plots may be laid out.

Access to plots

The plots will be located with the help of cartography tools. Some reference points that facilitate the orientation in the field will also be identified on the maps. The local member of the field crew will help to access the plots 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 unique codes will be reported in the form.

Establishment of permanent plots

When arriving to the plot, a permanent marker (a wooden stake and marked on the bottom with yellow paint the plot number) should be placed exactly on the central 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 central point of the plot. Marker location data must be collected in the form. 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.

Data collection in the plot

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

Tree measurements

All trees over 10 cm (also ≤10 cm and ≥ 2.5 cm if the plantation is ≤5 years old) of DBH will be measured, and these data will be recorded in a field form presented in the § 5.3.3 - Recoding the data. All trees will be marked with yellow paint in order to identify the measuring point for further measurements. Trees located at the border of the plot will be considered as being inside the plot if at least half of the stem diameter at breast height is inside the limit of the plot. 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 breast height, 1.3 m above the ground with the exception of particular cases mentioned below (Figure 01). Measurement may be carried out with the help of a diameter tape (tape which diameter unit is in centimeters) or with the use of a caliper.

Figure 01: 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;

▪ 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 contact 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 02).

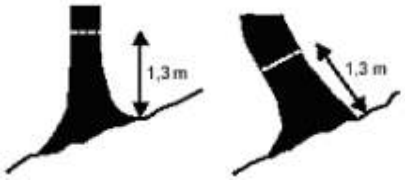


Figure 02: DBH measurement position for a tree on steep terrain.

▪ For fork trees 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 1.3 m height. 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 03).

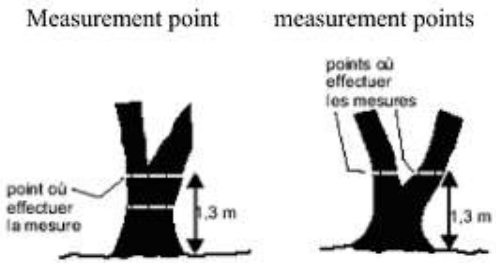


Figure 03: Measurement points at fork trees.

▪ Trees with irregular stem at 1.3m, like 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 04).

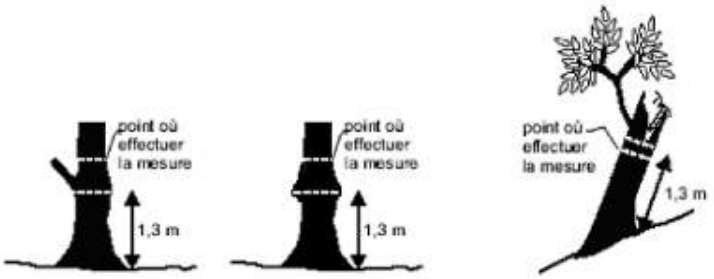


Figure 04: DBH measurement position for a tree with branch enlargement at 1.3 m and for other trees.

Tree Height measurement

At every monitoring period, 40% of the heights will be recorded in each plot. Height measurements will be taken with clinometer. With the data collected in each monitoring, a tree height model will be constructed for the species of the Project (*E. uro-grandis*). This model will be used for estimating the tree height of the 60% remaining trees. The model will be updated in each monitoring with the new data collected. Total height model will have the following structure:

$$H = aDBH^b$$

where:

H = Height of the trees (m);

DBH = Diameter at Breast Height (cm);

a, b = Parameters to be estimated for the model.

The process for measuring three heights is the following:

▪ Choice of a point away from the tree where the person in charge of the measurement can clearly observe the crown of the tree.

▪ Measure of the horizontal distance (*HD*) from the point chosen, to the base of the tree. Slope corrections must be applied when needed.

▪ Observation of angles: the operator must observe two angles (*A1* and *A2*), one at the top level of the tree and another one at the base of the tree. These angles must be recorded in percentage scale.

▪ Determining the total height of the tree. After each sighting, the operator must do the following: when the base of the trunk is below eye level (operator is standing uphill), the percent values must be added, when the base of the trunk is above eye level (standing downhill), the trunk base percent is subtracted from the tree-top percent. Then, the following equation should be used:

$$H = HD * \frac{(Sum/substraction\ \ of\ \ angles\ )}{100}$$

5.3.3 Recording the data

The field data collected will be recorded using specifically designed forms and reported on paper and digital format. Table 24 shows the field form for collecting the data in each plot.

Project Fazenda Nascente do Luar – FIELD FORM							
Date		**Plot number**		**Coordinates**		**Plot size**	
Person in charge		**Stratum**					
Tree	**Scientific name**	**Common name**	**DBH (cm)**	**Height-Angles (%)**		**HD (m)**	**Comments**
				A1	**A2**		

Table 24: Field Form for collecting data on plots.

The collected data, the calculations and the related outputs will be 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.

5.3.4 Monitoring intervals and frequency

According to the VCS and CCB rules, the Project will be monitored every 5 years.

5.3.5 Analysis of the monitored data and parameters Recording the data

The data recorded in the forest inventory (DBH and HEIGHT) will be the input for growth models that will define the total biomass accumulated for the Project at the time of monitoring (all the data proposed can be updated). For *E. uro-grandis,* the unique species planted in the Project Area, the following equation will be used for volume estimation. This equation was fitted by PEREIRA et al. (2014)[69] for a forest plantation of this species in Brazil.

$$V = \frac{DBH^2 H}{27{,}149.8 + 118.757 * DBH}$$

where:

V = stem volume in m^3 ;

H = Total Height (m);

DBH = Diameter at Breast Height (cm);

Stem biomass will be estimated using the Wood Density (*WD*) of the species. The total above-ground biomass will be estimated using the relevant Biomass Expansion Factor (*BEF*) for the species, and Root-Shoot-Ratio (*R*) will be used for estimation of below-ground biomass, with the following equation:

$$TB = V * WD * BEF * (1 + R)$$

where:

TB = Total Biomass in t/ha/year;

V = Stem Volume in m^3/ha/year;

WD = Wood Density (0,51)[70];

BEF = Biomass Expansion Factor (1,50)[71];

69 PEREIRA, E. L. Assis, F., Akio, H., Alves, U. 2014. *Modelagem na predição do volumen individual emplantio de Eucalyptus uro-grandis*. Rev. Bras. Biom, 32(4), 584-598.

70 Source: IPCC – TABLE 3A.9-2 of ANNEX 3A.1 of IPCC "Good Practice Guidance for LULUCF". Value of *Eucalyptus robusta* in Latin America (the only species of *Eucalyptus* reported in the table).

71 Source: IPCC – TABLE 3A.10 of ANNEX 3A.1 of IPCC "Good Practice Guidance for LULUCF". Value of Tropical Climatic Zone and Broadleaf Forest Type.

R = Root-Shoot-Ratio (0.35)[72];

72 Source: IPCC – TABLE 3A.8 of ANNEX 3A.1 of IPCC "Good Practice Guidance for LULUCF". Mean value for *Eucalyptus* plantations, when above-ground biomass is in a range of 50-150 ton/ha.

Total biomass (*TB*, above and below-biomass) will be used in the following equation for CO_2e estimations:

$$CO_{2e} = TB * CF * \frac{44}{12}$$

where:

CO2-e = Carbon Dioxide equivalent in t/ha/year;

TB = Total Biomass in t/ha/year;

CF = Carbon Fraction (0.45)[73].

Deadwood, litter and soil organic 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.

5.3.6 Procedures for internal auditing and 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 method of using two types of procedures in order to ensure that the inventory estimates and their contributing data are of high quality. Since a QA/QC plan is fundamental to create credibility, it will be developed one 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:

- Standard Operating Procedures (SOP) that will be established for all procedures such as GIS analysis; field measurements; data entry; data documentation, and data storage.
- Training will be held for all relevant personnel on all data collection and analysis procedures.
- Steps will be taken to control errors in the sampling and data analysis in order 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.

73 Default value from AR-TOOL 14 "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities".

Field data collection

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.

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.

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 the following equation:

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

The proper entry of data into the data analyses spreadsheets is required to produce reliable carbon estimates. All data sheets will include a “Person in charge” 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 the crew leader of the monitoring team further ensuring that the data and analysis are realistic.

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

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. 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. The main activities to be developed for the QA/QC process, are described in Table 25.

QC activity	Procedures
Check that assumptions and criteria for the selection of emission factors and other estimation parameters are documented.	Cross-check descriptions of project activity, 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 (either measurements or parameters used in calculations) for transcription errors.
Check that removals are calculated correctly.	Reproduce a representative sample of removal calculations. Selectively mimic complex model calculations with abbreviated calculations to judge relative accuracy.
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 that the movement of inventory data among processing steps is correct	Check that removal data are correctly reported when preparing summaries. Check that removal data are correctly transcribed between different intermediate products.
Check that uncertainties in removals are estimated or calculated correctly.	Check that qualifications, assumptions and expert judgments are recorded. Check that calculated uncertainties are complete and calculated correctly, following the methodology requirements.
Undertake review of internal documentation	Check that there is detailed internal documentation to support the estimates and to enable reproduction of the emission, removal estimates. Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review. Check integrity of any data archiving arrangements of outside organizations involved in inventory preparation.

QC activity	Procedures
Check time series consistency.	Check for temporal consistency in time series input data for biomass estimation. Check for consistency in the algorithm/method used for calculations throughout the time series.
Undertake completeness checks	Confirm that estimates are reported 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.	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.

Table 25: Verification and checklist considered to guarantee the quality of the information gathered and its management.

Uncertainty assessment

The Project will follow 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, and carbon fraction.

Verification of Project emissions

The Project will quantify and monitor the Non-CO_2 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-CO_2 GHGs resulting from the loss of aboveground tree biomass due to fire will be calculated in each verification period, by using the above ground biomass of trees belonging to relevant strata calculated in the previous verification and the default values for the combustion factor, the emission factors and the global warming potential.

6. APPENDICES

6.1 List of Appendices

01. Cadastral Parcel of FAZENDA NASCENTE DO LUAR
02. Corporate bylaws of AGROBUSINESS FLORESTA E PECUÁRIA LTDA
03. Tenancy Agreement between AGROBUSINESS and FAZENDA N.L.
04. Terrestrial Map of FAZENDA NASCENTE DO LUAR
05. KLM Map of FAZENDA NASCENTE DO LUAR
06. Planting Permit
07. Agreement between Project Owner and Project Proponent.
08. Non-permanence Risk Report.
09. Risk Calculation.
10. Ex-ante ERs Estimation Schedule.
11. Article: Impacto Ambiental de Florestas de Eucalipto.
12. Compendio de Legislação Aplicada a Cultura De Eucalipto.
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