THE ARR HORIZONTE CARBON PROJECT

Document Prepared by Waycarbon Soluções Ambientais e Projetos de Carbono LTDA

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The ARR Horizonte Carbon Project is located at the Cerrado Biome, in the state of Mato Grosso do Sul, Brazil. It is an AFOLU project, and therefore is classified within scope 14. More specifically, the project falls under the ARR category.

The ARR Horizonte Carbon Project's purpose is to remove and reduce GHG emissions through an increase in forestry area in the state of Mato Grosso do Sul, at the Cerrado biome, initially near the cities of Três Lagoas, Brasilândia, Santa Rita do Pardo, Selviria, Bataguassu, Água Clara and Aparecida do Taboado. The carbon credits are a result of the change of land use in previous pasture areas, through the plantation of Eucalyptus species in an area of 14,427.66 ha, as well as a result of the recovery of pasture and degraded areas with exposed soil, through the plantation of native vegetation most adequate for each case in an area of 999.10ha, both classified under the ARR category.

This activity is of great importance for the region under the light of deforestation events and rates for cattle ranching activities, which constitutes the baseline of the project. The state of Mato Grosso do Sul has the highest deforestation rates under the Cerrado biome, which has been the second most impacted biome by deforestation in the country, with 33,5% of the deforested areas[1].

In addition, the credit's revenue will allow for an additional restoration of native vegetation on Legal Reserves (RL – Reservas legais, in Portuguese) and Permanent Protection Areas (APP – área de preservação permanente, in Portuguese).

Under the social sphere, the project also brings benefits for the region, with the implementation of additional social activities (programs named Inclusive Recycling and the Nursery for Native and Ornamental Seedlings), beyond those already implemented by Suzano where it operates, which will be implemented due to the credit's revenue. In addition to the socioeconomic benefits, both projects linked to the social scope will bring

[1] MapBiomas, 2021. Relatório anual do desmatamento no Brasil - 2020. Available at: <https://s3.amazonaws.com/alerta.mapbiomas.org/rad2020/RAD2020_MapBiomasAlerta_FINAL.pdf>. Last access on 25 November 2021.

environmental awareness to the target population about climate change and mitigation actions.

The project started on 02-11-2017 with soil preparation activities. This is the start date of the project, which will have a renewable crediting period of 35 years, from 02-11-2017 to 01-11-2052. The project is expected to generate 86,995 tCO2/year.

1.2 Sectoral Scope and Project Type

The sectoral scope applied to the ARR Horizonte Carbon Project is scope 14 - Afforestation, Forestation and Other Land Use (AFOLU), specifically under the Afforestation, Reforestation and Revegetation (ARR). This is not a multiple activity project. This is a grouped project.

1.3 Project Eligibility

The ARR Horizonte Carbon Project meets all the eligibility criteria and requirements set by the VCS Program for the AFOLU sectorial scope. The project includes areas subject to the afforestation, reforestation and revegetation (ARR) category.

- The project falls under the Afforestation, Reforestation and Revegetation category;
- The project is not located in REDD + program zones. So far, Brazil has REDD+ program zones in the Amazon biome, and a REDD+ program for the Cerrado biome, located in another state, Mato Grosso;
- The project area, where the plantation of trees will be implemented, was identified as degraded pasture or exposed sandy soil before the start of the project activity and was not cleared of native ecosystems for the development of the project activity. Hence, there has not been a change in land use in the project activity area within the last 10 years prior to the project start date. Images below show the project activity areas 10 years before the project start date. On one farm, 5 ha were converted to non-forest between 2006 and 2007. Nevertheless, this area will be recovered by the project with native vegetation, as a part of APPs and RLs reconstitution.

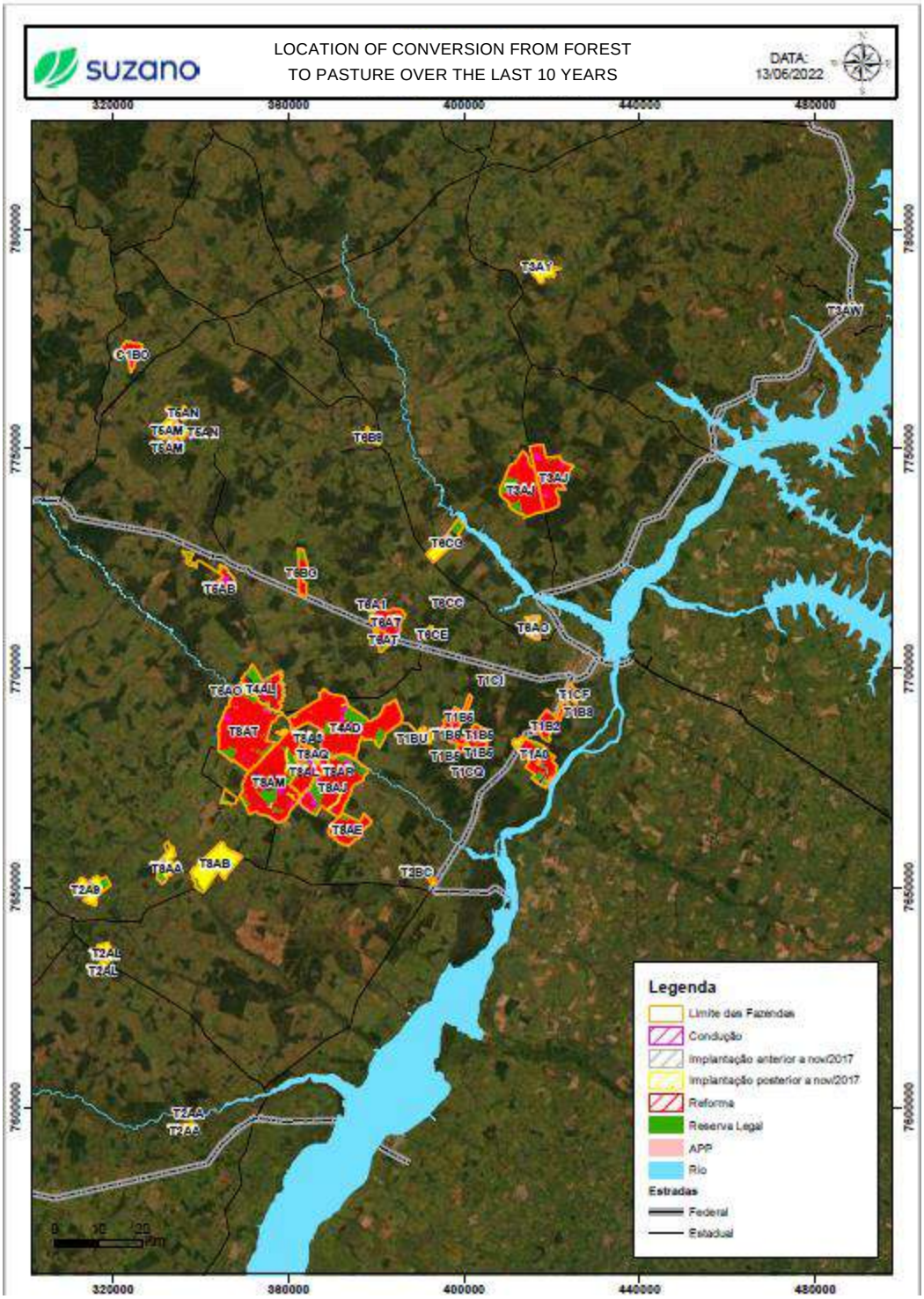


Figure 1 – Project activity map, evidencing where the project will be implemented.

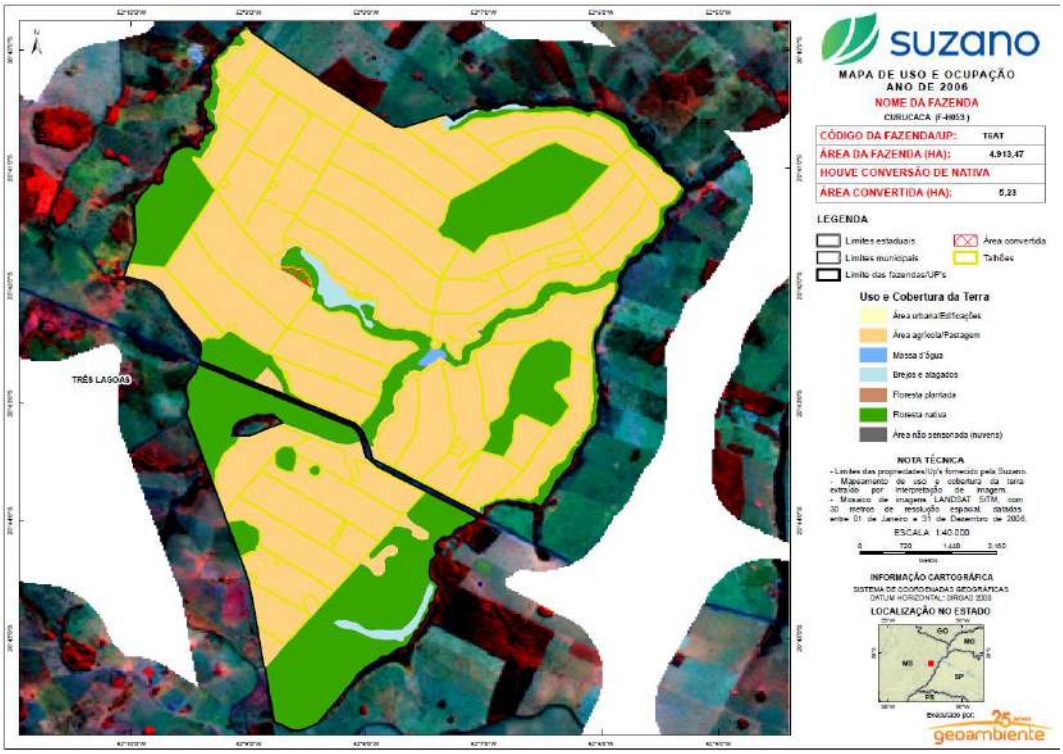


Figure 2 – Map evidencing the only converted area from forest to pasture in the 10 years preceding the project activity.

As aforementioned, before the implementation of the project, its area was characterized as degraded pasture or areas with exposed soil. In addition, Suzano assumed a No Deforestation Policy, where it "reinforces its commitment to establish its plantations in areas previously anthropized by other uses, whose conversion has not occurred under its direct or indirect responsibility"[2]. Annual reports[3] are provided to guarantee transparency to the commitment and updates on the agenda. Therefore, the project activity does not drain native ecosystems.

- For the project development, there has not been nor will occur the degradation of any hydrological functions. In addition to restrictive laws, where a Permanent Preservation Area (APP) is created in the presence of water, there are no water courses within the project areas where commercial plantation will be implemented. Thus, the region and biome where the project area is located are not categorized as

[2] Suzano's No Degradation Policy.Available at: <https://storage.googleapis.com/stateless-site-suzano-en/2020/08/a6f0cae8-wood-supply-policy.pdf>. Last access on 10 December 2020.

[3] Zero Deforestation Annual Report, Suzano, 2020. Available at: <https://storage.googleapis.com/stateless-site-suzano-en/2020/10/bd710250-relato%CC%81rio-anual-de-desmatamento-zero-suzano-2020-contribuic%CC%A7o%CC%83es-ym-green-en-us.pdf>. Last access on 10 December 2020.

wet land areas and no draining activities will be conducted. The image below shows the water courses at the project region and APPs, where no project activity will be implemented.

Moreover, it is important to highlight how Suzano is concerned about water resources where it operates. There is a dedicated process to assess and analyze hydrological conditions, where monthly and annual reports are structured to control the ecosystems where operations occur. This procedure is based on qualitative and quantitative data measured on site to identify water quality, flow rate and rainfall.

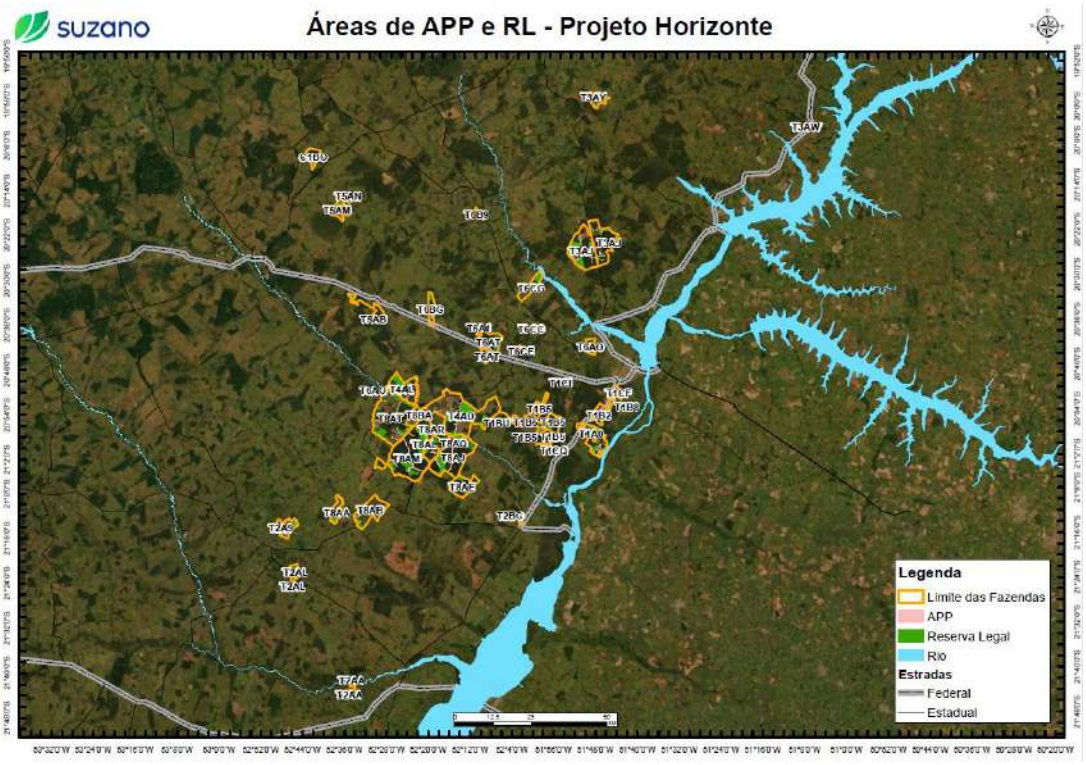


Figure 3 - Map with the location of water courses, permanent protection areas (APP) and legal reserves (RL) nearby or inside project areas.

1.4 Project Design

This project is a grouped project and a single project activity. The Project consists of the plantation of eucalyptus species for commercial purposes, which will be submitted to a 7 year harvesting cycle for all the project longevity, as well as pasture and degraded areas with exposed sandy soil recovery, using native species, which will not be submitted to harvesting events. The project activity will be implemented on several areas, which compose a grouped project.

The project will implement commercial plantation of species from the Eucalyptus spp gender. So far, the farms that already started commercial planting implemented the *E. urophylla, E.grandis*, and a hybrid from the two species *(E. grandis x E. urophylla).*

The *E.urophylla* is an Indonesian species, mainly from the Timor and Flores islands. This species can adapt to a wide range of altitudes, from sea level to 3,000m altitude levels, and is known by its important characteristics, such as the tolerance to water stress, resistance to plagues and capacity of rooting.

On the other hand, the *E. grandis* originally from the Australian coastlands, from the New South Wales and Queensland states. This species has good properties for cellulose pulping and is known by its vigorous growth.

The hybrid of the two species is widely used by the forestry sector given its productive capacity and combination of important characteristics.

Brazil has the largest ex-situ collection of eucalyptus germplasm in the world. The species has enabled a significant increase in the quantitative and qualitative productivity of planted forests in its territory.[4] The prominence of the eucalyptus culture is related to the gains obtained by the advancement of genetic improvement and the improvement of forest management practices.[5]

It is important to stress that the project proponents only allow the plantation of Eucalyptus, and there is a list of permitted species under this gender that can be used in order to assure the intensity of wood production and carbon captured.

In addition, the project will plant and conduce native species on pasture and degraded areas with exposed soil which represent a higher effort on recovery activities. The project proponent conduced an analysis on which species were usually observed on the project region, with the intention to plant the species already present at the region, considered the availability of the seedlings and Phyto physiognomy at the project farm, which resulted on a list of 939 species mapped that could be used for restoration activities. Some of them that are worth mentioning are:

Astronium fraxinifolium Schott; Vitex polygama Cham.; Astronium graveolens Jacq.; Endlicheria paniculata (Spreng.) J.F.Macbr; Astronium urundeuva (M.Allemão) Engl.;

[4] PINTO JÚNIOR, J. E. P.; SANTOS, P. E. T.; AGUIAR, A. V.; KALIL-FILHO, A. A.; PIRES, I. E.; RESENDE, M. D. V.; SILVA, R. L.; RESENDE JÚNIOR., M. R. R. Genética florestal. Viçosa-MG: Arka, 2011. 318 p. Last access: 25 November 2021.

[5] CASTRO, C. A. O.; RESENDE, R. T.; BHERING, L. L.; CRUZ, C. D. Brief history of Eucalyptus breeding in Brazil under perspective of biometric advances. Ciência Rural, Santa Maria, v. 46, n. 9, p.1585-1593, 2016. Last access: 25 November 2021.

Nectandra megapotamica (Spreng.) Mez; Lithraea molleoides (Vell.) Engl.; Ocotea velloziana (Meisn.) Mez; Tapirira guianensis Aubl.; Byrsonima intermedia A.Juss.; Cordia sellowiana Cham.; Guazuma ulmifolia Lam.; Cordia trichotoma (Vell.) Arráb. ex Steud.; Luehea candicans Mart.; Trema micrantha (L.) Blume; Luehea divaricata Mart.; Caryocar brasiliense Cambess.; Luehea grandiflora Mart.; Terminalia argentea Mart. & Zucc.; Pseudobombax longiflorum (Mart.) A.Robyns; Terminalia glabrescens Mart.; Pseudobombax tomentosum (Mart.) A.Robyns; Erythroxylum campestre A.St.-Hil.; Cedrela fissilis Vell.; Erythroxylum deciduum A.St.-Hil.; Cedrela odorata L.; Croton urucurana Baill.; Guarea kunthiana A.Juss.; Mabea fistulifera Mart.; Guarea macrophylla subsp. tuberculata (Vell.) T.D.Penn.; Sapium glandulosum (L.) Morong; Maclura tinctoria (L.) D.Don ex Steud.; Anadenanthera colubrina var. cebil (Griseb.) Altschul; Eugenia florida DC.; Anadenanthera peregrina var. falcata (Benth.) Altschul; Eugenia pitanga (O.Berg) Nied; Bowdichia virgilioides Kunth; Myrcia bella Cambess.; Copaifera langsdorffii Desf.; Myrcia splendens (Sw.) DC.; Dipteryx alata Vogel; Psidium guineense Sw; Enterolobium contortisiliquum (Vell.) Morong; Myrsine coriacea (Sw.) R.Br. ex Roem. & Schult.; Enterolobium timbouva Mart.; Myrsine gardneriana A.DC.; Hymenaea courbaril L.; Myrsine guianensis (Aubl.) Kuntze; Hymenaea stigonocarpa Mart. ex Hayne; Myrsine umbellata Mart.; Inga laurina (Sw.) Willd.; Prunus myrtifolia (L.) Urb.; Inga vera Willd.; Alibertia edulis (Rich.) A.Rich.; Leptolobium dasycarpum Vogel; Rudgea viburnoides (Cham.) Benth.; Leptolobium elegans Vogel; Zanthoxylum rhoifolium Lam.; Machaerium aculeatum Raddi; Zanthoxylum riedelianum Engl.; Machaerium acutifolium Vogel; Casearia gossypiosperma Briq.; Machaerium hirtum (Vell.) Stellfeld; Casearia sylvestris Sw.; Machaerium opacum Vogel; Allophylus edulis (A.St.-Hil. et al.) Hieron. ex Niederl.; Machaerium stipitatum Vogel; Cupania vernalis Cambess.; Parapiptadenia rigida (Benth.) Brenan; Dilodendron bipinnatum Radlk.; Platypodium elegans Vogel; Matayba elaeagnoides Radlk.; Pterogyne nitens Tul.; Matayba guianensis Aubl.; Stryphnodendron adstringens (Mart.) Coville; Qualea grandiflora Mart.; Stryphnodendron rotundifolium Mart.; Qualea multiflora Mart.; Tachigali vulgaris L.G.Silva & H.C.Lima; Qualea parviflora Mart.; Aegiphila verticillata Vell.; Vochysia tucanorum Mart

In addition, 86 species were identified for planting clumps of grass, from which 18 were most frequently observed and are more likely to be found at the project region, listed below:

Axonopus pressus (Nees ex Steud.) Parodi; Gymnopogon foliosus (Willd.) Nees; Andropogon leucostachyus Kunth; Axonopus marginatus (Trin.) Chase; Axonopus siccus (Nees) Kuhlm.; Loudetia flammida (Trin.) C.E.Hubb.; Andropogon virgatus Desv.; Saccharum asperum (Nees) Steud.; Gymnopogon spicatus (Spreng.) Kuntze; Panicum sellowii Nees; Andropogon bicornis L.; Paspalum cordatum Hack.; Aristida riparia Trin.; Eriochrysis cayennensis

P.Beauv.; Aristida setifolia Kunth; Trachypogon spicatus (L.f.) Kuntze; Schizachyrium microstachyum (Desv. ex Ham.) Roseng., B.R.Arrill. & Izag.; Axonopus brasiliensis (Spreng.) Kuhlm

Considered the effort to recover the native areas from the project, any species that are found to be more fit and adequate for the area could be used. Initially, the species to be used by the project are those from the Cerrado biome that can be found in nearby seedling nurseries, such as: *Annona crassiflora, Calophyllum Brasiliense, Campomanesia adamantium, Caryocar Brasiliense, Copaifera langsdorffii, Cybistax antisyphilitica, Dimorphandra mollis, Diospyros hispida, Dipteryx alata, Enterolobium gummiferum, Eriotheca pubescens, Hancornia speciosa, Hymenaea stigonocarpa, Inga laurina, Jacaranda cuspidifolia, Platypodium elegans, Pouteria ramiflora, Pouteria torta, Pterodon pubescens, Styrax camporum, Syagrus romanzoffiana, Tabebuia aurea, Tapirira guianensis, Terminalia argentea and Xylopia aromatica.*

1.4.1 The project is not a multiple activity project, it is a Grouped Project. The project is designed to a mosaic configuration and can include new instances on future monitoring reports.

Eligibility Criteria

"3.5.15: Grouped projects shall include one or more sets of eligibility criteria for the inclusion of new project activity instances. At least one set of eligibility criteria for the inclusion of new project activity instances shall be provided for each combination of project activity and geographic area specified in the project description. A set of eligibility criteria shall ensure that new project activity instances:

1) Meet the applicability conditions set out in the methodology applied to the project:

all instances under the ARR Horizonte Carbon Project must meet the applicability conditions set out in the AR-ACM0003 methodology. Regarding the initial instances, the applicability conditions are met as demonstrated:

I. The lands subject to the project activity does not fall in wetland category. The region and biome where the project area is located are not categorized as wet land areas and no draining activities will be conducted (see Figure 3)

II. Soil disturbance attributable to the project activity does not cover more than 10 per cent of area in each of the following types of land, when these lands are included within the project boundary: (i) Land containing organic soils; (ii) Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 of the methodology. None of the initial instances of this project

are located at lands containing organic soils (see section 1.13). In addition, is important to highlight that Suzano thrives to implement best practices available at the market, in line with FSC and other quality standards. Only the subsoiling procedure can cause disturbance to the soil, where a stem is used. Furthermore, it is based on the principle for minimum cultivation, where soil disturbance is as minimal as possible, maintaining all plant residues as coverage. Subsoiling activities are also monitored and controlled.

2) *Use the technologies or measures specified in the project description: The technologies and measures available are detailed in sections 1.11 and 5.* To standardize the measurement procedures, Suzano established a comprehensive manual for field activities, named Field Activities Manual. It indicates tools to be used, shows how activities must be done, and which must be followed by all personal conducing field measurement activities in all properties owned or leased by Suzano.
3) *Apply the technologies or measures in the same manner as specified in the project description: With document Field Activities Manual document, all procedures, measures and technologies used by Suzano in its activities are guided and standardized. The description of these procedures can be found in section 1.11 and 5.*
4) *Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area: as described in section 3.4, all new instances should follow the same baseline approach. In this sense, the ARR Horizonte Carbon Project assumes as the initial baseline scenario large areas of grassland with sparse trees in landscape.*
5) *5) Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area. For example, the new project activity instances have financial, technical and/or other parameters (such as the size/scale of the instances) consistent with the initial instances, or face the same investment, technological and/or other barriers as the initial instances: considering that the grouped project refers to reforestation (ARR project) in large areas of grassland with sparse trees in landscape, all the subsequent project activity instances must follow the same additionality approach of initial instances that are*

detailed in section 3.5. In this way, the additionality analysis should be based on the three plausible scenarios already identified:

I. *Continuation of extensive cattle farming;*
II. *Afforestation of the land within the limits of the Project carried out without registration as an AFOLU VCS project activity; and*
III. *Land use within the project boundary for soy farming*

1.4.2 Eligibility Criteria for New PAIs

Provided this is a grouped project, new areas to be included at the project must follow all displayed eligibility criteria displayed below. The new areas can be included in each monitoring event, considered all relevant information are made available at the time of the inclusion, and must be validated by the VVB when verifying the respective monitoring report. For the areas with eucalyptus planting, the following set of eligibility criteria must be followed:

- New areas must be certified or seek certification under a recognized and high-level market sustainability program, for example the FSC;
- Plant only eucaplytus species from the positive list provided by Suzano;
- The pre-existing land use of the grouped project instance area must be degraded pasture.

For the native vegetation recovery areas, the following set of eligibility criteria must be followed:

- Plantation of native species most adequate for the area in question;
- The baseline for these areas must be degraded pasture or degraded areas with exposed soil.

The following set of criteria must be met regardless of the species to be planted at the project area.

- Land owned or leased by Suzano;
- Located at the Cerrado biome, state of Mato Grosso do Sul, highlighted by the map under the green dot area:

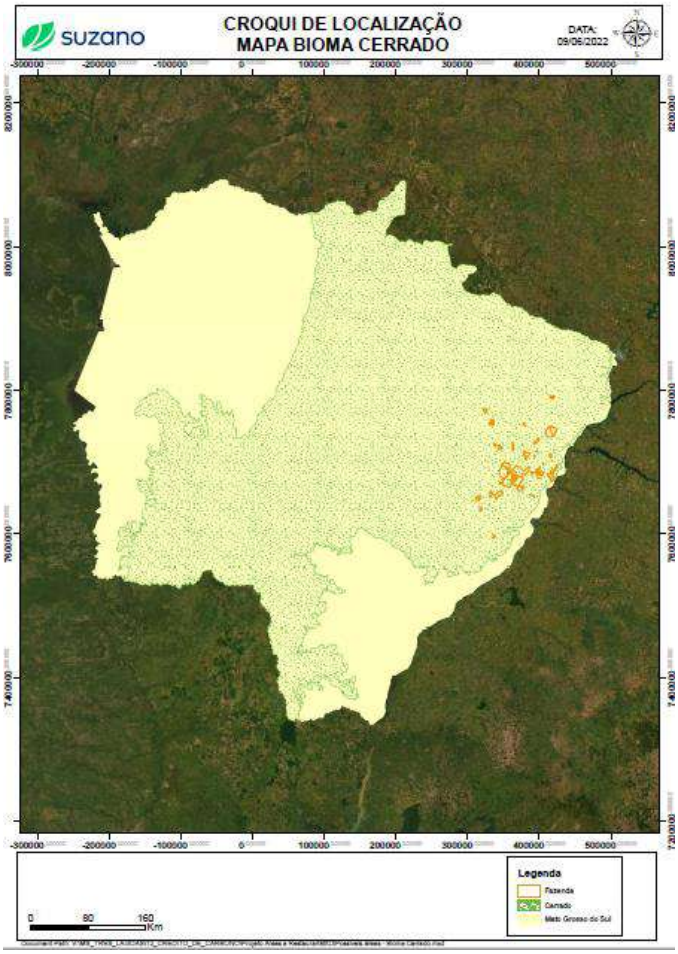


Figure 4 – New instances eligibility area.

- New areas must meet the applicability conditions set out in the methodology and relevant tools applied to the project;
- New areas must prove some characteristics in common under the additionality assessment according to the rationale applied in the project description:
    - Present at least the baseline scenario for the project activity as an alternative land use scenario, in addition to the scenario of the project without generating credits;
    - Be additional under a new barrier analysis assessment;
    - Actively restore and maintain native vegetation at RL and APP areas, and financially support the implementation of social activities developed by the grouped project, in addition to the social programs usually conducted and those required for the operation of the industry being built nearby the project location.

- New areas must be subject to the same baseline scenario as the determined by the project description;
- New areas must have a start date on or after the project start date of the first project instance, of 02/11/2017.

1.5 Project Proponent

Organization name	Suzano S.A.
Contact person	Julio Cesar Natalense
Title	Carbon Initiatives Executive Manager
Address	Brigadeiro Faria Lima Avenue, 1355. CEP 01452-919. São Paulo, SP. Brazil
Telephone	+55 11 99642 1051
Email	jcnatalense@suzano.com.br

1.6 Other Entities Involved in the Project

No other entity involved in the project

1.7 Ownership

The project activity will initially be conducted in 41 areas, owned or leased by Suzano S.A. and its controlled companies. Therefore, Suzano is the project owner and the project proponent. As part of the assessment procedure for selecting new properties, the property deeds for each property are assessed by Suzano to guarantee they comply with all legal requirements, and documents are available in the project files. Each farm participating in the initial phase of this project is listed below, with the corresponding document ID of the CAR, in compliance with the Brazilian Forest Code.

Farms owned by Suzano and its controlled companies:

- Barra da Moeda Farm (T1A0)

  - CAR: Federal number - MS-5008305-B40F7267DD934A99A2A5D841B6880BA2; State number – CARMS0000997

- Estradão Farm (T1B5)
  - CAR: Federal Number - MS-5008305-5E41.5F8F.496C.47FF.A27B.ECF7.C938.B0FD; State Number – CARMS0005228
- Casa Branca Farm (T1B8)
  - CAR: Federal Number - MS-5008305-054A9EDCE6584635BC2E335E0349CFF3
- Laguna Farm (T1CF)
  - CAR: Federal Number - MS-5008305-E4F78FAA74FD4A799B3EE62817ACCAD5; State Number - CARMS0005372
- Matão Farm (T3AJ)
  - CAR: Federal Number - MS-5007802-0C32.34B1.E69E.4B8E.86B4.72AB.EB5F.0E28; State Number – CARMS0003351
- Boa Esperança III Farm (T3AW)
  - CAR: Federal number - MS-5001003-215FAEB145AB4F1B8243787C734F5DEE; State Number - CARMS0019096
- Rio Verde A Farm (T4AD)
  - CAR: Federal Number - MS-5008305-DFAB94F3C9AE4B0A9010063773B93FDD and MS-5008305-B5E802B307454AE787691AAAA983AB64
- São Marcos Farms (T4AL)
  - CAR: Federal Number - MS-5000203-B48AD61FA75740A493FBA61F1C4E0A61; State Number – CARMS0004921
- Ana Rosa Farm (T5AP)
  - CAR: Federal Number - MS-5008305-6CC6F6B1C84E4D028AB7FCAE62E9CBB4
- Curucaca Farm (T6AT)
  - CAR: Federal Number - MS-5008305-E66956CD581B4EE9837D91CDCC992B63
- Flor da Serra Farm (T6BG)

  - CAR: Federal Number - MS-5008305-E7F26E362F6E4D35A74768936C580EE8

- Guara-Suia Farm (T8AE)
  - CAR: Federal Number - MS-5002308-03F1AFAB77494446BCD975A5E9EFC591; State Number – CARMS0005378
- Brasileira Farm (T8AJ)
  - CAR: Federal Number - MS-5002308-46CD.CE67.96B8.4FC9.A167.68B2.FCE7.AADA
- Vale do Gerivá Farm (T8AL)
  - CAR: Federal Number - MS-5002308-9893E1F1BD4948A8A23B0EFC88252AEC; State Number – CARMS0005356
- Duas marias Farm (T8AM)
  - CAR: Federal number - MS-5002308-C14EFAF7F9B6475FAA1F563AB63886A1
- Bom Jesus Farm (T8AQ)
  - CAR: Federal Number - MS-5002308-C14EFAF7F9B6475FAA1F563AB63886A1; State Number – CARMS0004065
- Paraiso Farm (T8AR)
  - CAR: Federal Number - MS-5002308-6F4E670A57084C30947CE3E9C7736798; State Number – CARMS0004915
- Cristo Redentor Farm (T8AS)
  - CAR: Federal Number - MS-5002308-0830.4E20.1D26.4029.AB0F.AE23.B362.558D ; State Number – CARMS0004189
- Rio Verde B Farm (T8AT)
  - CAR: Federal number - MS-5002308-A942F42C7ADC49C4AC209E97ACF3D527

Farms Leased by Suzano and its controlled companies:

- Arete Farm (T1BU)
  - CAR: Federal Number - MS-5008305-B8581EE005604BD2B866EBC55F4F0E43; State Number - CARMS0018530
- Barra do Cervo Farm (T1CI)

  - CAR: Federal Number - MS-5008305-B056A4A34EE5411F986C63A2441E64B9; State Number - CARMS0003577

- São Miguel III Farm (T1CQ)
  - CAR: Federal Number - MS-5008305-C88E1C9E65064ECF9D61A15528E05941; State Number – CARMS069991
- Nossa Senhora de Fátima Farm (T1CU)
  - CAR: Federal Number - MS-5008305-131EF7528BBD4F5D91962315CEF6501B;
- Monte Alto Farm (T2A9)
  - CAR: Federal Number - MS-5007554-A07C926FCDD04239AF6F2A5A2FD0DB85; State Number - CARMS0002702
- Figueira Farm (T2AA)
  - CAR: Federal Number - MS-5001904-4E2C4BDF27A449489134D96F3D491F5F; State Number - CARMS0025322
- São João IV Farm (T2AL)
  - CAR: Federal Number - MS-5007554-5BC570C54AF744A5BC0BECFB3C23259F; State Number - CARMS0049391
- Jandaia Farm (T2BC)
  - CAR: Federal Number - MS-5002308-C4BE286F0EAC4389AA782652CDE7DAA4; MS-5002308-A5DFA15ED2724A9DA442A6FC23BFB206;
- Joamar Farm (T3AY)
  - CAR: Federal Number - MS-5007802-545102DDB28143A78F0EFB472CD65728; State Number - CARMS0052313
- Ariranha Farm (T5AB)
  - CAR: Federal Number - MS-5000203-713C2F6CECF04CE7AD23D9E26CC0BCCC; State Number - CARMS0011519
- Santa Inês Gleba C Farm (T5AM)
  - CAR: Federal Number - MS-5008305-2AC8A845D07C485A895DED97015BB166; State Number - CARMS0004270
- Santa Inês Farm (T5AN)
  - CAR: Federal Number - MS-5008305-D8B6A68827354D5F9121E56E72891F02; MS-5008305-

DA850A57C552442FB29CB93EAE805881; MS-5008305-DE43F0A33855454BAA3195CF61621983; MS-5008305-DA850A57C552442FB29CB93EAE805881; MS-5008305-181C47D1F83E43AC85FB367F1C1C5874; State Number - CARMS0025875

- Triangulo do Vale Farm (T6A1)
    - CAR: Federal Number - MS-5008305-716127DCCABC4015955177B0C7A8F244; State Number - CARMS0024593
- São Lucas Farm (T6AO)
    - CAR: Federal Number - MS-5002308-510877EE7FCA46DEAA9CC0480728B9E2; MS-5008305-4A6BB673956346849ACC2EEDAF33E472; State Number - CARMS0023478
- Matinha do Brioso Farm (T6B8)
    - CAR: Federal Number - MS-5008305-AFA694C0230D4819BB5A8ED29A72BB17; State Number - CARMS0039384
- Pontal do Brioso Farm (T6B9)
    - CAR: Federal Number - MS-5008305-92615D425AFF43DDA2DCC13079D341BD; State Number - CARMS0039385
- Vista Alegre III Farm (T6CC)
    - CAR: Federal Number - MS-5008305-11E9EC4D1A9F45F4BF74B9B158EDA1E8; State Number - CARMS0018162
- Santa Terezinha II Farm (T6CE)
    - CAR: Federal Number - MS-5008305-B635889599E64EEFABFCCEFD4B32CD68; State Number - CARMS0003365
- Sucuriu Farm (T6CG)
    - CAR: Federal Number - MS-5008305-7D9BABB52E4445DAAE34FE728663A01C;
- Santo Antonio IV Farm (T8AA)
    - CAR: Federal Number - MS-5007554-E47C48B6E0CB4FB6A67ADF757983BF9E; State Number - CARMS0003352
- Vista Alegre II Farm (T8AB)
    - CAR: Federal Number - MS-5002308-E7A5A93F803A4A74BB277919417B72D4;
- São José Farm (T8BA)

- CAR: Federal Number - MS-5002308-07967A7EABA4418E900CB2F1AFC2608D;

1.8 Project Start Date

According to the VCS Standard Version 4.3 section 3.7, the project start date for AFOLU projects is the date on which activities, that lead to the generation of GHG emission reductions or removals, are implemented. Therefore, the project start date is defined as 02 November 2017, the date when activities for preparing land for seedling were implemented at the first PUS (Plantation units), at Santa Inês (T5AM) and Monte Alto (T2A9) Farms, according to internal documentation.

1.9 Project Crediting Period

The Project Crediting Period will be 35 years, renewable.

The first crediting period will be from 02 November 2017 to 01 November 2052, both days included.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	Yes
Large project	No

Year	Estimated GHG emission reductions or removals (tCO_2e)
02/11/2017 to 31/12/2017	5,057
01/01/2018 to 31/12/2018	314,292
01/01/2019 to 31/12/2019	726,444
01/01/2020 to 31/12/2020	1,348,861
01/01/2021 to 31/12/2021	1,952,291
01/01/2022 to 31/12/2022	2,640,621
01/01/2023 to 31/12/2023	3,308,834

01/01/2024 to 31/12/2024	3,857,816
01/01/2025 to 31/12/2025	2,748,405
01/01/2026 to 31/12/2026	2,747,970
01/01/2027 to 31/12/2027	2,050,515
01/01/2028 to 31/12/2028	2,710,889
01/01/2029 to 31/12/2029	2,786,928
01/01/2030 to 31/12/2030	3,351,149
01/01/2031 to 31/12/2031	3,912,109
01/01/2032 to 31/12/2032	2,813,485
01/01/2033 to 31/12/2033	2,825,482
01/01/2034 to 31/12/2034	2,140,458
01/01/2035 to 31/12/2035	2,811,987
01/01/2036 to 31/12/2036	2,895,338
01/01/2037 to 31/12/2037	3,465,595
01/01/2038 to 31/12/2038	4,028,826
01/01/2039 to 31/12/2039	2,931,976
01/01/2040 to 31/12/2040	2,944,104
01/01/2041 to 31/12/2041	2,259,210
01/01/2042 to 31/12/2042	2,930,906
01/01/2043 to 31/12/2043	3,014,118
01/01/2044 to 31/12/2044	3,582,574
01/01/2045 to 31/12/2045	4,142,710
01/01/2046 to 31/12/2046	3,042,732
01/01/2047 to 31/12/2047	3,051,778
01/01/2048 to 31/12/2048	2,362,819
01/01/2049 to 31/12/2049	3,027,447

01/01/2050 to 01/11/2050	3,102,902
01/01/2051 to 31/12/2051	3,662,294
01/01/2052 to 01/11/2052	3,611,091
Total estimated ERs	99,110,028
Total number of crediting years	35
Average annual ERs	86,995.21

Considering the eucalyptus planted areas will be submitted to harvesting cycles of 7 years, there is a limit that must be observed which defines the quantity of estimated ERs that can be converted to actual VCUS, The Long-term average GHG benefit. Project proponents will consider the long-term average GHG benefit, as required by VCS Standard. Project LTA will be estimated by the following equation:

$$LA = \frac{\sum_{t=0}^{n} PE_t - BE_t}{n}$$

Where:

LA = The Long-Term Average GHG benefit

PE_t = The total to-date GHG emission reductions and removals generated in the project scenario (tCO2e). Project scenario emissions reduction and removals shall also consider project emissions of CO2, N2O, CH4 and leakage.

BE_t = The total to-date GHG emissions reductions and removals projected for the baseline scenario (tCO2e)

T = year

N = total number of years in the established time period

The LTA estimation does not exclude yet the number of credits that must be directed to the pooled buffer account. This will be indicated under sections 4 and 6, where more information on the calculation and rationale applied is also available.

1.11 Description of the Project Activity

The ARR Horizonte Carbon Project aims to recover and guarantee the reforestation of degraded areas through the plantation of Eucalyptus, and through the plantation of native vegetation on pasture and degraded areas with exposed soil located outside APPs and RL areas.

Moreover, native vegetation will be recovered through the assisted regeneration of native species on degraded APP and RL areas and protect native vegetation in the project area from unplanned deforestation, besides the social projects to be implemented, although these activities do not count for carbon reductions and removals.

Through the natural process of photosynthesis, trees absorb carbon from the atmosphere and store it in their biomass, a phenomenon also known as carbon sequestration. In this process, the trees absorb the molecules of CO_2 and water which, in the presence of light, results in the production of glucose ($C_6H_{12}O_6$) and water, releasing oxygen (O_2) to the atmosphere. The glucose goes through several chemical reactions during the metabolic process, resulting in the production of biomass. Approximately 47% of a tree's biomass is carbon[6].

Forests have an important role in preserving characteristics of a certain region. They improve the microclimate of the regions, making local temperatures milder, reducing erosion, maintaining biodiversity, protecting water resources, and finally reducing other negative impacts that climate change could cause. Also, planted forests increases the availability of wood and fiber supply for industrial consumption, reducing the pressure on native forests.

As pointed out in section 1.3, the project is not located within a jurisdiction covered by a jurisdictional REDD+ program.

Process of implementation and management of the Eucalyptus plantation areas

The forest implementation process is composed of a set of silvicultural activities, precisely designed to obtain a safe environment and technical conditions for the development of a planted forest. The eucalyptus plantations follow a specific protocol, whose ID is PO.12.02.001, developed by Suzano. It is important to highlight that implementation funds were hired to assist the project proponent in planting activities, which must follow the requirements set by the project proponent.

[6] SOARES, C. P. B.; PAULA NETO, F.; SOUZA, A.L. Dendrometria e inventário florestal. 2ed. Viçosa, MG: Editora UFV, 2011. 272p. Last access: 25 November 2021.

The procedure starts with the silviculture team, where supervisors and technicians receive the micro-planning map of the area, with information about the location, conditions and the activities to be performed.

During the execution of the silvicultural implantation activities, the teams must follow the micro planning information, which defines the execution area for planting Eucalyptus and delimits the areas that will be conserved and remain in permanent preservation.

The forest implantation process is developed in sequential steps, as follows

1. Cleaning of the area: The activity is implemented in a way that may facilitate the execution of subsequent silvicultural activities. The process is implemented in the project area as informed to the environmental agency. Eventually, chemical cleaning can be applied, depending on the characteristics of the area. The recommended dosage is defined by experts and varies according to the degree of infestation of invasive species.

   It is important to highlight that the project area's location has a high number of occurrence of weeds, which compete with the trees for water, light and nutrients, and is also vulnerable to plagues that can damage the leaves and lead to the death of great extensions of adult forests. Under this context, weeds and pests control is essential for the maintenance of the planted trees. However, the edaphoclimatic context also promotes a higher and quicker degradation of defensives when compared to temperate climate regions.

   In order to mitigate and address all environmental risks that may occur, the project activities follows all the Brazilian laws regarding the application of such products, applying only registered products allowed by the agriculture, environmental and sanitary authorities; meets all the procedures and criteria listed by the chemical policies from the applied certifications (FSC and CERFLOR); has specific internal procedures to the appliance of such products, seeking safety; supports research institutes and companies that develop more sustainable products from the environmental perspective; apply such defensives only with a previous basement on monitored data, where it is evaluated the environmental impact; the chemical defensives are applied only as a last resource; drones and other equipment for spraying products are only used at the project areas, and mainly for the application of fertilizers and biological products. Fungicides are rarely applied.

2. Ant control: This activity can occur throughout the entire cycle of the eucalyptus crop, including the cleaning step. It begins with the systematical granulated bait or micro

bait holders. Whenever active scouts are found, they must be fought in a localized manner. Interventions shall be made until the pest is under control or until it does not pose a risk to the establishment of the eucalyptus crop. Depending on the climatic conditions (humidity), powdered product and/or thermal spraying may also be used under the circumstances, conditions and procedures aforementioned.

3. Soil preparation: this activity precedes planting, and its purpose is to make sure that the soil is in perfect conditions for seedling development and maintenance of forest productivity. The execution of this step must be based on the concepts of minimum cultivation, using the fewer operations as possible (restricted to the rows or the planting holes), to assure a balance between quality of soil preparation and maintenance of forest residues on the soil. The activity is carried out by agricultural tractors using subsoilers, which have a precision system that controls the execution of the step, following the recommendations and specifications outlined in the micro planning.

   It is important to highlight that Suzano thrives to implement best practices available at the market, in line with FSC and other quality standards. The subsoiling procedure is the only step that can cause disturbance to the soil, where a stem is used. The soil preparation is based on the principle for minimum cultivation, where soil disturbance is as minimal as possible, maintaining all plant residues as coverage.

   In addition, Suzano has specific additional procedures to soil preparation in line with the biome of the region, where stumps can be cut and kept at the project site instead of being removed. Moreover, the process is monitored and controlled, included the depth of subsoiling activities and spacing between planting lines.

4. Fertilization: Set of activities that supply the micro and macro nutrients needed by the plant, enabling the ideal conditions for its development according to the technical recommendation specified in the forestry micro planning. Fertilization can be performed manually or with help of machines (through land or air). In the manual activity, a manual device for dosing the fertilizer is used, whereas in the mechanized activity, a device can be coupled to the subsoiler during soil preparation, or a drone can be used.

5. Planting: The seedlings destined for planting can be treated with termite prevention, according to specific technical recommendations for the implantation area. The seedling is then placed in the soil previously prepared, up to a specific height where it can stand still at a right an angle to the ground. The soil surrounding the seedling is then pressed, to assure its fixation. In some cases, gel can be used during the

planting process, where it is added in the soil surrounding the seedling, making it unnecessary to press the soil as previously described.

For this step, the ideal climate and soil conditions must be evaluated to define which procedure must be followed: manual, semi-mechanized or mechanized planting, ensuring optimum seedling development in the field.

Figure 5 – Planted and Irrigated seedling.

6. Irrigation: the purpose of this step is to ensure soil moisture and provide the ideal conditions for the plant's development in cases where the soil presents water deficit. The evaluation of the lack of soil moisture is done visually by the silvicultural team and by the assessment of meteorological data, such as precipitation, relative humidity and temperature. The wilting aspect of the seedling is also taken into consideration. Irrigation can be performed through watertight valves in a mechanized system, or manually using costals to transport the necessary amount of water to be applied per pit. To improve the effectiveness of irrigation, gel can be used at the planting activity with a dose between 1.5 to 2.0 g/seedling of absorbent polymers (gel) and irrigation. An evaluation must be made within 2 to 5 days after the first irrigation to assess the adaptation of the seedlings and to define if another irrigation is necessary. In case irrigation is necessary, the company fulfills all legal requirements before starting the operation.

All operational processes involved in the plantation procedure are submitted to auditing.

Forest maintenance and management process

It is up to the Planning team to annually prepare the schedule of plantation units (PUs) to be monitored, proceed with the installation of plots and data collection, ensure data

consistency and prepare the preliminary report of the monitoring results. This information will be used to make decisions regarding management recommendations/changes to the PUs.

The activities for forest maintenance are listed below:

1. Ant control: previously described under item 2;
2. Weeding: consists in the removal of all the invasive vegetation from the area surrounding the trees, with appropriate tools.

Figure 6 – Manual weeding.

Depending on the local characteristics and technical recommendations, the weeding can also be treated with the use of herbicides, avoiding them to grow with pre-emergent, or eradicating it once it has germinated with conventional/ pressurized or semi-mechanized knapsack sprayers. Mechanized chemical weeding can also be used, which is performed with spraying equipment coupled to tractors.

The method to be applied must be defined according to the location of the area and its topography, vegetation and climate conditions.

3. Complementary Fertilization: Fertilization can be performed manually or with help of machines (through land or air). In the manual process the fertilizer is applied close to the seedling using a hose connected to the sprayer or metering cup. In mechanized fertilization, the activity must be performed with a fertilizer spreader coupled to the tractor (figure 5). The tractor is equipped with precision management equipment and should be calibrated twice a day following the dosage recommended by experts. In mechanized fertilization it is not allowed to use wet or stoned fertilizer because it may compromise the quality of fertilization. In areal application, the aircrafts have

integrated GPS that dimension application by strip, making it possible to apply fertilizer in the whole PU. Soil correction (lime, gypsum, lime mud or inorganic compost) is done by tamping machines as per Figure 7.

Figure 7 – Mechanical Fertilization.

Figure 8 – Application of soil correction.

4. Brush clearing: this activity targets controlling weeds that are in competition with the eucalyptus in the planting line through appropriate tools such as hoes and scythes. In the pre-cutting phase, the activity is carried out before harvesting begins.

Figure 9 – Mechanical pre-cut trimming.

Areas to be restored with native plantation

The areas to be restored under the ARR Horizonte project were chosen based on two criteria: minimum size and current classification of land use and land cover.

According to FAO, areas can be classified as forests if they have more than 0.5 hectares, trees greater than 5 m in height and canopy coverage greater than 10%, or trees capable of reaching these parameters in situ. Therefore, only areas larger than 0.5 hectares were included in the project.

For the current classification of land use and land cover, a field evaluation stage was carried out between March 1 and 21, 2021, by a qualified company. All conservation areas belonging to Suzano S.A. were classified. For the classification of vegetation in the field, high resolution maps were generated for each of the rural properties, containing the polygons of the natural areas with the classification of land use used by the mapping base of Suzano S.A. The classification of the types of natural vegetation within each polygon was carried out based on (i) identification of the predominant plant species, (ii) forms of growth of the species (e.g. grass, shrub, tree, sub-shrub), (iii) vegetation structure (canopy cover and native or exotic herbaceous-shrubby vegetation) and (iv) abiotic factors considered diagnostic characters for certain phytophysiognomies (e.g., permanent or periodic flooding of the area, soil water saturation, shallow soil and/or rocky outcrop) .

In the end, degraded areas classified as pasture with sparse shrubs and trees (PSR), pasture (PST) and exposed soil (SLE) were included in the project. These areas were classified as follows:

- Pasture with sparse shrubs and trees (PSR) : Areas previously used as pasture where there is a dominance of exotic grasses and low density and diversity of typical species of regenerating cerrado (shrubs and trees, rarely non-graminoid grasses and native grasses) (Figure 12). It is possible to find exposed soil in these areas.

Figure 10 - Pasture with sparse shrubs and trees. Source: Report of characterization of vegetation in natural areas of Suzano in Mato Grosso do Sul farms (attachment 4). Source: Biophilium Consultoria Ambiental, 2021.

- Pasture (PST): Areas completely dominated by exotic grasses, which may also present native ruderal grasses and non-graminoid herbs (e.g., *Andropogon leucostachyus* Kunth and *Andropogon bicornis* L.) and very low density of regenerating shrubs (Figure 11).

Figure 11 Pasture. Source: Report of characterization of vegetation in natural areas of Suzano in Mato Grosso do Sul farms (attachment 4 -Biophilium Consultoria Ambiental, 2021.)

- Exposed Soil: degraded areas with no vegetation cover (Figure 12):

Figure 12: Exposed soil. Source: Report of characterization of vegetation in natural areas of Suzano in Mato Grosso do Sul farms (attachment 4 - Biophilium Consultoria Ambiental, 2021.)

Process of implementation and management of the Native plantation areas

1. Control of erosive process and rehabilitation of degraded areas: application of tools and engineering techniques to reestablish the physical conditions of the environment, with special attention to degraded areas due to erosion and silting process.
2. Conduction and natural regeneration: this step is divided into 3 activities, listed below.
    a. Control of invasive exotic grasses: The exotic species is usually brachiaria, which impedes the natural regeneration of native species, especially herbs and undershrub. Therefore, it is indicated to implement weeding control procedures or the application of herbicides. Nevertheless, it is important to control the soil coverage permanently, considered the removal of weeds may lead to soil exposure, and could result in an erosion process, a serious environmental problem at the project region.
    b. Eradication of exotic tree species: even though exotic species can be planted by the project, considered the intention of restoring natural ecosystems, the removal of eventual sparse exotic trees may be done by the project proponent.
    c. Plantation of native species: This activity should take place in cases where degradation surpasses the limit under which natural regeneration of native vegetation could occur spontaneously or would take too long to occur. It consists of planting seedlings under a specific project for each area. No planting activity is recommended unless monitoring data shows low resilience. In cases of exposed and eroded soil, the use of native grasses is recommended.

Suzano's team will be responsible for implementing the project activity, whether by its own manpower, or through third parties hired to conduce such activities, such as the funds for planting trees, or hired teams to conduce part of the inventories. Local community will provide seedlings for native species plantations.

Social activities

Social activities will be implemented with carbon credit revenue and have not been started in this monitored period (2017-2022).

When implemented, the activities will bring environmental awareness about the importance of the implementation of the Project in the area, decrease of GHG emissions and,

consequently, generation of VCUs credits, which, once commercialized, will be used to support social activities, allowing the generation of income and improvement in the families' lives. In addition, maintaining good relationships with the surrounding communities will help maintain the activities, engaging the individuals in participation, making them aware of climate change, nature-based solutions, and the importance of the Project in this context, and thus ensuring the effectiveness of the implementation of the proposed activities and the Project's success.

Below are listed the two activities linked with the social scope:

Inclusive Recycling Project

The activity has as its main objective the inclusion of individuals in situations of social vulnerability and under the poverty line, and members of the recycling community, implementing activities that promote the improvement of their incomes and development, strengthening and fostering the organized production of local recycling cooperatives. In addition, it will contribute to public health as it will help public institutions to manage solid waste and reduce the amount of waste deposited in landfills. The activity also proposes to organize a network of individual collectors who work informally and professionalize them by offering them minimum working and safety conditions.

Its monitoring will take place in biannual cycles, thus ensuring that the stakeholders in this activity are being contemplated and that the indicator for income increase is rising, removing participants from social vulnerability and poverty line.

Furthermore, risk factors, improvements, deviations, and corrections of possible failures in the implementation of the activity will be monitored monthly, through meetings with the directors of the Social Cooperative, thus preparing a preventive or corrective action plan.

Nursery for Native and Ornamental Seedlings Project

This activity will target families from communities near the Project area and will be based on the implementation of a nursery of native Cerrado seedlings suitable for restoration of the areas that will be restored by the ARR Horizonte Carbon Project, ensuring species diversity and genetic variability in plantations. The supply of seedlings by the nursery will be extremely important for conducting the restoration activity that will ensure the removal of GHG not only in the project areas. The activity also proposes the organization of awareness and training workshops on issues related to biodiversity, the formalization of a group of associates to build a nursery of native and ornamental seedlings and the organization of a space in the municipal fair for the commercialization of native and ornamental species.

Also, ornamental species will be included in the activity, allowing the families involved to maintain the nursery activities in more financially stable conditions.

All the families of the communities involved in the activity will be trained and will receive all the necessary resources to maintain the activity. The net benefit for the communities is the generation of employment and income, which will be monitored annually by means of income generation questionnaires to the families.

1.12 Project Location

The ARR Horizonte Carbon Project is situated in Três Lagoas (10,217 km²), Brasilândia (5,807 km²), Santa Rita do Pardo (6,142 km²), Selvíria (3,259 km²), Bataguassu (2,418 Km²), Água Clara (7,809 km²) and Aparecida do Taboado (2,750 km²), cities of Mato Grosso do Sul state. Together, these cities representing 10.75% of the State area.

The designated areas and land occupation at the farms where the projects will be implemented are detailed below.

- Project area: 15,426.76 ha

Degraded pasture areas, designated to the current Project activity, where ARR activities will be accounted under the emission removals calculations. Emission removals can be monitored and accounted for this area in specific because the project proponents have set clear limits on where the project activity will take place. The eucalyptus plantation area is highlighted in yellow on the maps below. The native plantation area is highlighted in light pink.

- Permanent Preservation Areas and legal Reserves (APP and RL): 34,964 ha

As defined per law n. 12,651/2012, the Permanent Preservation area can be covered or not by native vegetation, and has the purpose to preserve hydrological resources, landscape, geological stability and biodiversity, protecting the soil and assuring the wellbeing of communities. Project proponents will help recovering the area, although this will not be considered under the emission reductions calculations.

The same regulation outlines that every rural property must maintain an area with vegetation coverage, as a legal reservation. It is an area located inside the rural property or possessed by the same owner, with the purpose to grant the sustainable and economical use of natural resources, helping on conservation, ecological process rehabilitation, as well as promoting the biodiversity's conservation, wildlife protection and native flora.

These areas can be identified in yellow, mustard, white or pink on the maps below.

- Planted areas: 98,577.2 ha

Areas that were Eucalyptus plantation before the beginning of the Project. These areas are not being considered under this Project.

These areas can be identified in slashed pink, red and light grey on the maps below.

- Infrastructure: 4,542.4 ha

Farm areas occupied with infrastructure, such as roads and hearquarters.

A KML file is attached separately to better indicate the coordinates of the project, and images of each area can be seen below. In the following maps the project area are highlighted in yellow when the project activity is the planting of eucalyptus and in yellow, mustard, white or pink when the activity is the native restoration planting. It is important to note that some of the activities have not yet started. The eucalyptus plantation areas of the "São Miguel III" and "Vista Alegre III" farms are scheduled for December 2022 and the start of the native restoration planting activity is scheduled to begin in 2023.

Figure 12 - Location and stratification of Ana Rosa. Native vegetation plantation area highlighted in white (PSR), light pink (PST) and mustard (SLE).

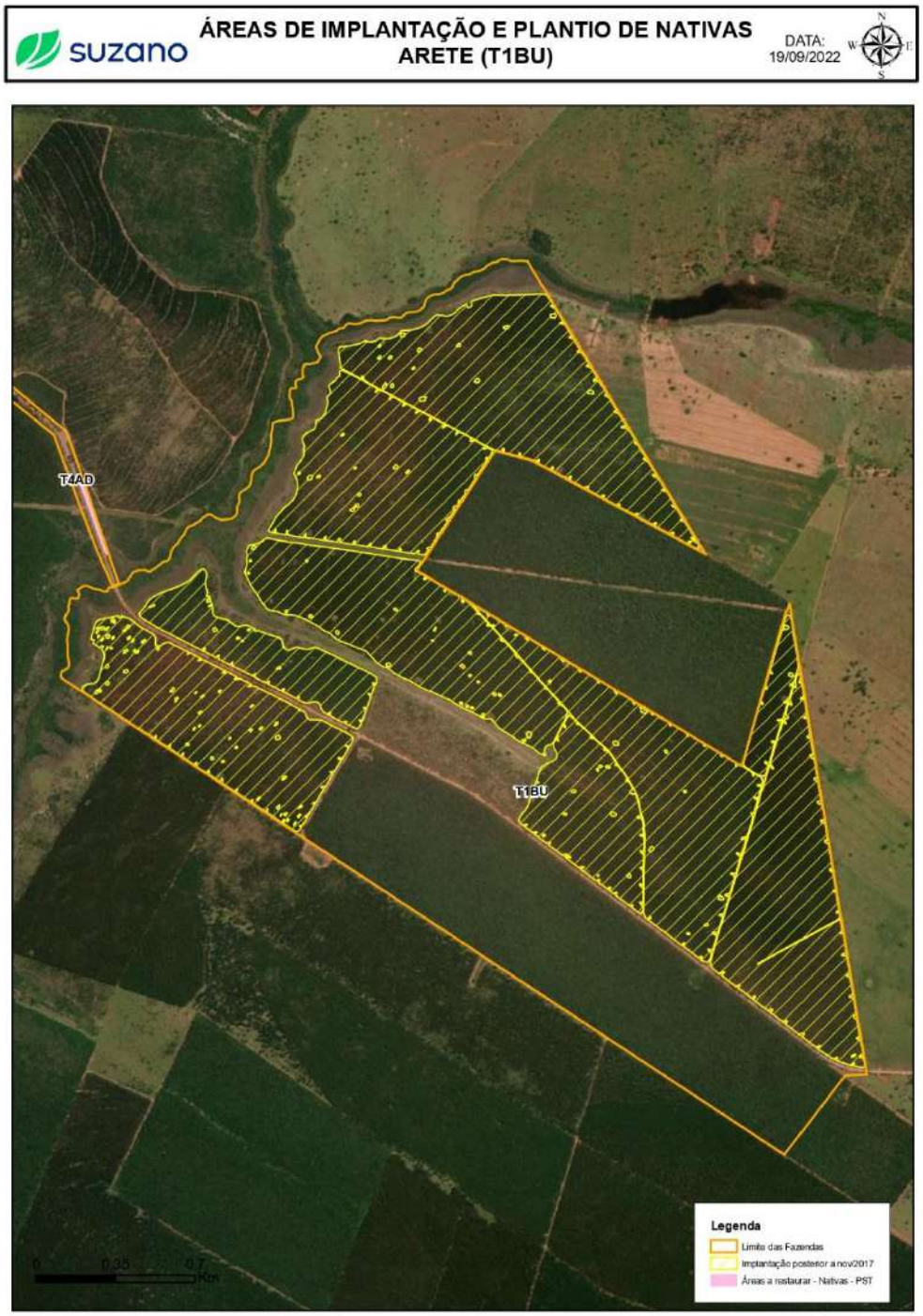


Figure 13 – Location and stratification of Arete. Eucalyptus plantation area highlighted in yellow.

Figure 14 – Location and stratification of Ariranha. Eucalyptus plantation area highlighted in yellow.

Figure 15 – Location and stratification of Barra do Cervo. Eucalyptus plantation area highlighted in yellow.

Figure 16 - – Location and stratification of Barra do Moeda. Eucalyptus plantation area highlighted in yellow and native restoration planting area in white (PSR), light pink (PST) and mustard (SLE).

Figure 17 – Location and stratification of Boa Esperança III. Eucalyptus plantation area highlighted in yellow and native restoration in light pink.

Figure 18 - Location and stratification of Bom Jesus. Eucalyptus plantation area highlighted in yellow and native restoration planting area in light pink (PST) and white (PSR).

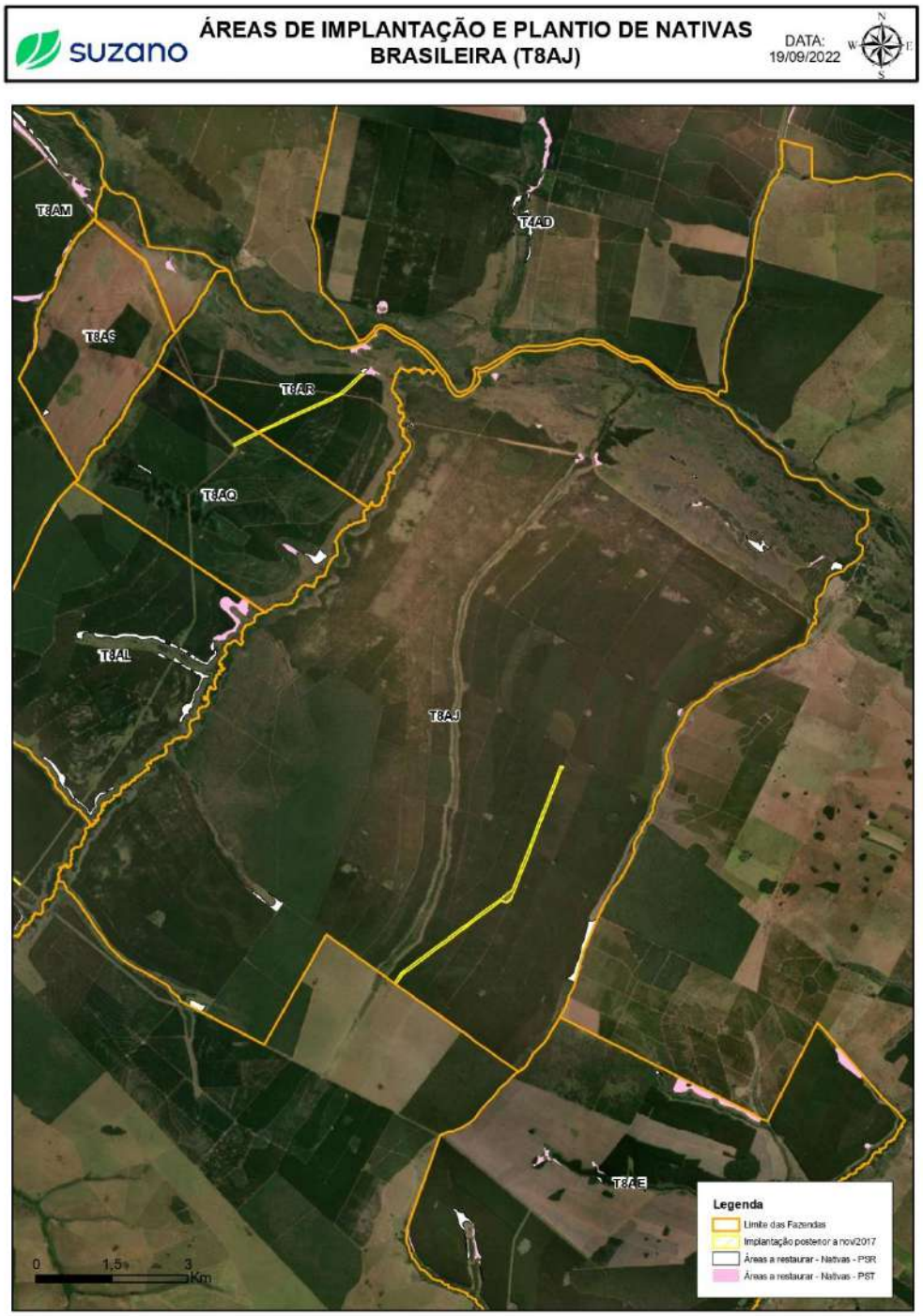


Figure 19 - Location and stratification of Brasileira. Eucalyptus plantation area highlighted in yellow and native restoration planting area in light pink (PST) and white (PSR).

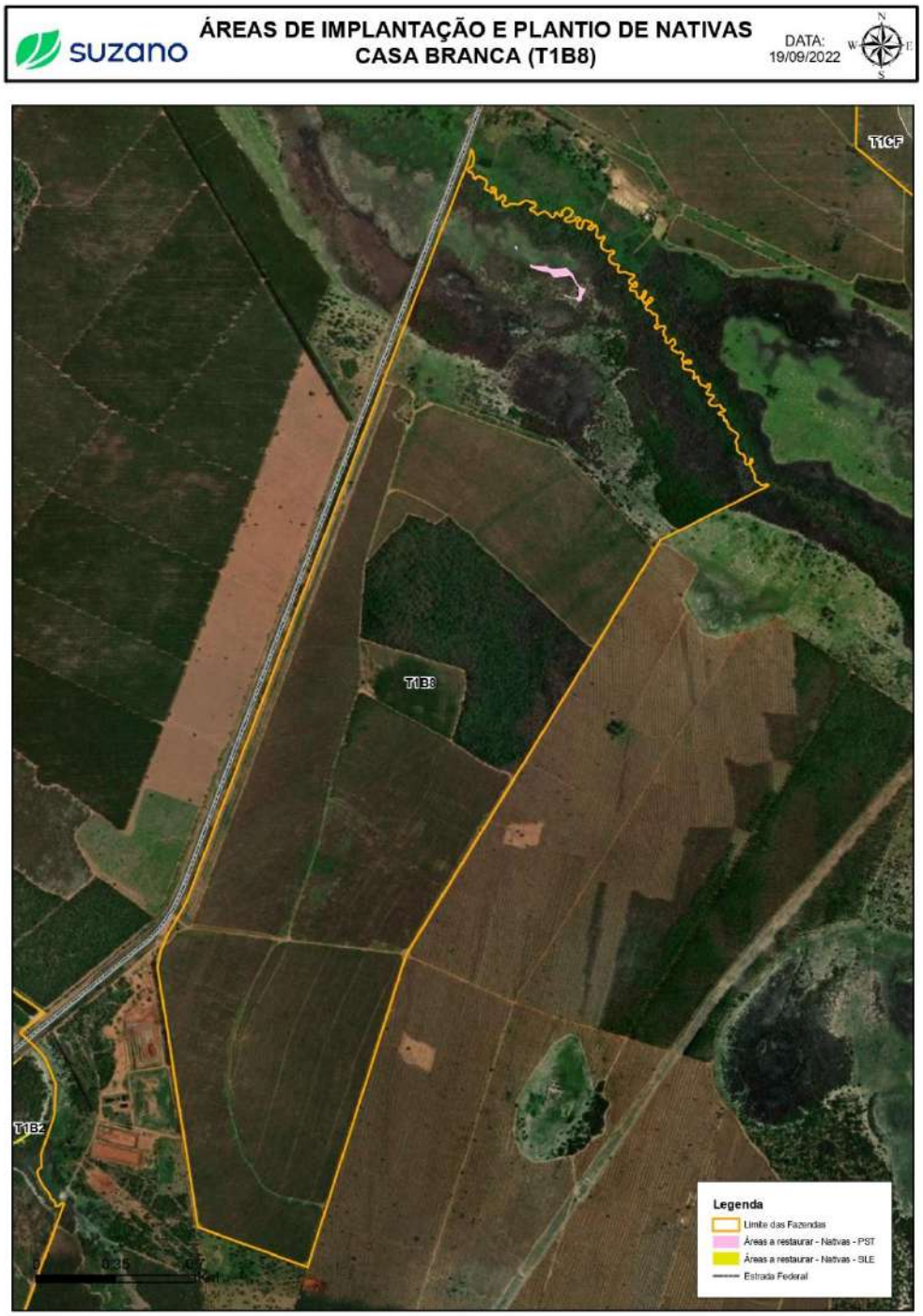


Figure 20 - Location and stratification of Casa Branca. Native restoration in light pink (PST) and mustard (SLE).

Figure 21 - Location and stratification of Cristo Redentor. Eucalyptus plantation in yellow and Native restoration plantation area highlighted in light pink (PST) and white (PSR).

Figure 22 - Location and stratification of Curuaca. Eucalyptus plantation in yellow and Native restoration plantation area highlighted in light pink (PST) and white (PSR).

Figure 23 - Location and stratification of Duas Marias. Eucalyptus plantation area highlighted in yellow and native restoration planting area in light pink (PST) and white (PSR).

Figure 24 - Location and stratification of Estradão. Native restoration plantation area highlighted in light pink (PST) and white (PSR).

Figure 25 - Location and stratification of Figueira. Eucalyptus plantation area highlighted in yellow.

Figure 26 - Location and stratification of Flor da Serra. Native restoration planting area highlighted in white (PSR).

Figure 27 - Location and stratification of Guara-Suia. Native restoration planting area highlighted in light pink (PST) and white (PSR).

Figure 28 - Location and stratification of Jandaia. Eucalyptus plantation area highlighted in yellow

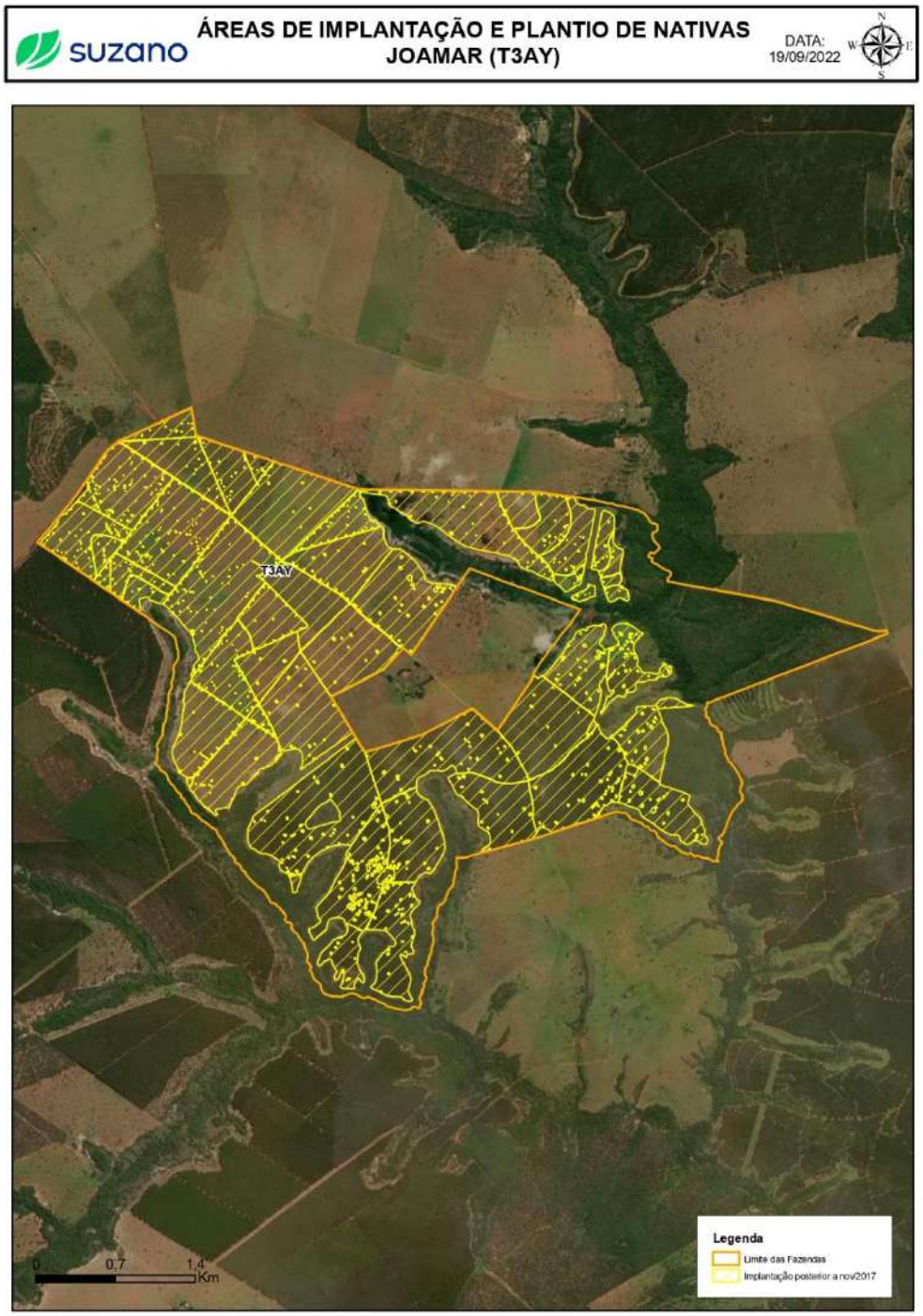


Figure 28- Location and stratification of Joamar. Eucalyptus plantation area highlighted in yellow.

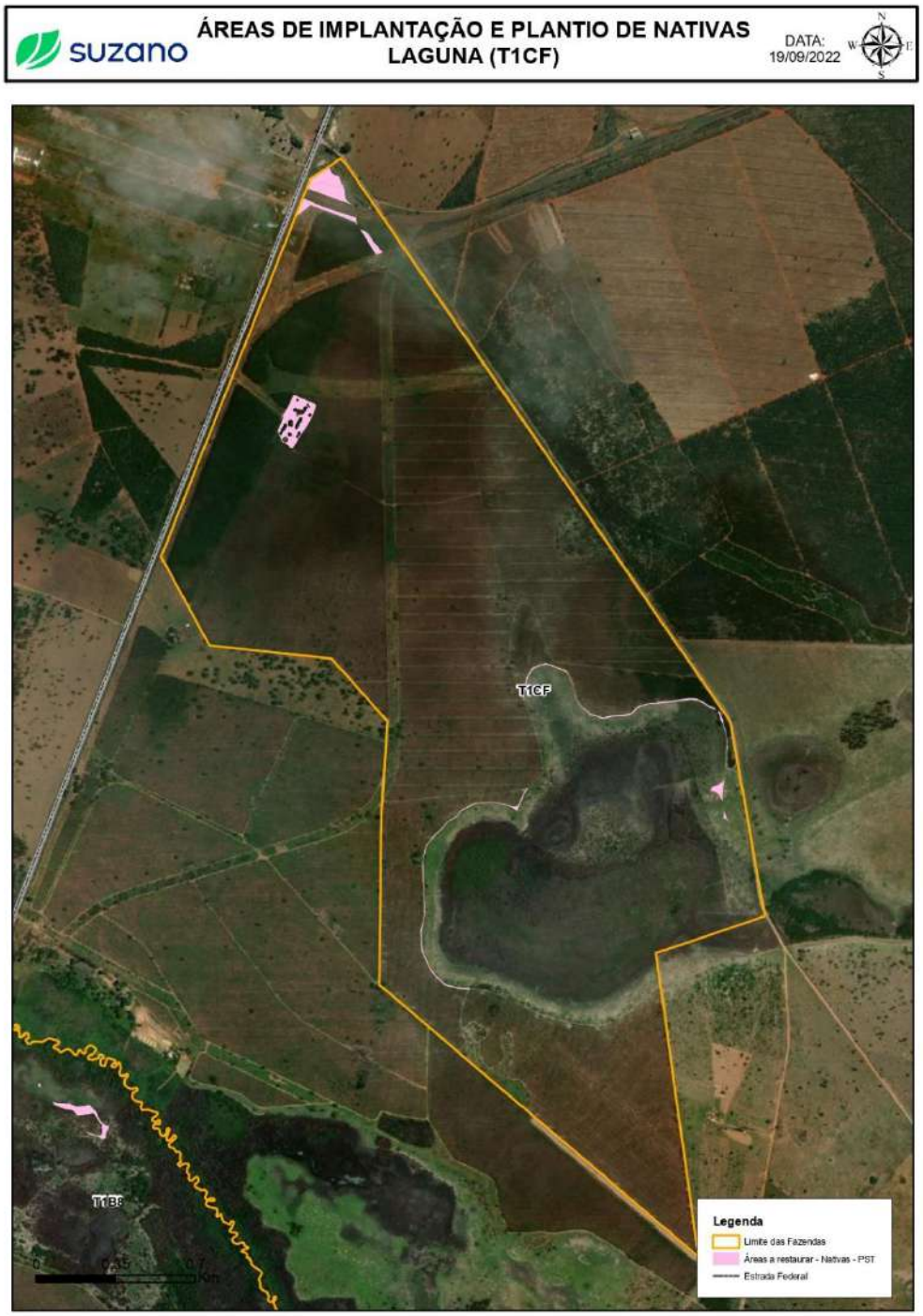


Figure 29- Location and stratification of Laguna. Native restoration planting area highlighted in light pink (PST).

Figure 30 - Location and stratification of Matão. Native restoration area highlighted in light pink (PST) and white (PSR).

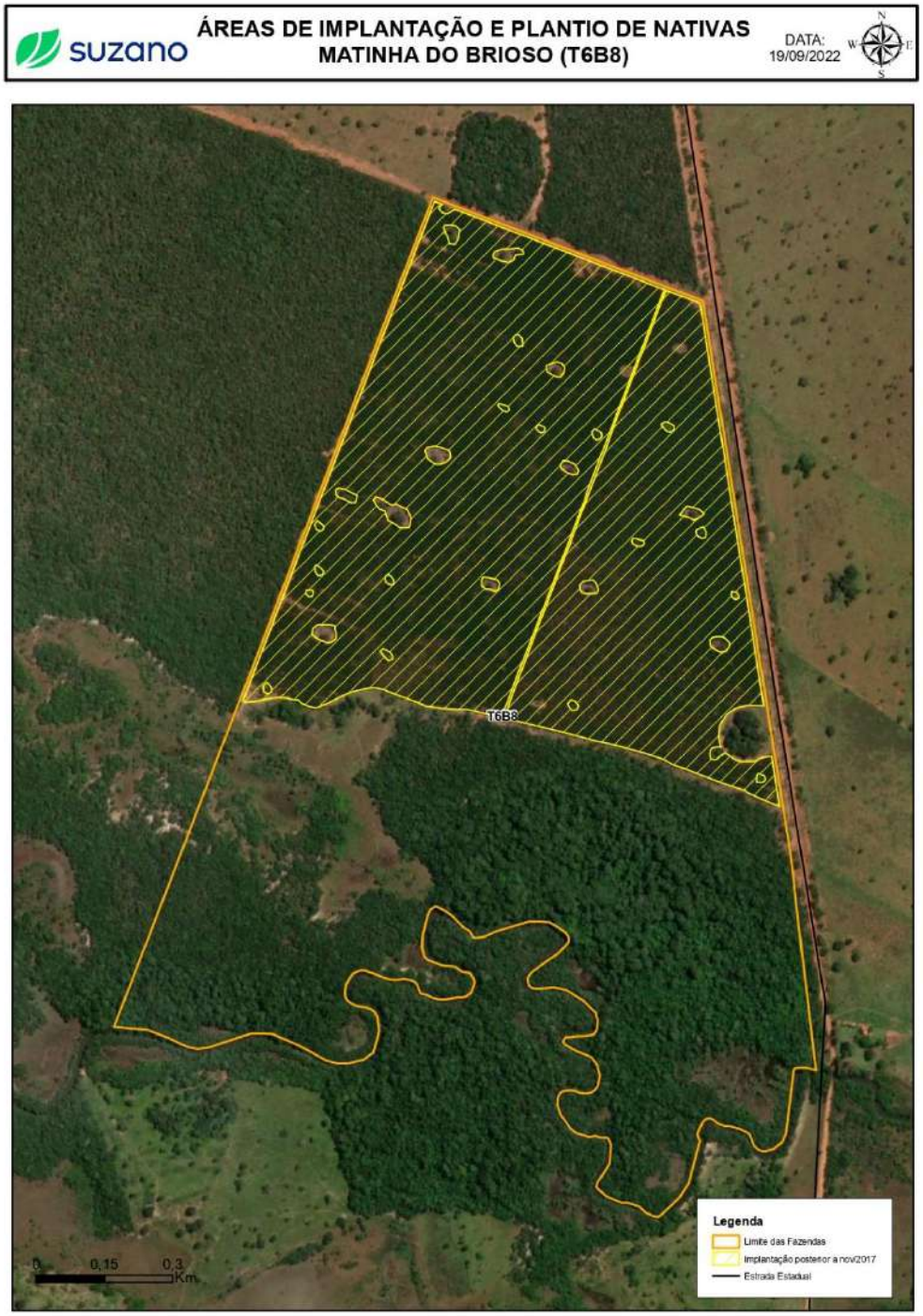


Figure 31 - Location and stratification of Matinha do Briosio. Eucalyptus plantation area highlighted in yellow.

Figure 32 - Location and stratification of Monte Alto. Eucalyptus plantation area highlighted in yellow.

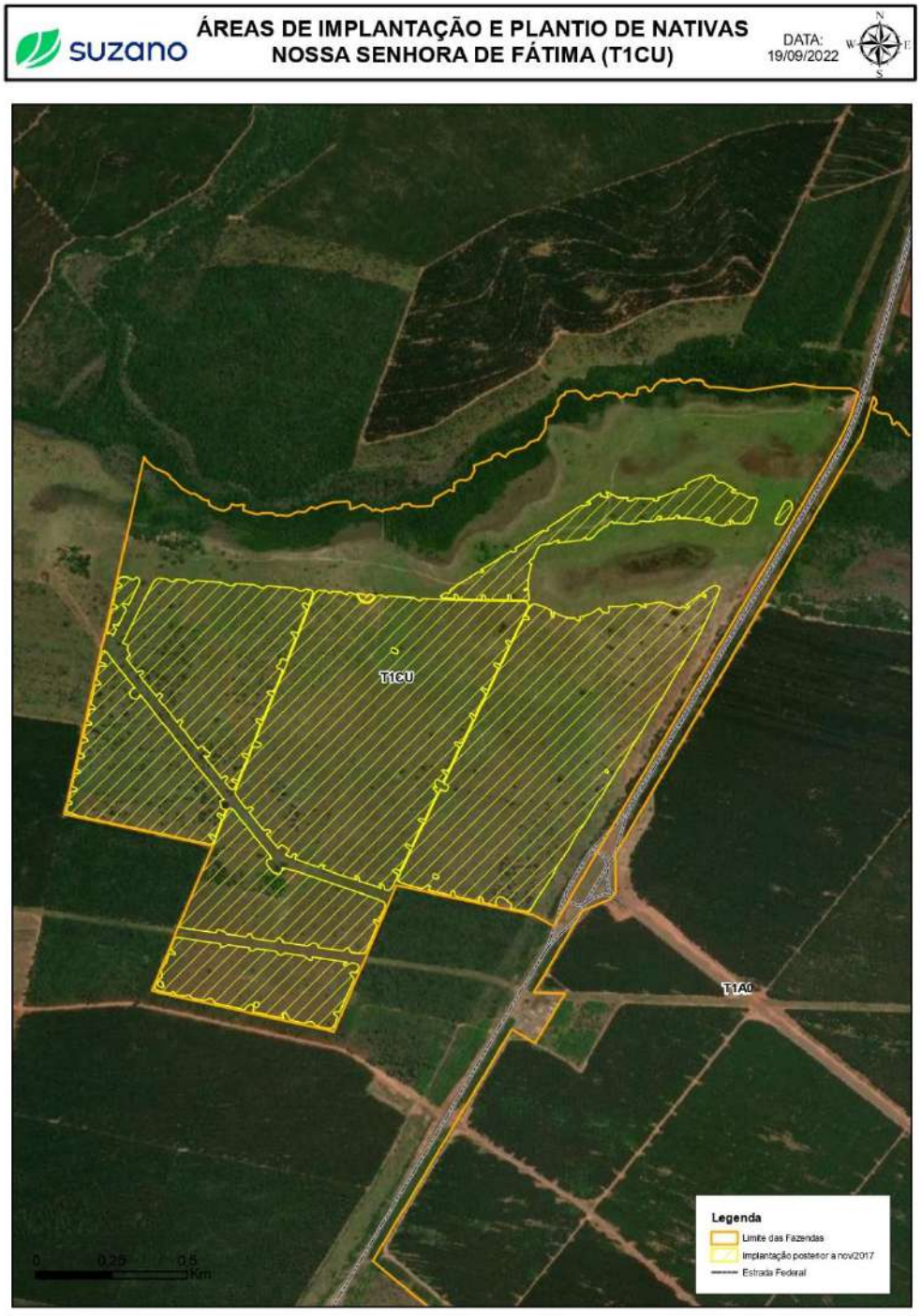


Figure 33 - Location and stratification of Nossa Senhora de Fátima. Eucalyptus plantation area highlighted in yellow.

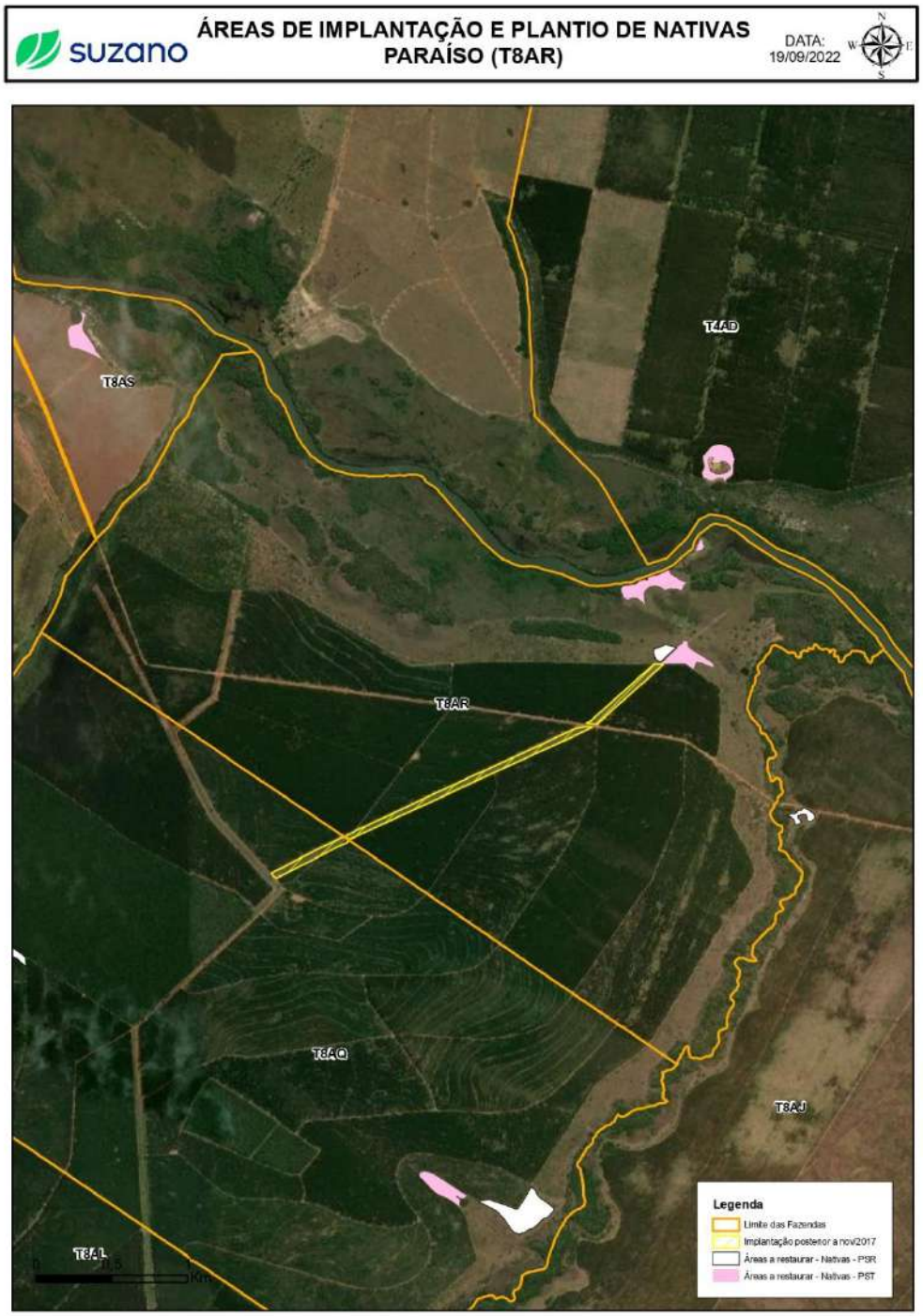


Figure 34 - Location and stratification of Paraíso. Eucalyptus plantation area highlighted in yellow and native restoration area highlighted in light pink (PST) and white (PSR).

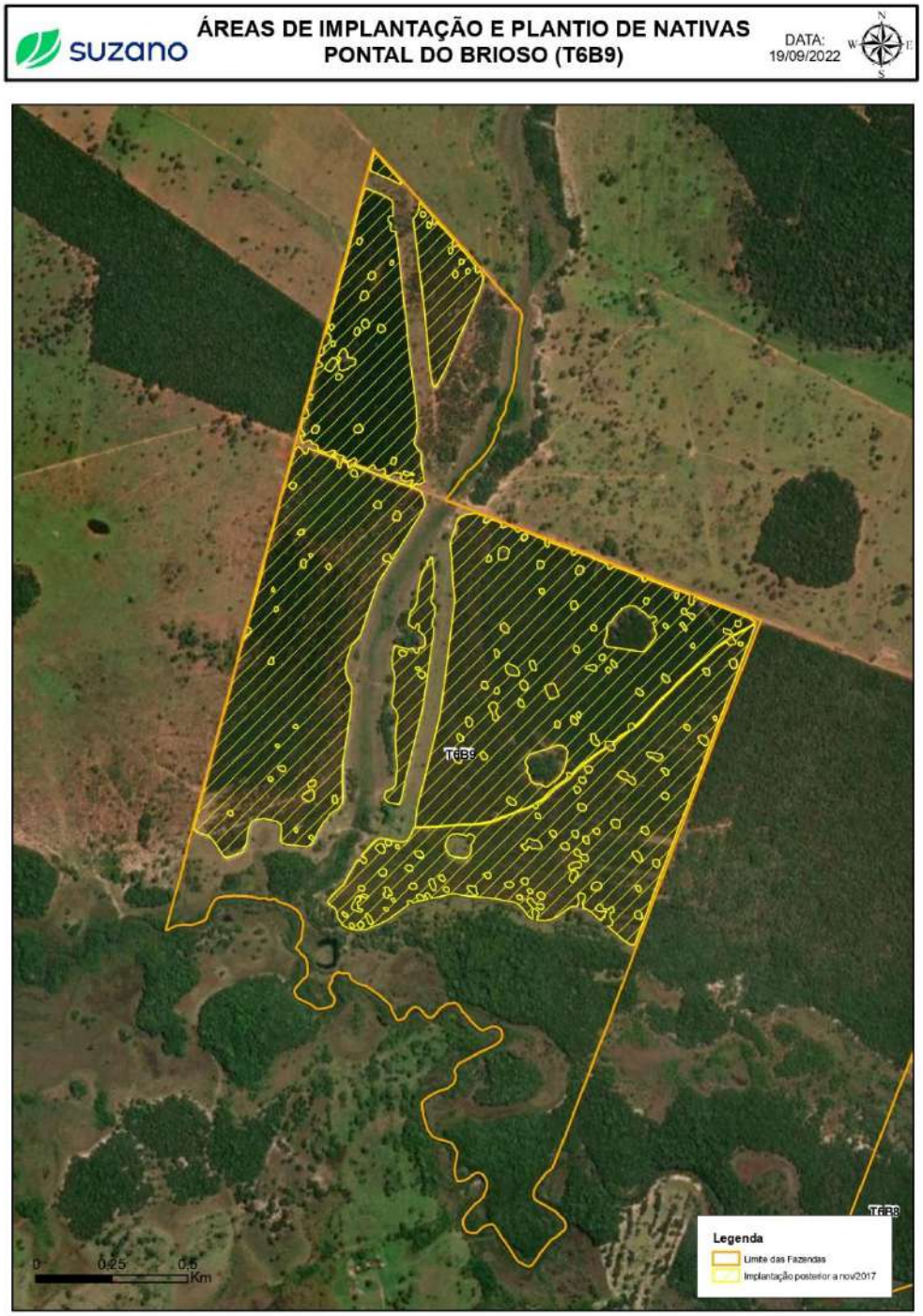


Figure 35 - Location and stratification of Pontal do Briosio. Eucalyptus plantation area highlighted in yellow.

Figure 36- Location and stratification of Santa Inês Gleba C. Eucalyptus plantation area highlighted in yellow.

Figure 37- Location and stratification of Santa Inês. Eucalyptus plantation area highlighted in yellow.

Figure 38 - Location and stratification of Santa Terezinha II. Eucalyptus plantation area highlighted in yellow.

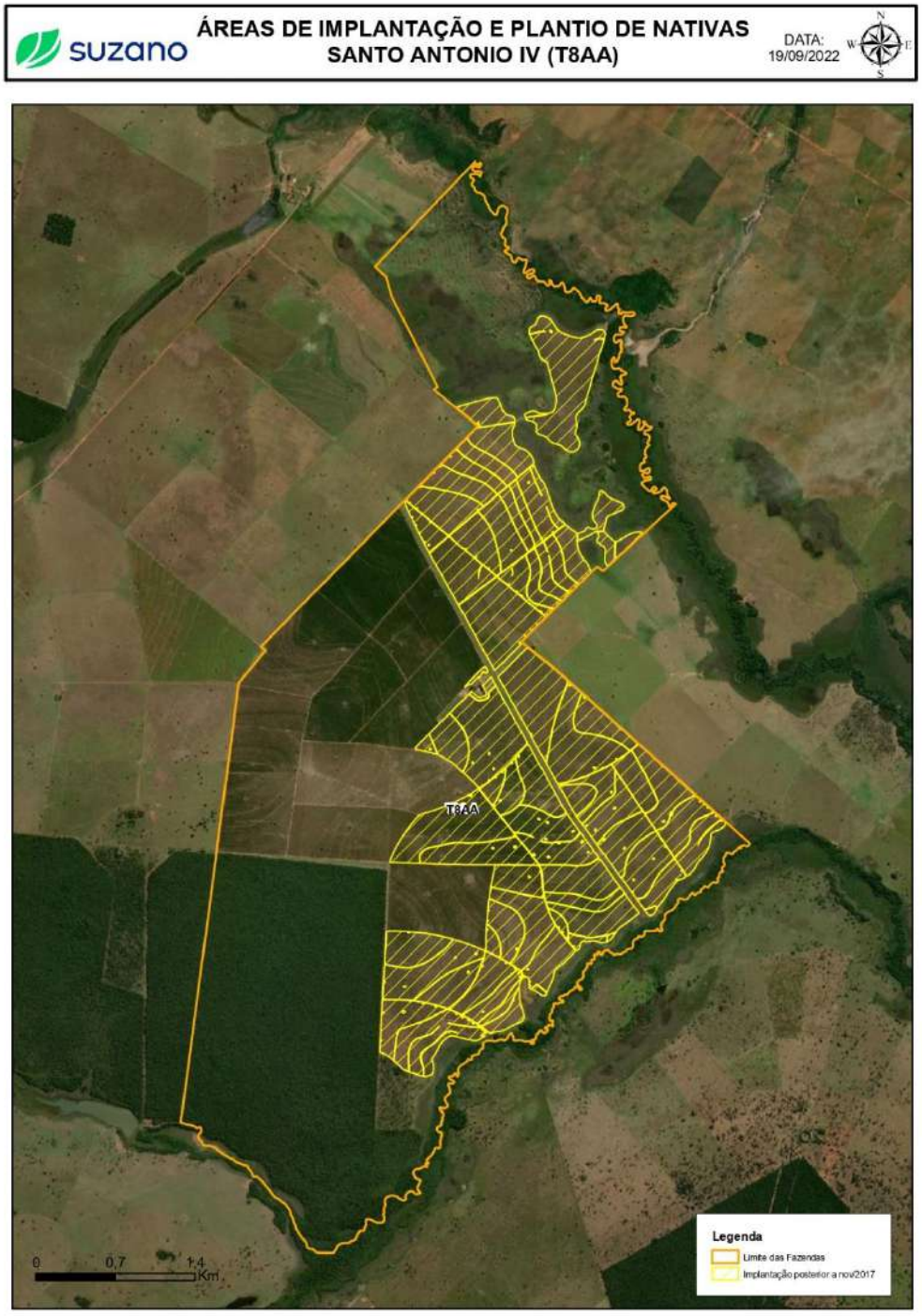


Figure 39 - Location and stratification of Santo Antônio IV. Eucalyptus plantation area highlighted in yellow.

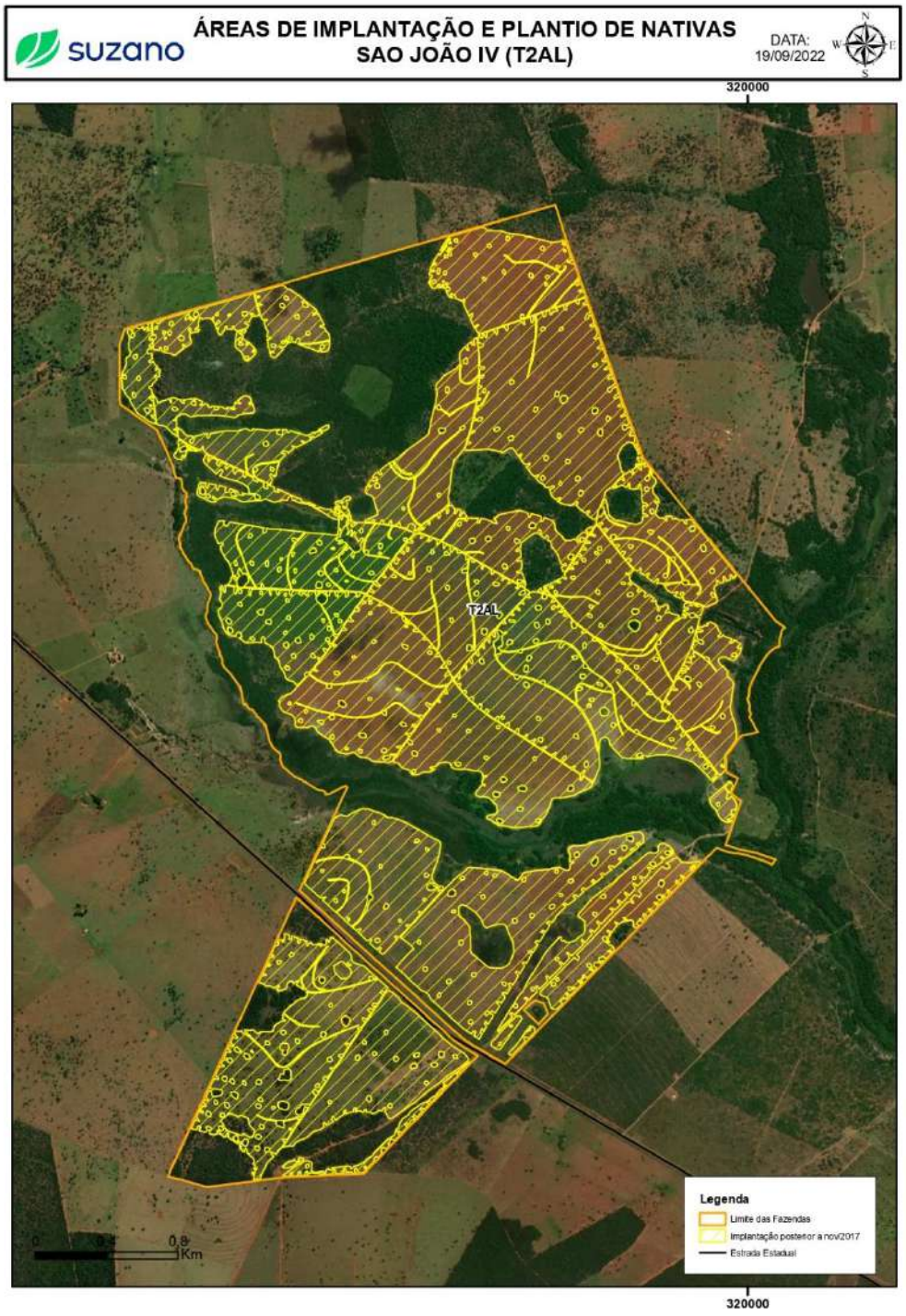


Figure 40 - Location and stratification of São João IV. Eucalyptus plantation area highlighted in yellow.

Figure 41 - Location and stratification of São José. Eucalyptus plantation area highlighted in yellow and native restoration area highlighted in light pink (PST) and white (PSR).

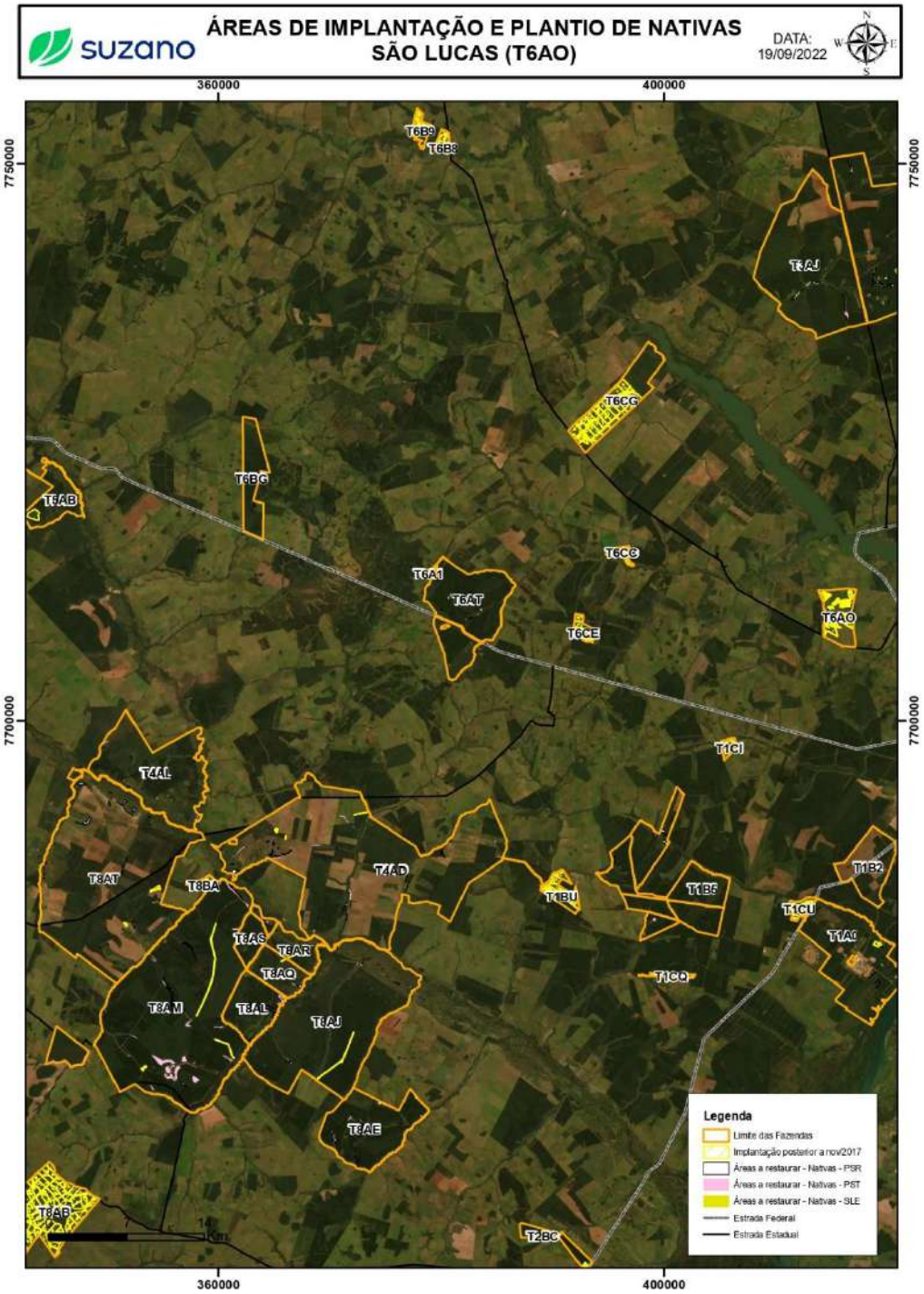


Figure 42 - Location and stratification of São Lucas. Eucalyptus plantation area highlighted in yellow.

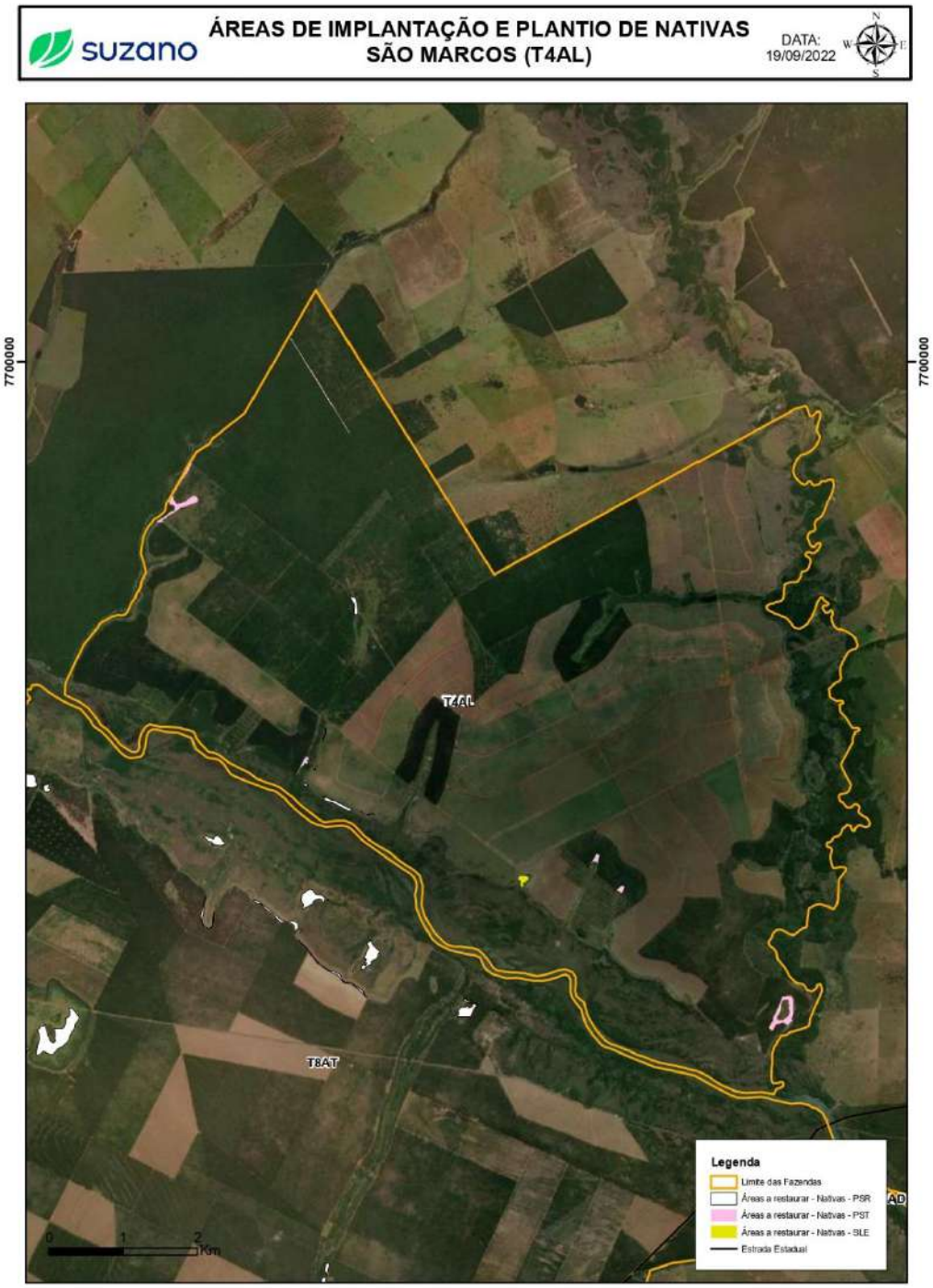


Figure 43- Location and stratification of São Marcos. Native restoration planting area highlighted in light pink (PST), white (PSR) and mustard (SLE).

Figure 44- Location and stratification of São Miguel III. Eucalyptus plantation area highlighted in yellow and Native restoration planting area highlighted in light pink (PST).

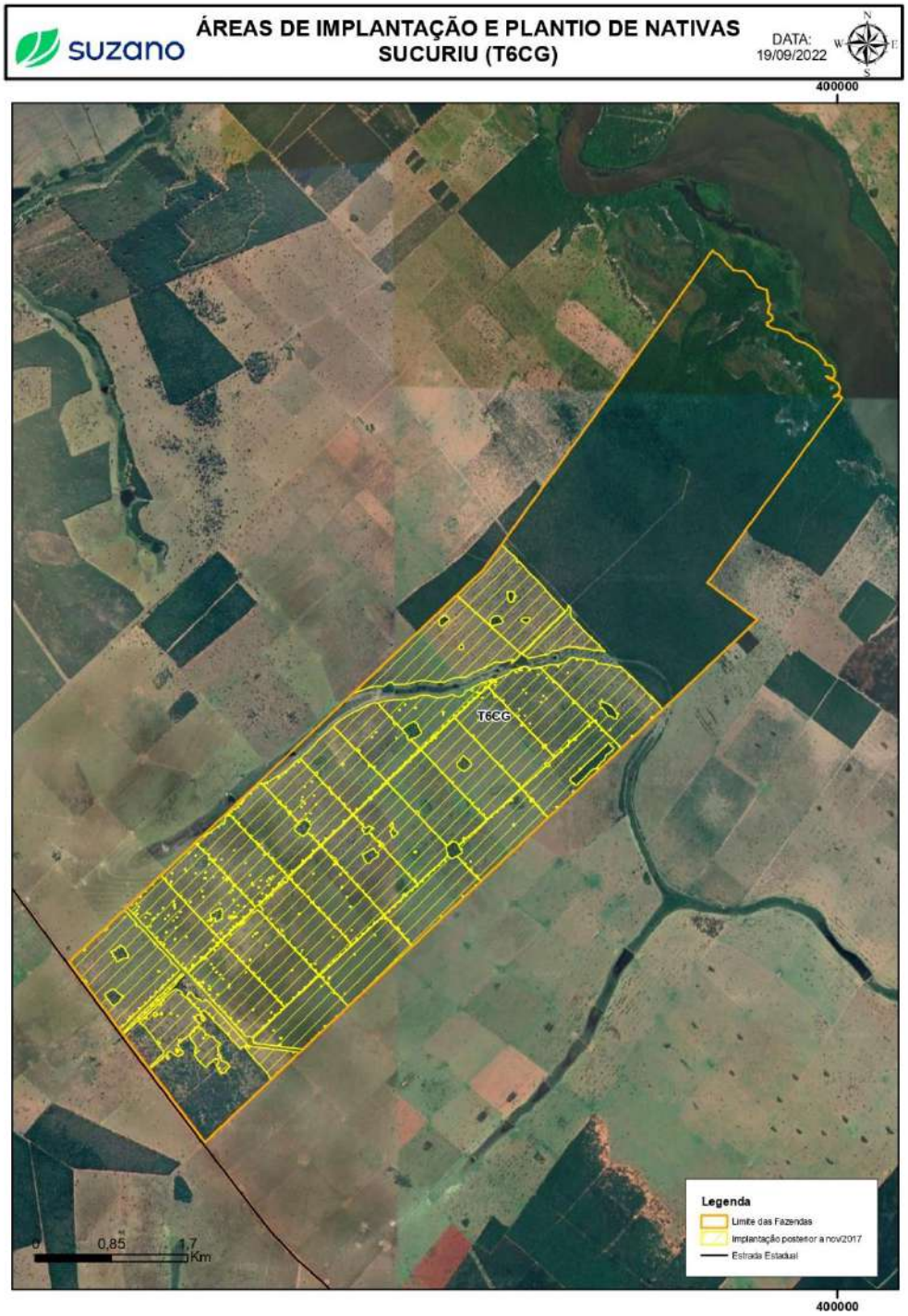


Figure 45- Location and stratification of Sucuriu. Eucalyptus plantation area highlighted in yellow.

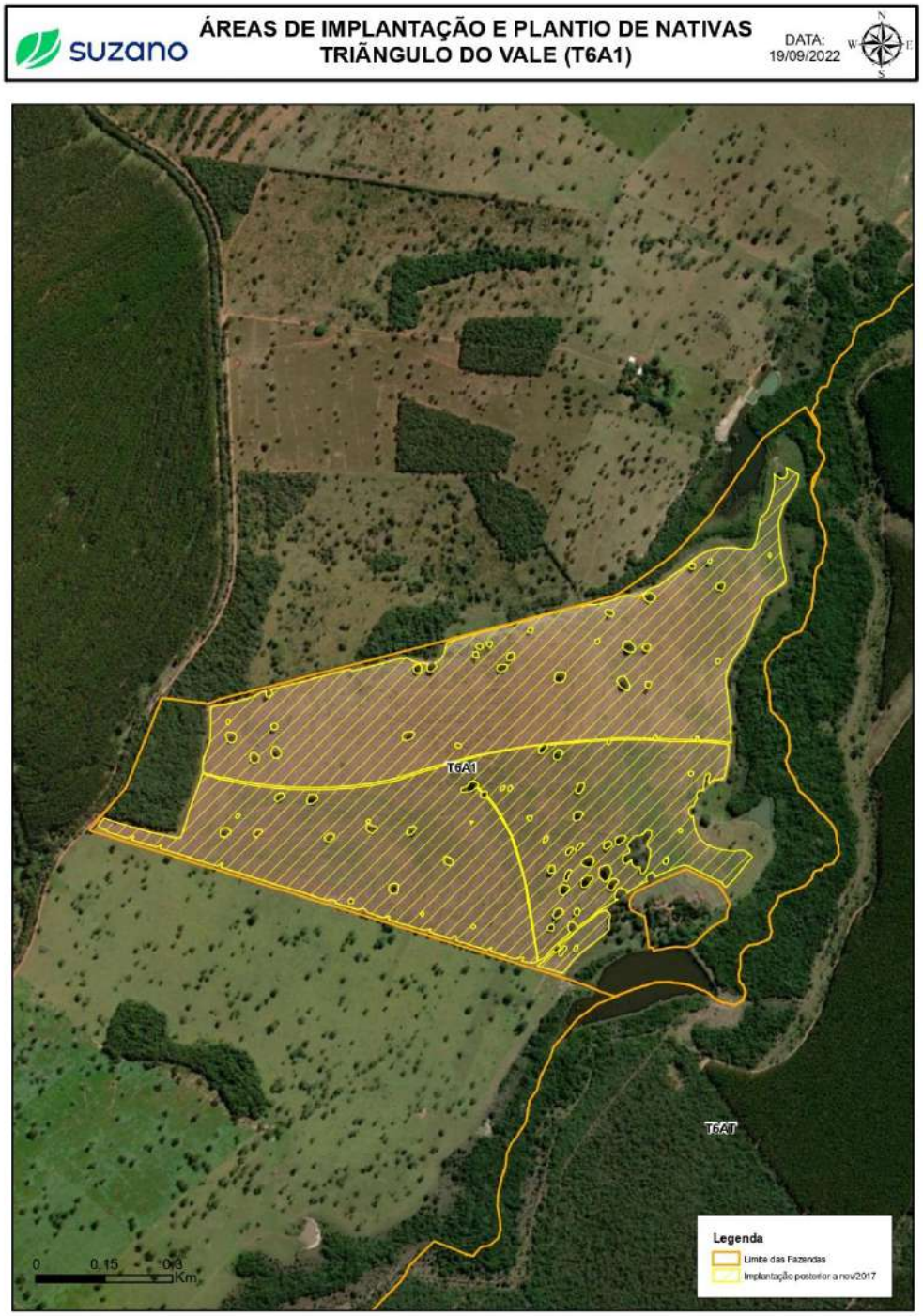


Figure 46 - Location and stratification of Triângulo do Vale. Eucalyptus plantation area highlighted in yellow.

Figure 47 - Location and stratification of Vale Gerivá. Eucalyptus plantation area highlighted in yellow and Native restoration planting area highlighted in light pink (PST) and white (PSR).

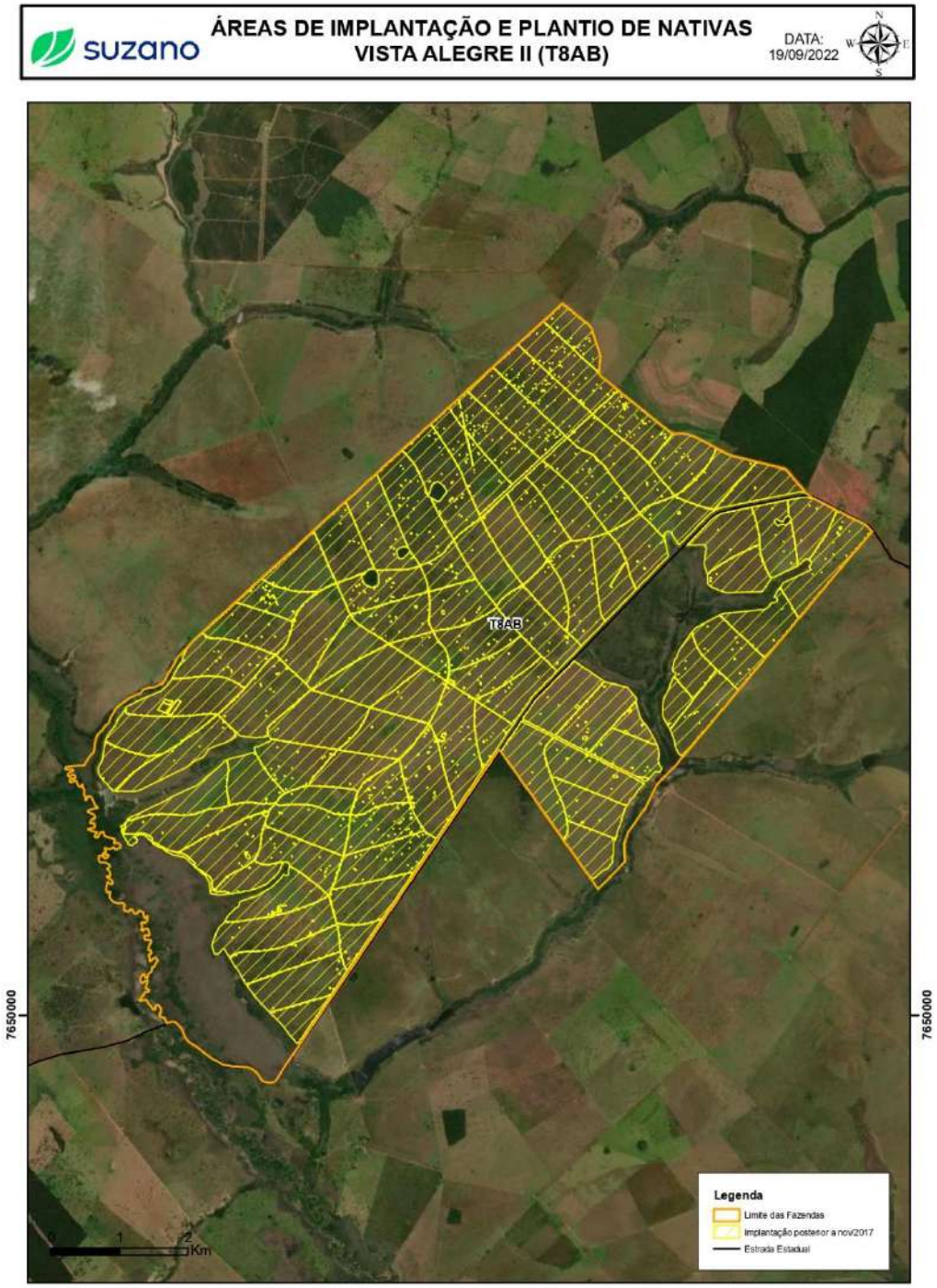


Figure 48- Location and stratification of Vista Alegre II. Eucalyptus plantation area highlighted in yellow.

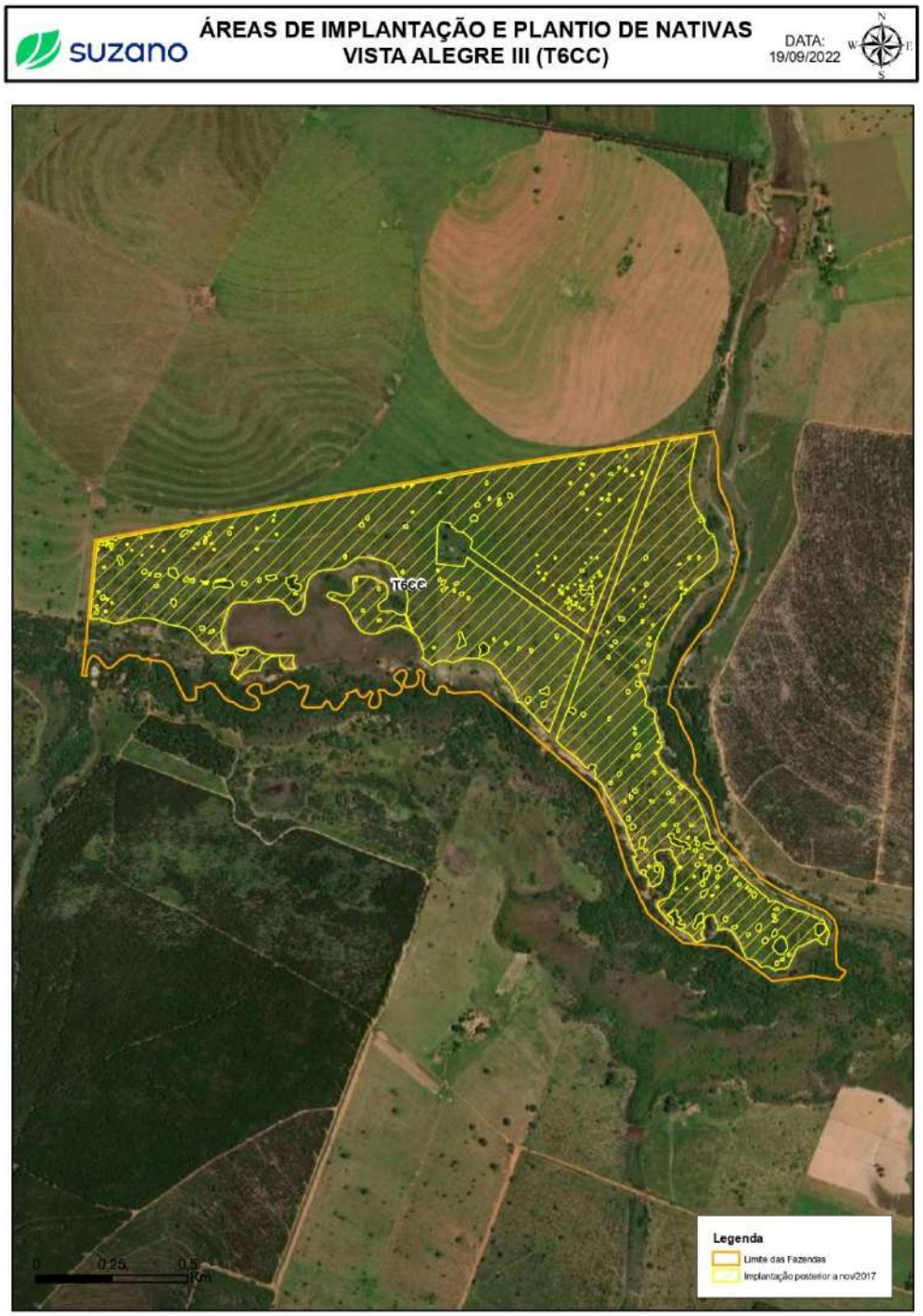


Figure 49 - Location and stratification of Vista Alegre III. Eucalyptus plantation area highlighted in yellow.

1.13 Conditions Prior to Project Initiation

Current and historical land-use

According to MapBiomas[7], currently the cities of Três Lagoas, Brasilândia, Santa Rita do Pardo, Selviria, Bataguassu, Água Clara and Aparecida do Taboado has together only 14.05% of its area occupied by native formations. 77.93% of its area occupied by cattle ranching, agriculture, and forestry. The predominance of land use for the cities has been the same since 1985, date from which data is available at the website, being the most relevant activity the cattle ranching, even though native vegetation has been a target of deforestation activities. Since 1987, over 865k ha have been deforested in all cities combined. Before the implementation of the project, the areas were in fallow, and before that, they were occupied by extensive cattle ranching, hence the classification as degraded grasslands, combined with areas of Cerrado (Brazilian Savanah).

The degraded land was characterized by exposed soil patches. The factors that led to this gradual depletion of pasture and soil were cattle grazing, cattle trampling and lack of rational fertilization and pasture care. 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.

The general characteristics of the project area and reference region are described below:

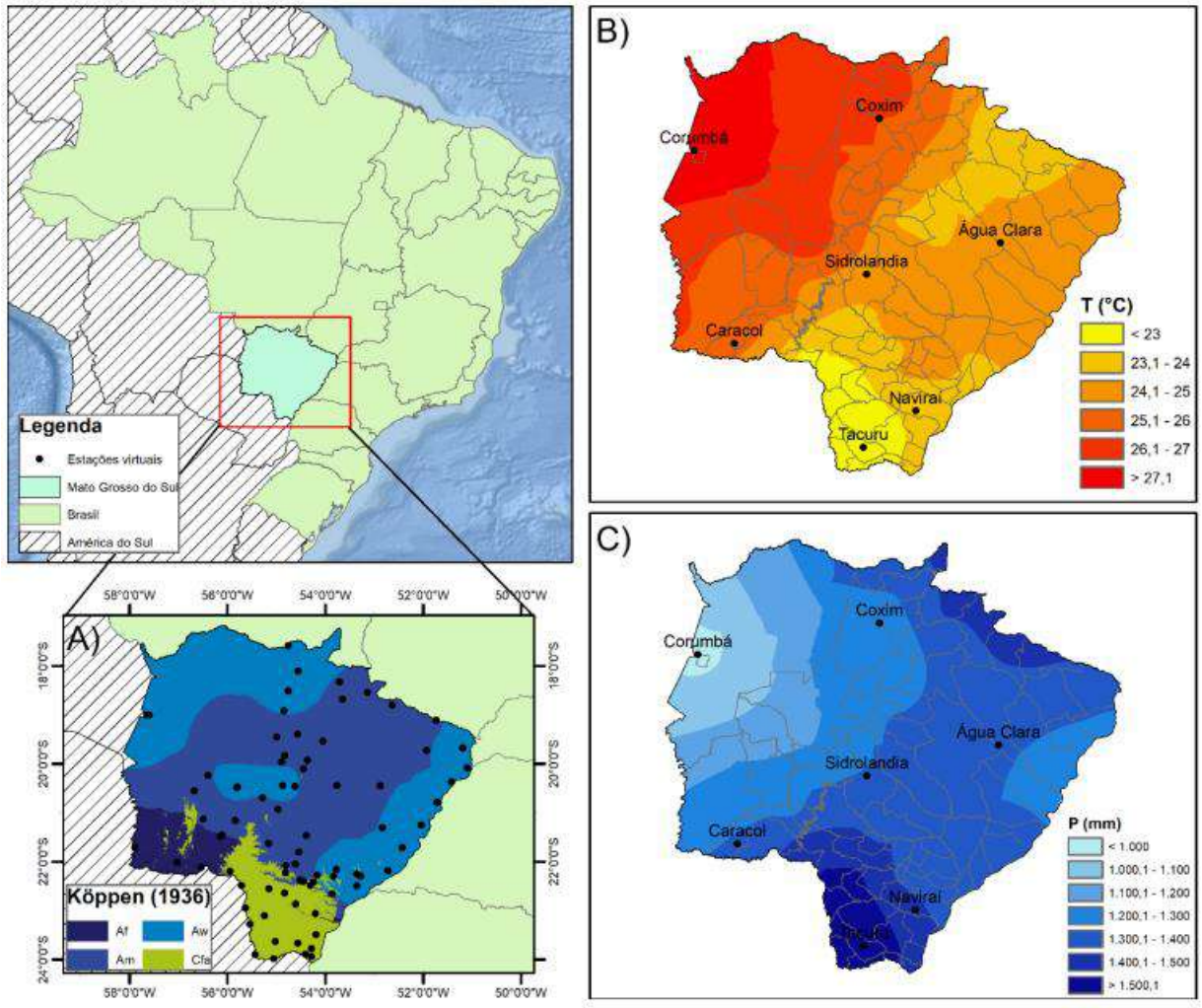
Climate

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 eastern part of the State, where the project is located, with at least 3 months of dry season and a longer rainy season, with the highest rainfall concentration. According to Koppen classification, in Três Lagoas the climate type is AW (Tropical Savannah climate)[8]. This climate is similar to a tropical climate, with dry winters, whereas the summer is the rainy season. The average temperature is 24.7 °C, reaching on average 21.2 °C on the coldest month (June) and 26.7 °C on the warmest month (October), and the annual average rainfall is 1340 mm, reaching 1800 mm in some years.[9]

[7] MAPBIOMAS, Coleção 6 (1985-2020). Available at: <https://mapbiomas.org/>. Last access: 27th May 2022.

[8] Climate Data. Clima Três Lagoas. Available at: < https://pt.climate-data.org/america-do-sul/brasil/mato-grosso-do-sul/tres-lagoas-34651/>. Last access: 30th June 2022.

[9] EMBRAPA. Clima. Available at: <https://www.cnpf.embrapa.br/pesquisa/efb/clima.htm#:~:text=Aw%20%2D%20Clima%20tropical%2C%20com%20inverno,frio%20%C3%A9%20superior%20a%2018%C2%BAC.>. Last access: 30th June 2022.



Fonte: Autores (2021).

Figure 50 – Koppen classification (a), Rainfall (c) and temperature (c) of Mato Grosso do Sul8

Hydrology

In Mato Grosso do Sul territory there are two national hydrographic basins: at west the Paraguai River basin and at east the Paraná River basin, separated by Serra das Araras, Serra Camapuã and part of Serra de Maracajú mountain ranges[10]. The project area is in the

[10] Instituto Histórico e Geográfico do Mato Grosso do Sul. Quais as principais bacias hidrográficas do Mato Grosso do Sul? Available at: <https://ihgms.org.br/vc-sabia/quais-as-principais-bacias-hidrograficas-de-mato-grosso-do-sul-8#:~:text=As%20duas%20principais%20bacias%20hidrogr%C3%A1ficas,de%20Mato%20Grosso%20do%20Sul.>. Last access: 30th June 2022.

Verde River and Sucuriú River sub-basins, in the Paraná River basin[11], and is located at the margin of the Paraná River, near its division with the Sucuruiú River and the Verde River.

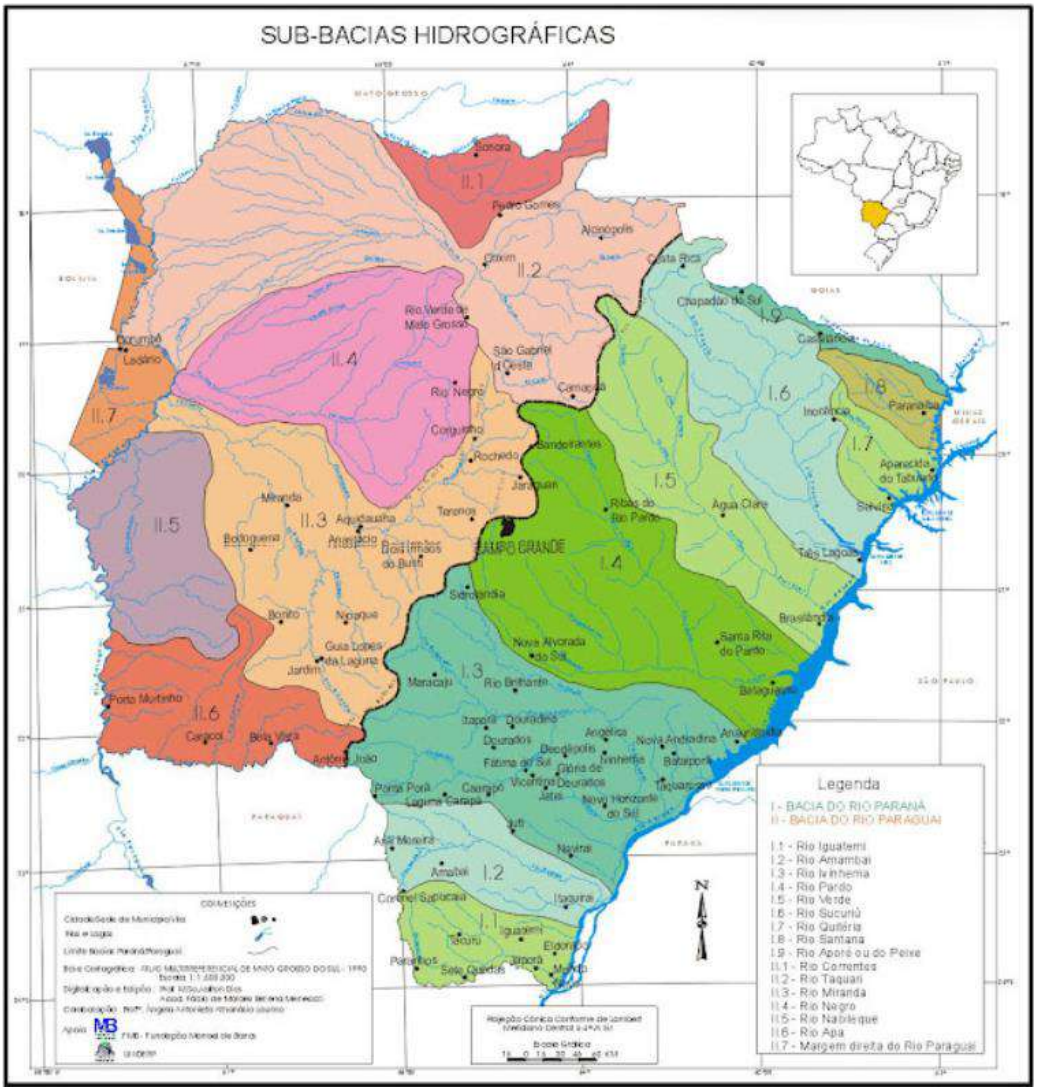


Figure 51 – Sub-basins at Mato Grosso do Sul[12]

Topography

As seen in all the altitude of the western part of the Paraná Basin, there is a slight inclination of the surface towards the south-southeast direction. Altitudes at ridges reach 550m and at valleys reach 400m. The cities of Três Lagoas, Brasilândia, Santa Rita do Pardo, Selviria,

[11] Prefeitura Municipal de Três Lagoas. Município Participa na formação da Enciclopédia das Águas. Available at: <http://www.treslagoas.ms.gov.br/municipio-participa-na-formacao-da-enciclopedia-das-aguas/>. Last access: 30th June, 2022.

[12] Brasil Turismo. Mato Grosso do Sul no Mapa do Turismo. Available at: < http://www.brasilturismo1.rf.gd/2020/08/09/mato-grosso-do-sul-no-mapa-do-turismo/?i=1>. Last access: 15th July, 2022

Bataguassu, Água Clara and Aparecida do Taboado have an altitude range from 309m to 396m[13].

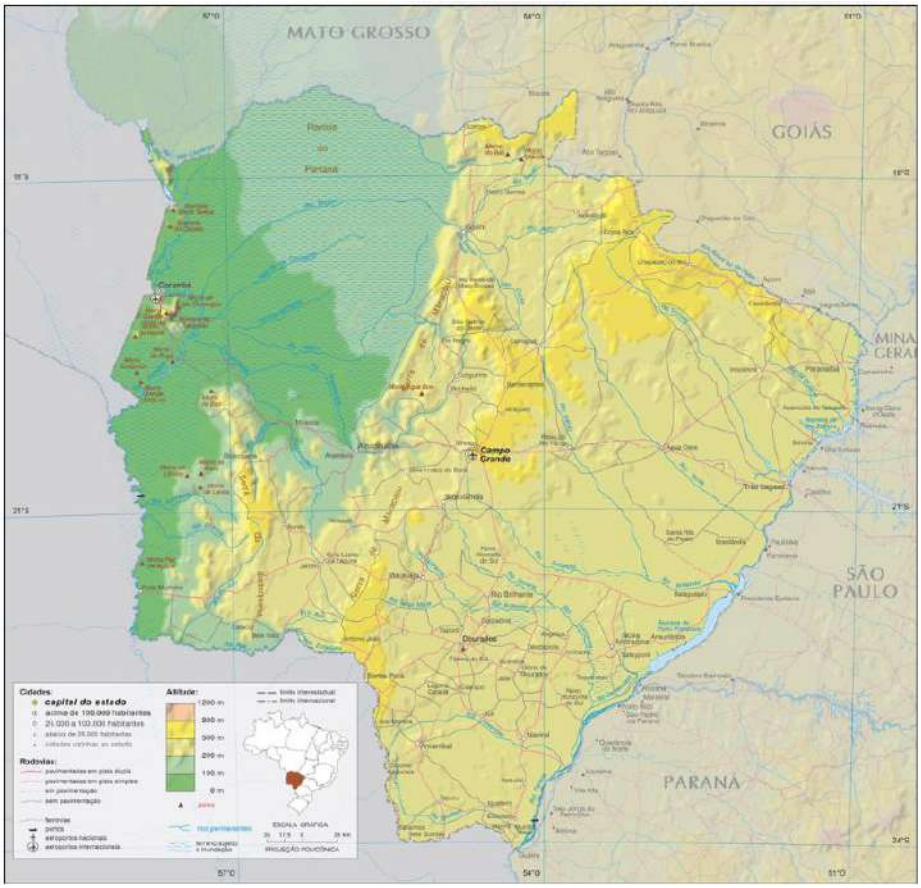


Figure 52 – Altitude at Mato Grosso do Sul [12]

Demography and Land Use

According to IBGE[14], the State of Mato Grosso do Sul has a total extension of 357,145 km^2 (35.71 million hectares) and the resident population amounts to 2,839,188 inhabitants, with a population density of 6.86 inhabitants/km^2. The State is divided into 79 Municipalities, including the cities that host 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, including planted forests.

[13] Cidade Brasil. Mato Grosso do Sul. Available at: <https://www.cidade-brasil.com.br/estado-mato-grosso-do-sul.html >. Last Access: 06 July, 2022.

[14] Instituto Brasileiro de Geografia e Estatística. Cidades e Estados – Mato Grosso do Sul. Available at: <https://www.ibge.gov.br/cidades-e-estados/ms.html>. Last access: 26th Nov. 2021.

In the city of Três Lagoas, the most relevant city from the ones where the project is located, the most relevant economical activity is cattle ranching. Other important activities are the industries and tourism. According to the IBGE, considered all of the cities where the project is located, they have an estimated population of 194,160 citizens (2021), with an average demographic density of 5.06 habitants/km² [15].

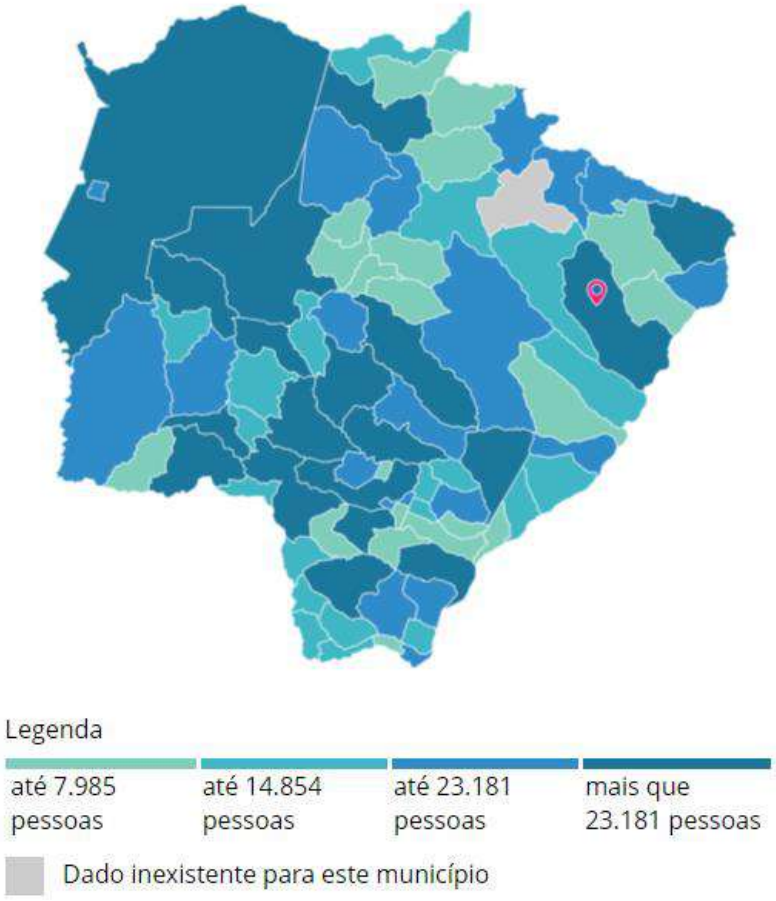


Figure 53 – Population at Mato Grosso do Sul[16]

Soils

The main soils present at the project area are the Dark Red Latosoil and Purple Latosoil. Because they are deep and porous or very porous, they present adequate conditions for

[15] IBGE. Cidades e Estados. Available at: <https://www.ibge.gov.br/cidades-e-estados/ms/tres-lagoas.html>. Last access: 07th July, 2022.

[16] Instituto Brasileiro de Geografia e Estatística. Cidades e Estados – Três Lagoas. Available at: < https://cidades.ibge.gov.br/brasil/ms/ribas-do-rio-pardo/panorama>. Last access: 15th July. 2022

good root development in depth. These soils are considered suitable for forestry and perennial plantations if well managed from an agronomic point of view.

Under natural conditions, Dark Red Latsoil present low Carbon ("C") contents in the soil, due to the intense process of weathering, the highest content for organic matter on these soils was 4.5% 17. On the other hand, Purple Latosoils show even lower rates of organic matter on its composition, of 3.5% on the highest assessment[18]. Therefore, the soils that occur within the project boundary are not inserted in the category of organic soils[19], being eligible for project activity in accordance with the applied methodologies in this PD.

Moreover, a few farms under the project had their soil sampled and tested. All results indicated the areas have a composition of more than 80% of sand in their soil, being classified as loamy sand soils (USDA). Nevertheless, organic matter results indicated an average value of 1.1 dag/dm³.

[17] CARNEIRO, Silvia Pereira. Qualidade de um Latossolo Vermelho sob diferentes tipos de uso e manejos em área do cerrado. Available at: <https://repositorio.ufmg.br/bitstream/1843/MPBB-8FXLGP/1/mestrado_silvia.pdf>. Last access: 25th November 2021

[18] CENTURION, J.F; Et. al.. Characteristics of dusky latosols developed from alkaline and basic rocks in Jaboticabal, SP. Sci. agric. (Piracicaba, Braz.) 52 (2). Ago 1995. Available at: <https://www.scielo.br/j/sa/a/BZBzr3LV9CRWZf69Sy4ZggJ/?lang=pt#>. Last access: 19th May 2021.

[19] PENMAN et al. "Good practice guidance for land use, land-use change and forestry." (2003).

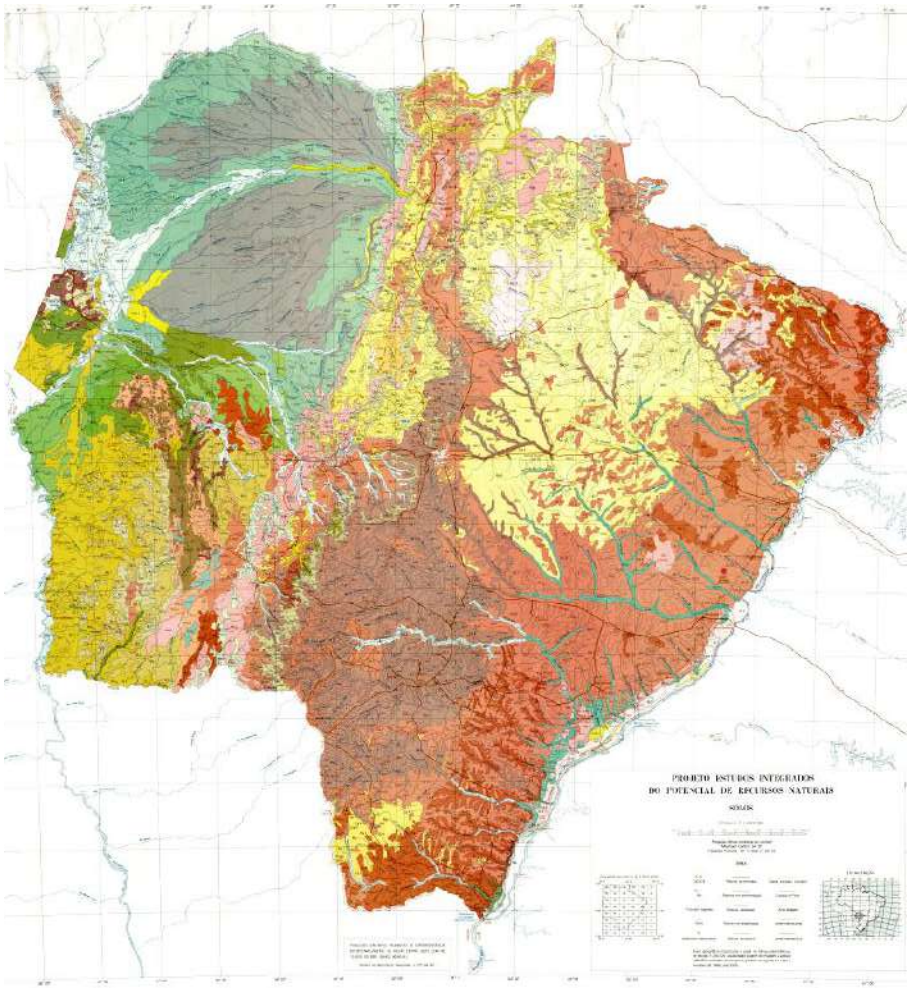


Figure 54 – Mato Grosso do Sul Soil Map [20]

Vegetation

In the cities where the project area is located present, the Cerrado biome is predominant. For the Cerrado biome, the classification of the vegetation in the field is supported by Ribeiro and Walter (2008)[21] who define forests as environments with a predominance of tree species and continuous or discontinuous canopy formation, while savanna formations are characterized by the coexistence of arboreal, shrub and herbaceous layers. The grassland

[20] Instituto Brasileiro de Geografia e Estatística – IBGE. Estado de Mato Grosso do Sul. Available at: <http://www.servicos.ms.gov.br/semade_download/Mapas%20Tem%C3%A1ticos/Mapa%20Solos.pdf>. Last access: 18th July, 2022.

[21] RIBEIRO, José Felipe; WLATER, Bruno Machado Teles. As Principais Fitofisionomias do bioma Cerrado. 2008. Available at: < https://www.researchgate.net/publication/283072910_As_principais_fitofisionomias_do_bioma_Cerrado>. Last Access: 07th July, 2022.

formations are characterized by the prevalence of herbaceous and shrub species, with fewer trees and a lack of canopy formation. The Figure below provides a pictorial representation of 12 vegetation Phyto physiognomies typical of the Cerrado, including: Riparian Forest (Mata Ciliar), Gallery Forest, Dry Forest, Tall Woodland (Cerradão), Dense Cerrado, Typical Cerrado, Sparse Cerrado, Park Savanna, Palmland, Vereda, Rupestrian Cerrado, Rupestrian Grassland, Shrub Grassland and Open Grassland (low-grass savanna).

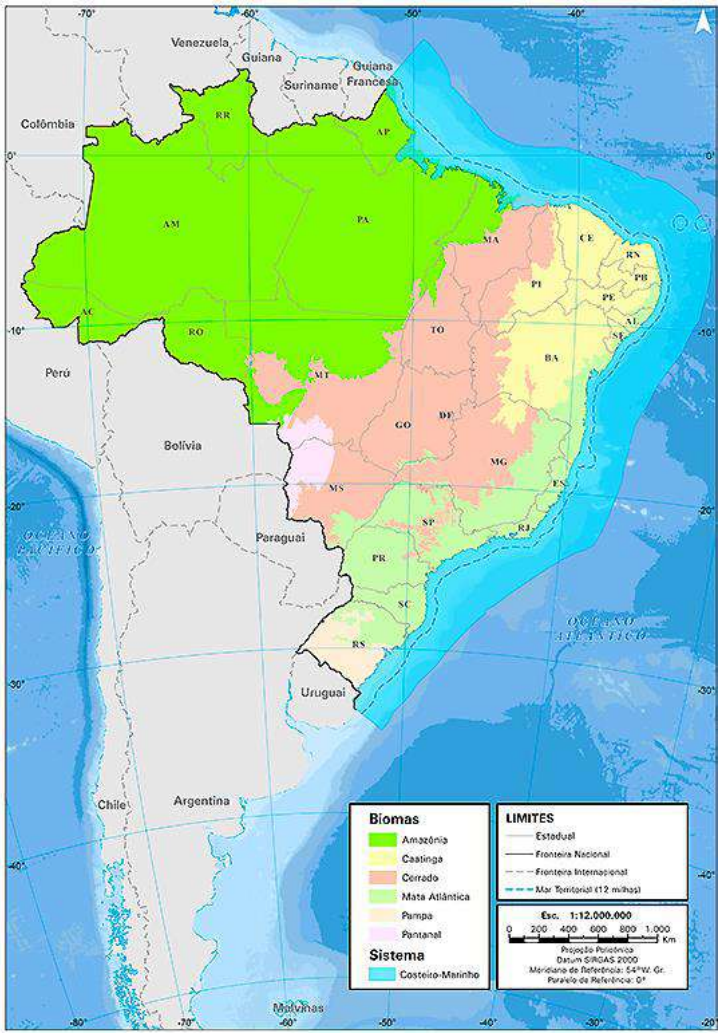


Figure 55 – Map of the Brazilian biomes[22]

In the project region, there is one main natural Cerrado formation, the Cerradão (Tall Woodland), that is a target for conservation activities; The project area, however, is mostly occupied by abandoned pasture, that will be the areas occupied by reforestation activities.

[22] Instituto Brasileiro de Geografia e Estatística. IBGE lança mapa inédito de Biomas e Sistema Costeiro-Marinho. Available at: <https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/25798-ibge-lanca-mapa-inedito-de-biomas-e-sistema-costeiro-marinho>. Last access: 15th July. 2022

Tall Woodland is a forest formation with sclerophyllous characteristics (large occurrence of hard plant organs, mainly leaves) and xeromorphic (with characteristics such as reduced leaves, succulence, dense pilosity or with thick cuticles for conserving water, rendering them suitable to endure dry conditions). It is characterized by the occurrence of species found in the Typical Cerrado (Cerrado Stricto Sensu) and in forests, particularly Dry Forest and Riparian Forest. It is a forest from a physiognomic point of view, but floristically it resembles more closely the Typical Cerrado. It is a denser type of vegetation.

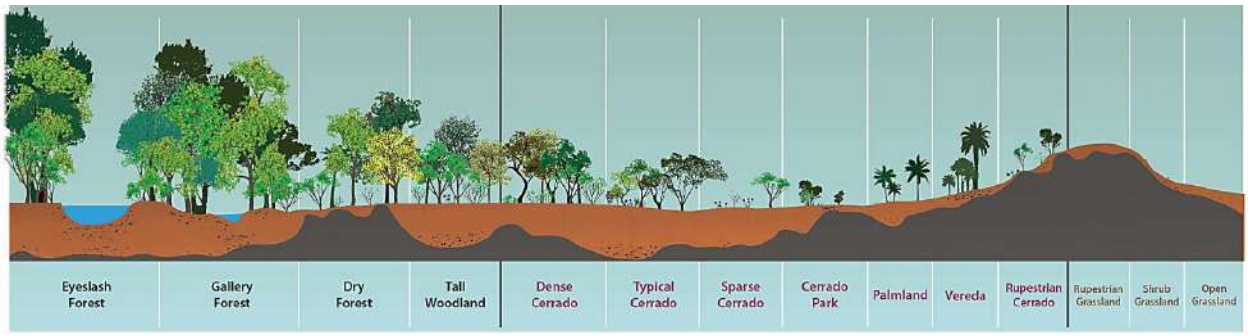


Figure 56 - Pictorial representation of the main vegetation Phyto physiognomies in the Cerrado biome, in a biomass gradient (from the largest forest formations, on the left, to the smallest ones - savannas and grasslands, on the right). Source: Adapted from Ribeiro and Walter, 2008

It is important to highlight that the project area did not remove any native ecosystems within 10 years of the project start date. The project area was converted for cattle ranching beforehand, and although sparse trees may be removed from project areas to implement the project activity, they do not configure ecosystem conversion.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project activity is compliant to all mandatory Laws, Statues and Other Regulatory Frameworks. The most relevant regulations to which the project is subjected to are:

- Resolution CERH MS nº 25, from 3 March 2015, states the criteria for grants and rights about the use of water resources.

The grants and rights to use for the project activity will be made available at each monitoring report for each new area included.

- Resolution SEMADE nº 9, from 13 May 2015, states the standards and procedures for environmental licensing among other guidelines. According to this resolution, the plantation and conduction of native or exotic forestall species aiming for extraction or production of forestry products in lands with alternative soil use, such as

agriculture and livestock, or in areas underexplored or degraded, do not need to fulfill the environmental licensing process, given the activities will not be implemented in Pantanal areas, Permanent Preservation areas, or Legal Reservation areas. The only requirement is that the responsible for the activity must submit a communication to the IMASUL (Instituto de Meio Ambiente de Mato Grosso do Sul in Portuguese) before starting the activities.

Suzano submitted the communication letter to the IMASUL before starting the project activities. All letters shall be made available for the VVB assessment at the first monitoring event after the inclusion of new areas.

- Law nº 12.727, from 17 October 2012, defines general requirements about the vegetation protection, Permanent Preservation areas and Legal Reservation areas, the forestry exploitation, the supply of forestry raw material, control of the forestry products origin, and prevention and control of forestry fires.

The commercial plantation will neither be implemented in a Permanent Preservation area, nor in Legal Reservation areas. Moreover, the project activity seeks to preserve and restore such areas.

It is important to highlight that the project proponents are aware about the possibility of progress on the regulations during the project crediting period and are committed to follow all current and future demands and requirements, and to the sustainable management principles.

- Law n. 8.171/1991: National regulation for agriculture and instruments for agriculture, livestock, aquiculture and forestry; in Regulating Standard N. 31: provides for the use, storage, transport, and disposal of pesticides and other agricultural inputs.

All the chemical products used in the forest plantations are authorized for eucalyptus cultivation and have MSDS available in the area. Their handling is done according to its instructions and can be applied only after Preliminary Risk Analysis and with the proper Individual Protection Equipment.

No one is allowed to enter or remain at site during the spraying, only the applicator, who must wear appropriate clothing for the procedure, which is dully sanitized, maintained and preserved before each application. No mechanized equipment is used for application.

The products are kept in their original packaging, and in accordance with Suzano's regulatory norms and procedures, which are not reused: they must be correctly destined for the reception point.

- Law no. 10,711, of August 5, 2003: Provides on the National Seed and Seedling System and makes other provisions.

The production of seedlings by Suzano is compliant with the National Registration of Seeds and Seedlings - Renasem as a seedling producer (art. 8). The cultivars are registered in the RNC. IPB2: 15534; AEC0144: 21874; FJ460: 36383. The seedlings transported are tagged with invoices, which contain appropriate information.

- Law No. 12651 of May 25, 2012 - Brazilian Forest Code: Determines the maintenance of preserved or restoring native vegetation in areas around springs or perennial water sources, whatever their topographical situation, with a minimum radius of fifty meters (permanent preservation area - APP). The reforestation of Permanent Preservation Areas, in the scope of the Environmental Regularization Programs - PRA, must be done according to the criteria of article 19 of Decree No. 7.830, of October 17, 2012

The project proponent maintains the 50 meters required by law, as outlined under section 1.3. Rural Environmental Registration (CAR) was conducted for Suzano's properties and can currently be verified in the Sicar[23] database, where all national CAR registrations can be accessed.

The legal reserve and permanent preservation areas are defined and identified during the micro-planning stage of each property. The project is based on environmental zoning, environmental legislation, and the principles of forest certification. The inscription or update of the CAR will be made after the micro-planning of the area is carried out. At this step, it is identified any RL and APP deficits by satellite images, with the support of GIS tools, images obtained by UAVs (Unmanned Aerial Vehicle) and field visits.

The next step is to define the medium and long-term actions, in order to make the necessary adjustments to the Permanent Preservation Areas - APP and Legal Reserve – RL, in compliance with the Brazilian Forestry Code. Suzano also has an Environmental Restoration Program, recognized as one of the largest biodiversity conservation and environmental restoration strategies in the country. This program prioritizes the areas declared as

[23] Serviço Florestal Brasileiro. Consultar demonstrativo do CAR. Available at: <https://www.car.gov.br/#/consultar>. Last Access: 25th November 2021.

Permanent Preservation Areas and Legal Reserves on its properties in all the Brazilian biomes.

- INMETRO Ordinance No. 547, October 25, 2012: Outlines the requirements for obtaining and maintaining the Sustainable Forest Management Unit certificate.

Suzano S.A. declares its commitment to conduct its forest stewardship system following the Principles and Criteria of FSC and NBR 14.789 CERFLOR Forest Stewardship Certifications, with the objective of providing long-term sustainability for its business, continuous improvement of its activities and performance, as well as the adoption of environmentally correct and socially responsible practices.

- State Law no. 214, of March 25, 1981: Prohibits cutting trees from species in extinction and makes other provisions to avoid cutting the following endangered plant species: Prunus avium (angelim or cherry tree); Tabebuia spp (ipê); Caesalpinia ferrea (ironwood); Cedrela fissilis (cedar); Paratecoma peroba (peroba); Platypodium elegans (faveiro); Phillanthus nobilis (castle); Piptadenia spp (angico); Astronium urundeuva (aroeira). Note: The extraction of the species can only be done by means of a Cutting License provided by the competent environmental agency, under the terms of Decree No. 1,017, dated May 19, 1981.

The project activities will not cut the species cited in the norm. If necessary, due to force majeure, it will only be done with the express authorization of the licensing environmental agency and documentation will be dully shared with the VVB.

- Law 2.406, of January 29, 2002: establishes the State Policy for Water Resources, creates the State System for the Management of Water Resources, and makes other provisions.

The project proponent's water resources capture activities are considered exempt from licensing. Anyhow, the activities are registered, the information is evaluated and approved by IMASUL, and the declaration of user of water resources (DURH) is issued.

- Decree No. 13,977, of June 5, 2014: Provides for the Rural Environmental Registry of Mato Grosso do Sul, the MS More Sustainable Program, and other provisions.

Suzano has a policy of not suppressing native vegetation, both inside and outside Permanent Preservation Areas. In case the company should undertake any intervention, it will occur upon express authorization from the environmental agency. The Rural Environmental Registry (CAR) was conducted for the project properties, as mentioned above.

- CBMMS Technical Standard n. 45, of 2021: provides for forest fire prevention and combat measures.

Suzano has a modern fire monitoring system, controlled by the Forestry Security area. This system counts with different tools, such as forest monitoring towers that collect data for fire risk monitoring. The field teams work in full synergy with the system operators allowing for an almost immediate intervention in fire occurrences[24].

The Company has trained firefighters, a fleet equipped with firefighting kits, as well as water trucks and a CAF truck (compressed air foam). Suzano also works with the engagement of the neighboring communities through the Floresta Viva Program, which establishes communication channels so that anyone can indicate where there are fire spots on their plantations.

- IMASUL Ordinance n. 912, of June 02, 2021: Implements the Electronic Environmental Licensing system in the scope of the Environmental Institute of Mato Grosso do Sul.

Obligations verified and fulfilled. All processes susceptible to protocol via e-licensing are requested digitally and will be made available for the VVB assessment:

- Decree No. 11.075, of May 19, 2022: Establishes the procedures for the elaboration of Sectoral Plans for Mitigation of Climate Changes referred to in the sole paragraph of art. 11 of Law No. 12,187, of December 29, 2009, and institutes the National System for the Reduction of Greenhouse Gas Emissions - Sinare.

Suzano participates actively in the discussions for the establishment of a regulated carbon market with the purpose to reduce emissions in Brazil. The company is aware of the Decree 11.075/2022 and collaborates with the necessary actions required by the legislator. It is important to highlight that the SINARE system is a digital tool to centralize the reporting of carbon inventories, and to register carbon credits that will be part of the Brazilian regulated system. The registration of carbon credits from voluntary projects, such as Verra projects, is optional and can be made at the discretion of the project owner. SINARE will also host other voluntary reporting such as carbon stocks, product footprint, and blue carbon. The company is participating in different organizations to contribute with the implementation of the

[24] SUZANO. Relatório 2020. Available at: <https://r2020.suzano.com.br/wp-content/uploads/2021/05/RelatorioSuzano2020.pdf>. Last access on 12th May 2022.
SUZANO. Central de Indicadores – Informações consolidadas base 2020. Page 252. Available at: <https://centraldeindicadores.suzano.com.br/wp-content/uploads/2021/05/Central-de-Indicadores-Suzano-2020_port.pdf>. Last access on 12th May 2022

applicable legislation and to build the sectorial plans. These organizations include IBA – Brazilian Tree Industry; CEBDS – Brazilian Business Council for Sustainable Development; Coalizão Clima – Brazilian Coallition for the Climate, Agriculture and Forestry; ABBI – Brazilian Bioinovation Association; ICC – International Chamber of Commerce, Brazilian Branch; and Climate Connections, among others.

1.15 Participation under Other GHG Programs

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

The project has not been registered, nor is it seeking registration under any other GHG program.

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 activities that result on the GHG removal of the project are not included in any other emission trading programs or mechanisms that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The activities that result on the GHG removal of the project has not sought for, nor is it interested in any other forms of environmental credit.

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

The Project is responsible for more than just carbon fixation through reforestation. It is in line with the Brazilian NDC, which has a specific topic for the forestry and land use change sectors[25]. The project is aligned to the following points:

- Enforcement of the forestry code: The project considers extra efforts on conservation and restoration of RLs and APPs, in line with the forestry code.

[25] MMA. **REDD+ e a NDC do Brasil, 2019**. Available at: < http://redd.mma.gov.br/pt/redd-e-a-indc-brasileira>. Last Access: 20th October. 2021.

- Afforestation and reforestation of 12 million Ha of forest until 2030: This project consists of ARR activities implementation.
- Enlarge the sustainable management with native vegetation system scale: The project encompasses native vegetation restoration.

The project is also in line with the SDGs[26]. A percentage of the profits will be directed to the development of social activities, which will be monitored from implementation of the Programs and activities throughout the life cycle of the Project through the monitoring reports according to the VCS Standard, status of Programs, indicators and activities developed, and other evidences that may be necessary:

- No Poverty (1):

  United Nations Goals (UN): 1.2 - By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.

  National Goals (Brasil): 1.2 - By 2030, halve the proportion of men, women and children of all ages living in monetary and non-monetary poverty, according to national definitions.

  Application rationale in the project: The Inclusive Recycling project, to be implemented, targets people in social vulnerability conditions and under the poverty line to generate more income and strengthen the recycling cooperative structure. The project provides for biannual monitoring cycles, to ensure that the target audience is being served and that the income increment indicator is evolving, so that at the end of 12 months, participants are removed from the poverty line condition. In addition, there will be operational monitoring based on monthly follow-up meetings with directors of the Social Cooperative, in order to mitigate risks and correct possible deviations from the project, with the preparation of a preventive or corrective action plan (section 1.11). The Nursery Seedlings project also contributes to this SDG. The project aims to meet the demands of supplying native forest seedlings from the Cerrado for the restoration of the company's areas. The generation of work and income from this project will be monitored annually through the application of income generation questionnaires to the participating families.

[26] IPEA. **ODS – Metas Nacionais dos Objetivos de Desenvolvimento Sustentável.** 2018. Available at: < https://www.ipea.gov.br/portal/images/stories/PDFs/livros/livros/180801_ods_metas_nac_dos_obj_de_desenv_susten_propos_de_adequa.pdf>. Last access: 20th October 2021.

- Decent Work and Economic Growth (8):

  United Nations Goals (UN): 8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.

  National Goals (Brasil): 8.5 By 2030, reduce by 40% the rate of unemployment and other forms of underutilization of the labor force, ensuring decent work, with an emphasis on equal pay for work of equal value.

  Application rationale in the project: The Inclusive Recycling and the Nursery Seedlings projects contributes for this SDG promoting the generation of jobs in the lines of the local Recycling Cooperative and in the Cerrado native seedling nursery, with the goal of providing seedlings for the restoration activity. This ensures decent jobs for the population. It is important to highlight that both projects will follow the current labor laws and norms.

- Sustainable Cities and Communities (11):

  United Nations Goals (UN): 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

  National Goals (Brasil): 11.6 By 2030, reduce the negative environmental impact per capita of cities by improving air quality indices and solid waste management; and ensure that all cities above 500,000 inhabitants have implemented air quality monitoring systems and solid waste management plans.

  Application rationale in the project: The Inclusive Recycling project creates a new source of revenue for local families, where the solid residues will be handled in a correct way and with less disposal in landfills, helping with public health and other related socio-environmental problems.

- Responsible Consumption and Production (12):

  United Nations Goals (UN): 12.2 By 2030, achieve the sustainable management and efficient use of natural resources.

12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

National Goals (Brasil): 12.2 By 2030, achieve the sustainable management and efficient use of natural resources.

12.5 By 2030, substantially reduce waste generation through the Circular Economy and its prevention, reduction, recycling and reuse actions.

Application rationale in the project: The Inclusive Recycling project contributes for this goal, promoting the adequate management of a larger amount of solid residues, thus increasing recycling and reuse activities and decreasing their generation and disposal in landfills.

- Climate Action (13):

  United Nations Goals (UN): 13.1 Strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries.

  National Goals (Brasil): 13.1 Enhance resilience and adaptive capacity to risks and impacts resulting from climate change and natural disasters.

  Application rationale in the project: At its core, VCS standard carbon projects have climate benefits as their main objective. In this sense, the project activity contributes for this goal, because of the emission removals promoted by the project.

- Life on Land (15):

  United Nations Goals (UN): 15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

  National Goals (Brasil): 15.1.1br Until 2020, at least 30% of the Amazon will be conserved, by conservation unit systems as provided in the National System of Conservation Units Law (SNUC), and other categories of officially protected areas such as Permanent Preservation Areas (APPs), Legal Reserves (RLs) and indigenous lands with native vegetation, at least 30% of the Amazon, 17% of each of the other terrestrial biomes and 10% of marine and coastal areas, mainly areas of special importance for biodiversity and ecosystem services, ensuring and respecting the demarcation, regularization and effective and equitable management, in order to

ensure interconnection, integration and ecological representation in larger terrestrial and marine landscapes.

Application rationale in the project: The project activity contributes for this goal, because of native restoration activity. In addition, the Nursery Seedling project will supply native species for the regeneration activities. The local fauna and flora are also frequently monitoring.

The Sustainable Development Goals will be monitored through the indicators of the activities to which they are linked:

- For the Inclusive Recycling Project, the number of partners supplying recyclable material, the volume of recyclable material delivered to the Arara Azul Cooperative, the number of collectors active in the activity, as well as measuring the evolution of the municipal index of recyclable material collection in the municipality of Três Lagoas directed to the Arara Azul cooperative, will be quantified;
- The SDG linked to the Native and Ornamental Seedling Production Project will be monitored through the quantification of the volume of species produced and the volume of areas restored based on the volume of seedlings sold. Furthermore, by establishing a connection with other seedling production groups in the state of Mato Grosso do Sul, it will be possible to measure the representativeness of the production of seedlings with other territories;
- The SDGs linked to climate and biodiversity (13 and 15) will be monitored with the results in each monitored period of the Project.

It is important to point out that for all the items, a questionnaire will be applied to define the baseline, and the monitoring of the evolution of the indicators will follow every six months.

1.17.2 Sustainable Development Contributions Activity Monitoring

The development of the activities proposed by the Project contribute to several Sustainable Development Goals, as described in section 1.17.1. In this sense, the activities developed during the monitoring period contributed to the following SDGs:

The Project contributed to the purpose (13) Climate Action, ensuring the restauration of 12,121.87 hectares of a forest coverage preventing the emission of 1,900,911.33 tCO2 and

GHG emissions during the monitored period, reducing the vulnerability of ecosystems and communities to climate change.

And, during the monitored period, Project contributed to target (15.1), related to SDG (15) Life and Land, by promoting restoration of 12,121.87 hectares of forest.

The ARR Horizonte Carbon Project is committed to SDGs, as described in table 1 below:

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	By planting 12.121,87 ha of Eucalyptus, the project has removed 1,900,911.33 tCO2e from the atmosphere during the monitoring period	By planting 12.121,87 ha of Eucalyptus, the project has removed 1,900,911.33 tCO2e from the atmosphere during the monitoring period
2)	15.1	Number of hectares of forest reforestation	Implemented activities to increase	By planting 12.121,87 ha of Eucalyptus	By planting 12.121,87 ha of Eucalyptus

This section will be completed on the following monitoring report, after 2023.

1.18 Additional Information Relevant to the Project

Leakage Management

The leakage assessment for this grouped project is determined as per AR-TOOL15, an A/R Methodological tool for the "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity", which sets out a procedure for assessing and estimating the increase in GHG emissions resulting from displacement of pre-project agricultural activities from the project boundary.

As previously outlined, the project area was characterized as degraded pasture or degraded areas with exposed soil before project implementation, hence, no crop cultivation activities would be displaced by the first group of instances. Grazing activities are also unlikely to be displaced by the project. The Phyto physiognomy of the area indicates that these areas had not been managed for a few years, given the state of the grassland seen at the areas. This is likely considered since Suzano bought the areas, no grazing activities were conducted at the project site.

The displacement of cattle activity is also unlikely. As will be discussed under the additionality analysis, cattle ranching is significantly more attractive financially than any forestry activity and face no barrier for its implementation. A recent study by IHS Markit shows that leasing areas for Forestry usage was on average 27% more expensive than for cattle ranching nationally, for the year of 2020[27]. This corroborates the real scenario where it's highly unlikely that a forestry activity could displace cattle ranching.

Furthermore, the land typically becomes available to the market when the family that owns the property is no longer interested in the cattle ranching business, usually when younger members are seeking better opportunities at bigger cities.[28] More recently, with the expansion of Commodity production areas, there has been a considerable increase in pastureland prices in the region which has provided additional financial incentives to sell the properties.[29]

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[27] IHS Markit, 2020. **Arrendamento de terras.** Semestral Report - 25th edition. Available at: <https://fnpstore.commercesuite.com.br/arrendamento-ct-34-349650.htm>. Last access: 20th October 2022.

[28] Maria Telma de Aquino Rodrigues, Araújo, C. de A., Deneson Oliveira Lima, & Conceição Maria Dias de Lima. (2020). Êxodo Rural: perspectivas dos jovens sobre a vivencia em meio rural. *Diversitas Journal*, *5*(2), 729–738. Available at: <https://doi.org/10.17648/diversitas-journal-v5i2-777>. Last access: 12th May 2022

[29] Sauer, Sérgio e Leite, Sergio Pereira. Expansão agrícola, preços e apropriação de terra por estrangeiros no Brasil. Revista de Economia e Sociologia Rural [online]. 2012, v. 50, n. 3 [Acessado 22 Outubro 2021] , pp. 503-524. Available at: <https://doi.org/10.1590/S0103-20032012000300007>. Epub 02 Out 2012. ISSN 1806-9479. Last access: 12th May 2022.

In addition, Suzano will develop a series of activities with local community and stakeholders which will assure best job opportunities, health, and educational conditions, and inform the population on how to develop more sustainable activities, including cattle ranching.

Commercially Sensitive Information

Complete information on the forestry implementation and inventory processes, procedures for determining the wood density of the species planted and guidelines on Suzano's relationship management were considered commercially sensitive because of the company's business activity (attachment 1 and 2).The forest implementation and inventory processes and the procedures for determining the wood density of the planted species were the basis for determining the values applied in the estimation and monitoring of GHG removed throughout the life of the project (section 4) and (section 6), while Suzano's relationship management manual guided the development of safeguards (section 2) and social projects (section 3.5) (attachment 3). Although the hole process was not shared under the monitoring plan section, all relevant information on how variables will be measures, stored, treated, and controlled for QA/QS purposes were fully disclosed on the public Project Description by the project proponents.

Full information on internal procedures were shared with the VVB for auditing purposes, who can testify that all relevant information is present under this Project Desciption.

Further Information

There is no further relevant information to be included about the project.

2 SAFEGUARDS

2.1 No Net Harm

Considered the project activity (Eucalyptus planting and native vegetation planting), which are based on planting a new forest on a degraded land, as described under section 2.3, there are no potential negative environmental and socio-economic impacts to highlight and mitigate by the project.

From other project implementation it is also known that even the eucalyptus plantations could bring benefits for local fauna and biodiversity, not to mention the benefit from the native plantations. Moreover, to keep track of the benefit brought by this activity, Suzano

also monitors and register local fauna apparitions, which will be available at the monitoring events.

It is also important to highlight that the project will employ members from the local community. Nevertheless, as described under section 1.17, the ARR Horiznte Carbon Project will implement specific social activities targeting the local communities, to improve their income, ensure work availability and to teach more sustainable practices, ensuring food availability for the entire year. An update of the implementation of such activities will be provided for the VVB assessment each monitoring event.

Potential negative impacts from planting eucalyptus are alterations at the water resources and misuse or overuse of fertilizers. Regard the possible alteration at the water resources, as explained under section 2.3, this does not represent a risk for areas with pluviometry above 400mm/year, which is the case for the project city. Nevertheless, Suzano will monitor the water availability and quality frequently, to ensure no net harm over these resources.

In order to avoid the misuse or overuse of fertilizers in the plantations, Suzano has well defined processes and procedures by a specific department of Soil, Nutrition and Forest Management. Thus, it is possible to closely control forest fertilization activities and nutritional monitoring.

In the planting areas of the ARR Horizonte Carbon Project, NPK and corrective fertilization were used (as seen in the spreadsheet shared with the VVB team). If necessary, Suzano's team controls weeds using defensives. These types of fertilizers and defensives help in soil preparation and forest growth. Furthermore, given the initial state of the soil (degraded pasture) and the pace of intensive forestry, to achieve forest sustainability, the replacement of nutrients, via mineral fertilization or another alternative source, is essential[30]. However, it is important to note that all soil preparation and maintenance in Suzano's areas is carried out under the premise of minimum cultive.

In the documents "FLORESTAL MS – Aplicação Defensivo", "Florestal corporativo- Manual de treinamento – Silvicultura – Adubação manual" and "Florestal corporativo- Manual de treinamento – Silvicultura – Adubação mecanizada"Suzano establishes guidelines for the preparation and application of fertilizers and pesticides in order to prevent poisoning accidents. Furthermore, in the document "FLORESTAL MS – Devolução de Embalagens"

[30] GONÇALVES, J.L.M. Recomendações de Adubação para Eucalyptus, Pinus e Espécies Nativas. 2009. Available *here:* < https://www.ipef.br/publicacoes/acervohistorico/informacoestecnicas/recomendacoes_de_adubacao_para_eucalyptus_pinus_e_especies_nativas.aspx>

there are guidelines for the control of agrochemicals and fertilizer packaging, with the purpose of reducing environmental impacts.

Nevertheless, the potential risks identified for local community are listed at the Suzano website[31], and local community is frequently consulted on the matters, as informed under section 2.2. So far, no negative impacts have been indicated by the local community members. It is also worth mentioning that the project will also bring socio-economic benefits for the region.

2.2 Local Stakeholder Consultation

The local stakeholder consultation targeted two main publics: local authorities and local communities.

The first public included the mayor and city hall, the president and city council. The communication was contacted via e-mail, where a draft of the PD was sent, as well as a copy of the flyer developed to help understanding key concepts of the ARR Horizonte Carbon Project. Suzano also informed a specific e-mail for responding to any questions and clarifications requested and to maintain ongoing communication with this public. No relevant comments that could impact project design were received before the project validation.

The local community consultation was led by a trained team on how to present the project and solve most frequently asked questions, which counted with a set of resources to better explain to the community how ARR carbon projects works, and how this project works, such as videos and flyers.

[31] SUZANO. Central de indicadores – Impactos em comunidades locais, 2020. Available at: <https://centraldeindicadores.suzano.com.br/wp-content/uploads/2021/05/Central-de-Indicadores-Suzano-2020_port.pdf>. Last access on 26 July 2022.

Figure 57 – The ARR Horizonte Carbon Project flyer used on onsite local stakeholder consultation.

This consultation was also conducted in two ways, due to the Covid-19 pandemic. The first one targeted the social entities and settlements, where meetings were held to explain the project, share the video and flyer prepared, so it could be publicized throughout the communities. The meetings were held with 3 local entities and 14 representative members on 26 and 28 July 2022.

Casa Branca – Ponte Velha

Jandaia - Almanara

Monte Alto – São Thomé

Figure 58 – Local Stakeholder consultation with social entities

The second approach targeted the rural public, where each neighbor was approached by the project proponent team to consult them on the matter, with the assistance of the flyers and video, to ensure that the information would be always available and on an appropriate format. On total, 55 neighbors were visited and 60 people were consulted from 21 to 30 July 2022.

Figure 59 – Local Stakeholder consultation on neighbor properties

During the consultation with local communities, the telephone number of those interested in receiving the video were written down and all questions raised were answered on time. The local community was excited about the project and did not raise questions over specificities, only to when the social activities should begin.

To guarantee the ongoing communication and clarification of any questions, Suzano informed a specific email (creditosdecarbono@suzano.com.br). Suzano also has a continued operational procedure named operational dialogue, where neighbor properties and social entities are frequently visited, following an annual plan developed to contact such stakeholders before operational procedures, to inform about the operation to be conducted, its start and end date, Suzano's contacts, any possible impacts (positive and negative) of the operations on local community, and any preventing or mitigative action to be adopted. All meetings are recorded through a presence list, GPS, images, and the filling of a form.

Eventual negative impacts that may be identified by local stakeholders due to project implementation[3131] is increase on risk of accidents, increase on noise, dust, smoke, lower levels on water courses, water pollution, increase on garbage, disorder, damage to property and local roads, traffic interruption, impacts on fishing and hunting, increase on forest fires, impact over neighbor cultures due to excessive shade, impact on food security, impact or disrespect on local traditions and habits, interference on communication systems and spoil of products in neighbor areas. No negative impact was felt by local communities before project validation. Only the expectation and excitement of local communities could be seen during local stakeholder consultation. It is important to highlight that the project will have positive impact of increasing job opportunities on the area is mentioned.

All pertinent demands must be assessed and validated with operational areas, and inserted at the SISPART (Sistema de Partes Interessadas, in Portuguese). The implementation of the actions is a responsibility of forestry operations at the region. The Social Development area must send its socioenvironmental recommendations to operational areas. The Social Development area is also responsible for assessing the effectiveness of the activities implemented with the community and representative entities.

In cases where the operation surpasses a period of thirty days, the Social Development area must assess the effectiveness of the operations implemented, and all non-compliances must also be registered at SISPART.

Each verification event will be notified through the operational dialogue events and the result of previous monitoring events will be made available during these meetings. The results will also be made available at the company website.

It is important to highlight that all workers involved at the project have received information about their rights. This is a standard procedure for the project proponent, conducted by the HR every time a worker is hired by the company, where a power point presentation with all rights and benefits is shared and communication lines are indicated for solving any questions.

During the consultation, all questions raised by stakeholders were answered promptly. No other inquiries were received during the monitoring period in the disclosed channels.

2.3 Environmental Impact

For the project activity implementation, no environmental impact assessment or report is necessary, as stated by the Resolution SEMADE nº 9, from 13 May 2015.

However, and as listed under section 1.14, for implementing the project, it is important to obtain grants and permits, such as grants and rights about the use of water resources (Resolution CERH MS nº 25, from 3 March 2015), inform the IMASUL before starting planting activities (Resolution SEMADE nº 9, from 13 May 2015) and obtain the authorization for suppressing sparse trees (State Law no. 214, of March 25, 1981) when such intervention is needed. Moreover, Suzano will seek for FSC certifications for all the farms under this project, granting a sustainable management of the areas.

Considered the eucalyptus plantations, it is known that it is not as beneficial for the environment as a native species plantation. Nevertheless, studies show that eucalyptus

plantations can be more beneficial to the environment than keeping the degraded area, in terms of biodiversity, native areas preservation, water and soil quality and carbon fixation[32].

According to Amorim et. al (2021), compared to other agricultural and forestry activities, eucalyptus planting is the one to demand least water resources. It also prevents the soil from eroding and improves its quality through the deposition of litter and organic matter which also contributes for cycling nutrients. Eucalyptus plantations can also help on recovering degraded areas or areas with poor use of the soil, such as this project area condition. It also reduces the pressure for deforestation over native forest formations.

Another relevant study shows that eucalyptus plantations are unlikely to lead to impacts on water availability on the soil on areas with pluviometry above 400mm/year. It also indicates that it demands lower quantity of water per biomass produced, being it the most efficient culture on water consumption[33].

In addition, Vital (2007) states that the eucalyptus plantations are among the cultures which demands least nutrients quantities on nitrogen, phosphor and potassium. It also highlights that it can improve the biodiversity when such plantations occur on degraded areas, and when compared to other monocultures.

Moreover, as previously mentioned, Suzano is concerned about the biodiversity at the area and the Forest Environment team monitors the water availability and quality frequently, to ensure no net harm over these resources.

Therefore, the eucalyptus will be planted over degraded areas can be more beneficial for the environment than its non-implementation.

As for the native species planting, it is known that native restoration can bring great benefits to the area where it is being implemented. However, it is important to highlight the importance of ensuring the use of the right species to match the surrounding vegetation, which can also vary inside a biome. It is also important to ensure that the plantations will be accompanied and monitored, so that they can thrive and endure for longer periods.

[32] AMORIM, Vanessa da Silva Santos; et. Al. The environmental benefits of eucalyptus planting: literature review. Research, Sociery and development, v. 10, n. 11. 2021. Last access: 20th April 2022.

[33] VITAL, Marcos H. F. Environmental Impacto of Eucalyptus forests. BNDES Maganize, Rio de Janeiro, v. 14, n. 28, pages 235-276, Dec 2007. Available at: <https://edisciplinas.usp.br/pluginfile.php/3427263/mod_resource/content/1/florestal.pdf>. Last access: 20th April 2022.

Nevertheless, is important to mention that credits revenue will allow for additional activities on native forest to grant its improved restoration and social activities as mentioned under section *1.17*.

2.4 Public Comments

The public comment period on the Verra website was between08/08/2022 to 07/09/2022. Comments received during this period were answered promptly in a document made available to Verra and VVB team. Below is the summary of the questions answered:

- Questions regarding the completion of the baseline emissions calculations were answered, which are disclosed in section 4 of this document;
- Suzano S.A will do all the necessary diligence for the inclusion of new areas throughout the Project's life cycle, ensuring compliance with all the legal requirements of Brazilian legislation;
- All information about Local Stakeholder Consultation and AFOLU-Specific Safeguards was completed in sections 2.2 and 2.5 of this document;
- As made clear, the social activities will contribute to GHG reduction and removal and will be implemented with credit revenue. In addition, they will be monitored, as described in section 1.11, however they have not yet been implemented in this monitored period. Furthermore, the project activity generates credits through the commercial plantation and revegetation of native areas. The restoration of native vegetation will be carried outside RLs and APPs;
- As mentioned, all the requirements set out under the additionality tool (AR-AM-TOOL02) were strongly complied with;
- The ARR Horizonte Carbon Project does not have multiple activities. All sections of this document have been revised and updated.

2.5 AFOLU-Specific Safeguards

The ARR Horizonte Carbon Project implemented a thorough process to identify the local stakeholders and its characteristics, to know its economic, social and cultural profile, and to determine the best social projects to be additionally implemented at the project area.

The municipalities where the project take place occupies an area of 38,402 km². Together, these cities representing 10.75% of the State area. Each city of the ARR Horizonte Carbon Project is composed by the urban and rural inhabitants, composed by different communities with their own particularities and demands:

The municipality of Três Lagoas has an estimated population of 125,137 people (2021), and the largest age group, in 2010, was between 25 and 29 years (9687 people); at this same year the city had a demographic density of 9,97habitants/km²; an HDI of 0,744; the schooling index for people between 6 and 14 years old is equivalent to 97.2% and adequate sanitation coverage for 52.6% of the population. In 2020 the child mortality registered in the city was of 9,79 deaths per thousand live births; and the average monthly salary at that year was 2,9 minimum wages, with 31,5% of the population occupied[34].

The municipality of Brasilândia has an estimated population of 11,835 people (2021), and the largest age group, in 2010, was between 25 and 29 years (1110 people); at this same year the city had a demographic density of 2,04habitants/km²; an HDI of 0,674; the schooling index for people between 6 and 14 years old is equivalent to 98.7% and adequate sanitation coverage for 53.6% of the population. In 2020 the child mortality registered in the city was of 18,4 deaths per thousand live births; and the average monthly salary at that year was 2,2 minimum wages, with 21,6% of the population occupied[35].

The city of Santa Rita do Pardo has an estimated population of 7,259 people (2021), and the largest age group, in 2010, was between 10 and 14 years (749 people); at this same year the city had a demographic density of 1,18habitants/km²; an HDI of 0,642; the schooling index for people between 6 and 14 years old is equivalent to 97.7% and adequate sanitary sewage coverage was of 7.5% of the population. In 2020 the child mortality registered in the city was of 28,57 deaths per thousand live births; and the average monthly salary at that year was 2,2 minimum wages, with 16,4% of the population occupied[36].

The city of Selviria has an estimated population of 6,555 people (2021), and the largest age group, in 2010, was between 10 and 14 years (613 people); at this same year the city had a demographic density of 1,93habitants/km²; an HDI of 0,682; the schooling index for people between 6 and 14 years old is equivalent to 96.1% and adequate sanitary sewage

[34] IBGE. Três Lagoas. Available at: < https://cidades.ibge.gov.br/brasil/ms/tres-lagoas/panorama >. Last access: 11th July 2022.

[35] IBGE. Brasilândia. Available at: < https://cidades.ibge.gov.br/brasil/ms/brasilandia/panorama>. Last access: 11th July 2022.

[36] IBGE. Santa Rita do Pardo. Available at: < https://cidades.ibge.gov.br/brasil/ms/santa-rita-do-pardo/panorama >. Last access: 11th July 2022.

coverage was of 8.2% of the population. In 2020 the average monthly salary at that year was 2,8 minimum wages, with 31,9% of the population occupied[37].

The city of Bataguassu has an estimated population of 23,620 people (2021), and the largest age group, in 2010, was between 25 and 29 years (1833 people); at this same year the city had a demographic density of 8,21habitants/km²; an HDI of 0,71; the schooling index for people between 6 and 14 years old is equivalent to 97.9% and adequate sanitary sewage coverage was of 49.7% of the population. In 2020 the child mortality registered in the city was of 4,34 deaths per thousand live births; and the average monthly salary at that year was 1,8 minimum wages, with 28,5% of the population occupied[38].

The city of Água Clara has an estimated population of 16,025 people (2021), and the largest age group, in 2010, was between 10 and 14 years (1426 people); at this same year the city had a demographic density of 1,31habitants/km²; an HDI of 0,67; the schooling index for people between 6 and 14 years old is equivalent to 96.6% and adequate sanitary sewage coverage was of 3.8% of the population. In 2020 the child mortality registered in the city was of 4,1 deaths per thousand live births; and the average monthly salary at that year was 2,5 minimum wages, with 31,4% of the population occupied[39].

The city of Aparecida do Taboado has an estimated population of 26,386 people (2021), and the largest age group, in 2010, was between 10 and 14 years (1938 people); at this same year the city had a demographic density of 8,12habitants/km²; an HDI of 0,697; the schooling index for people between 6 and 14 years old is equivalent to 97.5% and adequate sanitary sewage coverage was of 15.6% of the population. In 2020 the child mortality registered in the city was of 7,81 deaths per thousand live births; and the average monthly salary at that year was 2,2 minimum wages, with 31,7% of the population occupied[40].

Local Stakeholders were identified by Suzano, through its social inventory, which observes directly onsite and conduces interviews with local people and is conducted every 4 years, and are composed of any interested person, group of people or entity which may be subject to the impact of its activities. The information of these interested parties is updated by the

[37] IBGE. Selviria. Available at: < https://cidades.ibge.gov.br/brasil/ms/selviria/panorama >. Last access: 11th July 2022.

[38] IBGE. Bataguassu. Available at: < https://cidades.ibge.gov.br/brasil/ms/bataguassu/panorama >. Last access: 11th July 2022.

[39] IBGE. Água Clara. Available at: < https://cidades.ibge.gov.br/brasil/ms/agua-clara/panorama >. Last access: 11th July 2022.

[40] IBGE. *Aparecida do Taboado*. Available at: < https://cidades.ibge.gov.br/brasil/ms/aparecida-do-taboado/panorama >. Last access: 11th July 2022.

Social Development Area, and vary according to the party in question, as outlined in the Relationship Management Manual.

The project proponent purpose with its communication strategy is to ensure the social legitimacy of the project activity, through a strong relationship with local community, conducted in the long term, and is based on knowing the socio-economic reality at the city, engaging with local people, articulating and alignment with local government, keep the coherence between speech and act, and to be a catalyzing agent for local development.

On total, 3 main communities, of which two association located on the maps below, and 55 neighbors were identified and considered stakeholders relevant for the Public Community Consultation in the ARR Horizonte Carbon Project context. Such relevance was due to the proximity to project area: rural settlements or private farms that border project areas or are within a radius of less than 3 kilometers. None are within project area or have any legal or customary tenure/access rights to territories and resources, including collective and/or conflicting rights held by Suzano or are reliant on the project area.

Figure 60 – Associação Ponte Velha location and Suzano Properties

Figure 61 – Associação Almanara location and Suzano Properties

About the legal and customary tenure of these 3 main communities:

- Almanara: The community was formed by families who accessed the "PNCF – Programa Nacional de Crédito Fundiário" (i.e. National Land Credit Program): a federal government program that offers conditions for farmers without access to land or with small lands to buy rural property through rural credit financing. In addition to the land, financed resources can be used in structuring the property and the productive project, in hiring Technical Assistance and Rural Extension (ATER). After the financing is discharged, the property becomes private;

- Ponte Velha: The Ponte Velha community was formed by families who own private rural properties and are in the area and/or close to the Suzano pulp mill in Três Lagoas/MS. They are medium and small rural producers who live with the presence of the factory on a daily basis. The landholdings are their own, so they can sell or lease their properties.

- São Thomé: The São Thomé community is an agrarian reform settlement. The settlement is a set of agricultural units installed by INCRA – "Instituto Nacional de Reforma agrária" (i.e. National Institute of Colonization and Agrarian Reform). Each of these units, called plots or lots, is intended for a family of agriculturist or rural worker without economic conditions to acquire a rural property. The number of lots or plots in a settlement is defined based on a study of the property's ability to

generate income. Families that receive the lot undertake to live and exploit it for their livelihood. Until the issuance of the title to the domain, the lot belongs to INCRA, therefore, without the possession document, the beneficiary cannot sell, rent, donate, lease or lend his land to third parties.

- *History of communities and their social, economic and cultural diversity*Almanara: There have been no significant changes in the routine of this community since its inception and with the arrival of the forest enterprise, which, it is understood, has become more valued since then. This is because they are small properties. Currently, Almanara is made up of families, the vast majority of whom are elderly. Their main activity on their plots is livestock and subsistence agriculture. Due to its proximity to the urban center (about 5 km away), there are many lots used for leisure on weekends and part of the families develop their economic activities in the services offered by the municipality.

- Ponte Velha: Ponte Velha has properties that vary in size, from 10 to 100 hectares, the main source of income for the community is based on dairy and beef cattle. Those are properties managed by fathers and children most of the time, with a small presence of women; There were no significant changes in the composition of the Ponte Velha community with the arrival of forestry activities.

- São Thomé: Some families are hired by Suzano's service providers to work directly in forestry. Currently, the residents of this community are typical family farmers, the main source of income coming from the work carried out on the lots, such as dairy farming and cutting and production of fruit trees for sale at fairs and public procurement programs. A minority of families perform paid work outside their lots, on other properties, as day laborers and/or in forestry companies. There were no significant changes in the composition of the São Thomé community with the arrival of forestry activities.

Through knowledge about these communities and neighbors, stakeholder consultation could be planned and driven in a culturally appropriate manner, as detailed in 2.2. Also, although, the project will not trespass nor affect other private or public real estate assets, traditional communities or environmental protection areas, the project is being undertaken with full consent of the communities, local and municipality government. Communities and government group representatives were invited to a board meeting where Suzano’s teams introduced the concept of the ARR Carbon project.As mentioned under sections 2.1 and 2.2, the project implementation will only bring positive impacts for the community and for the

environment. In general, all communities mentioned above benefit in some way from the implementation of the project. For the introduction of planted forests, a set of local investments is necessary that benefit directly and indirectly. As an example, the improvement of rural roads with the frequent necessary maintenance carried out by the company and the provision of a firefighting structure that allows support to families in the communities. In addition, during the operational dialogue to be implemented throughout the project, any positive or negative impacts that may be identified by the management teams involved in the project and will be reported to the local community and updated under the specific Monitoring Report section.

Eventual negative impacts that may be identified by local stakeholders due to project implementation is increase on noise, dust, smoke, lower levels on water courses, water pollution, increase on garbage, disorder, damage to property and local roads, impacts on fishing and hunting, and forest fires. So far, no negative impact was felt by local communities.

To mitigate this impact, the operational dialogues will occur before each harvest event to inform local stakeholders and to ensure a minimum disturbance. Local community can also communicate whenever needed with the project proponent through the e-mail made available on the flyers and video publicized via a communication app named WhatsApp. In addition. Nevertheless, Suzano monitors frequently the water quality and availability, as well as the presence of local fauna and flora, to mitigate any potential negative impact, as previously mentioned.

All pertinent demands must be registered at the SISPART system, and the Social Development area will follow up with the activities to mitigate any impact or to attend any demand. In addition, Suzano has a policy for loss and damage repair, where it is committed to take the initiative to mitigate and repair any damage even if no complaints may be registered, to ensure the choice on how to repair the impact and a fair value for the impacted party.

Although the project is implemented on private properties and do not impact local stakeholder's property rights, Suzano has a procedure for solving conflicts on land use claims and rights, which is based on prioritizing an amicable resolution between the parties. All contacts must be registered by the representative manager of Suzano, which must inform the proposed terms, the decision of each involved party, and all steps followed for a consensual solution.

Also, the project proponent or any other entity involved in the design or implementation of the project is involved in any form of discrimination or sexual harassment. Suzano's code of ethics is widely publicized, and its compliance is required for the development of any company activity. In addition, the project proponent has a training of agents to prevent sexual violence against minors and elimination of violence against women, through sensitizing the project workforce and stakeholders, called “Agente do bem”, available for VVB.

Finally, continuous communication with the community will be carried out in a way that is adaptive to the local context, respecting the resources and tools available and are most adhered to by the local population, keeping them comfortable.

The design and implementation of the project, as well as the risks, costs and benefits that the project could bring to local stakeholders, were disclosed as described in section 2.2. In addition, the results of the first monitoring will be presented to the community through the sustainable development team.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The project activity will apply the AR-ACM0003 – Afforestation and Reforestation of Lands Except Wetlands, version 2 – A/R Large-scale Consolidated Methodology. The tools and modules to be applied are:

- VCS AFOLU Non-Permanence Risk Toll (T-BAR) – version 4.0
- AR-TOOL02: “Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities” – version 1;
- AR-TOOL14: “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities” – Version 04.2;
- AR-TOOL12: “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities” – Version 03.1;
- AR-TOOL08: “Estimation of non-CO2 greenhouse gas (GHG) emissions resulting from burning of biomass attributable to an A/R CDM project activity” – version 04.0.0;

- AR-TOOL15: "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" – version 02.0.
- AR-TOOL16: "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" – version 01.1.0

3.2 Applicability of Methodology

The AR-ACM0003 methodology is applicable under the following conditions:

Condition	Project adherence
The land subject to the project activity does not fall in wetland category	Although the state of Mato Grosso do Sul has a biome categorized as wetland, the Pantanal, the project is located in the Cerrado biome, which has a vegetation similar to a savannah and has no flooded area or characteristics that could be categorize as wetland. Therefore, the project does not fall into the wetland category and the methodology is applicable.
Soil disturbance attributable to the project activity does not cover more than 10 per cent of area in each of the following types of land, when these lands are included within the project boundary: (i) Land containing organic soils; (ii) 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.	As indicated under the section 1.13, the project is not located at lands containing organic soils. In fact, results show that the soil composition at the project area contains more than 80% of sand, which means it is a sandy soil. In addition, more than half of the cultivated pasture area in the Cerrado biome is degraded or in the process of degradation[41]. The emission of CO2 in degraded pasture is one of the great

[41] VOLPE, E.; MARCHETTI, M. E.; MACEDO, M. C. M.; ROSA Jr., E. J. Renovação de pastagem degradada com calagem, adubação e leguminosa consorciada em Neossolo Quartzarênico. Acta Scientiarum Agronomy, Maringá, v. 30, n. 1, p. 131-138, 2008. Last access: 25th November 2022

	bottlenecks of Brazilian cattle breeding. Degraded pastures have shown a reduction in carbon content in the soil[42] and consequently this reduction leads to the emission of CO2 into the atmosphere, because it loses significant amounts of organic matter[43]. It is estimated that 60% to 90% of the carbon content of the soil is released into the atmosphere in degraded pastures, compared to a rate of 12 to 25% in a common scenario[43]. The baseline of the project is defined as extensive cattle ranching. Nevertheless, it is important to highlight that Suzano thrives to implement best practices available at the market, in line with FSC and other quality standards. Only the subsoiling procedure can cause disturbance to the soil, where a stem is used. Furthermore, it is based on the principle for minimum cultivation, where soil disturbance is as minimal as possible, maintaining all plant residues as coverage. Subsoiling activities are also monitored and controlled.

Applicability conditions of T-BAR – "AFOLU non-permanence risk-tool"

Condition	Project adherence

[42] FIGUEIREDO, E. B.; PANOSSO, A. R.; BORDONAL, R. O.; TEIXEIRA, D. D. B.; BERCHIELLI, T. T.; LA SCALA, N. Soil CO_2–C emissions and correlations with soil properties in degraded and managed pastures in southern Brazil. Land Degradation & Developrent, v.28, p. 1163-1492, 2016. Last access: 25th November 2022

[43] EMBRAPA - Desafios e perspectivas na recuperação de pastagens degradadas na Amazônia, Belém, 2015. Last access: 25th November 2022

There are no internal applicability conditions	As outlined under section 3.2 of the VCS Standard v4.3, all AFOLU projects must apply the non-permanence risk tool. This project applies the tool, as required by the standard.

Applicability conditions of AR-TOOL02 – "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities"

Condition	Project adherence
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.	The project does not lead to violation of any applicable law, as identified in section 1.14.
This tool is not applicable to small - scale afforestation and reforestation project activities.	This is not a small-scale A/R project as per the definitions of the CDM: "SSC A/R CDM project activity: An afforestation or reforestation measure, operation or action: (a) Where the average projected net anthropogenic GHG removals by sinks for each verification period do not exceed eight kilotonnes of carbon dioxide equivalent per year; and (b) Which is developed or implemented by low-income communities and individuals as determined by the host Party." The projected net anthropogenic GHG removals exceed 8.000 tCO2e/year, and is not developed by a low-income community and individuals.

Applicability conditions of TOOL14 – "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"

Condition	Project adherence
This tool has no internal applicability conditions	-

Applicability conditions of TOOL12 – "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"

Condition	Project adherence
This tool has no internal applicability conditions	-

Applicability conditions of TOOL16 – "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"

Condition	Project adherence
The areas of land to which this tool is applied: (i) Do not fall into wetland category; or (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;	The tool will not be applied for the first project activity, only for the plantation of native vegetation. Nevertheless, as mentioned previously under the AR-ACM0003 applicability conditions, this project does not fall into wetland category, nor does it contain organic soil or is subject to the land management practices mentioned in the tables 1 and 2.
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; and	The tool will not be applied under eucalyptus plantation areas, as the harvest cycles are due to occur each seven years. It will only be applied native revegetation areas, where no disturbances to the soil will take place after planting the species.

(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.	As per the project management practices, the litter is not removed from the site, and the soil disturbance is limited, given the project implements the best practices available at the market for soil preparation, plantation and harvest.

Applicability conditions of TOOL08 – "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"

Condition	Project adherence
The tool is applicable to all occurrence of fire within the project boundary.	This project activity does not include burning biomass. In addition, all due fire prevention measures are provided by Suzano. In case of a loss event caused by fire, a loss event report will be dully submitted to Verra as per the VCS Standard. In this case, this tool will be applied.
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.	This project activity does not include burning biomass. In addition, all due fire prevention measures are provided by Suzano. In case of a loss event caused by fire, a loss event report will be dully submitted to Verra as per the VCS Standard. In this case, given the threshold of fire occurrence in ≥5% of the area is met, this tool will be applied.

Applicability conditions of TOOL15 – "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity"

Condition	Project adherence
This tool is not applicable if the displacement of agricultural activities is expected to cause, directly or indirectly, any drainage of wetlands or peat lands.	This project activity does not cause the displacement of agricultural activities. As previously mentioned, the activity implemented before the project was extensive cattle ranching. The project also does not cause directly or indirectly the drainage of wetlands or peat lands. Although the state of Mato Grosso do Sul has a biome categorized as wetland, the Pantanal, the project is located in the Cerrado biome, which has a vegetation similar to a savannah and has no flooded area or characteristics that could be categorize as wetland.

3.3 Project Boundary

Table 2 - Sources of GHG emissions included in or excluded from the project activity

Source		Gas	Included?	Justification/Explanation
Baseline	Above and below ground biomass	CO_2	Yes	This is the major carbon pool subject to project activity as per the ACM0003 definitions. This pool is represented by isolated trees and grassland, which will be harvested for implementing this project. For each area where suppression of sparse trees may be necessary, the suppression license will be provided for VVB assessment, and such carbon stock will be dully accounted by the project.
		CH_4	No	This is not a requirement of the methodology
		N_2O	No	This is not a requirement of the methodology

Source		Gas	Included?	Justification/Explanation
	Dead wood and litter	CO_2	Yes	Carbon stock in this pool is expected to increase due to implementation of the project activity. The tools for accounting such pools have no internal applicability conditions.
		CH_4	No	This is not a requirement of the methodology
		N_2O	No	This is not a requirement of the methodology
	Soil Organic Carbon	CO_2	Yes	Carbon stock in this pool is expected to increase due to implementation of the project activity. The tool for accounting this pool have internal applicability conditions that are met for this second project activity in specific and will only be accounted for under areas where native vegetation is being implemented.
		CH_4	No	This is not a requirement of the methodology
		N_2O	No	This is not a requirement of the methodology
	Burning of woody biomass	CO_2	No	CO2 emissions due to burning of biomass are accounted as change in carbon stock
		CH_4	No	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology. The project proponents will not burn biomass for site preparation or forest management.
		N_2O	No	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology. The project proponents will not burn biomass for site preparation or forest management.
Project	Above and below ground biomass	CO_2	Yes	This is the major carbon pool subject to project activity as per the ACM0003 definitions. This pool is expected to increase with 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 and litter	CO_2	Yes	Carbon stock in this pool is expected to increase due to implementation of the project activity. The tools for accounting such pools have no internal applicability conditions.
		CH_4	No	This is not a requirement of the methodology
		N_2O	No	This is not a requirement of the methodology

Source		Gas	Included?	Justification/Explanation
	Soil Organic Carbon	CO_2	Yes	Carbon stock in this pool is expected to increase due to implementation of the project activity. The tool for accounting this pool have internal applicability conditions that are met for this second project activity in specific, and will only be accounted for under areas where native vegetation is being implemented.
		CH_4	No	This is not a requirement of the methodology
		N_2O	No	This is not a requirement of the methodology
	Burning of woody biomass	CO_2	No	CO2 emissions due to burning of biomass are accounted as change in carbon stock
		CH_4	No	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology. The project proponents will not burn biomass for site preparation or forest management.
		N_2O	No	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology. The project proponents will not burn biomass for site preparation or forest management.

The project does not account for sources of GHG emissions, given no burning of biomass will occur during the project activity.

Furthermore, as per AR-ACM0003, GHG emissions resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary, and transportation attributable to the project activity shall be considered insignificant and therefore accounted as zero.

The map below illustrates the initial areas considered for the project implementation.

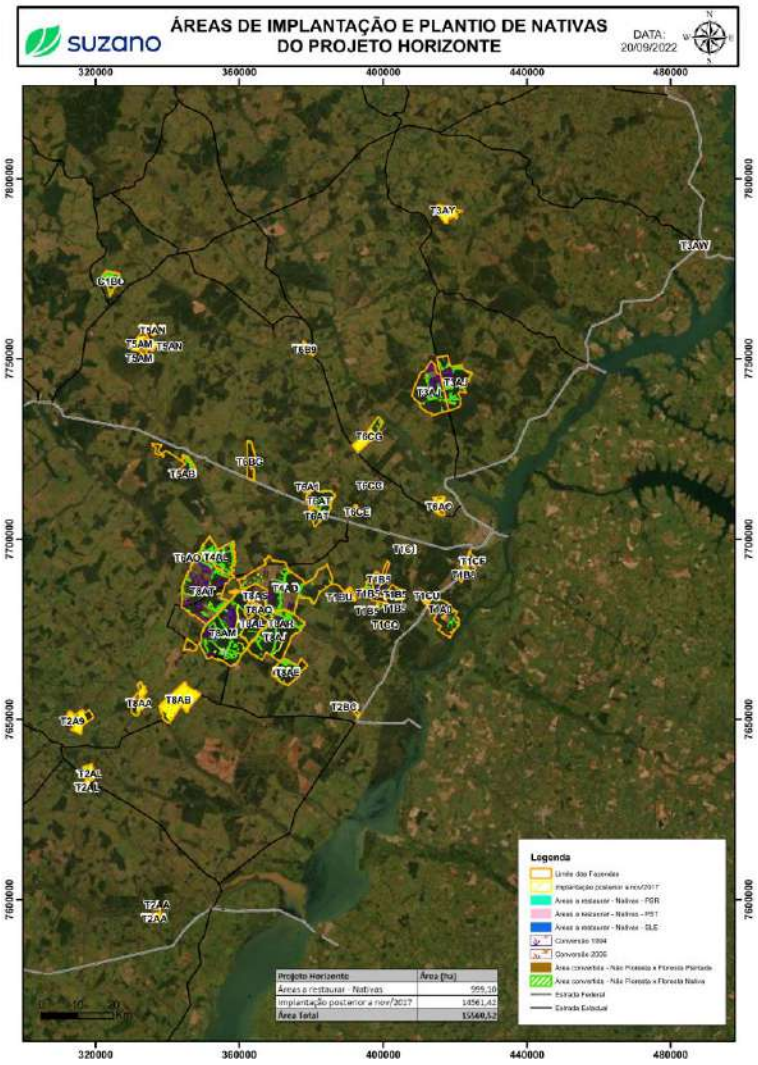

Figure 62 – Project activity map, where the project area is highlighted in yellow, light pink, light blue and dark blue.

3.4 Baseline Scenario

For the project activity to be implemented, the baseline scenario is identified on section 3.5, following the steps outlined at the AR-TOOL02, "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities".

The baseline scenario is constituted by large areas of grassland with sparse trees in landscape. The pasture areas, mostly occupied by extensive cattle raising, consist of raising

cattle on pasture. This is generally done without major investments and with the occupation of large areas, considered ideal for the so-called beef cattle.[44]

The main incentives of extensive cattle raising are the low investment needs, although there are still expenses with mineral replacement and supplementation, depending on the type of animal being raised. The disadvantages are the need to occupy large areas, which can generate environmental problems because of the availability of pasture and the lack of cattle feed in this type of breeding system. Historically, cattle ranchers in the region use the practice of burning the vegetation to clean the soil, either to prepare for planting or to form pasture.[45]

The use of fire to "prepare" the soil causes negative environmental impacts, since it eliminates fundamental nutrients for any vegetative crop, such as potassium and phosphorus, kills microorganisms that help the development of plants, reduces the humidity of the soil and facilitates the process of soil degradation. Also worth mentioning are the problems of air pollution and even the pollution of springs, groundwater, and rivers by the ashes.[45]

Over the years, abusive extensive cattle raising has caused a serious process of pasture degradation characterized by: deterioration of the pasture; small patches of land erosion; and reduced soil fertility (decrease in macro and micro trace elements and organic matter). Pasture degradation originates from factors such as: cattle feeding pressure (during grazing, cattle ingest large amounts of green fodder, which contains nutrients derived from the soil); lack of rational soil fertility management, which is a necessary practice to replenish the nutrients extracted from the soil by grazing; cattle trampling, affecting areas where pasture rotation is not practiced, which leads to reduced vegetation cover, exposing the soil to rainfall and subsequent erosion and exhaustion of the superficial fertile layer; the shrinking of the original tree cover as the tree plants present in the pastures are seen as competitors for light, nutrients, and forage water. For this reason, there is a tendency to eliminate the tree

[44] LANGE, Anderson; DANTAS, Jeferson; FREDDI, Onã S.; et. al. Degradação do solo e pecuária extensiva no norte de Mato Grosso. Available at: <https://periodicoscientificos.ufmt.br/ojs/index.php/nativa/article/view/6838>. Last Access on 26 Nov. 2021.

[45] ARAUJO, Fernando M.; SILVA; Janete R.; COSTA, João V.S.. As queimadas e sua relação com o desmatamento no bioma cerrado. Available at: <https://www.researchgate.net/profile/Janete_Rego/publication/333450782_AS_QUEIMADAS_E_A_SUA_RELACAO_COM_O_DESMATAMENTO_NO_BIOMA_CERRADO/links/5cee8befa6fdcc791692bcdb/AS-QUEIMADAS-E-A-SUA-RELACAO-COM-O-DESMATAMENTO-NO-BIOMA-CERRADO.pdf>. Last access: 26th Nov. 2021.

component from the landscape, reducing soil resistance to erosion and causing increased evaporation of water present in the soil.[46]

This is the configuration of the landscape prior to the start of project activity.

3.5 Additionality

The AR-TOOL02, "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities", version 01 is used for the assessment of the additionality and identification of the baseline.

The applicability conditions for the tool are detailed under section 3.2 and dully met.

The additionality and baseline identification must follow the steps:

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

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

If the project participants claim that the afforestation or reforestation project activity has a starting date after 31 December 1999 but before the date of its registration, then the project participants shall:

- *Provide evidence that the starting date of the A/R project activity was after 31 December 1999, and*
- *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.*

Outcome:

[46] NOGUEIRA, Deise C. S.; TAVANTI, Renan F. R.; MONTANARI, Rafael; et. Al. Variabilidade espacial da emissão de CO2 em sistema silvipastoril e pastagem degradada na região do Cerrado. Available at: <http://cadernos.aba-agroecologia.org.br/index.php/cadernos/article/view/6278/2380>. Last access: 26th Nov. 2021.

Although the start date (in 2017) is before the project registration date, the project proponents have been considering credits revenue for its commercial plantation activities since 2017, when a prior consideration letter was submitted to the CDM board[47], proving its intention in registering a project and consideration of the credit's revenue. It is important to highlight that the entity name registered accounts for Fibria Celulose S/A, which was initially in charge of developing the project and was incorporated by Suzano in 2018 having the operation at the project area and city where the project is located continue under similar circumstances.

In addition, the start date of the project activity is of 02 November 2017, after 31 December 1999, as required by the AR-TOOL02. Detailed information about the acquisition of each specific area was provided to the VVB for a better assessment and detailed at section 1.7.

STEP 1. Identification of alternative scenarios to the proposed A/R 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 alternative land use scenarios to the proposed CDM project activity

Identify realistic and credible land-use scenarios that would have occurred on the land within the proposed project boundary in the absence of the afforestation or reforestation project activity under the Verified Carbon Standard (VCS). The scenarios should be feasible for the project participants or similar project developers taking into account relevant national and/or sectoral policies and circumstances, such as historical land uses, practices and economic trends.

Outcome:

SCENARIO 01: Continuation of extensive cattle farming

The first alternative land use scenario is the permanence of extensive cattle ranching in degraded grasslands, in continuation of the pre-project land use. The agricultural establishments in the state of Mato Grosso do Sul total an area of 30.5 million hectares, where 60.4% are occupied by natural and planted pastures, used mainly

[47] CDM Prior Consideration Registry. Available at: <https://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html>. Last access: 26th November 2021

for cattle production. The state accumulates 19.5 million heads of cattle, representing 11.3% of the national cattle herd (172.7 million heads of cattle)[48].

The grasslands used for cattle raising were originally occupied by the Cerrado, which, after the process of deforestation or suppression of vegetation, were converted to pasture. This deforestation process is still in force in Brazil. In 2019, an estimated 1.29 million ha were deforested, of which 33.5% occurred in the Cerrado biome [60]. The indiscriminate advance of the agricultural frontier for production, especially soybeans and cattle raising, is currently the main threat to Brazilian Cerrado.

Therefore, it can be concluded that livestock farming is characteristic for Mato Grosso do Sul and for the whole country. It is clearly established in the regional economy. Nevertheless, according to MapBiomas [60], the total area destined for cattle ranching in the cities where the project is located was over 2,187,900 ha in 2017, and is credible to assume that the project area could be destined for such activity, considered this is the previous land use. Based in a recent study by Ferreira, the proportional estimated costs for this activity would be of R$ 1,369.57 per ha, composed by R$ 558.87 of variable costs, and R$ 810.70 of fixed costs[49].

Hence, the alternative Scenario 01 is deemed as a plausible alternative land use scenario to the project activity.

SCENARIO 02: Afforestation of the land within the limits of the Project carried out without registration as an AFOLU VCS project activity

Scenario 02 represents the afforestation of the land within the limits of the Project carried out without being registered as an AFOLU VCS project activity, considering not only the eucalyptus and native vegetation planting activities, but with the implementation of the social activities that are additional to what Suzano is used to do.

In Brazil, the planted tree sector has been an important indicator of the economic, social and environmental development, since it promotes local economic change,

[48] IBGE. Resultados definitivos Mato Grosso do Sul. Available at: <https://censos.ibge.gov.br/agro/2017/templates/censo_agro/resultadosagro/pdf/ms.pdf>. Last Access: 26th November 2021.

[49] FERREIRA, Robson Leandro. Avaliação Economico-Financeira de um sistema de gado de corte em região leiteira de Minas Gerais. UFRRJ: 2019. Available at: <https://tede.ufrrj.br/jspui/bitstream/jspui/5125/2/2019%20-%20Robson%20Leandro%20Ferreira.pdf>. Last access: 14th July 2022.

offers new job opportunities and generates income for the population. Additionally, it contributes to climate change adaptation, mitigation and the provision of ecosystem services.

Usually, the wood produced by commercial plantations is consumed by the industrial sector of pulp and paper, as a source to renewable energy production through biomass, to produce charcoal, to produce furniture and to be used as an input to the construction sector.

In 2019, the total area of planted trees totaled 9.0 million hectares in Brazil, which is an increase of 2.4% compared to 2018 (8.79 million hectares, considering the adjustment according to the new methodology)[50].

Nevertheless, revegetation of degraded also occur at the project country, even if not in such a high frequency. To promote this activity, several guides for restoring native vegetation were published, considering the Biome particularities. [51,52]

The costs for implementing such activities are estimated as R$ 10,998.31/ha per cutting cycle, according to the Agrianual, published in 2020[53].

Therefore, Scenario 02 is deemed as a plausible alternative land use scenario to the project activity.

SCENARIO 03: Land use within the project boundary for soy farming

Scenario 03 refers to the destination of the areas within the project boundary to soy production. The expansion of soybean cultivation in Brazil, particularly in the Cerrado, happened because of a series of technical and political factors. These range from

[50] *IBÁ – Indústria Brasileira de Árvores; Relatório 2020, ano base: 2019. Brasília – DF; 2020, 66p. Last Access: 26th November 2021.*

[51] KUHLMANN, Marcelo; RIBEIRO, José Felipe. Recomposição da Vegetação Nativa no Bioma Cerrado. EMBRAPA, 2011. Available at: < https://www.infoteca.cnptia.embrapa.br/infoteca/bitstream/doc/1135031/1/Recomposicao-da-vegetacao-nativa-do-bioma-cerrado-Felipe.pdf>. Last Access: 08th of July, 2022.

[52] DURIGAN, Giselda; et. al. Manual para Recuperação da Vegetação de Cerrado. São Paulo: SMA, 2011. Available at: < https://www.icmbio.gov.br/educacaoambiental/images/stories/biblioteca/permacultura/Manual_recuperacao_cerrado.pdf>. Last access: 08th of July, 2022.

[53] Agrianual. Anuário da Agricultura Brasileira, 2020. Available at: < http://www.agrianual.com.br/>. Last access 14th July 2022.

biotechnological innovations, such as the production of cultivars that are adapted to the edaphoclimatic conditions of this biome and its variations, to the inevitable participation of the State as a promoter and articulator of private agents, all due to the external demand for commodities[54].

In the period between January and November 2020, soybean exports in the state of Mato Grosso do Sul reached an export value of (US$ FOB) 1.62 billion, an increase of 42.4% compared to 2019[55]. To demonstrate the evolution of soybean crop expansion in the state, the figure below represents the spatialization of data that conclusively attest to the expansion of the planted area in the last decades in the state. This predatory form of expansion is consistent with the dynamics of modern production; there is still the advance of crops over portions of native vegetation, as well as a more technological management of crops, increasing their average yield per hectare through the massive use of fertilizers and pesticides[56].

[54] *FACCIN, A. C. T. M. Complexo soja no Mato Grosso do Sul: competitividade regional e vulnerabilidade territorial. Tese (Doutorado em Geografia). Faculdade de Ciências Humanas, Universidade Federal da Grande Dourados. Dourados, 2017. Available at: <https://repositorio.ufgd.edu.br/jspui/handle/prefix/390>. Last Access: 26th November 2021.*

[55] *Governo Federal – Ministério da Indústria, Comércio Exterior e Serviços. ComexVis Available at: <http://comexstat.mdic.gov.br/pt/comex-vis>. Last Access: 26th November 2021.*

[56] CAMPOS, Margarida C.. Modernização da Agricultura, Expansão da soja no Brasil e as transformações socioespaciais no Paraná. Geografar Magazine, Curitiba, v. 6. N. 1. P. 161-191. June/2011. Available at: <https://revistas.ufpr.br/geografar/article/download/21808/14203>. Last Access: 26th November 2021.

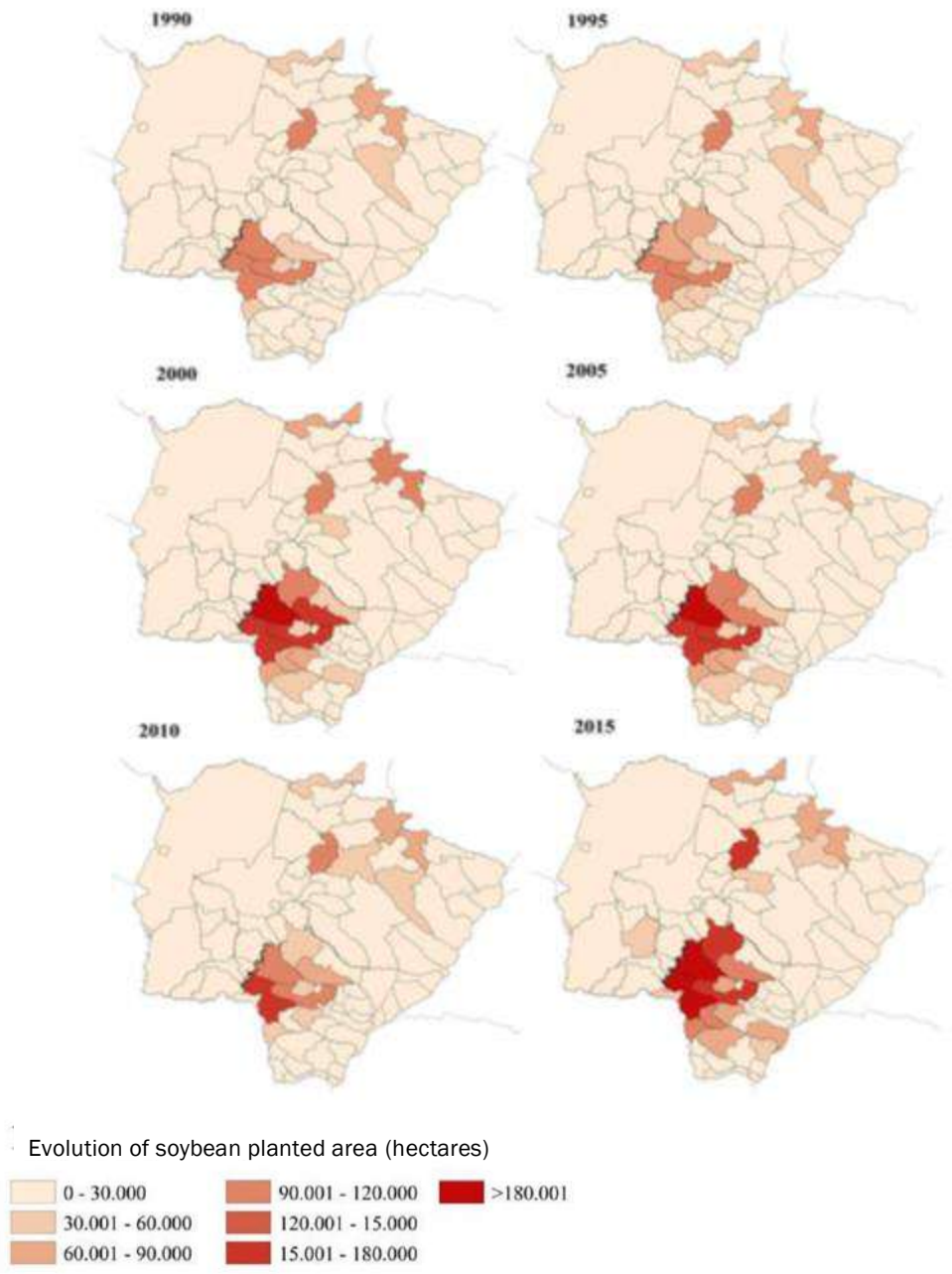

Figure 63 - Mato Grosso do Sul. Evolution of soybean planted area: 1990, 1995, 2000, 2005, 2010 and 2015.[54]

It is a fact that the expansion of commodity cultivation encounters few obstacles in frontier agricultural areas, suggesting that the growing volume of soybean production in the state rather occurs because of horizontal expansion (occupation of new areas) than vertical expansion (increase in yield).

Nevertheless, according to MapBiomas [60], the total area destined for soy farming at the city where the project is located was over 10,000 ha in 2017, and is credible to assume that the project area could be destined for such activity, considered this is the previous land use. The costs for implementing such activities are estimated as R$2,964.86/ha per cutting cycle, according to the Agrianual, published in 2020[53].

Although the cities where the project is located might not have been impacted by the increase of soy production at the state, this activity is still present at the region[1] Therefore, Scenario 03 is deemed as a plausible alternative land use scenario to the project activity.

SCENARIO 04: Land use within the project boundary for sugar cane farming

Scenario 04 refers to the destination of the areas within the project boundary to sugar cane production. Although soy farming may be considered the most usual agricultural culture under the state of Mato Grosso do Sul, Sugar Cane production is the more common at the cities where the project is located [60]. The expansion of sugar cane cultivation in Brazil happened because of a series of technical and political factors. These range from technological innovations, such as the development of the mills to proper factories, to the implementation of laws to incentive alcohol and sugar cane production, the *Proalcool*.[57]

In the period between January and Semptember 2020, sugar exports (one of the main products of processing sugar cane) in the state of Mato Grosso do Sul grew almost 3.5 times if compared to the same period in 2019.[58] According to the IBGE, as highlighted by Figure 64, the state of São Paulo is the one who concentrates the major part of sugar cane production in Brazil, and due to the proximity of the cities where the project is located to the State, they also have sugar cane farms.[59]

[57] RODRIGUES, Gelze Serrat de Souza Campos; ROSS, Jurandyr Luciano Sanches. A trajetória da cana-de-açúcar no Brasil. EDUFU, 2020. Available at: <http://www.edufu.ufu.br/sites/edufu.ufu.br/files/edufu_a_trajetoria_da_cana-de-acucar_no_brasil_2020_ficha_corrigida.pdf>. Last access: 8th July 2022.

[58] ARMÔA, Marcelo. Indústria sucroenergética de MS amplia em 3.5 vezes o volume de açúcar exportado em 2020. SEMAGRO, 2020. Available at: < https://www.semagro.ms.gov.br/industria-sucroenergetica-de-ms-amplia-em-35-vezes-o-volume-de-acucar-exportado-em-2020/>. Last access: 8th July 2022.

[59] IBGE. Cerrado Paulista concentra 1/3 da área cultivada de cana-de-açúcar do país. 2017. Available at: < https://censoagro2017.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/19008-cerrado-paulista-concentra-1-3-da-area-cultivada-de-cana-de-acucar-do-pais>. Last access: 8th July 2022.

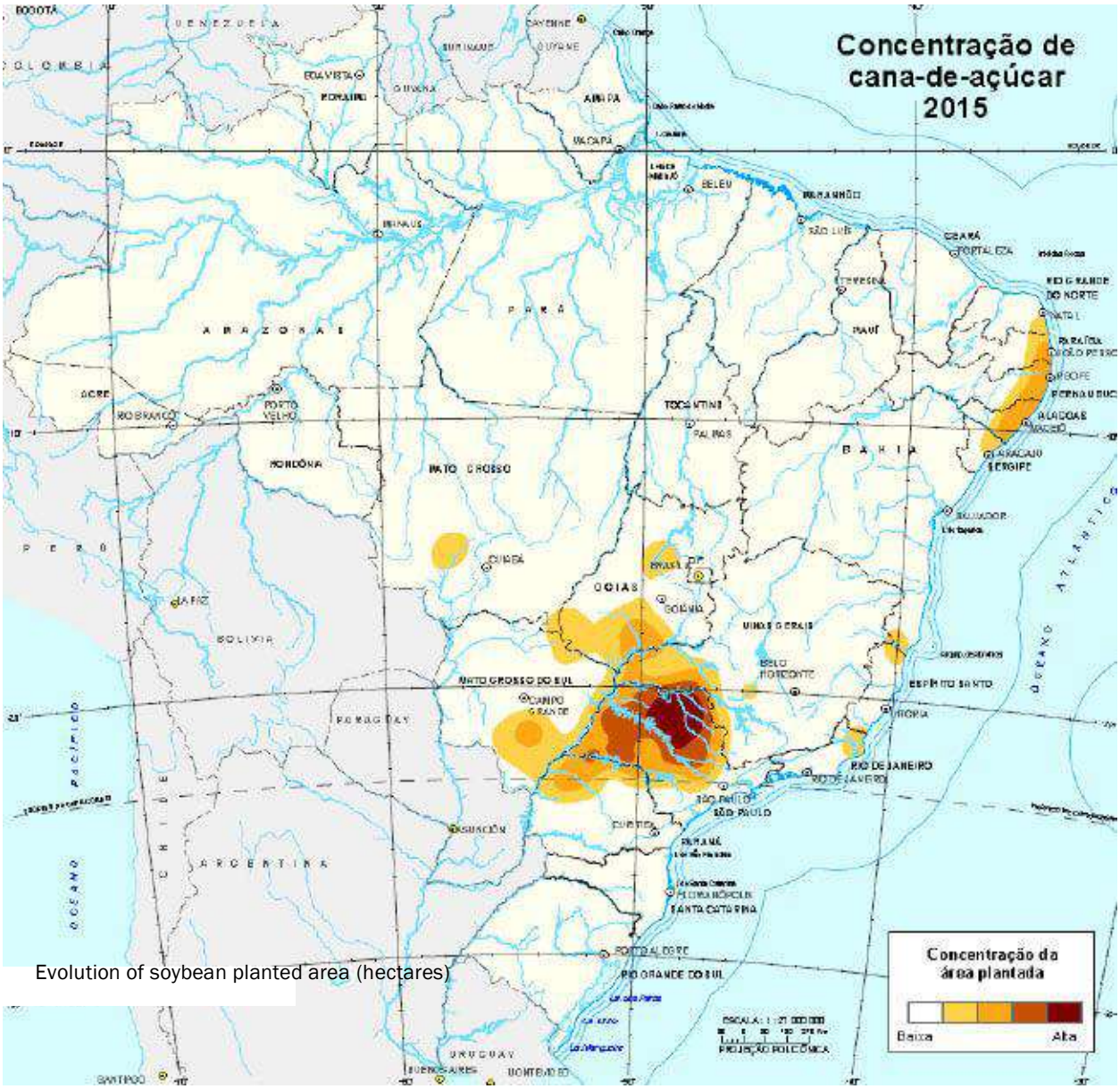

Figure 64 – Sugar cane concentration in 2015 [59]

Nevertheless, according to MapBiomas [60] the total area destined for sugar cane farming at the city where the project is located was over 30,800 ha in 2017, and is credible to assume that the project area could be destined for such activity, considered this is the previous land use. The costs for implementing such activities are estimated as R$40,399/ha per 5 year cutting cycle, according to the Agrianual, published in 2020[53].

Therefore, Scenario 04 is deemed as a plausible alternative land use scenario to the project activity.

Outcome:

As an outcome of sub-step 1a. the following alternative land uses were identified: Cattle farming, afforestation of the land within the limits of the project carried out without registration as an AFOLU VCS project activity, soy farming and sugar cane farming. Following the Brazilian Forest Code, the implementation of such scenarios would occur in 80% of the areas of the farms, since at least 20% of the total area of the rural properties must be preserved.

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

This step requires the demonstration that all land use scenarios identified in the sub-step 1a are in compliance with all mandatory applicable legal and regulatory requirements.

The implementation of all the scenarios is deemed legal considered the laws in Brazil for these activities. According to the Brazilian Forest Code, at least 20% of the area must be preserved. However, the implementation of such scenarios would take place on the other 80% of the areas of the farms. Therefore, all scenarios follow mandatory applicable legal and regulatory requirements. A list of other laws for executing such activities are listed below, however, they do not prevent the implementation of the scenarios.

<u>SCENARIO 01: Continuation of extensive cattle farming</u>

The applicable laws for the continuation of extensive cattle farming are:

- Law n. 6.938, from 31 August 1981, which states the necessity to register the activity under the Federal Technical Record, at the IBAMA, for potential pollutant activities;
- Law n. 12.727 from 17 October 2012, which states the standards for the protection of the vegetation, areas for permanent preservation, Legal reservation, as well other guidelines;
- Law n. 8.171/1991: National outlines for agriculture and instruments for agriculture, livestock, aquiculture and forestry.

SCENARIO 02: Afforestation of the land within the limits of the Project carried out without registration as an AFOLU VCS project activity

The most relevant regulations and laws for the forest plantation activity are mentioned at subsection 1.14. However, there are no laws and regulations that obstruct or block the conversion of degraded areas into reforestation areas.

SCENARIO 03: Land use within the project boundary for soy farming

The applicable laws for the continuation of extensive soy farming are:

- Law n. 12.727 from 17 October 2012, which states the standards for the protection of the vegetation, areas for permanent preservation, Legal reservation, as well other guidelines;
- Law n. 8.171/1991: National outlines for agriculture and instruments for agriculture, livestock, aquiculture and forestry;
- Law n. 13.366 from 1 December 2016: Guidelines for plantation and commercialization of the genetically modified soy production from 2004 and other guidelines;
- Law n. 5.025 from 19 July 2017: Sanitary measures for preventing, controlling and eradicating the Asian Soybean Rust and other guidelines;
- Law n. 11.105 from 24 March 2005: States the standards and guidelines for safety surveillance mechanisms of activities that involve Genetically Modified Organisms.

SCENARIO 04: Land use within the project boundary for sugar cane farming

The applicable laws for the continuation of extensive sugar cane farming are similar to soy farming:

- Law n. 12.727 from 17 October 2012, which states the standards for the protection of the vegetation, areas for permanent preservation, Legal reservation, as well other guidelines;

- Law n. 8.171/1991: National outlines for agriculture and instruments for agriculture, livestock, aquiculture and forestry;
- Law n. 8.817 from 15 January 2008: States about the phasing out of burning sugar cane straw;
- Law n. 11.105 from 24 March 2005: States the standards and guidelines for safety surveillance mechanisms of activities that involve Genetically Modified Organisms.

Outcome:

Mandatory regulation for all scenarios is to protect Permanent Preservation Areas and Legal Reserve (20% of property area), according to Brazilian Forest Code (Law 12.651/2012 and its alterations). Although the laws mentioned above are applicable, there are neither laws nor regulations that prohibit any of the identified alternative land use scenarios since the properties have undergone all necessary environmental compliance procedures, such as declaration of Legal Reserve and Permanent Protection areas. Hence, all scenarios are in accordance with applicable laws and regulations and would not be prevented from implementation.

STEP 2. Identification of barriers that would prevent the implementation of at *least one alternative land use scenarios*

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

Identify realistic and credible barriers that prevent realization of the land use scenarios identified in Sub-step 1b. The barriers should not be specific for the project participants but should apply to the proposed VCS project activity as such, even if similar project developers would have developed the project activity.

BARRIERS RELATED TO LOCAL TRADITION OF LAND USE:

Local tradition of land use is a barrier for the implementation of scenarios 02, 03 and 04, considered cattle ranching (scenario 01) is widely spread at the project region.

In the state of Mato Grosso do Sul, livestock and more recently also agriculture are essential to the state'' economy since it boosts the industrial sector and services.

Livestock farming is a cultural legacy in the region, which gave the state a prominent position among the other Brazilian federations, with the 5t^{h} largest effective herd in the country, reaching the mark of 19.5 million cattle heads and a production of 424 million liters of milk in the latter[15]. It is an activity transmitted through generations of local producers.

During the last two decades, there has been an effective advance in the implementation of agricultural crops (soybean, corn, rice, etc.) and forest plantations

According to the last agricultural census in the State of Mato Grosso do Sul, livestock represents 44.3% of land use, being the most representative activity, followed by agricultural crops with 11.8%, and by forest plantations, which represents only 3.3% of the land use in the State[60].

Although there is an initiative for implementing other activities in the agricultural sector, the current situation of land use in the State reflects, without objections, the inclination of the local tradition to the permanence of livestock, to the detriment of agricultural crops and even more so to the activity of reforestation. Considered the trends for the cities where the project is located, cattle ranching represented 73.7% of areas occupied for agriculture, cattle ranching and other agricultural practices in 2017, before the project implementation, while eucalyptus plantations represented 14.8% of the area[1]. In 2020, the numbers for cattle ranching were 71,0%, whereas for eucalyptus plantation the number was equal to 17,6%[61]. Hence, and in spite of the trends observed of increase to eucalyptus plantations and decrease on cattle ranching, it will still take years before other practices are to overcome the cattle ranching scenario, and it is an unlikely alternative to be materialized, even at the cities where the project activities are being implemented. Moreover, it is important to highlight that native vegetation area decreased since the project start date (from 2017 to 2020) in 2.7%[1]. This is also an important aspect under second scenario, and corroborates the consideration that there are significant barriers considered local tradition of land use.

[60] IBGE – Censo Agropecuário, Mato Grosso do Sul. Available at: <https://cidades.ibge.gov.br/brasil/ms/pesquisa/24/0>. Last Access: 26th November 2021.

[61] MAPBIOMAS, Coleção 6 (1985-2020). Available at: <https://mapbiomas.org/>. Last access: 18th March 2022.

Therefore, the historical context and the strong local tradition land use suggests that the most likely land use scenario in the absence of the ARR Horizonte Carbon Project would be characterized by livestock farming. Hence, local tradition is considered a barrier for Scenario 02, 03 and 04.

Moreover, considered the size of the magnitude of the project, both activities to plant eucalyptus and recover native vegetation and the particularities of the social activities that will be implemented, local tradition is a strong barrier. As for the size and nature of the eucalyptus plantation project, no project this size would be observed on this area if not implemented by a robust company such as Suzano. In addition, local community had no experience to implement by itself the social activities planned for this project the size Suzano is planning. Nevertheless, it is not usual for the cities where the project is located to restore native vegetation outside RLs and APPs.

INSTITUTIONAL BARRIERS:

Institutional barriers are relevant for the second scenario, considered the number of incentive actions that have been developed for fomenting the other scenarios.

When reviewing the structure of the national agribusiness productive chain, it is noticeable that the State has a major role, which can clearly be attributed to the period known as the "modernization of agriculture". During that period, public policies were established seeking to intensify economic transactions through political and social discounts, whether in the commercial, financial or technological ambit, for the agricultural, industrial and service sectors[62].

Studies based on official data have highlighted the importance of State intervention in the process of transformation of the regions, which have been under analysis since 1970[62]. For example, the implementation of Prodecer (Japan-Brazil Agricultural Development Cooperation Program of the Cerrado Region) was fundamental for the introduction of soybean cultivation and to attract farmers from other regions of the country[63].

[62] Diagnóstico e Desafios da Agricultura Brasileira, Embrapa,2019. < Availaible at: https://www.embrapa.br/documents/1355219/40809920/Diagn%C3%B3stico+e+desafios+da+agricultura+brasileira/e908d3c3-f8f2-9f82-fff9-26f41398b336>

[63] Japan-Brazil agricultural development cooperation programs in the Cerrado Region of Brazil, 2002.

Nevertheless, on a national level, it is important to mention the Proalcool program[57], which was implemented on the 70s, to promote the production of alcohol, which is based on sugar cane processing mainly, in order to provide an alternative for the exceeding sugarcane produced based on the demand for sugar. This initiative brought highly important technology advancements, not only for the sugar and alcohol industries, but also for vehicles, which had motors developed to work by alcohol as a fuel as well.

Despite the recent institutional uncertainty in the country, agribusiness in Brazil is recognized for its participation in the national economy, which safeguards its support even in times of institutional crisis. A survey by the National Confederation of Agriculture and Livestock (CNA) shows that the Gross Value of Production in 2020 reached R$ 728.6 billion, which is the highest real figure in the history of the sector. Compared to 2019, the sector had an increase of 11.8%[64]. Amid the pandemic, agribusiness is expected to account for 23.6% of the country's total GDP.

These statistics corroborate State initiatives to promote Brazilian agribusiness, such as the recent Agribusiness Law (Law No. 13,986/20)[65], created on April 7, 2020, which deals with incentives created by the government to stimulate the sector after the Covid-19 pandemic. In a brief description, the Agribusiness Law presents legislative innovations in several areas of agribusiness, addressing topics ranging from financing to rural credit, which brings a relevant increase in legal security for domestic and foreign investors.

On the other hand, although Brazil has one of the world's largest forests, the Brazilian federal legislation still does not define planted forests, though the term is inserted in Decree No. 5,975/06, Law No. 11,284/06 and the current Forest Code No. 12,651/12. In fact, Brazil's current participation in the world market of forest products is the result of private initiative[66]. There is an important gap to be filled by the State as an inducer of development, capable of planning and working on public policies aimed at fostering and financing the planted forest sector.

[64] Confederação Nacional da Agricultura e Pecuária (CNA), 2020.

[65] Agribusiness Law (Law No. 13,986/20). Available at : http://www.planalto.gov.br/ccivil_03/_Ato2019-2022/2020/Lei/L13986.htm

[66] Plano Nacional de Desenvolvimento de Florestas Plantadas,Embrapa and MAPA, 2018. Available at: < https://www.embrapa.br/documents/10180/0/Plano+Nacional+de+Desenvolvimento+de+Florestas+Plantadas/90e38846-d556-da1d-0213-dda16a75088e>

Based on the information exposed, it can be assessed that institutional interference has been and is still fundamental to agriculture and cattle ranching activities. Given its relative size to the country's economy, it is highly unlikely that this institutional support may be discontinued in the future. Thus, the lack of similar structures to the forestry sector are major setbacks for implementing such activities and can be defined as a barrier for the scenario.

In the last few years, the political scenario also testified how the rural entities gained power. Currently, the Agrobusiness Parliamentary front counts with over 280 politicians, from senators to deputies.[67]

Under the perspective that other activities receive support from the national and federal institutions, whereas the second scenario activities do not, the implementation of the project can face major setbacks. It takes a strong company to implement a project the size of this project activity, so that institutional barriers may not prevent the implementation of the project.

TECHNOLOGICAL BARRIERS:

Technological barriers do impact the implementation of the Scenarios 02 and 03.

Access to technological inputs is strongly related to financial incentives for the modernization of agriculture and technology transfer. The profitable production of crops such as soybeans are closely linked to the implementation of such technologies.

Soy was commercially introduced in Brazil in the 1960s in Rio Grande do Sul and for the last 50 years it has expanded to all regions of the country[68]. However, there are still two major bottlenecks regarding technological components which impact the profitability of agricultural crops: low productivity and high production costs.

The lower levels of productivity are related to the occurrence of the Asian rust disease, which fostered the Brazilian producers' choice to an intense use of

[67] Frente Parlamentar da Agropecuária. Members. Available at: <https://fpagropecuaria.org.br/todos-os-membros/>. Last access: 29th November 2021.

[68] Wanali Brasilizan Foods. About Soy. 2019. Available at: < https://wanali.com.br/sugar-export-2/?lang=en > Acess at: September 20th 2022.

fungicides[69]. The control of the disease has been threatened by the progressive resistance of the fungus to agrochemicals, hence, efficiency has been lost during the last years, making it increasingly difficult to limit the damage caused by rust[69].

Another aspect related to the decrease in productivity is the spontaneous, or invasive, presence of weeds[69]. To maintain high yields of commercial crops, there has been control of spontaneous species in order to avoid competition for environmental resources, or even to avoid reduction of the technical harvest coefficient and an increase in the percentage of impurity and humidity of grains.

In 2006, the first cases of resistance were detected, and since that date, resistant biotypes of Lolium multiforum (azevém), Digitaria insularis (capim-amargoso), Eleusine indica (capim-pé-de-galinha), and three species of buva (Conyza canadenses, Conyza sumatrensis and Conyza bonariensis) are present in the production areas. Areas infested with resistant weeds are more difficult to manage and have higher production costs[69]. Productivity losses can vary depending on the species and the infestation but can reach 70% in the most serious cases. It is estimated that the current average cost of weed's resistance in Brazil is almost R$ 5 billion. When adding the losses from the competition, this value can reach R$ 9 billion annually[69].

Even with institutional incentives, it is important to highlight that technological setback is still present in soy farming to be able to treat and prevent such diseases. Weed competition is a great problem for soy farming, and has a technological barrier associated. Studies show that it could compromise up to 90% of the soy harvest, and its impacts can vary according to the edaphoclimatic conditions over the years, making it hard to foresee and to deal with[70].

The joint analysis of the limiting aspects for the implementation of soy farming corroborates the preference of rural producers in Mato Grosso do Sul to remain with the cattle ranching activities that are already consolidated in the region. These activities are under an extensive management that does not demand any kind of

[69] Contini et al., 2018. COMPLEXO SOJA - Caracterização e Desafios Tecnológicos, Embrapa. Available at: < https://www.embrapa.br/documents/10180/0/COMPLEXO+SOJA+-+Caracteriza%C3%A7%C3%A3o+e+Desafios+Tecnol%C3%B3gicos/709e1453-e409-4ef7-374c-4743ab3bdcd6 >

[70] Brighenti, Alexandre, et al. Períodos de convivência entre plantas daninhas e a cultura da soja; Available at: <https://www.scielo.br/j/pd/a/6k78YFNt5qJ5PxDPpkRd4vF/?format=pdf&lang=en >. Last access 05th July, 2022.

great technological commitment[71], instead of incurring the risks of producing soy and other grains which are extremely dependent on technological inputs, as previously explained. Hence the identification of the barrier for the third scenario.

However, the scenario for sugarcane farming is different from the soybean farming. As previously mentioned, the Proalcool program brought uncountable benefits for processing and destining the products of sugar cane, especially for increasing sugar cane production, modernization and expansion of distilleries, implement new industries and build storing facilities[57]. This program also brought incentives to the production of ethanol, so that it could be used as a fuel for vehicles, or to be added to gas to power the same vehicles[57]. Under the light of such program, no institutional barriers could prevent the implementation of the scenario 04, only promote it.

The project activity presents a different scenario. Forest planting is not a traditionally widespread activity and demands previous technical knowledge about planning and cultivation techniques[66]. The success of a forest plantation, whether for restoration or wood production, is closely related to the technical mastery of aspects such as the choice of species for cultivation, ecological suitability, management and conservation of soil for cultivation, silvicultural treatments suitable for the conduct of the species, management techniques, and harvesting[66]. As a matter of fact, the project proponent had to develop a specific technological area to foster and develop better techniques for planting Eucalyptus, which reinforces the low availability of information and technology at the market[72].

The logistics involved in harvesting and transportation operations are also critical for forest production, where all the operations involved must be optimized. The logistics aspects are mentioned in the Investment barrier analysis. Furthermore, to control for the activities to be carried out, it is necessary to know, with the greatest possible precision, the restrictions and alternatives inherent to each operation. The most common restrictions that involve such operations are, among several others, the slope of the land, planting spacing, volume of trees, management adopted, and power and productivity of the machines.

[71] Cotrin et al., 2021. Análise comparativa de sustentabilidade na pecuária de corte: Um estudo multicaso. Research, Society and Development, v. 10, n. 9 | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v10i9.18127

[72] SUZANO. Centro de Tecnologia da Suzano em Jacareí desenvolve projeto inovador de clones de eucalipto. 2020. Available at: <https://www.suzano.com.br/centro-de-tecnologia-da-suzano-em-jacarei-desenvolve-projeto-inovador-de-clones-de-eucalipto/>. Last access: 15th July, 2022

In addition to these aspects, the reforestation activity has additional costs compared to other agricultural activities, such as the removal of stumps after harvesting. This is an onerous activity necessary to convert the area into other uses after the rotation cycle, which makes the activity even less attractive to rural producers. Hence the identification of the barrier for the second scenario, not to mention the additional costs for restoring completely degraded areas with native vegetation, and the costs for implementing social activities.

Based on what has been discussed above, there is a clear barrier for producers to opt for cattle ranching and sugar cane plantations over soy plantations and forestation activities. For soy plantations and forestation activities, it is necessary to mobilize a considerable number of resources, as well as technology and knowledge, which is scarcely available on the market. It is important to highlight that the technological barrier that prevent scenario 02 do not apply in the internal context of Suzano S.A, but in the context of the activity: the large-scale Eucalyptus plantation.

INVESTMENT BARRIERS:

The lack of access to credit is a barrier for implementing the second scenario.

As previously mentioned, agribusiness in Brazil contributes significantly to the development and growth of the country by placing it in a prominent position, especially regarding food production and the export of primary products[64].

With the country achieving a higher market share in the world market for food and primary products, government investments in favor of rural producers are growing to optimize their productive activities[62]. Thus, through public policies, rural producers feel safer to make investments that allow for an increase in income.

A relevant factor when considering an investment is the return time of the amount invested. It is known that reforestation activities require a significant investment, which is determined according to the technical, operational, and economic planning of the enterprise. Assuming that the risks are overcome, planting needs a much longer period than the return of annual agricultural activities. When considering a short cycle for eucalyptus production, the financial return would be after 7 years. Meanwhile, the area is occupied without generating income.

In addition, in the last decade, the value of reforestation wood in general, oscillated below the Inflation, which denotes low wood prices and brings dissatisfaction to

producers. Recent studies point out a trend of a reduction in wood prices following the supply growth, as it is a product substituted by native wood. [73]

For the eucalyptus forests in Mato Grosso do Sul, a relevant complication is the distance between the forests and the industries. A radius of 150 kilometers is usually a threshold from which the transportation of the raw material (wood) is no longer viable. Despite this, there are many planted forests located in areas of difficult access or with precarious roads, which makes the costs of bringing the raw material to the industries too expensive.[74]

Under such conditions, farmers are unlikely to take the risks and challenges of long-term investment, rather than continuing with a well-known land use activity, with higher financial returns that also occurs on a short-term horizon, which constitutes an investment barrier for forest plantations. Here, as well as the technological barrier, the investment barrier that prevent the scenario 02 does not apply in the internal context of Suzano S.A, but in the context of the activity: the large-scale Eucalyptus plantation and restoration of areas of native vegetation without legal obligation.

Moreover, it must also be taken into consideration the effort on native species plantations, which is not to generate any profit besides the one from carbon credits revenue, and the importance of the social activities included under this project. Such activities would not be implemented by Suzano if the credits revenue were not a possibility. Although Suzano has the funds to implement such activities and did not have to find a lender, it is not the standard procedure, and it had to develop a specific conception for such activities, and request for additional funds, considered the revenue of the credits.

These are unfavorable aspects to reforestation in the region where the present project will be implemented, the low price of wood added to the high costs of logistic operations and the direction of State incentives to competing activities, makes the activity far less attractive and, thus, in line with the generation of carbon credits.

[73] ALMEIDA, Jaqueline Sousa. Dinâmica temporal dos preços de madeira serrada de Eucalyptus sp. No estado de São Paulo. 2019. Available at: < https://www.eumed.net/rev/oel/2019/03/precos-madeira-serrada.html>. Last Access: 29th November 2021.

[74] ORTIGOZA, Francielly de S. S.; SENNA, Ricardo J.. Caracterização do segmento de florestas plantadas de eucalipto em Mato Grosso do Sul. 2016. Available at: <https://seer.sede.embrapa.br/index.php/RPA/article/download/1126/1001>. Last access: 29th November 2021.

BARRIERS BY SOCIAL CONDITIONS:

The lack of skilled and/or properly trained labor force can be a major setback for the Scenarios 02, 03 and 04.

Technology transfer in rural areas occurs through rural extension, whose main tool is technical assistance. This has been pointed out in several studies as one of the main bottlenecks for the implementation of new crops and technology among rural producers[75;76]. Technical Assistance and Rural Extension Services do not reach all farmers, as the agricultural census points out. Technical guidance reaches only 22% of establishments, this indicates a serious failure in the transfer of technology to the rural environment[77]. This gap in the technical assistance service is associated with staff shortages and the extinction of the Ministry of Agrarian Development, which was the governmental representative that would be responsible for managing rural extension policies at the federal level.

The success of a forestry or agricultural company also depends on professionals with adequate technical competence, capable of indicating solutions to challenges such as the absence of adequate infrastructure for production outflow, lack of fiscal incentives and instability of the foreign exchange market. These challenges highlight the importance of good management of all processes in the forest chain, from the planning stages, definition of the wood purchasing market, choice of the best suppliers of materials, and services and efficient control in the purchase of inputs. In eucalyptus production chain, for example, to preserve the quality of the logs, the cutting and delivery logistics for the industry must be just in time. For this, the planner must be equipped with solid information on the productivity of forests, quality, strategy, and logistics. In other words, the technical competence of the manager, such as the eucalyptus planted forests, is a determining factor as to whether the activity is bound to be successful and whether local labor force lacks skilled professionals for this position.

[75] LOPES, Renato Simplicio. O modelo brasileiro de extensão rural.

[76] DE OLIVEIRA, Nathally Costa; DE SOUSA, Hortência Araújo; SANTOS, Marco Aurélio Oliveira. Extensão rural: necessidade humanas desarticuladas com a saúde pública na região amazônica. Revista de Administração e Negócios da Amazônia, v. 11, n. 3, p. 19-38, 2019.

[77] IBGE. Censo Agro 2006: IBGE revela retrato do Brasil agrário. 2009. Available at: < https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/13719-asi-censo-agro-2006-ibge-revela-retrato-do-brasil-agrario> Acess at: September 20th 2022.

Another characteristic of the planted forest sector at the cities where the project is located is the need to improve the coordination issues, especially the alignment among agents for knowledge generation, planning and technology transfer to the local population, who traditionally does not have the knowledge for the proper development of activities other than cattle raising, highlighting the lack of qualified labor in the region[78].

The need for technical and highly specified knowledge is evident, as it is generally inaccessible to a rural producer simply interested in such activity. This is another reason for the rural producer in Mato Grosso do Sul to prefer to continue the use of land for livestock, rather than opting for activities such as reforestation or soybean plantations.

Suzano has developed a training procedure in order to ensure all the workforce hired has the adequate skills and training for conducting their activities. This is needed considered the low availability of trained professionals where its activities are implemented. Therefore, is important to highlight that the skilled labor barrier that prevent scenario 02 do not apply in current internal context of Suzano S.A, but in the context of the activity: the large-scale Eucalyptus plantation.

Outcome:

Significant barriers have been identified for some of the scenarios identified on Step 1: Barriers related to local tradition of land use; Institutional barriers; Technological barriers; Barrier to investment and Barriers by social condition.

Sub-step 2b. Elimination of land use scenarios that are prevented by the identified barriers

Determine which land use scenarios identified in the Sub-step 1b are prevented by at least one of the barriers listed in sub-step 2a. Substantiate, that the barrier identified as preventing realization of a land use scenario is valid and conclusive in the context of the land use scenario in question. The assessment of a barrier may take into account the level of access to and availability of information, technologies and skilled labour in the region where the planned VCS project activity is located. Eliminate these scenarios from further consideration.

[78] AECWeb. Falta de mão de obra qualificada para novos projetos no Brasil. Available at: < https://www.aecweb.com.br/revista/noticias/falta-mao-de-obra-qualificada-para-novos-projetos-no-brasil/9401 > Acessat: september 20th 2022.

If the land within the boundary of the proposed of the VCS project activity was at least partially forested since 31 December 1989 and the land is not a forest at the project start, identify reasons/actions/incentives that allowed for the past forestation and demonstrate that the current legal/financial or other applicable regulations or socio-economical or ecological or other local conditions have changed to the extent that allows for conclusion that repetition of the forestation performed without being registered as the VCS project activity is not possible.

Include all land use scenarios that were identified in the Sub-step 1b and were not eliminated in the Sub-step 2b into the list of land use scenarios that are not prevented by any barrier.

The following table identifies which barrier applies to each scenario, as described under the sub-step 2.a:

SCENARIO ***BARRIER***	***SCENARIO 01:*** *Continuation of extensive cattle farming*	***SCENARIO 02:*** *Afforestation of the land within the limits of the Project carried out without registration as an AFOLU VCS project activity*	***SCENARIO 03:*** *Land use within the project boundary for soy farming*	***SCENARIO 04:*** *Land use within the project boundary for sugarcane farming*
Barriers related to local tradition of land use		*X*	*X*	*X*
Institutional barriers		*X*		
Technological barriers		*X*	*X*	
Barrier to investment		*X*		
Barriers by social conditions		*X*	*X*	*X*

Outcome:

Given the barriers identified for scenario 02, scenario 03 and scenario 04, only the first scenario is still applicable. Therefore, the list of land use scenarios that are not prevented by any barrier is composed by Scenario 01: Continuation of extensive 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?

→ If yes, then: Does the list contain only one land use scenario?

→ If yes, then the proposed A/R CDM project activity is not additional.

→ If no, then continue with Step 3: Investment analysis.

→ If no, then: Does the list contain only one land use scenario?

→ If yes, then the remaining land use is the baseline scenario. Continue with Step 4: Common practice test

→ If no, then through qualitative analysis, assess the removals by sinks for each scenario and select one of the following options:

Option 1: Baseline scenario is the land use scenario that allows for the highest baseline GHG removals by sinks. Continue with Step 4: Common practice test,

Option 2: Continue with Step 3: Investment analysis.

Outcome:

The forestation without the AFOLU VCS project activity is not included in the list of land use scenarios not prevented by any barrier. The list contains only one scenario. Proceed to step 4.

STEP 3. Investment analysis

This step serves to determine which of the remaining land use scenarios identified in the Sub-step 2b is the most economically or financially attractive. For this purpose, an investment comparison analysis is conducted.

Sub-step 3a. Determine appropriate analysis method

Determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis. If the planned VCS project activity generates no financial or economic benefits other than VCS related income, then apply the simple cost analysis (Option I). Otherwise, use the investment comparison analysis (Option II) or the benchmark analysis (Option III). Note, that Options I, II and III are mutually exclusive hence, only one of them can be applied.

Outcome:

Given the barrier analysis identifies only one alternative land use scenario, it is not necessary to proceed with step 3. However, as shown under the non-permanence risk, the activity does not present the most profitable scenario among the alternative activities identified. It is also important to highlight that the eucalyptus plantations have the highest payback period, considered the revenues from the activity will only occur after harvesting cycles, which are to take place 7 years after the planting activity.

Sub-step 3b. – Option II. Apply investment comparison analysis

Identify the financial indicator, such as IRR, NPV, payback period, cost benefit ratio most suitable for the project type and decision-making context.

Outcome:

Given the barrier analysis identifies only one alternative land use scenario, it is not necessary to proceed with step 3.

Sub-step 3c. Calculation and comparison of financial indicators (only applicable to options II and III)

Calculate the suitable financial indicator for the proposed VCS project activity without the financial benefits from the VCS and for all the land use scenarios that are not prevented by any barrier. Include all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding VCU revenues, but including subsidies/fiscal incentives where applicable), and, as appropriate, non-market cost and benefits in the case of public investors.

The following decision tree must be applied:

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?

→ If yes, then: Has the proposed A/R CDM project activity a less favorable financial indicator (e.g. IRR), than at least one land use scenario that is not prevented by any barrier?

→ If yes, then select as the baseline scenario the land use scenario that allows for the highest value of the financial indicator (e.g. IRR).

Proceed to Sub-step 3d. Sensitivity analysis.

→ If no, then the proposed A/R CDM project activity is not additional.

→ If no, then: Select as the baseline scenario the land use scenario that allows for the highest financial indicator (e.g. IRR). Proceed to Sub-step 3d. Sensitivity analysis

Outcome:

Given the barrier analysis identifies only one alternative land use scenario, it would not be necessary to proceed with step 3. Nevertheless, it is important to highlight that eucalyptus plantations have longer payback than other activities[79]. In addition, as shown under the Non-permanence risk assessment, even when credits revenue is considered, the project payback would be in 10 years, which would be less

[79] REIS, Julio Cesar dos; et. al. Sistema de integração lavoura-pecuária-floresta como estratégia de desenvolvimento sustentável no estado de Mato Grosso. CEPAL (Comissão Econômica para a América Latina e o Caribe das Nações Unidas), 2020. Please note that activities including forest implementation has higher payback than alternative scenarios as indicated under table 1. <https://archivo.cepal.org/pdfs/bigpushambiental/Caso72-SistemadeIntegracaoLavouraPecuariaFloresta.pdf>. Last access on 16 May 2022.

financially attractive if compared to soy farming payback, which occurs within the first year of plantation.

STEP 4. Common Practice Analysis

Provide an analysis to which extent similar forestation activities to the one proposed as the VCS project activity have been implemented previously or are currently underway. Similar forestation activities are defined as that which are of similar scale, take place in a comparable environment, inter alia, with respect to the regulatory framework and are undertaken in the relevant geographical area, subject to further guidance by the underlying methodology. Other registered VCS project activities shall not to be included in this analysis. Provide documented evidence and, where relevant, quantitative information. Limit your considerations to any period since 31 December 1989.

If forestation activities similar to the proposed VCS project activity are identified, then compare the proposed project activity to the other similar forestation activities and assess whether there are essential distinctions between them. Essential distinctions may include a fundamental and verifiable change in circumstances under which the proposed VCS project activity will be implemented when compared to circumstances under which similar forestations were carried out. For example, barriers may exist, or promotional policies may have ended. If certain benefits rendered the similar forestation activities financially attractive (e.g., subsidies or other financial flows) explain, why the proposed VCS project activity cannot use the benefits. If applicable, explain why the similar forestation activities did not face barriers to which the proposed VCS project activity is subject.

The eucalyptus plantation is not a common practice under the Mato Grosso do Sul state, given its small representativeness when land use is put into perspective. According to the last agricultural census, only 3,3% of the State area is dedicated to forest plantation, a small number when compared to cattle ranching and soy plantation, occupying 44,3% and 11% of the total area, respectively[60].

Also, the native revegetation activity is even more important when deforestation is put into perspective. Since the year of the project start date (2017) to 2020, almost 2.6% of the reminiscent natural vegetation area was deforested. It is also important to take into perspective that that the state has the highest deforestation rates under the Cerrado biome, which has been the second most impacted biome by deforestation in the country, with 33,5% of the deforested areas[61]

In the state of Mato Grosso do Sul there are three projects registered as ARR projects at the VCS database, these projects are in the municipalities of Costa Rica and Campo Grande, and near the Nascentes do Rio Taquari State Park and have the following similarity: being in the same state; having similar dimensions; being maintained by medium and small entrepreneurs.

However, whereas two of the mentioned registered projects consists in eucalyptus planting, the eldest one consists in recovering native vegetation. Differently, The ARR Horizonte Carbon Project, will be implemented in a strategic location and can be described as a bigger forestation project, with a proposed forestation area of 14,427.66 ha with eucalyptus plantations and 999.10 ha of native revegetation, on a higher dimension than the other registered projects, which combined cover an area of 1,217 ha [80].

Furthermore, Suzano is of one of the largest companies in the Brazilian forestry sector, an important differential when compared to the entrepreneur profile of the aforementioned ARR projects. This initiative may represent the establishment of a new level for ARR projects in Brazil.

It is also worth mentioning that the way this project activity was designed is unusual even for the project proponent business, where it takes responsibility not only for planting the eucalyptus areas, but to restore native vegetation outside RLs and APPs and to recover the legally required areas, which are inside the RLs and APPs for the leased lands. Another great highlight of this project are the additional social activities, that will bring benefits to the local community.

The project will implement two main additional activities for enhancing the native environment:

1. Ecological Restoration: The program's purpose is to restore the ecological processes, which are responsible for the formation of a functional and sustainable forest. The activities are implemented at Permanent Preservation Areas (APP – *Área de Preservação Permanente,* in Portuguese) and at Legal Reserves (RL – *Reservas Legais,* in Portuguese), going further the legal requirements of protecting such areas, promoting the revitalization of such areas. In addition, Suzano also developed a procedure to identify and characterize the

[80] Verified Carbon Standard – Verra Registry. Please, search for Agriculture, Forestry and other land use at project type, ARR, Registered projects at Brazil. Available at: <https://registry.verra.org/app/search/VCS>. Last Access 23 Nov. 2021

different Phyto physiognomies of the Cerrado biome, in order to implement more assertive activities for restoration of the areas. The program is based on the assumptions for an integrated management at the landscape scale and contributes for the enhancement of biodiversity and environmental services at the region, with the application of the following methodologies: planting seedlings of regional native species, conducting natural regeneration, controlling invasive species and isolating protected areas with passive restoration. The most adequate technical choice depends on environmental conditions of the areas where such activities are implemented, considered the regeneration potential, the presence of degradation factors and its historic, and the verification of the development and results of activities that have already been implemented, through monitoring events. Suzano has committed to renew life and connect half a million hectares of prioritized areas for the conservation of biodiversity of the Cerrado, Atlantic Forest and Amazon biomes.

2. Environmental Monitoring: Suzano assesses the effect of its activities over the quality and quantity of hydrological resources, biodiversity, fauna and flora through a representative monitoring net, considered the scale and intensity of plantation activities, with pre-stablished periodicity, in order to better understand the impacts and implement new action plans, whenever deemed necessary.

This project will also enable the implementation of a series of social activities focused on meeting the needs of the communities surrounding the project, which would not take place without the credit's revenue from this project:

- Inclusive Recycling: This project's target is to implement activities that will promote the inclusion of the members of the recycling community, in a way to improve their income, and to develop, give strength and foster the organized production of cooperatives at the project region. The implementation of this project will contribute to the improvement of public health by helping the government to deal with solid waste, reducing the amount of waste disposed on the landfills. It will also include the individuals at the recycling chain and improve their income. This project targets individuals who lives under a social vulnerability condition.

- Native and ornamental seedlings nursery: This project will target families from the local community in nearby areas from the project implementation. The activity will be based on the implementation of a nursery of seedlings to provide the adequate

species for implementing the native species plantations, so to ensure the perpetuity of this business and enable project implementation. Nevertheless, ornamental species will also be included in this conception, so that local families can keep the nursery seedling running in a more financially stable condition. All the members of the local community involved in this project will be trained and given the needed resources.

To define which social activities should take place, Suzano's social development team did a thorough research to better understand the local community needs and what activities could benefit the community the most. Therefore, the project develops additional activities directly linked to the project activity that are unlikely to be found in any other location, even when compared to operations from Suzano. The inclusion of new areas along the project lifetime can and should also bring other social activities to the area, based on the revenue of extra credits.

As mentioned, at the time of this monitoring period, such social activities have not yet been implemented, and will be implemented in the next verification period with carbon credit revenue (VCS Standard, v. 4.3, section 3.2.6).

Outcome:

In addition to eucalyptus and native plantation not being a common practice, in Mato Grosso do Sul State, additional activities will be implemented through the credit's revenue. In doing so, besides removing and reducing carbon emissions, the project will enrich fauna and flora biodiversity, provide a safe habitat to local fauna, recover degraded areas, improve the soil condition, and reduce its erosion, increase water retention, and protect water resources, and improve the microclimate of the region by making local temperatures milder. Furthermore, it will reduce rural exodus through the creation of more job opportunities for local community in areas of economical vulnerability, improve life quality and reduce forest degradation and deforestation in the region.

The project can be considered unique by the way it has been designed, associating social activities to the project activity itself. No other project can be deemed similar to this configuration, even those already implemented by the project proponents and the one also under development by Suzano.

→ If Step 4 is satisfied, i.e. similar activities can be observed and essential distinctions between the proposed VCS project activity and similar activities cannot be made, then the

proposed VCS project activity is not additional. Otherwise, the proposed VCS project activity is not the baseline scenario and, hence, it is additional.

No similar activity can be observed, this is not a common practice. The project is additional.

Outcome of "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities"

Step 0 provides the information to suffice the requirements for starting date of the Project Activity and previous consideration of credit's revenue.

Under Step 1, 4 alternative scenarios were identified: cattle ranching, soy farming the execution of the project without the benefit of carbon credits and sugarcane farming, and Step 2 identifies that only the cattle ranching scenario would not be prevented by any barriers identified. Hence, step 3 was not needed for this additionality assessment.

No similar activity can be observed as determined by Step 4, proving this is not a common practice activity.

Thus, the project is additional.

3.6 Methodology Deviations

No methodology deviations were applied.

4 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The baseline emissions must be determined as per AR-ACM0003, as detailed below:

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

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
$\Delta C_{DW\_BSL,t}$	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

Carbon stock in tree in the baseline

Although the trees present under the baseline are sparse and limited, the phytophysiognomy of the area has been characterized as degraded pasture and exposed soil. The present sparse trees at the eucalyptus plantation areas will be removed by the project proponent. This removal is legally allowed through legal authorizations called CANI (in Portuguese, Cutting of Isolated Native Trees).

For this reason, tree stock under the baseline should be accounted for, for such trees to be removed. The Project will follow the approach of proportional canopy cover, described under section 8.3 of AR-TOOL14. This method is suitable for estimating baseline carbon stock in tree biomass where the average tree crown cover in the baseline is less than 20% of the threshold tree crown cover reported by the Host Party, considering the current definition of forest or forest formation.

The Brazilian Designated National Authority informed the following values for afforestation and reforestation project activities[81]:

Table 3 – Brazilian Afforestation/Reforestation informations

Requirements	Host party's selected single minimum
Canopy cover	30 %
Minimum height	1m
Area	5 m

The mean pre-project tree crown cover is 1.01%, less than 20% of the threshold tree crown over defined by the DNA (6%), as required by the AR-TOOL0014, which requires under paragraph 49 that "This method is applicable only for estimation of the pre-project carbon stock in tree biomass in the baseline where the mean pre-project tree crown cover is less than 20 per cent of the threshold tree crown cover reported by the host Party under paragraph 8 of the annex to decision 5/CMP.1.".

The map below shows canopy crown cover of sparse trees to be removed and the respective occupied area, of 157.07 ha.

[81] Countries Afforestation/Reforestation informations. Clean Development Mechanism. Brazil information. Available at: <https://cdm.unfccc.int/DNA/allCountriesARInfos.html>. Last access: 29th April 2022.

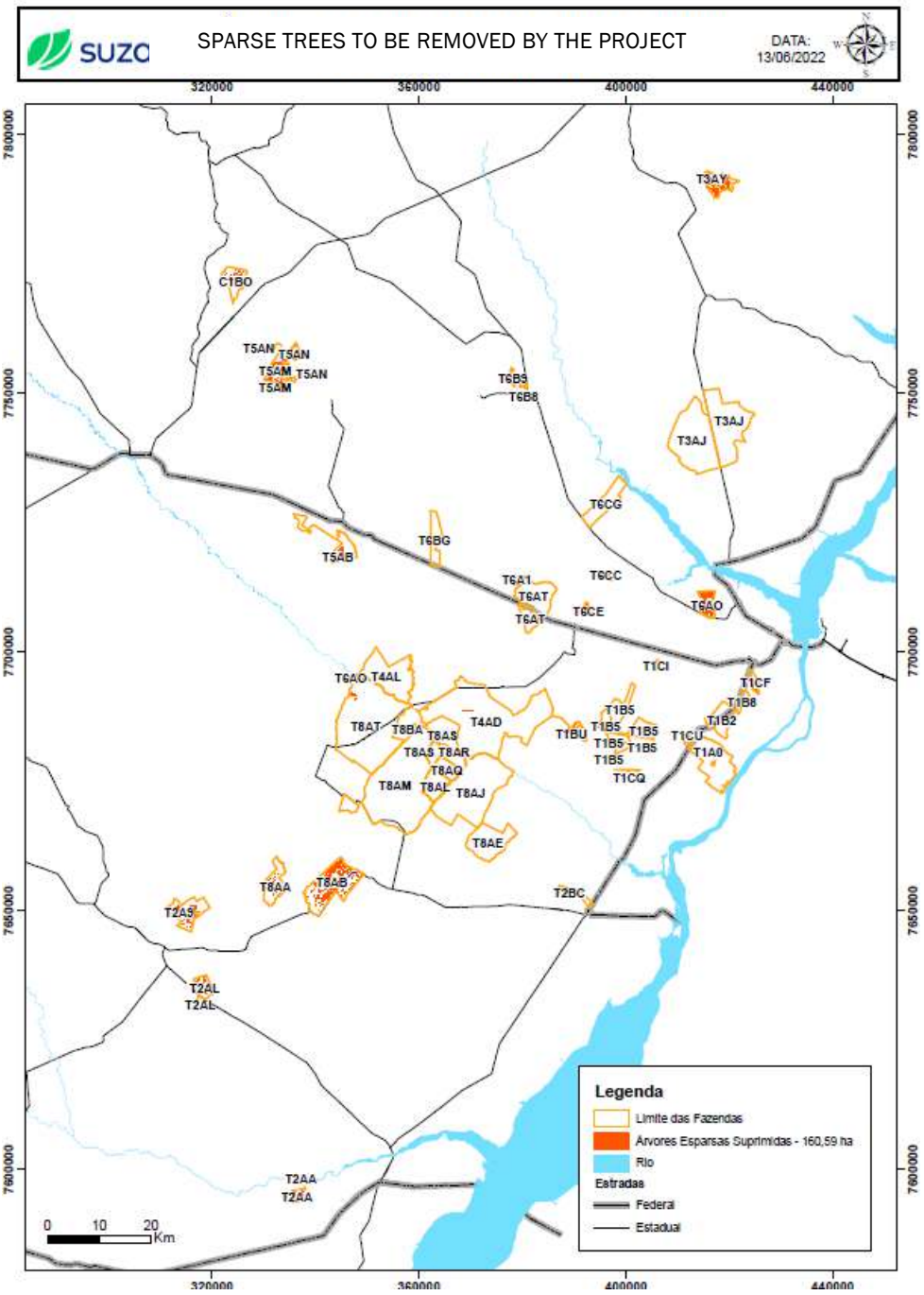

Figure 65 – Sparse trees to be removed from the project area, identified in red.

Meeting the guidelines of AR-TOOL14 tool section 8.3, in paragraph 25, the change in tree carbon stock at baseline is estimated as follows:

$$C_{TREE\_BLS} = \sum_{t=1}^{M} C_{TREE_{BLS},i}$$

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

Where: C_{TREE_BLS} = Mean annual change in carbon stock in trees in the baseline; t CO_2e yr^{-1}

$C_{TREE_{BLS,i}}$ = Mean annual change in carbon stock in trees in the baseline, in baseline stratum i; t CO2e yr^{-1}

CF_{TREE} = Carbon fraction of tree biomass; t C $(t.d.m.)^{-1}$.

b_{FOREST} = Mean above-ground biomass in forest in the region or country where the A/R CDM project activity is located; t d.m. ha^{-1} yr-1.

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

$CC_{TREE_{BLS},i}$ = Crown cover of trees in the baseline, in baseline stratum i, at the start of the A/R CDM project activity, expressed as a fraction; dimensionless

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

The parameters applied are detailed below:

Table 4 – Parameters applied for calculating baseline carbon stock on trees

Parameter	Value	Unit	Reference
CF_{TREE}	0.47	t C $(t.d.m.)^{-1}$	Default value defined by the AR-TOOL14.
b_{FOREST}	110.12	t d.m. ha^{-1} yr-1	MIRANDA, et al. 2014. Regional variations in biomass distribution in Brazilian Savanna woodland. Data for biomass above and below ground for forest formations.
R_{TREE}	0.25	Dimensionless	Default value defined by the AR-TOOL14.
$CC_{TREE_{BLS},i}$	0.0101	Dimensionless	Measured for each farm. This is the average value
A_i	15,517.87	Ha	Measured

The AR-TOOL14 defines that changes in carbon stocks in trees and shrubs in the baseline may be accounted as zero for those lands where one or more indicators apply:

- Observed reduction in topsoil depth (e.g. as shown by root exposure, presence of pedestals, exposed sub-soil horizons);
- Presence of gully, sheet or rill erosion; or landslides, or other forms of mass-movement erosion;
- Presence of plant species locally known to be indicators of infertile land;
- Land comprises of bare sand dunes, or other bare lands;
- Land contains contaminated soils, mine spoils, or highly alkaline or saline soils;
- Land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;
- Conditions under the previous paragraph apply (conditions a, b and c from paragraph 11 at AR-TOOL14).

Scenarios including erosion and base lands can be seen on project areas, both for the areas with eucalyptus planting planned and for native reforestation activities, as indicated by the map below. In addition, the baseline scenario was extensive cattle ranching, which often applies slash and burning procedures for both activities.

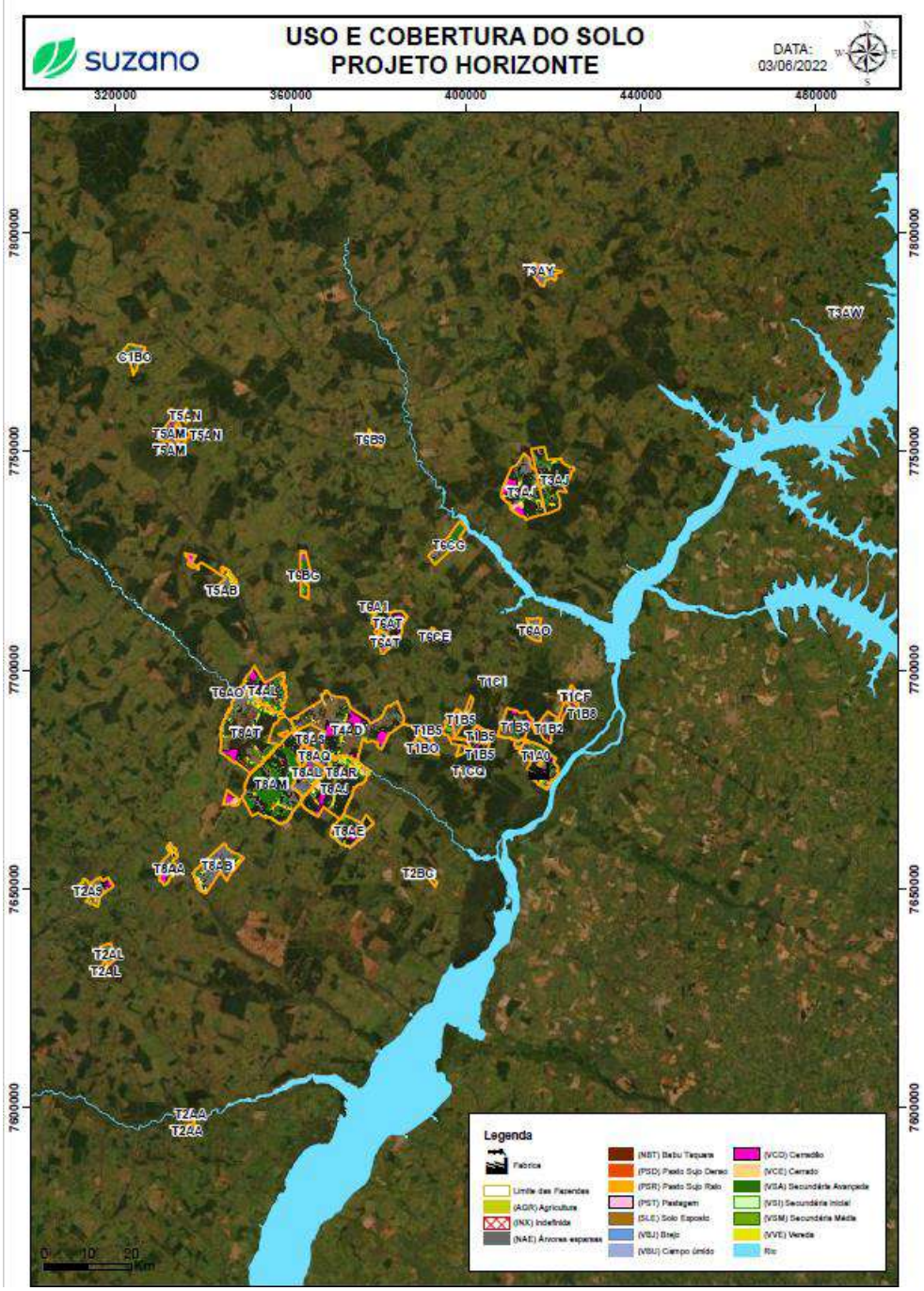

Figure 66 – Soil coverage of the project farms, with presence of exposed soil.

For this reason, changes in carbon stock in shrubs and trees at the baseline are estimated as zero.

4.1.1 Carbon stock in shrubs

It is assumed that the carbon stock in shrub biomass is zero in the baseline scenario for the project activity, because changes in above- and below-ground biomass carbon stock of non-arboreal vegetation on degraded soil in the baseline scenario is not plausible.

4.1.2 Changes in carbon stock in trees, litter, and dead wood in baseline

For the estimates of carbon stock in dead wood and litter, the AR-TOOL12 topics 6.2 and 7.2 were applied, respectively, named the "conservative default-factor based method for estimation of carbon stock". The method allows for estimating carbon stocks under such pools based on conservative default factors, as outlined in the following equations:

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

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

Where:

$C_{DW_{BSL},t}$	Carbon stock in dead wood within the project boundary at a given point of time in year t; t CO_2e
$C_{LI\_BSL,t}$	Carbon stock in litter within the project boundary atat 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
DF_{LI}	Default factor for the relationship between carbon stock in litter and carbon stock in living trees biomass ; per cent

Through the guidelines of the AR-TOOL12, carbon stock under litter and dead wood pools were estimated by correlating them with the carbon stock in the tree biomass, applying the estimated data for the stock in trees at baseline within the project boundaries (as described earlier, in item 4.1.1) and conservative default factors presented by the tool. Dead wood and litter remain in situ and is not removed from the project boundary through any type of

anthropogenic activities described in Suzano's internal forest implementation process (attachment 5). This document has been dully shared with VVB and will be available to Verra.

The Table 5 outlines the baseline emissions calculated according to the equations above-mentioned.

Table 5 – Baseline Emissions resume per year (carbon stock)

	$C_{BSL,t}$	$C_{TREE_{BSL},t}$	$C_{SHRUB_{BSL},t}$	$C_{DW_{BSL,t}}$	$C_{LI\_BSL,t}$
Year	tCO2e	tCO2e	tCO2e	tCO2e	tCO2e
02/11/2017 to 31/12/2017	12,627.08	12,379.49	0	123.79	123.79
01/01/2018 to 31/12/2018	13,439.48	13,175.96	0	131.76	131.76
01/01/2019 to 31/12/2019	13,439.48	13,175.96	0	131.76	131.76
01/01/2020 to 31/12/2020	18,372.81	18,012.56	0	180.13	180.13
01/01/2021 to 31/12/2021	25,500.54	25,000.53	0	250.01	250.01
01/01/2022 to 31/12/2022	25,500.54	25,000.53	0	250.01	250.01
01/01/2023 to 31/12/2023	38,006.00	37,260.78	0	372.61	372.61
01/01/2024 to 31/12/2024	38,006.00	37,260.78	0	372.61	372.61
01/01/2025 to 31/12/2025	38,006.00	37,260.78	0	372.61	372.61
01/01/2026 to 31/12/2026	38,006.00	37,260.78	0	372.61	372.61
01/01/2027 to 31/12/2027	38,006.00	37,260.78	0	372.61	372.61
01/01/2028 to 31/12/2028	38,006.00	37,260.78	0	372.61	372.61
01/01/20129 to 31/12/2029	38,006.00	37,260.78	0	372.61	372.61
01/01/2030 to 31/12/2030	38,006.00	37,260.78	0	372.61	372.61
01/01/2031 to 31/12/2031	38,006.00	37,260.78	0	372.61	372.61

01/01/2032 to 31/12/2032	38,006.00	37,260.78	0	372.61	372.61
01/01/2033 to 31/12/2033	38,006.00	37,260.78	0	372.61	372.61
01/01/2034 to 31/12/2034	38,006.00	37,260.78	0	372.61	372.61
01/01/2035 to 31/12/2035	38,006.00	37,260.78	0	372.61	372.61
01/01/2036 to 31/12/2036	38,006.00	37,260.78	0	372.61	372.61
01/01/2037 to 31/12/2037	38,006.00	37,260.78	0	372.61	372.61
01/01/2038 to 31/12/2038	38,006.00	37,260.78	0	372.61	372.61
01/01/2039 to 31/12/2039	38,006.00	37,260.78	0	372.61	372.61
01/01/2040 to 31/12/2040	38,006.00	37,260.78	0	372.61	372.61
01/01/2041 to 31/12/2041	38,006.00	37,260.78	0	372.61	372.61
01/01/2042 to 31/12/2042	38,006.00	37,260.78	0	372.61	372.61
01/01/2043 to 31/12/2043	38,006.00	37,260.78	0	372.61	372.61
01/01/2044 to 31/12/2044	38,006.00	37,260.78	0	372.61	372.61
01/01/2045 to 31/12/2045	38,006.00	37,260.78	0	372.61	372.61
01/01/2046 to 31/12/2046	38,006.00	37,260.78	0	372.61	372.61
01/01/2047 to 31/12/2047	38,006.00	37,260.78	0	372.61	372.61
01/01/2048 to 31/12/2048	38,006.00	37,260.78	0	372.61	372.61
01/01/2049 to 31/12/2049	38,006.00	37,260.78	0	372.61	372.61
01/01/2050 to 31/12/2050	38,006.00	37,260.78	0	372.61	372.61
01/01/2051 to 31/12/2051	38,006.00	37,260.78	0	372.61	372.61

01/01/2052 to 01/11/2052	38,006.00	37,260.78	0	372.61	372.61

4.2 Project Emissions and actual net GHG removals by sinks

The actual net GHG removals by pools 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 CO_2-e

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

$GHG_{E,t}$ Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year *t*, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e

4.2.1 Stratification

Stratification was defined according to section 5.3 of the "AR-ACM0003 A/R Consolidated Large Scale Methodology Afforestation and reforestation of lands except wetlands Version 02.0". The methodology states that if the distribution of biomass in the project area is not homogeneous, stratification should be performed to improve the accuracy of biomass estimation.

For actual net GHG removals for ex ante estimations, the stratification was based on the project planting plan, considering the year of plantation and the responsible for planting, as well as the type of species to be planted: Eucalyptus or native vegetation. Among native vegetation restoration activity, the stratification was also based on the three types of land use and land cover classification (i.e.Exposed soil -SLE, Pasture - PST and Pasture with

sparse shrubs and trees - PSR). For the project area, the stratification included farm identification, production unit, area and planting date, listed below.

Table 6 - Stratum for Eucalyptus planting plot sampling

Stratum	*Total area*	*Responsible for planting*	*Activity*	*Year of planting*
Stratum 1	3,275.66	Funds	Eucalyptus	2017
Stratum 2	2,438.70	Funds	Eucalyptus	2018
Stratum 3	234.52	Suzano	Eucalyptus	2017
Stratum 4	714.53	Suzano	Eucalyptus	2018
Stratum 5	5,202.27	Suzano	Eucalyptus	2019
Stratum 6	256.65	Suzano	Eucalyptus	2020
Stratum 7	207.21	Suzano	Eucalyptus	2021
Stratum 8	865.67	to be defined	Eucalyptus	2021
Stratum 9	212.95	Funds	Eucalyptus	2022
Stratum 10	947.52	to be defined	Eucalyptus	2022
Stratum 11	71.98	Suzano	Eucalyptus	2022

Table 7 - Stratum for native restoration planting plot sampling

Stratum	*Total area*	*Responsible for planting*	*Land use and land cover classification*	*Activity*	*Year of planting*
Stratum 12	55.49	Suzano	PST	Native vegetation	2023
Stratum 13	71.53	Suzano	PSR	Native vegetation	2023
Stratum 14	74.76	Suzano	PST	Native vegetation	2024
Stratum 15	59.23	Suzano	PSR	Native vegetation	2024
Stratum 16	2.95	Suzano	SLE	Native vegetation	2024
Stratum 17	122.59	Suzano	PSR	Native vegetation	2028
Stratum 18	180.19	Suzano	PST	Native vegetation	2028
Stratum 19	180.19	Suzano	PST	Native vegetation	2030
Stratum 20	122.59	Suzano	PSR	Native vegetation	2030
Stratum 21	31.72	Suzano	PST	Native vegetation	2032

Stratum 22	96.60	Suzano	PSR	Native vegetation	2032
Stratum 23	1.25	Suzano	SLE	Native vegetation	2032

SLE: Exposed soil; PST: Pasture and PSR: Pasture with sparse shrub and trees

According to AR-ACM0003, stratification for ex post estimation for actual GHG removals by sinks should be based on actual implementation of the project planting plan. If natural or anthropogenic impacts of other factors significantly alter the pattern of biomass distribution in the project area, then the ex-post stratification shall be revised accordingly.

4.2.2 Change in carbon stock in Project

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

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

Where:

$\Delta C_{P,t}$	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$\Delta C_{TREE\_PROJ,t}$	Change in carbon stock in tree biomass in project in year *t*, 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 CO_2-e
$\Delta C_{SHURB\_PROJ,t}$	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 CO_2-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 CO_2-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 CO_2-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 CO_2-e

It is considered that the eucalyptus plantations will be harvested every 7 years and reestablished by replanting the area. It is important to highlight that soil preparation at Suzano S.A is carried out based on the principles of minimum cultivation (restricted to the planting lines or pits), achieving a balance between soil preparation quality and maintenance of forest residues (litter and dead wood) on the soil, ensuring the conservation of the structure and biomass below the soil Long term average GHG benefit is being considered by the project proponent for this activity, as required by the VCS Standard 4.3. Detailed information is included under section 4.4.

Due to the company's procedures of keeping the stumps and lowering them at the time of the soil preparation operation (attachment 5),the below-ground biomass is not compromised when the above-ground biomass is harvested, or during replanting. The maintenance of forest residues after harvest improves the physical-chemical attributes of the soil, incorporation of organic matter, besides increasing the cycling and efficiency of nutrient use[82]. In areas that receive fertilization and irrigation, as in the Project areas, it is possible to notice an increase in the carbon stored in the soil, attributed to the higher production of fine roots[83]. Therefore, as long as the Eucalyptus stand is renewed and the above ground biomass grows again, the below ground biomass will be maintained in the area, and the same applies to the stock of litter and dead wood. Due to the application of the methodology AR-ACM0003, this stock behavior cannot be clearly visualized, and are devalued for the eucalyptus activity. This consideration is conservative.

The Native reforestation activity will not include harvesting events or improved forest management techniques whatsoever. Hence, the Long Term Average GHG benefit will not be applied for this stratum, considered it will not be disturbed throughout the project lifetime. Also, carbon stock in soil organic carbon will be applied only for this stratum.

[82] ALVARENGA, Ramon Costa et al. Sistema integração lavoura-pecuária-floresta: condicionamento do solo e intensificação da produção de lavouras. 2010.

[83] GATTO, Alcides et al. Estoques de carbono no solo e na biomassa em plantações de eucalipto. Revista Brasileira de Ciência do Solo, v. 34, p. 1069-1079, 2010.

Estimation for Change in carbon stock in tree and shrub biomass

Eucalyptus plantations

For ex-ante estimation of carbon stock in tree biomass at a given moment, the guidelines on AR-ACM0003 and AR-TOOL14, section 8.2 “Estimation by modeling of tree growth and stand development” was applied.

Existing data from Suzano's internal database were used in combination with the tree growth model to predict tree growth and stand development over time. These data are considered the best data available for estimating carbon stock in eucalyptus trees in the project area, since most were collected in Suzano eucalyptus plantations in the state of Mato Grosso do Sul. Suzano's first eucalyptus plantations in MS started in 2002 and since then data on eucalyptus growth have been collected. When data needed for the carbon stocks changes estimates were not available in the Suzano database, data from the reference literature were used, for instance, Miranda et. al 2014[84] and IPCC[85]. It was always observed the similarity of references in relation to species, climate, soil and management. Suzano's internal database has been dully shared with VVB and will be available to Verra, as well as, the internal document of procedure for collecting these data.

The estimation of above and below ground in tree biomass per hectare at a point in time (per year), considering the referenced parameters, was estimated based on the IPCC Equation 3.2.5 [85]:

$$G_{Total} = G_w * (1 + R)$$

Where:

G_{total} average annual biomass increment above and belowground, 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, dimensionless

$$G_w = I_v * d * BEF$$

Iv average annual net increment in volume suitable for industrial processing, m3 ha-1 yr-1

[84] MIRANDA, et al. 2014. Regional variations in biomass distribution in Brazilian Savanna woodland. Data for biomass above and below ground for forest formations.

[85] IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Chapter 3, Section 3.2. Available at: <https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Chp3/Chp3_2_Forest_Land.pdf>. Last Access: 18th March 2022.

d Basic wood density, tdm/m³ merchantable volume

BEF Biomass expansion Factor for conversion of merchantable volume to aboveground tree biomass, dimensionless

In order to determine the ΔCtree, the equations 3 and 4 of the ARR-TOOL14 were applied:

$$\Delta C_{tree} = \frac{44}{12} * CF_{tree} * \Delta B_{tree}$$

$$\Delta B_{tree} = A * \Delta b_{tree}$$

Where:

CF_{tree} Carbon fraction of tree biomass; t C (t d.m.)-1

A Project area

ΔB_{tree} Change in tree biomass within the biomass estimation strata; t d.m.

Δb_{tree} Mean change in tree biomass per hectare within the biomass estimation strata; t d.m. ha-1

The BEF parameter is estimated through a linear correlation of default values from IPCC[86], based on the age of the trees:

$$BEF = -0{,}033928571 * age + 0{,}432857143$$

The R parameter is also estimated through a linear correlation of default values from IPCC[86], based on the age of the trees:

$$R = -0{,}020714286 * age + 0{,}367142857$$

For ex-ante estimations, the values applied for the other parameters were based on data from other areas from Suzano that apply the same species, and are detailed below:

Table 7 – Parameter values applied for estimating Project emission removals

Species	Iv (m³/ha/year)	D (tdm/m³)	CF (tC/tdm)
Eucalyptus grandis	32.5*	0.44	0.47
Eucalyptus grandis x Eucalyptus urophylla	35.67	0.44	0.47
Eucalyptus spp.	30.92	0.47	0.47
Eucalyptus urophylla	37.03	0.48	0.47

[86] IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Available at: <https://www.ipcc.ch/publication/good-practice-guidance-for-land-use-land-use-change-and-forestry/>. Last Access: 18th March 2022

* Suzano has no information available on its database for this species' IMA. IPCC[86] value was applied considered it is the lowest value available

Native Reforestation

For ex-ante estimation of carbon stock in tree biomass at a given moment for native species plantations, the guidelines on AR-ACM0003 and AR-TOOL14, section 8.2 "Estimation by modeling of tree growth and stand development" was applied.

The Project estimation of carbon stock in trees is based on literature references, observing the similarity of references in relation to species, climate, soil and management.

The estimation of above and below ground in tree biomass per hectare at a point in time (per year), considering the referenced parameters, was estimated based on the IPCC Equation 3.2.3 [87]:

$$C = V * d * BEF * (1 + R) * CF$$

C Total Carbon in biomass, t C

V Merchantable volume, m3 ha-1 yr-1

d Basic wood density, tdm/m³ merchantable volume

BEF Biomass expansion Factor for conversion of merchantable volume to aboveground tree biomass, dimensionless

R root-to-shoot ratio, dimensionless

CF Carbon Fraction, tC t d.m.-1

Considered the equation 3 of the ARR-TOOL14 already includes the CF factor for converting t.d.m to tC, this factor was not considered, as indicated by equation 3.2.3.

In order to determine the ΔCtree, the equations 3 and 4 of the ARR-TOOL14 were applied:

$$\Delta C_{tree} = \frac{44}{12} * \ CF_{tree} * \Delta B_{tree}$$

$$\Delta B_{tree} = A * \Delta b_{tree}$$

Where:

[87] IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Chapter 3, Section 3.2. Available at: <https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Chp3/Chp3_2_Forest_Land.pdf>. Last Access: 18th March 2022.

CF_{tree} Carbon fraction of tree biomass; t C (t d.m.)-1

A Project area

ΔB_{tree} Change in tree biomass within the biomass estimation strata; t d.m.

Δb_{tree} Mean change in tree biomass per hectare within the biomass estimation strata; t d.m. ha-1

For ex-ante estimations, the values applied for the Iv, D, CF, BEF and R parameters were based on literature references:

Table 8 – Parameter values applied for estimating Project emission removals

Parameter	Unit	Value	Reference
V*d*BEF – Aboveground net biomass growth in natural forests ≤20y	t.d.m ha-1 yr-1	7.00	2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 4: Forest Land – table 4.9, value for tropical moist deciduous forest
V*d*BEF – Aboveground net biomass growth in natural forests >20y	t.d.m ha-1 yr-1	2.00	2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 4: Forest Land – table 4.9, value for tropical moist deciduous forest
R - above-ground biomass <125 tonnes ha-1	Dimensionless	0.2	2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 4: Forest Land – table 4.4, value for tropical moist deciduous forest
R - above-ground biomass >125 tonnes ha-1	Dimensionless	0.24	2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 4: Forest Land – table 4.4, value for tropical moist deciduous forest
CF	tC t.d.m-1	0.47	Default value defined by the AR-TOOL14, version 4.2

Estimation for Change in carbon stock in litter and dead wood

For the estimates of carbon stock in dead wood and litter, the AR-TOOL12 topics 6.2 and 7.2 were applied, respectively, named the "conservative default-factor based method for estimation of carbon stock". This was applied for both the eucalyptus plantation and for the native reforestation activities. This approach requires dead wood and litter not to be removed from the project area. Therefore, it is important to highlight that neither the carbon stocks will be removed from the project area, as identified at Suzano's operational

procedures. Dead wood and litter may be slightly moved aside when they are located at planting lines, and stumps may be cut in half or deepened at the soil, but not removed, in line with the methods requirements.

The method allows for estimating carbon stocks under such pools based on conservative default factors, as outlined in the following equations:

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

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

Where:

$C_{DW,i,t}$	Carbon stock in dead wood within the project boundary i at a given point of time in year t; t CO_2e
$C_{LI,i,t}$	Carbon stock in litter within the project boundary 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
DF_{LI}	Default factor for the relationship between carbon stock in litter and carbon stock in living trees ; per cent

Through the guidelines of the AR-TOOL12, carbon stock under litter and dead wood pools were estimated by correlating them with the carbon stock in the tree biomass, applying the estimated data for the stock in trees within the project boundaries.

For the dead wood and litter estimation, the conservative default factor identified by the tool was applied.

Estimation for Change in carbon stock in soil organic carbon

Eucalyptus plantations

As mentioned under sections 3.2 and 3.3, this stock was not included on project carbon stock estimations and boundary for the eucalyptus plantation. Therefore, it is estimated as zero.

Native Reforestation

The carbon stock in soil organic carbon for the native reforestation areas will be estimated as per AR-TOOL0016, which applies the following equation:

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

Where:

$SOC_{INITIAL,i}$	SOC stock at the beginning of the A/R project activity in stratum i of the areas of land; 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 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 applied for these parameters were obtained from the indicated tables from the tool:

Parameter	Value	Source
$SOC_{REF,I}$	39.00	Table 3, Tropical moist, sandy soil[88]
$F_{LU,i}$	1.00	Table 6, All climate regime
$F_{MG,i}$	0.70	Table 6, degraded
$F_{IN,i}$	1.00	Table 6, Low/Medium

Therefore, the $SOC_{INITIAL,i}$ is equal to 27.3 tC/ha. It is also important to mention that the project activity does not expect to disturb more than 10% of the area of the stratum. It is

[88] The average composition of the soils sampled are of 92.5% of sand and 5% of clay

expected that the space between each tree follows a 4x4m distance, to better adjust to natural formations of the Cerrado biome. Hence, $SOC_{LOSS,i}$ is considered equal to 0.

After assessing the parameter, the following set of equations to be applied are listed below to assess the rate of change in the project scenario until de steady-state SOC content is reached.

$$dSOC_{i,t} = 0 \quad for\ t < t_{PREP,i}$$

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

Where:

$dSOC_{i,t}$	The rate of change in SOC stock in stratum i of the areas of land, in year t; t C ha-1 yr-1
$t_{PREP,i}$	The year in which first soil disturbance takes place in stratum i of the areas of land
$SOC_{LOSS,i}$	Loss of SOC caused by soil disturbance attributable the A/R 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 normally forest) by climate region and soil type applicable to stratum i of the areas of land; t C ha-1
i	1, 2, 3, … strata of areas of land; dimensionless
t	1, 2, 3, … years elapsed since the start of the A/R project activity

The value estimated for the rate of change in SOC stock of the native reforestation project area is equal to 0.585 tC/ha.yr. The change in SOC stock for all the strata of the areas of land, in year t, is calculated as:

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

Where:

$\Delta SOC_{AL,i}$	Change in SOC stock in areas of land meeting the applicability conditions of this tool, in year t; t CO2-e

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

i 1, 2, 3, … strata of areas of land; dimensionless

4.2.3 Increase in non-CO2 GHG emissions

The AR-ACM0003 defines that GHG emissions resulting from herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary, and transportation attributable to the project activity shall be considered insignificant and therefore accounted as zero.

The AR-TOOL08 for estimating emissions from burning biomass indicates the following equation:

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

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-CO_2 GHGs resulting from use of fire in site preparation in year t;t CO_2-e

$GHG_{FMF,t}$ Emission of non-CO_2 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 CO_2-e

$GHG_{FF,t}$ Emission of non-CO_2 GHGs resulting from fire in year t; t CO_2-e

No burning activity will be implemented by the project proponent in any of the project areas, although this practice is usually widely implemented under the baseline scenario for deforestation and pasture regrowth stimulation.

Hence, fire will not be used by the project proponent for site preparation, nor will biomass be burned within the project boundary. Moreover, fire will not be used to clear the land of harvest residue prior to replanting of the land for the eucalyptus plantations or other forest management at both project area activities, although harvest events are foreseen for the project activity to be implemented.

In case of forest fires that surpasses a threshold of 5% of the project area, the AR-TOOL08 must be applied, and all the required procedures for loss events will be dully applied.

Under such conditions, $GHG_{SPF,t}, GHG_{FMF,t}$ and $GHG_{FF,t}$, are accounted as zero. Therefore, project emissions, $GHG_{E,t}$ are also accounted as zero.

4.3 Leakage

The estimation of the increase in GHG emissions resulting from the displacement of pre-project agricultural activities within the boundaries of a forestry or reforestation (A/R) project is governed by the instrument "Estimation of the increase in GHG emissions attributable to the displacement of pre-project agricultural activities in the CDM/R project activity"; t CO2-e. considering the determination of the following parameter:

$$LK_t = LK_{AGRIC,t}$$

Where:

LK_t = Leakage emission due to the displacement of agricultural activities in year t

$LK_{AGRIC,t}$ = Leakage emission resulting from displacement of agricultural activities in year t; t CO2e

For the lands within the project boundary from which pre-project agricultural activities are to be moved outside the project boundary are delineated and their area is to be estimated. The leakage emission resulting from the displacement of the activities is estimated considering equation 1 of the aforementioned tool:

$$LK_{AGRIC,t} = \frac{44}{12} * (\Delta C_{BIOMASS,t} + \Delta SOC_{LUC,t})$$

Where:

$LK_{AGRIC,t}$ = Leakage emissions resulting from displacement of agricultural activities in year t; t CO2e

$\Delta C_{BIOMASS,t}$ = Decrease in carbon stock in the carbon pools of the land receiving the activity displaced in year t; t d.m.

$\Delta SOC_{LUC,t}$ = Change in soil organic carbon (SOC) stock due to land-use change in the land receiving the displaced activity in year t; tC ha^{-1}

Considered the project area, both for the eucalyptus planting and for native reforestation, it can be said that:

The project activity does not expect any displacement of the agricultural activities present within the project boundary before its start, so leakage emissions are considered negligible and therefore considered zero.

Since land acquisition, previous owners are required to remove any animals present on area, and the areas are expected to remain unoccupied until the project implementation start, which can take more than a year to take place. However, according to MapBiomas[89], an initiative of the Greenhouse Gas Emissions Estimation System (SEEG) from the Climate Observatory's produced by a collaborative network of co-creators made up of NGOs, universities and technology companies organized by biomes and cross-cutting themes, the land occupied with pasture activities in the cities where the project is located have been slowly reducing since 2005. Between 2005 and 2021, the land covered by pasture reduced almost 22% and between 2017 and 2021, the first monitoring period of the ARR Horizonte Carbon Project, pasture areas decreased by 5%[89]. So, it is likely that the animals that were removed from project area were relocated to existing pastures, that is, no forest areas were opened for grazing because of the implementation of the project. Moreover, the number of cattle decreased by 12%[90] since 2017 in the cities where the project is located, suggesting that the total number of animals on the receiving pastures (displaced and existing) has not exceeded the capacity of the pastures, which corroborates low probability of leakage.

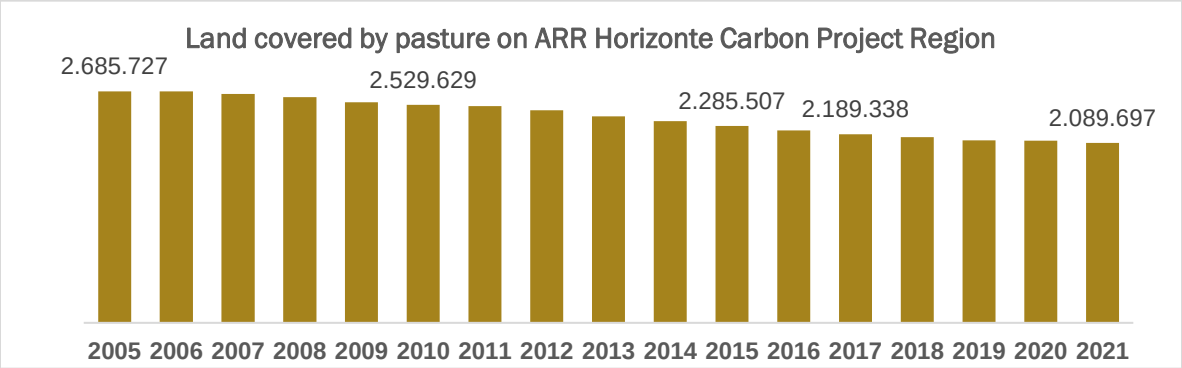

Figure 67: Land covered by pasture in the region of ARR Horizonte Carbon Project[89]

[89] Plataforma MapBiomas, 2022, filtred by cities where the ARR Horizonte Carbon Project is located. Link here

[90] https://cidades.ibge.gov.br/brasil/ms/agua-clara/pesquisa/18/16459?tipo=grafico
https://cidades.ibge.gov.br/brasil/ms/bataguassu/pesquisa/18/16459?tipo=grafico&indicador=16533
https://cidades.ibge.gov.br/brasil/ms/brasilandia/pesquisa/18/16459?tipo=grafico&indicador=16533
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https://cidades.ibge.gov.br/brasil/ms/tres-lagoas/pesquisa/18/16459?tipo=grafico&indicador=16533

In addition, it is known that the Cerrado biome is the second most impacted biome by deforestation in the country, with 33,5% of the deforested areas [60]. This can be noted by assessing images from the cities where the project is located, where most of the land can be easily identified as grasslands. Nevertheless, almost all forest areas near the project area belong to the project proponent.

It is also important to highlight that social activities to be implemented due to the project will bring another income for the local communities, so that they can raise independence from cattle ranching activities.

Therefore, Leakage emissions are considered insignificant and, therefore, accounted as zero.

4.4 Estimated Net GHG Emission Reductions and Removals

According to the equation 5 of the methodology AR-ACM0003 v2.0, the net anthropogenic GHG removal by sink is:

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

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 = GHG emissions due to leakage, in year t; t CO2-e

Table 9 Net GHG emission reductions or removals

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
02/11/2017 to 31/12/2017	12,627.08	17,684		5,057
01/01/2018 to 31/12/2018	13,439.48	327,732		314,293
01/01/2019 to 31/12/2019	13,439.48	739,883		726,444

01/01/2020 to 31/12/2020	18,372.81	1,367,234		1,348,861
01/01/2021 to 31/12/2021	25,500.54	1,977,792		1,952,291
01/01/2022 to 31/12/2022	25,500.54	2,666,122		2,640,621
01/01/2023 to 31/12/2023	38,006.00	3,346,840		3,308,834
01/01/2024 to 31/12/2024	38,006.00	3,895,822		3,857,816
01/01/2025 to 31/12/2025	38,006.00	2,786,410		2,748,405
01/01/2026 to 31/12/2026	38,006.00	2,785,976		2,747,970
01/01/2027 to 31/12/2027	38,006.00	2,088,521		2,050,515
01/01/2028 to 31/12/2028	38,006.00	2,748,895		2,710,889
01/01/2029 to 31/12/2029	38,006.00	2,824,934		2,786,928
01/01/2030 to 31/12/2030	38,006.00	3,389,155		3,351,149
01/01/2031 to 31/12/2031	38,006.00	3,950,115		3,912,109
01/01/2032 to 31/12/2032	38,006.00	2,851,490		2,813,485

01/01/2033 to 31/12/2033	38,006.00	2,863,488		2,825,482
01/01/2034 to 31/12/2034	38,006.00	2,178,464		2,140,458
01/01/2035 to 31/12/2035	38,006.00	2,849,993		2,811,987
01/01/2036 to 31/12/2036	38,006.00	2,933,344		2,895,338
01/01/2037 to 31/12/2037	38,006.00	3,503,601		3,465,595
01/01/2038 to 31/12/2038	38,006.00	4,066,832		4,028,826
01/01/2039 to 31/12/2039	38,006.00	2,969,982		2,931,976
01/01/2040 to 31/12/2040	38,006.00	2,982,110		2,944,104
01/01/2041 to 31/12/2041	38,006.00	2,297,216		2,259,210
01/01/2042 to 31/12/2042	38,006.00	2,968,912		2,930,906
01/01/2043 to 31/12/2043	38,006.00	3,052,124		3,014,118
01/01/2044 to 31/12/2044	38,006.00	3,620,580		3,582,574
01/01/2045 to 31/12/2045	38,006.00	4,180,716		4,142,710

01/01/2046 to 31/12/2046	38,006.00	3,080,738		3,042,732
01/01/2047 to 31/12/2047	38,006.00	3,089,784		3,051,778
01/01/2048 to 31/12/2048	38,006.00	2,400,825		2,362,819
01/01/2049 to 31/12/2049	38,006.00	3,065,453		3,027,447
01/01/2050 to 31/12/2050	38,006.00	3,140,908		3,102,902
01/01/2051 to 31/12/2051	38,006.00	3,700,300		3,662,294
01/01/2052 to 01/11/2052	38,006.00	3,649,097		3,611,091
Total	1,059,029.83	100,359,088		99,110,028

Additionally, according to the standard requirements, for those areas where harvesting practices are considered in the project activity, the loss of carbon due to harvesting shall be include in the quantification of the project emissions. Because the eucalyptus planting considers an increase in project area during the first seven years of implementation and a harvesting period every seven years, the long-term average (LTA) GHG benefit was calculated as follows for such areas and benefit generated:

$$LTA = \frac{\sum_{t=0}^{n} PE_t - BE_t}{n}$$

Where:

LTA = The long-term average GHG benefit

PE_t = The total to-date GHG emission reductions and removals generated in the project scenario (tCO2e). Project scenario emission reductions and removals shall also consider project emissions of CO_2, N_2O, CH_4, and leakage.

BE_t = The total to-date GHG emission reductions and removals projected for the baseline scenario (tCO_2e).

t = Year.

n = Total number of years in the established time period

The LTA (without risk buffer discount) is calculated considering 35 years.

The LTA estimated is 2,686,131 tCO_2e.and indicates the total credits available to be issued.

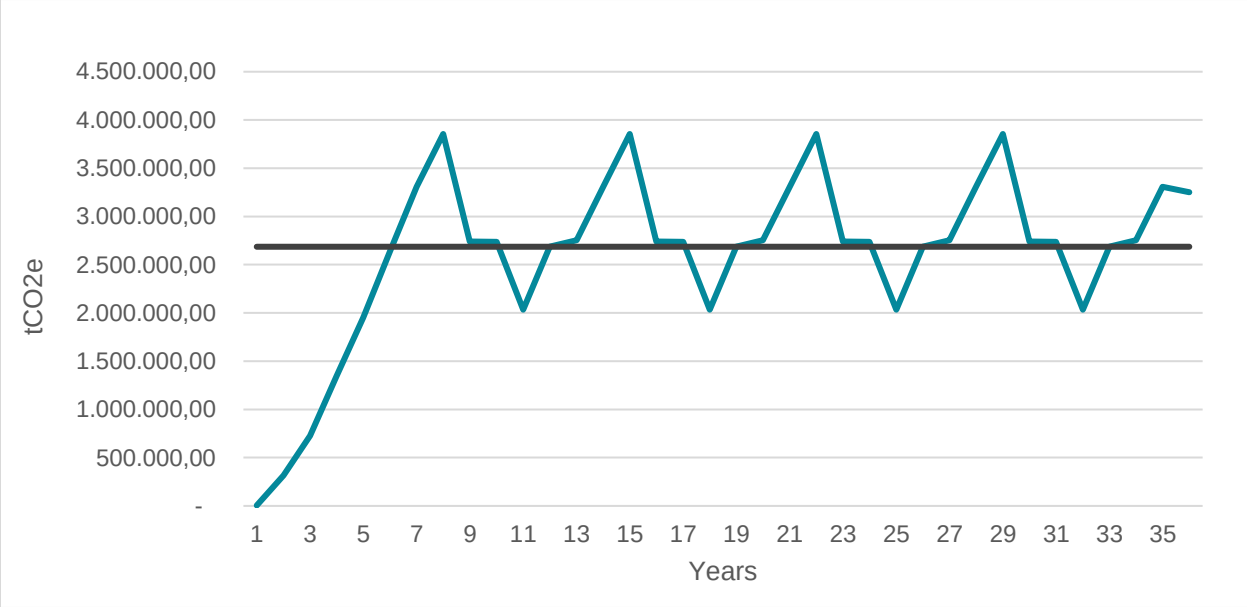

Figure 68 Illustration of the expected total GHG benefit of the project's long-term average

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	A
Data unit	ha

Description	Project Area
Source of data	Identification of strata and project area boundaries, using Geographical Information Systems (GIS).
Value applied	15,426.76 Composed by Eucalyptus planting area (14,427.66ha) and Native reforestation area (999.10 ha)
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, and estimation of Baseline emissions.
Comments	

Data / Parameter	A_{i_bsl}
Data unit	ha
Description	Area of stratum i at baseline scenario
Source of data	*Project activity area at each farm*
Value applied	

Stratum	*Total area*	*Responsible for planting*	*Activity*	*Year of planting*
Stratum 1	3,275.66	Funds	Eucalyptus	2017
Stratum 2	2,438.70	Funds	Eucalyptus	2018
Stratum 3	234.52	Suzano	Eucalyptus	2017
Stratum 4	714.53	Suzano	Eucalyptus	2018
Stratum 5	5,202.27	Suzano	Eucalyptus	2019
Stratum 6	256.65	Suzano	Eucalyptus	2020
Stratum 7	207.21	Suzano	Eucalyptus	2021
Stratum 8	865.67	to be defined	Eucalyptus	2021
Stratum 9	212.95	Funds	Eucalyptus	2022
Stratum 10	947.52	to be defined	Eucalyptus	2022

	Stratum 11	71.98	Suzano	Eucalyptus	2022
	Stratum 12	55.49	Suzano	Native vegetation	2023
	Stratum 13	71.53	Suzano	Native vegetation	2023
	Stratum 14	74.76	Suzano	Native vegetation	2024
	Stratum 15	59.23	Suzano	Native vegetation	2024
	Stratum 16	2.95	Suzano	Native vegetation	2024
	Stratum 17	122.59	Suzano	Native vegetation	2028
	Stratum 18	180.19	Suzano	Native vegetation	2028
	Stratum 19	180.19	Suzano	Native vegetation	2030
	Stratum 20	122.59	Suzano	Native vegetation	2030
	Stratum 21	31.72	Suzano	Native vegetation	2032
	Stratum 22	96.60	Suzano	Native vegetation	2032
	Stratum 23	1.25	Suzano	Native vegetation	2032

Justification of choice of data or description of measurement methods and procedures applied	Identified areas with eucalyptus plantation implemented or to be implemented under the project area, as well as native areas, registered under the Suzano's system.
Purpose of Data	*Estimation of baseline GHG emissions*
Comments	

Data / Parameter	CF
Data unit	tC/t d.m.

Description	Biomass proportion corresponding to carbon, named Carbon Fraction
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 applied.
Purpose of Data	Calculation of Baseline Emissions and project emissions reduction and removals
Comments	

Data / Parameter	b_{FOREST}
Data unit	t d.m./ha
Description	Mean above-ground biomass in forest in the region or country where the project is located
Source of data	MIRANDA, et al. 2014. Regional variations in biomass distribution in Brazilian Savanna woodland. Data for biomass above and below ground for forest formations.
Value applied	110.12
Justification of choice of data or description of measurement methods and procedures applied	Mean Value for forestlands biomass on the Cerrado biome, considering total aboveground biomass and total belowground biomass.
Purpose of Data	*Calculation of Baseline GHG Emissions*
Comments	

Data / Parameter	R_{TREE}
Data unit	dimensionless

Description	Root-shoot ratio for trees in the baseline
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	0.25
Justification of choice of data or description of measurement methods and procedures applied	Default value indicated for the parameter under AR-TOOL14, equation 21
Purpose of Data	*Calculation of Baseline GHG Emissions*
Comments	

Data / Parameter	$CC_{TREE\_BSL,i}$
Data unit	dimensionless
Description	Crown cover of trees in baseline stratum i, at the start of the project activity, expressed as a fraction.
Source of data	Shapefiles pointing trees authorized to be suppressed at the CANI, which are located inside the project area.
Value applied	1.01%
Justification of choice of data or description of measurement methods and procedures applied	The crown cover of trees was estimated based on CANI authorizations and identified trees for suppression. The crown cover of trees was identified on a shapefile, and trees under the project area, that compose the baseline, were considered for estimating the parameter.
Purpose of Data	*Calculation of Baseline GHG Emissions*
Comments	

Data / Parameter	DF_{DW}
Data unit	Per cent
Description	Conservative default factor expressing carbon stock in dead wood as a 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 03.1.*
Value applied	1%
Justification of choice of data or description of measurement methods and procedures applied	Default value for tropical biomes, under 2.000m elevation, under 1.000 – 1.600 mm yr-1 of precipitation
Purpose of Data	*Calculation of Baseline GHG Emissions and project activity removals*
Comments	

Data / Parameter	DF_{LI}
Data unit	Per cent
Description	Conservative default factor expressing carbon stock in Litter as a 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 03.1.*
Value applied	1%
Justification of choice of data or description of measurement methods and procedures applied	Default value for tropical biomes, under 2.000m elevation, under 1.000 – 1.600 mm yr-1 of precipitation
Purpose of Data	*Calculation of Baseline GHG Emissions and project activity removals*
Comments	

Data / Parameter	A_{i_pa}
Data unit	ha
Description	Area of stratum i at project activity

Source of data	*Projected planting areas by stratum and specie*
Value applied	*See* Table 6
Justification of choice of data or description of measurement methods and procedures applied	*The stratification for ex-post estimates will be based on the real implementation of the implementation of the project's planting/management plan. Considering the eventual need for adaptation of the strata within the project limit, according to management's evaluation. Thus, there is the possibility of several strata, in order to optimize costs and improve the results in forest inventories. New strata may also be defined.*
Purpose of Data	*Estimation of GHG Emission Reductions and Removals.*
Comments	
Data / Parameter	Mean annual Increment in Volume (IV)
Data unit	m3ha-1yr-1
Description	It is the average annual net increment in volume of eucalyptus trees to be planted on the project area, and it's used to calculate the Tree carbon stock on Eucalyptus plantations.
Source of data	Based on previous inventory data for areas near the project area owned by Suzano.
Value applied	Eucalyptus grandis: 32.5 m^3.ha-1.year-1 Eucalyptus urophylla: 36.1 m^3.ha-1.year-1 Eucalyptus grandis x Eucalyptus urophylla: 34.8 m^3.ha-1.year-1 Eucalyptus spp: 34.6 m^3.ha-1.year-1
Justification of choice of data or description of measurement methods and procedures applied	An ex-ante parameter was applied given measurements for forest plantation within forest boundary are still under implementation. Forest inventory data from Suzano's PUs in the region were used to estimate GHG removals, as they portray the productivity patterns of the species (Eucalyptus ssp.), based on past experience. At the time of monitoring this value will be replaced for the actual growth of the forest. Suzano has no information available on its database for the Eucalyptus Grandis species. IPCC[86] value was applied considered it is the lowest value available. This approach is conservative
Purpose of Data	Estimation of GHG Emission Reductions and Removals.
Comments	

Data / Parameter	Aboveground net biomass growth
Data unit	t.d.m/ha/yr
Description	It is the average annual net increment in volume of native trees to be planted on the project area, and it's used to calculate the Tree carbon stock on native restoration activities.
Source of data	*Available at 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 4: Forest Land – table 4.9, value for tropical moist deciduous forest*
Value applied	For natural forests ≤20y – 7.00 For natural forests >20y – 2.00
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	*Estimation of GHG Emission Reductions and Removals.*
Comments	

Data / Parameter	Wood density (D)
Data unit	t d.m./m^3
Description	*Wood density is used to convert the sparse trees volume into tree biomass under the project acitivity.*
Source of data	Based on a databank which concentrates the information of density for species planted by Suzano.
Value applied	Eucalyptus grandis: 0.44 t d.m./m^3 Eucalyptus urophylla: 0.48 t d.m./m^3 Eucalyptus grandis x Eucalyptus urophylla: 0.44 t d.m./m^3 Eucalyptus spp: 0.47 t d.m./m^3
Justification of choice of data or description of measurement methods and procedures applied	Data for each specific species applied under the project activity.

Purpose of Data	*Estimation of GHG Emission Reductions and Removals.*
Comments	The density is estimated according to the internal procedure MA.36.03.0007. The process is composed by a few steps. 1. Reception, classification of the chips and granulometry. Equipment: a conventional chip classifier and a digital scale. 2. Determination of basic density. Equipment: semi analytical balance, vacuum saturation system, compressed air, stove. The maximum moisture content method is applied. 3. Determination of apparent density. Equipment: digital scale and a device for defining the apparent density.

Data / Parameter	$SOC_{REF,i}$
Data unit	tC/ha
Description	SOC stock at the beginning of the A/R CDM project activity in stratum i of the areas of land
Source of data	AR-TOOL16, version 1.1.0, table 3, value for tropical moist climate region and sandy soils
Value applied:	39.00
Justification of choice of data or description of measurement methods and procedures applied	Factor-based approach presented by the AR-TOOL16
Purpose of Data	Calculation of soil organic carbon stocks
Comments	No additional comments

Data / Parameter	$f_{LU,i}$
Data unit	Dimensionless
Description	Relative stock change factor for baseline land-use in stratum i of the areas of land
Source of data	AR-TOOL16, version 1.1.0, table 6, value for all climate regime
Value applied:	1.00

Justification of choice of data or description of measurement methods and procedures applied	Factor-based approach presented by the AR-TOOL16
Purpose of Data	Calculation of soil organic carbon stocks
Comments	No additional comments

Data / Parameter	$f_{MG,i}$
Data unit	Dimensionless
Description	Relative stock change factor for baseline management regime in stratum i of the areas of land
Source of data	AR-TOOL16, version 1.1.0, table 6, value for severely degraded level
Value applied:	0.70
Justification of choice of data or description of measurement methods and procedures applied	Factor-based approach presented by the AR-TOOL16
Purpose of Data	Calculation of soil organic carbon stocks
Comments	No additional comments

Data / Parameter	$f_{IN,i}$
Data unit	Dimensionless
Description	Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum i of the areas of land
Source of data	AR-TOOL16, version 1.1.0, table 6, value for Low/Medium level
Value applied:	1.00
Justification of choice of data or description of measurement methods and procedures applied	Factor-based approach presented by the AR-TOOL16
Purpose of Data	Calculation of soil organic carbon stocks

Comments	No additional 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	*Each time a verification is conducted.*
Value applied	*Ex-post*
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 GHG emissions and removals.*
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	*Ex-post*
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 GHG emissions and removals.*
Calculation method	*Measurement*
Comments	

Data / Parameter	Ap.i
Data unit	M^2
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. Detailed description under section 5.3.*
Frequency of monitoring/recording	*Each time a verification is conducted.*
Value applied	*Ex-post*
Monitoring equipment	*Tape measure and GPS.*
QA/QC procedures to be applied	*Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the*

	absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied.
Purpose of data	*Calculation of Project GHG emissions and removals.*
Calculation method	*Measurement*
Comments	*Provide any additional comments*

Data / Parameter	N
Data unit	*Dimensionless*
Description	*Number of plots to be established in the project area*
Source of data	*Field measurement*
Description of measurement methods and procedures to be applied	*Estimation; 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. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied.*
Purpose of data	*Estimating the number of plots is required for granting the compliance with a sampling error lower than 10%*
Calculation method	*A/R Methodological Tool Calculation of the number of sample plots for measurements within A/R CDM project activities - Version 02.1.0,*
Comments	

Data / Parameter	Plot location
Data unit	*Latitude/longitude*

Description	*Localization for each sampling plot*
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	*Ex-post*
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	*See section 5.9*
Comments	*The sample plot location is registered with a GPS and marked on the project map.*

Data / Parameter	DBH
Data unit	*centimeter*
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	*The measurements are usually conducted 1.3 m aboveground. Measure all the trees above some minimum DBH in the permanent sample plots.*
Frequency of monitoring/recording	*Each time a verification is conducted.*
Value applied	*Ex-post*
Monitoring equipment	*Digital caliper and measuring tape*

QA/QC procedures to be applied	*All personnel involved on the DBH measurement procedure must have received proper training for field data collection. Data collected must be verified by a qualified person in charge to prevent error making and grant best practices implementations.*
Purpose of data	*Calculation of project emissions*
Calculation method	*See section 5.11.1*
Comments	

Data / Parameter	H
Data unit	*meter*
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 identified under the project area. Height measurements will be taken with a digital hypsometer.*
Frequency of monitoring/recording	*Each time a verification is conducted.*
Value applied	*Ex-post*
Monitoring equipment	*Clinometer*
QA/QC procedures to be applied	*All personnel involved on the DBH measurement procedure must have received proper training for field data collection. Data collected must be verified by a qualified person in charge to prevent error making and grant best practices implementations.*
Purpose of data	*Calculation of project emissions*
Calculation method	*See section 5.11.2*
Comments	

Data / Parameter	*T*
Data unit	*Year*
Description	*Period 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 section 5.3.*
Frequency of monitoring/recording	*Each time a verification is conducted.*
Value applied	*Ex-post*
Monitoring equipment	*N/A*
QA/QC procedures to be applied	*N/A*
Purpose of data	*Calculation of project emissions*
Calculation method	$T= t_2-t_1$
Comments	

5.3 Monitoring Plan

The ARR Horizonte Carbon Project will apply the approved afforestation and reforestation baseline and monitoring methodology "AR-ACM0003 Afforestation and reforestation of lands other than wetlands (Version 2.0)", more specifically Section 6 to guide the project monitoring plan.

The project monitoring plan also follows the general carbon accounting principles provided in Chapter 4 (AFOLU; Agriculture, Forestry and Other Land Use) of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and IPCC Good Practice Guidance (IPCC GPG 2006), specifically Chapter 4.3 Project Guidance. Over the project crediting period, carbon stock and stock change estimates will be derived from direct measurements on permanent plots and will therefore satisfy level 3 of the IPCC's highest accuracy criterion.

In accordance with IPCC guidance, the monitoring plan is designed to quantify and control uncertainty in estimates by employing sufficient sample plots and unbiased allocation to produce estimates with a known level of confidence. The monitoring plan must also include a Quality Assurance / Quality Control (QA/QC) plan to control errors in measurement and data analysis. The application of the QA/QC plan will provide documentation and consistency

in data archiving to allow efficient third-party audit and evaluation against measurement and quantification standards throughout the monitoring period.

The internal structure at Suzano for monitoring carbon stocks at the project area is composed by four main roles. Activities on site are conducted by an outsourced specialized company, whose forest technicians will perform the data collection for all parameters mentioned under section 5.2.

Suzano usually hires consolidated companies to perform its inventories or applies partnerships with universities to conduce the inventories at native reforestation areas. Nevertheless, the team involved in the monitoring activities receive prior training in Suzano's procedures from the service provider, as well as field safety instructions.

All the monitoring activities performed by this outsourced specialized partner will be supervised by the Suzano Supervisors and Auditors, through periodic audits performed to evaluate the quality of the field collection, where audit indicators are collected and compliance with the timeline is verified.

These activities are controlled and accompanied by the coordinator, and take place under the Forest, Logistics and Supplies board.

To standardize the measurement procedures, Suzano established a comprehensive manual for field activities, named Field Activities Manual. It indicates tools to be used, shows how activities must be done, and which must be followed by all personal conducing field measurement activities.

Stratification

The Stratification ex-post must follow guidance provided under the AR-ACM0003, section 5.3, where the stratification for ex post estimations is based on the actual implementation of the project planting/management plan. If natural or anthropogenic impacts (e.g. local fires) or other factors (e.g. soil type) significantly alter the pattern of biomass distribution in the project area, then the ex-post stratification is revised accordingly.

The stratum will be monitored to identify different growth patterns, which can lead to the consolidation or further stratification. It will also enable more accurate definition of permanent controlled sample plots for the project area stratums.

Data sampling is structured considering the stratification defined for the Project Area. Sample plots are established under each stratum, defined according to its useful area.

At first, the data sampling design will follow the stratification defined in section 4.2.1. Stratification, based on project planting plan, considering the year of plantation and the responsible for planting, as well as the type of species to be planted: Eucalyptus or native vegetation. Among native vegetation restoration activity, the stratification was also based on the three types of land use and land cover classification (i.e.Exposed soil -SLE, Pasture -PST and Pasture with sparse shrubs and trees - PSR). Particularity, for the native reforestation activity area, monitoring of different growth patterns inside each stratum may lead to the unification among strata or the creation of new strata. Also, at each monitoring event and at the inclusion of new instances of the grouped project, an update of the project stratification may be proposed based.

Monitoring plan

Suzano is used to a wide range of forest inventory types. For targeting the purpose of this project, it will implement the Continued Forest Inventory for monitoring parameters and estimating carbon stocks under the project area for the eucalyptus plantations activities. However, it is important to highlight that areas with forest age up to 2 years are not subject to a quantitative inventory such as the one mentioned. For this reason, such areas will follow all the procedures for qualitative inventories until they reach 2 years, and the emission removals for the respective planted forest at these specific areas will only be accounted for and generate credits once the quantitative inventory is made, and all parameters required to estimate the carbon stocks are available.

This method is applied to estimate the forest stock, both in volume and number of trees. It is also used to monitor forest growth and enables adjustments of production projections models for forests.

Monitoring events will take place before any harvest event and annually, considered that monitoring events can only be made on areas older than 2 years from the planting date. Suzano intends to monitor the project area for eucalyptus plantations annually.

It is also worth mentioning that the dynamics for native restoration areas are conduced in a different way, more fit to the purpose of the activities. The monitoring of such areas will take place every 5 years, considered the year on which the stratum in question was planted. Such events will also monitor the biodiversity of the area, the carbon stock present at the stratums and its increase in time. It will also improve the knowledge and process available at Suzano for such activities.

Eucalyptus plantations monitoring plan

Size and type of sample plots

The sample plot specifications follow the AR-TOOL14: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" – Version 04.2.

Sample plots are circular and permanent and must have the size of 400m². Whenever it is not possible to install a parcel of 400m², given the shape or size of the stratum, it is accepted a sample plot of 200m². In cases where this reduction is not enough, it shall be closed with an observation of the occurrence.

Under each sample plot it must be measured a 100% of circumference at breast height, height of 4 normal trees, height of 4 dominant trees, treetop height of 4 trees, index for leaf area (IAF) and grassland competition

Sample plots must be defined permanently for Eucalyptus plantations, in line with the Continued Forest Inventory.

Number of sample plots

Sample plot intensity follows basic premises, which can be altered whenever needed:

1 sample plot for areas from 5 to 12 ha

2 sample plots for areas from 12 to 25 ha, and

1 sample plots for each 10 ha for areas bigger than 25 ha.

According to A/R Methodological Tool Calculation of the number of sample plots for measurements within A/R CDM project activities - Version 02.1.0, the number of sample plots depends on the targeted precision and standard deviation for the parameter to be measured under the sample plots.

According to PEARSON et al (2005) [91], the acceptable precision level for forest inventories is between ±10 and ±20 per cent. For this project, it is assumed a minimum precision of 10%, associated with the sample plot intensity suggested by the forest inventory department of Suzano, which has a large experience on the matter and is used with good practices for this type of activity.

[91] PEARSON, T., Walker, S., & Brown, S. (2005). Sourcebook para uso da terra, mudança de uso da terra e projetos florestais. Winrock International e o Fundo BioCarbon do Banco Mundial, 57. Last access: 12th May 2022

For each monitoring event, Suzano will estimate the uncertainty associated to the measurements, which enables the adjustment of sample plot intensity.

The minimal number of sample plots required by the AR-TOOL03 will be observed and assured for each monitoring event.

$$n = \frac{N * t_{VAL}^2 * (\sum_i w_i * s_i)^2}{N * E^2 + t_{VAL}^2 * \sum_i w_i * {s_i}^2}$$

Where:

n Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless

N Total number of possible sample plots within the project boundary (i.e. the sampling space or the population); dimensionless

t_{VAL} Two-sided Student's t-value, at infinite degrees of freedom, for the required confidence level; dimensionless

w_i Relative weight of the area of stratum i (i.e. the area of the stratum i divided by the project area); dimensionless

s Estimated standard deviation of biomass stock in stratum i; t d.m. (or t d.m. ha-1)

E Acceptable margin of error (i.e. one-half the confidence interval) in estimation of biomass stock within the project boundary; t d.m. (or t d.m. ha-1), i.e. in the units used for si

i 1, 2, 3, … biomass stock estimation strata within the project boundary

If sampled areas represent less than 5% of the project area, the simplified equation can be used:

$$n = (\frac{t_{VAL}}{E})^2 * (\sum_i w_i * s_i)^2$$

Sample plot instalment

LOCATION – Sample plots are previously identified by the Forest Inventory team at Suzano through maps, which also point the geographic coordinates and program for the monitoring team. The monitoring team shall then identify the coordinates stablished through GPS and

install the sample plots, identifying the center of it. A sample plot may be relocated only in cases where it represents a safety risk for staff.

Trees inside the sample plot must be identified with paint to allow an easier identification of following monitoring events.

SAMPLE PLOT ALLOCATION – The sample plot number must be written on the first tree of the carrier, at the entrance point of the stratum. The following steps shall be applied:

The center of the parcel must be located under two trees from the same planting line, which must be marked. It must be identified the sample plot number and number of coves in paint.

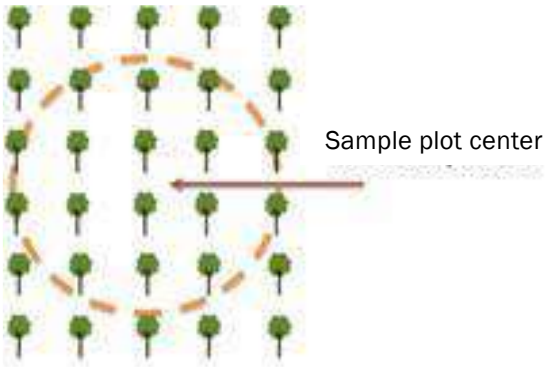

Figure 69 – Center of sample plot identification.

- Geographic coordinates and altitude at the center of the sample plot must be registered
- From the center of the sample plot, the predefined radius must be identified with measuring tape, and limiting trees must be marked with the metallic pin.
- The first tree to be measured at the sample plot must always be the first tree to the lower left indicated on the mirror of the sample plot. The following measurements must be made following the planting lines, identifying the trees.
- Whenever it is difficult to define if a tree is inside a sample plot or not, this tree must be identified. The D and slash mark shall be used when the tree was considered, and the D mark when the tree was not considered inside the sample plot.
- When the end of planting line inside the sample plot is inconsistent, the previous tree shall be marked with an F. The number of occurrences shall also be indicated. For parcels with an inconsistent line, the previous or following line shall be marked, identifying the number of inconsistencies. When there is an inconsistency in the

middle of the sample plot, the following tree must be marked with an F. A similar procedure must be applied for stumps, but with the T mark.

- When a parcel is located on an inconsistency area, the number of inconsistencies must be identified.

REMEASUREMENT OF PERMANENT SAMPLE PLOTS – Permanent sample plots must follow the same method described above, which enables de identification of measured stems and registration of tree mortality.

Measurement Procedures

For the Eucalyptus plantations, only the bellow and aboveground tree biomass will be monitored. Therefore, the growth in volumes will be monitored for each tree at the sample plots, based on the increment on the diameter at breast height and height of trees.

The carbon content on deadwood and litter at the project area will not be measured. This carbon stocks will be estimated as per AR-TOOL12: "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" – Version 03.1.

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

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

TREE DIAMETER AT BREAST HEIGHT (DBH): The DBH must be measured 1.3m above the ground. The equipment for this measurement are a post of 1.3m, measuring tape and suta. The measurement procedure must follow the steps:

- In regrowth areas, the post must not be positioned over stumps. In case of using the suta, it should be leaned on the bole. Two orthogonal measurements shall be made.

- The DBH must be measured at 1.3m, where a mark must be made on the position where the measurement took place, enabling future remeasurement events on the same position.

- Different occurrences can be observed when measuring the DBH. The procedures indicated at the image below must be followed. Measurement point is indicated by as measurement point.
- There are no lower limits for measurements under the sample plots. Dominant trees will be defined according to stem pattern inside the parcel.

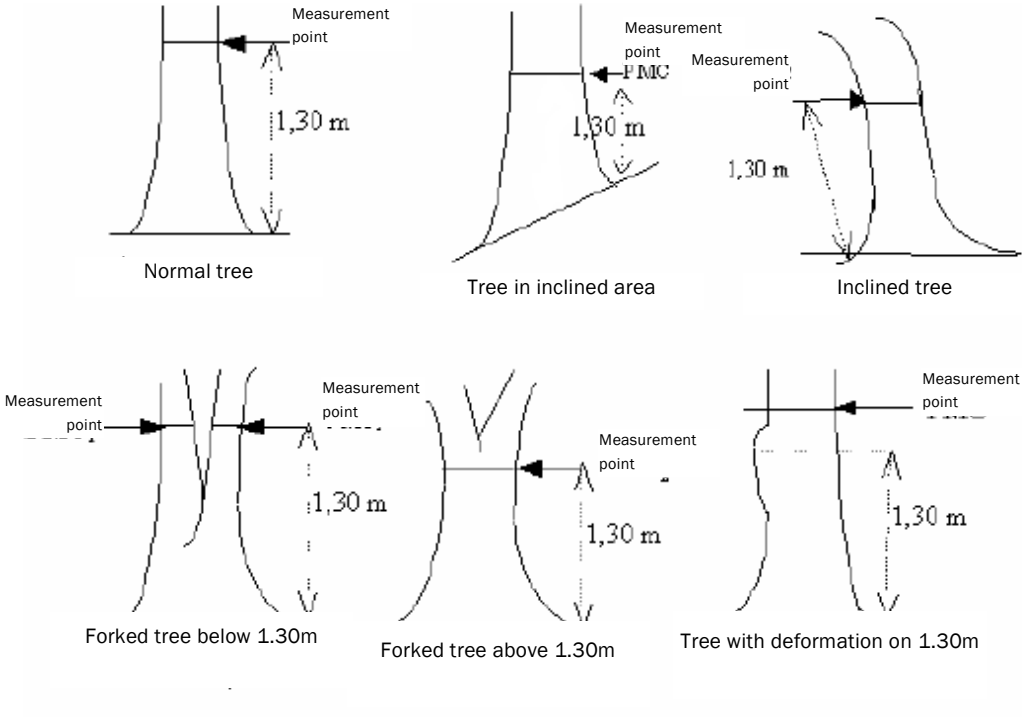

Figure 70 – Measurement point (PMC) in different conditions.

TREE HEIGHT (H): A clinometer must be used for assessing the tree heights. The following steps must be applied:

- The minimal distance of the operator must be equal to the tree height, assessed with a measuring tape.
- Measuring of tree heights must be made at the same level of the tree. The declivity of the area will be required as needed.
- The central line may be used as a reference for measuring the heights. If the central line does not present normal trees, the following line can be used.
- The dominant heights must be measured from the fist measuring event, as well as their treetop height.

- Measuring events must follow Table 11. In cases where a sample plot is composed of stumps or dead or alive burnt trees, the measuring event shall be made following the same procedures.
- Heights of all trees with broken treetops must be measured. This measuring event must be precisely at the broken point.
- In case of inclined trees, always measure perpendicularly to the inclination of the tree.
- Do not measure tree heights under strong winds.
- In some cases, where the tree basis visibility is compromised, the measuring point for the DBH can be used as a reference.
- On plane areas, where there is no level variation and the planting alignment is favourable, the measuring tape can be stretched perpendicularly to the planting line for indicating the measuring points.
- The direction and footage of where the measurement occurred must be informed.
- The treetop height will be obtained from the difference between the total height and the height until the beginning of the treetop, as indicated on the following image.

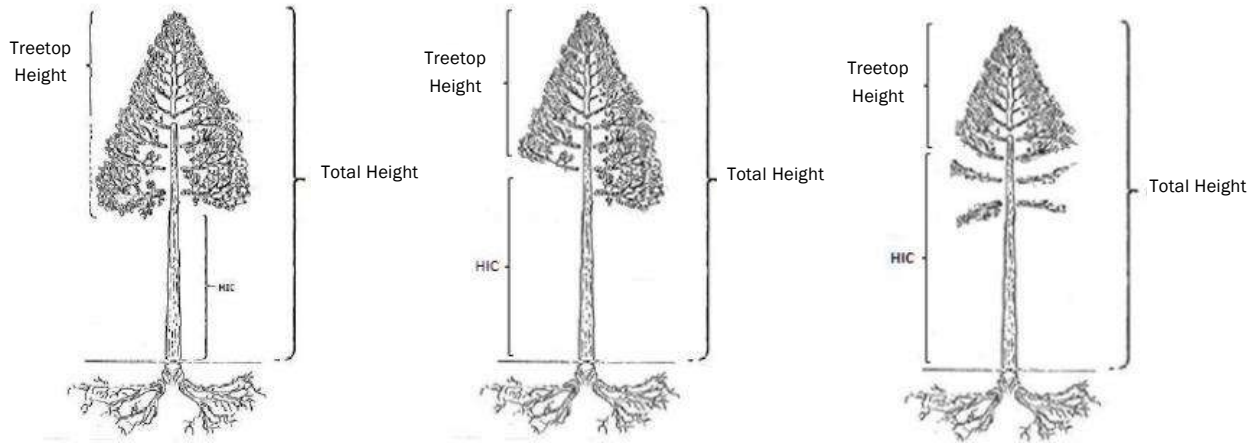

Figure 71 – Identification of the treetop height

STEM SITUATION CLASSIFICATION

Stem classification on site must follow the codification below.

Table 10 – Classification of stem situation

Code	Desciption	DAP	Height	Dominant	Exception
N	Normal	Measured	Sim	Sim	
F	Inconsistency	Not measured	Not measured	Not measured	
D	Dominated	Measured	Not measured	Not measured	
M	Dead	Measured	Not measured	Not measured	If there is no other option, height can be measured
Q	Broken	Measured	Measured	Not measured	Height measurement mandatory
A	Forked above DAP	Measured	Not measured	Not measured	
B	Forked below DAP	Measured	Measured	Measured	
RP	Replant	Measured	Not measured	Not measured	
FM	Ant	Measured	Measured	Measured	
L	Slight tortuosity	Measured	Measured	Measured	
TE	Strong tortuosity	Measured	Not measured	Not measured	
T	Stump	Não	Not measured	Not measured	
I	Inclined	Measured	Not measured	Not measured	
CI	Inclined toptree	Measured	Measured	Measured	
TV	Tumbled alive	Measured	Not measured	Not measured	
H	Dominant	Measured	Measured	Measured	Height measurement mandatory
E	Dry tip	Measured	Not measured	Not measured	
DD	Defornation of DAP	Measured	Not measured	Not measured	
XQ	Dead and burned	Measured	Not measured	Not measured	If there is no other option, height can be measured
XV	Alive and burned	Measured	Not measured	Not measured	If there is no other option, height can be measured
BR	Sprout	Measured	Not measured	Not measured	
MQ	Dead and broken	Measured	Measured	Not measured	Height measurement mandatory

SAMPLE PLOT OBSERVATION AND OCCURENCE

Sample plot observations are used to identify its conditions.

Table 11 – Codes for classifying observations on sample plots

Code	Description	Sample plot measurement	Sample plot allocation
1	None	Yes	No
10	Frost	Yes	No
11	Incompatible age	Yes	No

16	Standing dead tree	Yes	No
17	Wilt leaves	Yes	No
22	Broken	Yes, if there is no safety risk	No
23	Burnt	Yes	No
25	Replanted	Yes	No
28	Non identified silvopastoral	Yes	No
29	Native Shading	Yes	No
30	Dirty	Yes, if there is no safety risk	No
31	No bucket	Yes	No
32	Wood pile	Yes	No

Native reforestation activity monitoring plan

Size and type of sample plots

The sample plot specifications follow the AR-TOOL14: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" – Version 04.2.

Sample plots are rectangular and must have the minimum size of 2,500m² (25mx100m), as indicated on the figure below. This shape is important to capture the local productive gradient, and to ensure the georeferencing of the vertices of the plot, in order to allow future localization of the plots.

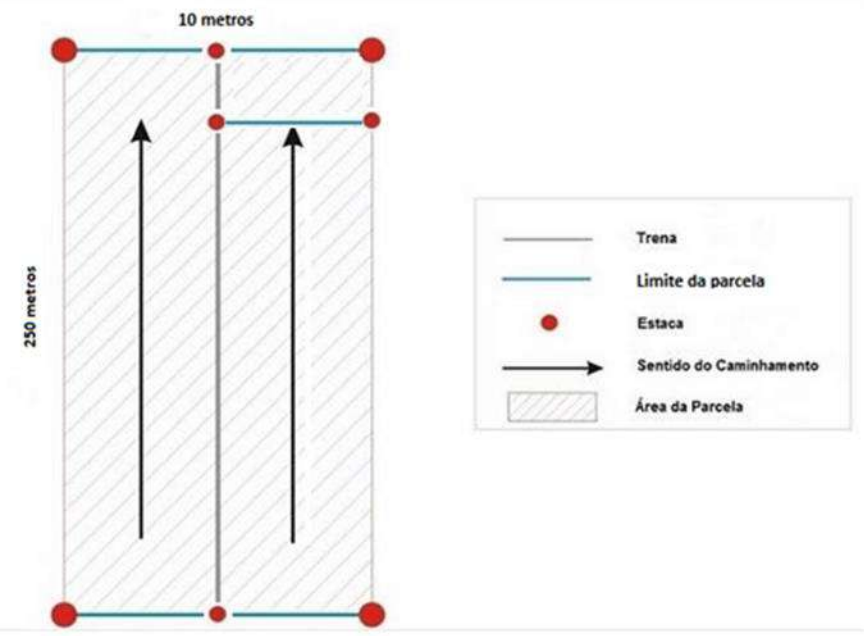

Figure 72 – Proposed sample plot size and distribution.

Number of sample plots

Sample plot intensity follows basic premises and seeks to meet the criteria set for the appliance of the AR-ACM0003.

According to A/R Methodological Tool Calculation of the number of sample plots for measurements within A/R CDM project activities - Version 02.1.0, the number of sample plots depends on the targeted precision and standard deviation for the parameter to be measured under the sample plots. For this project, it is assumed a minimum precision of 10%.

For each monitoring event, Suzano will estimate the uncertainty associated to the measurements, which enables the adjustment of sample plot intensity.

The minimal number of sample plots required by the AR-TOOL03 will be observed and assured for each monitoring event.

$$n = \frac{N * t_{VAL}^2 * (\sum_i w_i * s_i)^2}{N * E^2 + t_{VAL}^2 * \sum_i w_i * {s_i}^2}$$

Where:

n Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless

N Total number of possible sample plots within the project boundary (i.e. the sampling space or the population); dimensionless

t_{VAL} Two-sided Student's t-value, at infinite degrees of freedom, for the required confidence level; dimensionless

w_i Relative weight of the area of stratum i (i.e. the area of the stratum i divided by the project area); dimensionless

s Estimated standard deviation of biomass stock in stratum i; t d.m. (or t d.m. ha-1)

E Acceptable margin of [61]r (i.e. one-half the confidence interval) in estimation of biomass stock within the project boundary; t d.m. (or t d.m. ha-1), i.e. in the units used for si

i 1, 2, 3, … biomass stock estimation strata within the project boundary

If sampled areas represent less than 5% of the project area, the simplified equation can be used:

$$n = (\frac{t_{VAL}}{E})^2 * (\sum_i w_i * s_i)^2$$

Sample plot instalment

LOCATION – When installing a sample plot, the monitoring team shall identify the coordinates stablished through GPS and register the information, for following inventories.

Measurement Procedures

For native vegetation plantation, only the aboveground tree biomass will be monitored. Belowground biomass will be estimated as per the AR-TOOL14. All trees with DBH ≥ 5m shall be measured. Therefore, the growth in volumes will be monitored for each tree at the sample plots, based on the increment on the diameter at breast height and height of trees.

It is important to highlight that the trees must be identified through labeling. Their botanical identification must also be assessed.

The carbon content on deadwood and litter at the project area will not be measured. This carbon stocks will be estimated as per AR-TOOL12: "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" – Version 03.1.

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

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

TREE DIAMETER AT BREAST HEIGHT (DBH): All tree DBHs equal or greater to 5cm must be measured, even if the tree is dead. The DBH must be measured 1.3m above the ground. The equipment for this measurement are a post of 1.3m, measuring tape and suta. The measurement procedure must follow the figure below:

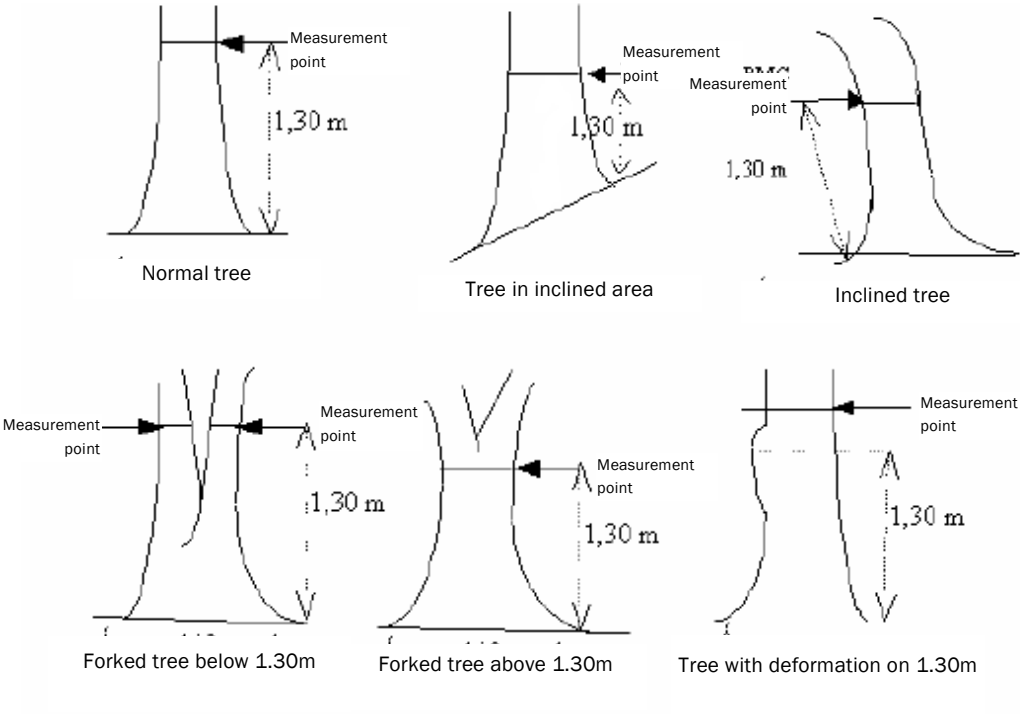

Figure 73 – Measurement point (PMC) in different conditions.

TREE HEIGHT (H): A telescopic stick must be used for assessing the total tree heights for all the stratums in an initial or medium regeneration stage. It is expected that the highest trees may have limited measuring, considered its height and other nearby trees.

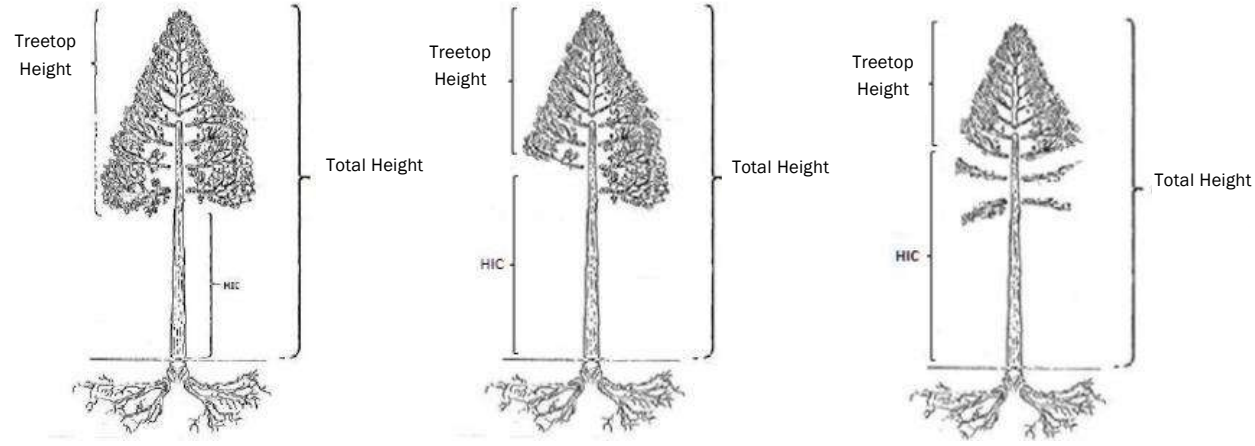

Figure 74 – Identification of the treetop height

Equipment calibration procedures

Measuring equipment must be submitted to calibration before usage for both the eucalyptus planting and for the native reforestation.

Measuring tape, surveyor cable and 1.3 posts must be measured and compared to a certified measuring tape. The procedure is made on site, during visits. When an equipment is outside of the allowed limits by Suzano, it must be substituted.

Clinometer must be calibrated on a post or tower with marks on 10, 20 and 30m. The operator must use a certified measuring tape to assure the marks and conduce the height measuring of the known values. When an equipment is outside of the allowed limits by Suzano, it must be substituted.

Table 12 – Limits allowed by Suzano.

Equipment	Limit
Measuring Tape – 20 cm	0.3 cm
Measuring Tape – 40 cm	0.3 cm
Measuring Tape – 60 cm	0.3 cm
DAB post – 1,3 cm	0.5 cm
Measuring tape – 10 cm	3 cm
Measuring Tape – 20 cm	3 cm
Measuring Tape – 30 cm	3 cm
Surveyor cable – 7,98 m	3 cm
Surveyor cable – 11,28 m	3 cm
Height Ruller– 3 cm	2 cm
Height Ruller – 5 cm	2 cm
Clinometer– 10 cm	0.5 cm
Clinometer – 20 cm	0.5 cm
Clinometer – 30 cm	0.5 cm
Telescopic stick	

Data validation, processing and storing (QA/QC)

It is of great importance to have procedures to deal with eventual mistakes that may occur during monitoring activities. Errors and inconsistencies from the data collection procedures can be identified internally during data processing, through the application of rigorous validation routines.

This validation routines take place during data import to the software EOL ZENIT SATA LOGGER, where information consistency is verified. This software is responsible for data storage for both the eucalyptus areas and for the native areas.

The software goes through each value, from tree to tree, to validate information and informs the possible inconsistencies. Consistent information validates the meeting or requirements for the forest inventory. Mathematical validation is also important to assess the consistency

of the monitoring event with the real condition of the forest indicated by the forest register, comparing input data to the register and tabled values.

There are two types of inconsistencies: impeditive and non-impeditive ones. The first type requires the data assessment and correction. The second type require the analyst assessment, which can ask for data correction or opt to use this information with an associated disclaimer. Possible inconsistencies are listed below:

Table 13 – Types of inconsistencies and disclaimers

Inconsistencies	Disclaimer
Inco 01 – Measured Height and empty DAP	Trees which height was measured, but the DAP is empty or equal to zero.
Inco 02 - Tree with empty height and DAP	Tree which height and DAP are empty or equal to zero and stem condition different from ('F','S','FP', 'T')
Inco 03 – Dominated with DAP>0 or wrong DAP	DAP from stem dominated tree without the D mark on field "SITUACAOFUSTE"
Inco 04 – tree with disproportional DAP and height	Tree with disproportional Height and DAP
Inco 05 – Discrepant DAP or Height	Discrepant DAP or height without Q mark on stem condition
Inco 06 – Tree out of the sequence	Tree out of the sequence
Inco 07 – Number of Trees do not match the size	Number of Trees do not match the size
Inco 09 – Check width and length	Check width and length of sample plot
Inco 11 – Check date of measurements	Check date of measurements
Inco 12 – Dominant Height missing	Dominant Height data missing
Inco 13 – Few heights measured	Few Heights measured (except for the dominant trees)
Inco 17 – Dead tree with height measured	Dead tree with height measured
Inco 18 – Broken tree without height	Broken tree without height
Inco 25 – Dead tree with height variation on DAP	Dead tree with height variation on DAP in comparison to previous measurements
Inco 26 – Tree with unusual DAP growth	Tree with unusual DAP growth

In case of inconsistent measurements, indicated by inconsistent data, the batch will be returned to the measurement team for proper correction. Field activity might be necessary to correct the data if the auditing team requires so, and according to previous measurement data score rated for the sample plots audited. Scoring follows the criteria below:

Table 14 – Score Criteria for assessing quality of measurements from sample plots

Code	Criteria	Score	Description	Relevance	Relevance (%)
1	N. of coves altered (inclusion or exclusion of stumps)	0	Correct	25	37.3
		1	Incorrect		
2	Absolute mean deviation - CAP	0	Correct	5	7.5

		1	Incorrect		
3	Absolute mean deviation - HT	0	Correct	20	29.8
		1	Incorrect		
4	Codification of trees	0	Correct	2	3
		1	Incorrect		
5	XY spatial coordinates for the sample plots	0	Correct	2	3
		1	Incorrect		
6	Identification of limiting trees for sample plots	0	Correct	7	10.4
		1	Incorrect		
7	Tree mark identification on mirror (n. of sample plot, n. of coves, distance/direction, height measurement) and DAP identification	0	Correct	1	1.5
		1	Incorrect		
8	Inconsistencies identification (field data collection)	0	Correct	5	7.5
		1	Incorrect		

The scoring starts at 100, and when an inconformity is identified, the respective relevance is discounted from the score.

- Scores between 90 and 100 indicates measurements according to expected, with minor adjustments in cases where a simple inconsistency event occurs.
- Scores between 80 and 90 indicates that the batch must be returned to the field monitoring team to remeasure the inconsistent information for all the sample plots from the batch (same team and date).
- Scores under 80 indicates that the whole farm must be remeasured.

Data and monitored parameter Analysis

Registered data for the Project area are inputs for growth models that will define the total biomass stock at the project at the time of the monitoring event. Only areas with more than 2 years will be considered for eucalyptus activities, whereas native reforestation activities will be implemented every 5 years.

For ex-post calculation, the monitored data will be modeled through volume and biomass equations, specific for each tree species and project region, considering the conformity required by the AR-TOOL14 - Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, Version 04.2.

Considering all requirements listed under the AR-TOOL14, monitoring must consider the confidence level of 90%, and an error margin of 10%

Procedure for calculating uncertainty

Uncertainty from carbon stocks estimates will be assessed through equation 6 of the AR-TOOL14 - Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, Version 04.2:

$$u_c = \frac{t_{VAL} \times \sqrt{\sum_{i=1}^{M} w_i^2 \times \frac{s_i^2}{n_i}}}{b_{TREE}}$$

Where:

u_c Uncertainty in C_{TREE}

t_{VAL} Two-sided Student's t-value for a confidence level of 90 per cent and degrees of freedom equal to n – M, where n is total number of sample plots within the tree biomass estimation strata and M is the total number of tree biomass estimation strata

s_i^2 Variance of tree biomass per hectare across all sample plots in stratum i; (t d.m. ha^{-1})^2

n_i Number of sample plots in stratum i.

$b_{TREE,i}$ Mean tree biomass per hectare in stratum i; t d.m. ha^{-1}

Monitoring of loss event due to biomass burning

Suzano is aware of the risk forest fires represent for this project activity and for its business in a whole. For this reason, it has a robust procedure (P0.12.02.2019) for keeping track of fire events and is determined to report them in a public way at its website[92].

According to the operational procedure, the team is equipped with a vehicle for reaching the fire spots, radio for communicating, a support team with equipment to extinguish the fire, such as dampers and water trucks.

The team is responsible to patrol Suzano's areas, and to observe the occurrence of fire events. In addition to extinguishing and controlling the areas, they must keep reports on the events and investigate what caused the fire. They also count with monitoring towers that can provide alerts in case of fire events.

[92] SUZANO. Número de Focos de incêndio nas áreas da Suzano. Available at: < https://centraldesustentabilidade.suzano.com.br/indicadores/?ind=numero-de-focos-de-incendios-nas-areas-da-suzano-625cec56bfc2e&filter_tag=temas_materiais;>. Last access: 05th July, 2022.

When a fire event takes place, the team has to quantify the damage caused, and inform its superior, so they can specifically identify the area damaged, with the most accurate information available. The security team must also be informed immediately after identifying the fire spot. The coordinator will decide the proper management of the area after the event.

All fire events must be reported on the Accident and Incident Investigation Analysis Report. If 5% or more of the project area is lost due to fire events, the project proponents will follow all the procedures set out by the VCS Standard through the process for communicating and accounting for the loss event.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

The monitoring period of this report is from the start date (02/11/2017) to 21/02/2022, which is the date the last parcel from the inventory was measured.

6.1 Data and Parameters Monitored

Data / Parameter	A
Data unit	*Ha*
Description	*Project Area (planted area).*
Value applied	12,121.87
Comments	No comments on the parameter

Data / Parameter	A_i
Data unit	*Ha*
Description	*Area of stratums*
Value applied	*Stratum 1 – 3,275.66* *Stratum 2 – 2,438.70* *Stratum 3 – 234.52* *Stratum 4 – 714.07*

	Stratum 5 – 5,202.27 *Stratum 6 – 256.65*
Comments	No comments on the parameter

Data / Parameter	Ap.i
Data unit	*M²*
Description	*Area of sample plot in stratum I.*
Value applied	*Stratum 1 – 41,200.00* *Stratum 2 – 35,809.70* *Stratum 3 – 9,600.00* *Stratum 4 – 30,000.00* *Stratum 5 – 200,800.00* *Stratum 6 – 10,800,00* *TOTAL AREA – 328,209.70*
Comments	No comments on the parameter

Data / Parameter	N
Data unit	*Dimensionless*
Description	*Number of plots to be established in the project area*
Value applied	*Stratum 1 – 103* *Stratum 2 – 89* *Stratum 3 – 24* *Stratum 4 – 75* *Stratum 5 – 502* *Stratum 6 – 27* *TOTAL– 820*
Comments	No comments on the parameter

Data / Parameter	Plot location
Data unit	*Latitude/longitude*

Description	*Localization for each sampling plot*
Value applied	*Please, see spreadsheet "Monitored ER", Sheet "Parcels", with detailed information*
Comments	*The sample plot location is registered with a GPS and marked on the project map.*

Data / Parameter	DBH
Data unit	*centimeter*
Description	*Diameter at breast height of the trees*
Value applied	*Please, see spreadsheet "Monitored ER", Sheet "Parcels data", with detailed information*
Comments	No comments on the parameter

Data / Parameter	H
Data unit	*meter*
Description	*Total height of trees*
Value applied	*Please, see spreadsheet "Monitored ER", Sheet "Parcels data", with detailed information*
Comments	No comments on the parameter

Data / Parameter	*T*
Data unit	*Year*
Description	*Period between two successive estimations of carbon stock in trees and shrubs*
Value applied	*0*
Comments	No comments on the parameter

6.2 Baseline Emissions

The monitoring period of this report is from the start date (02/11/2017) to 21/02/2022, which is the date the last parcel from the inventory was measured.

The baseline emissions must be determined as per AR-ACM0003, as detailed below:

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

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
$\Delta C_{DW\_BSL,t}$	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

Carbon stock in tree in the baseline

Although the trees present under the baseline are sparse and limited, the phytophysiognomy of the area has been characterized as degraded pasture and exposed soil. The present trees at the Eucalyptus planting area (eucalyptus plantation) will be removed by the project proponent. This removal is legally allowed through legal authorizations called CANI (in Portuguese, Cutting of Isolated Native Trees).

For this reason, tree stock under the baseline should be accounted for, for such trees to be removed. The Project will follow the approach of proportional canopy cover, described under section 8.3 of AR-TOOL14. This method is suitable for estimating baseline carbon stock in tree biomass where the average tree crown cover in the baseline is less than 20% of the threshold tree crown cover reported by the Host Party, considering the current definition of forest or forest formation.

The Brazilian Designated National Authority informed the following values for afforestation and reforestation project activities[93]:

Table 15 – Brazilian Afforestation/Reforestation informations

Requirements	Host party's selected single minimum
Canopy cover	30 %
Minimum height	1m
Area	5 m

The mean pre-project tree crown cover is 1.01%, less than 20% of the threshold tree crown over defined by the DNA (6%), as required by the AR-TOOL0014, which requires under paragraph 49 that "This method is applicable only for estimation of the pre-project carbon stock in tree biomass in the baseline where the mean pre-project tree crown cover is less than 20 per cent of the threshold tree crown cover reported by the host Party under paragraph 8 of the annex to decision 5/CMP.1.".

The map below shows canopy crown cover of sparse trees to be removed and the respective occupied area, of 157.07 ha.

[93] Countries Afforestation/Reforestation informations. Clean Development Mechanism. Brazil information. Available at: <https://cdm.unfccc.int/DNA/allCountriesARInfos.html>. Last access: 29th April 2022.

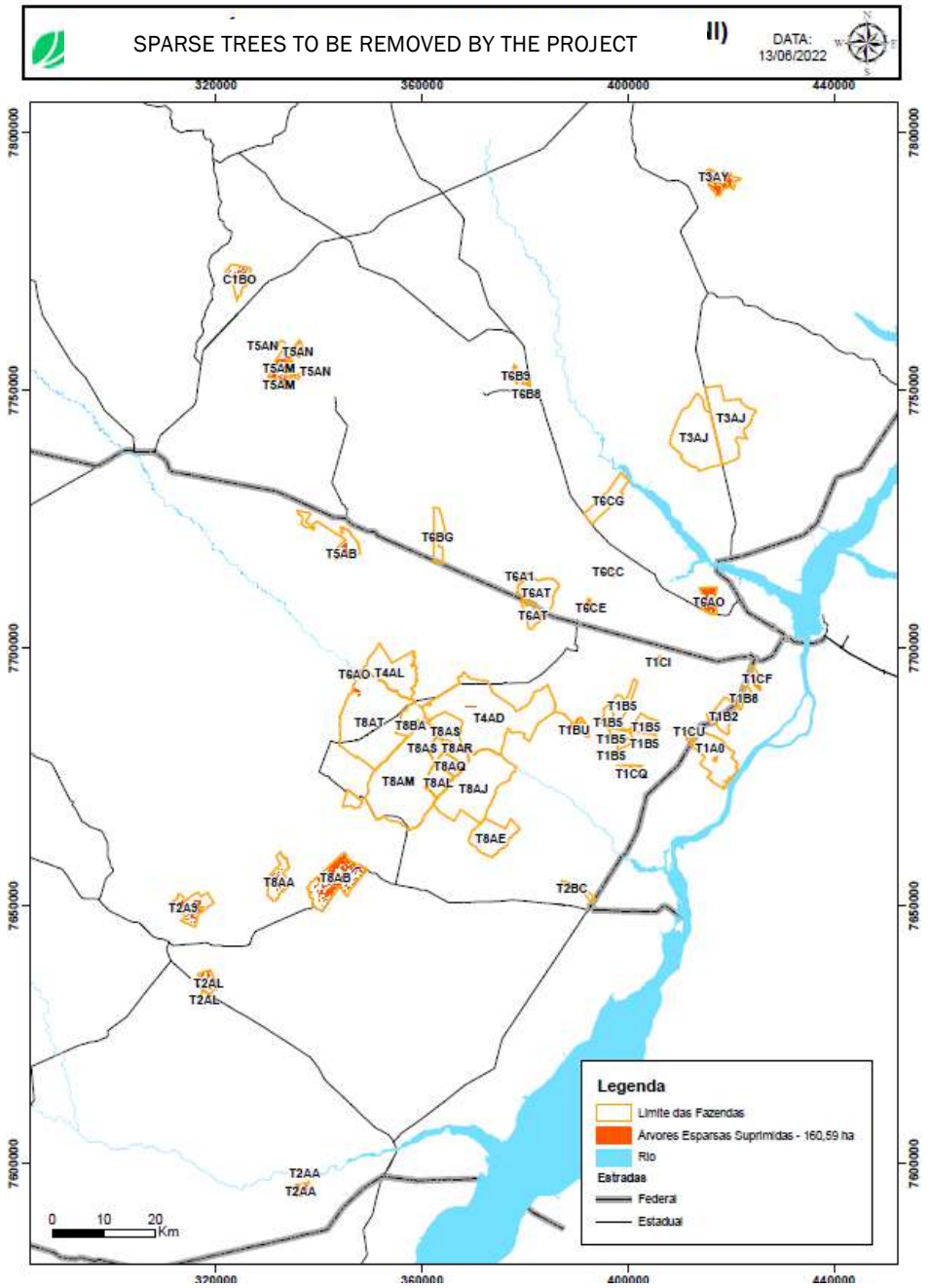

Figure 75 – Sparse trees to be removed from the project area, identified in red.

Meeting the guidelines of AR-TOOL14 tool section 8.3, in paragraph 25, the change in tree carbon stock at baseline is estimated as follows:

$$C_{TREE\_BLS} = \sum_{t=1}^{M} C_{TREE_{BLS},i}$$

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

Where: C_{TREE_BLS} = Mean annual change in carbon stock in trees in the baseline; t CO_2e yr^{-1}

$C_{TREE_{BLS,i}}$ = Mean annual change in carbon stock in trees in the baseline, in baseline stratum i; t CO2e yr^{-1}

CF_{TREE} = Carbon fraction of tree biomass; t C $(t.d.m.)^{-1}$.

b_{FOREST} = Mean above-ground biomass in forest in the region or country where the A/R CDM project activity is located; t d.m. ha^{-1} yr-1.

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

$CC_{TREE_{BLS},i}$ = Crown cover of trees in the baseline, in baseline stratum i, at the start of the A/R CDM project activity, expressed as a fraction; dimensionless

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

The parameters applied are detailed below:

Table 16 – Parameters applied for calculating baseline carbon stock on trees

Parameter	Value	Unit	Reference
CF_{TREE}	0,47	t C $(t.d.m.)^{-1}$	Default value defined by the AR-TOOL14.
b_{FOREST}	110.12	t d.m. ha^{-1} yr-1	MIRANDA, et al. 2014. Regional variations in biomass distribution in Brazilian Savanna woodland. Data for biomass above and below ground for forest formations.
R_{TREE}	0,25	Dimensionless	Default value defined by the AR-TOOL14.
$CC_{TREE_{BLS},i}$	0,0101	Dimensionless	Measured for each farm. This is the average value
A_i	15,517.87	Ha	Measured

The AR-TOOL14 defines that changes in carbon stocks in trees and shrubs in the baseline may be accounted as zero for those lands where one or more indicators apply:

- Observed reduction in topsoil depth (e.g. as shown by root exposure, presence of pedestals, exposed sub-soil horizons);
- Presence of gully, sheet or rill erosion; or landslides, or other forms of mass-movement erosion;
- Presence of plant species locally known to be indicators of infertile land;
- Land comprises of bare sand dunes, or other bare lands;
- Land contains contaminated soils, mine spoils, or highly alkaline or saline soils;
- Land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline;
- Conditions under the previous paragraph apply (conditions a, b and c from paragraph 11 at AR-TOOL14).

Scenarios including erosion and base lands can be seen on project areas, both for the areas with eucalyptus planting planned and for native reforestation activities, as indicated by the map below. In addition, the baseline scenario was extensive cattle ranching, which often applies slash and burning procedures for both activities.

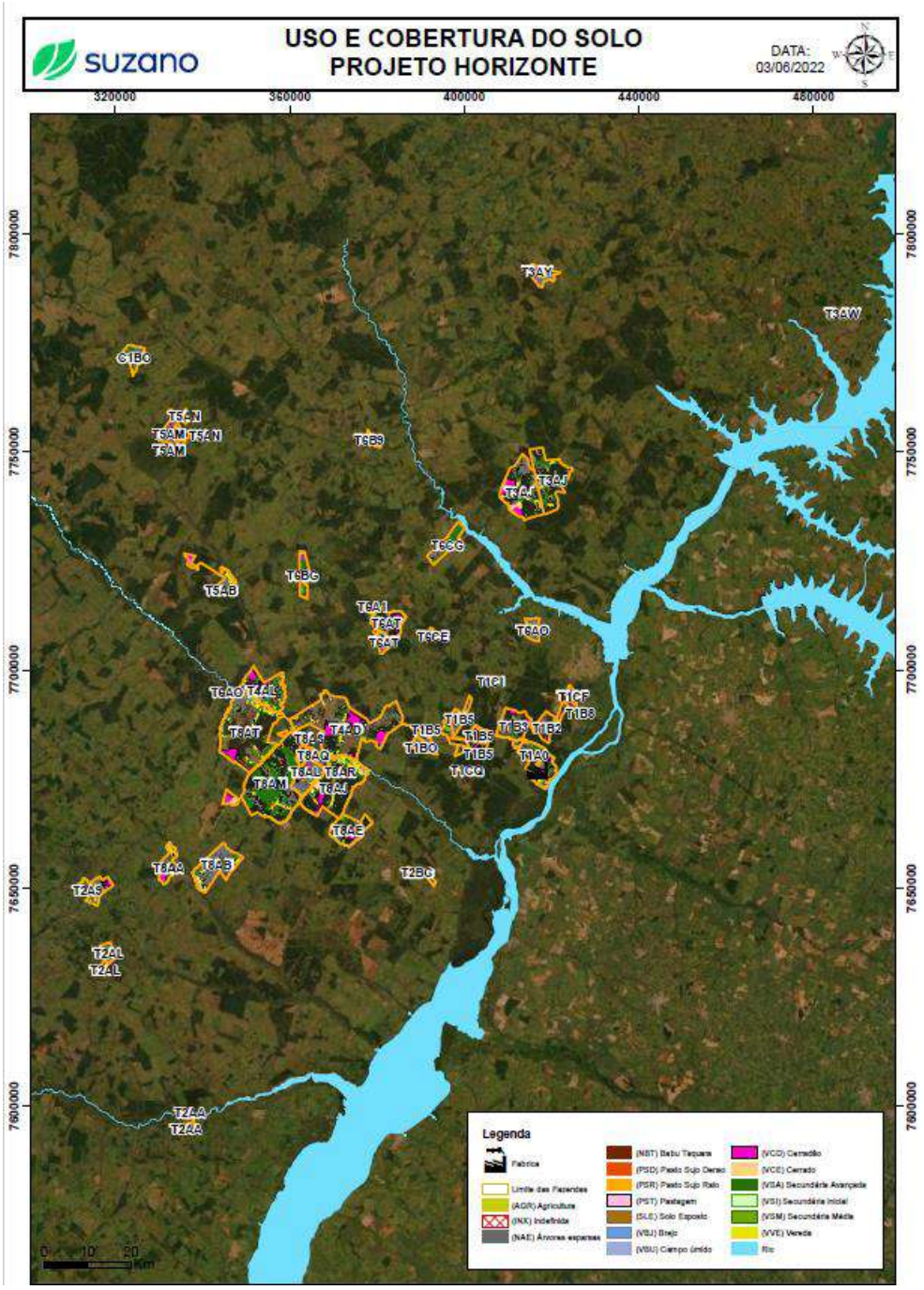

Figure 76 – Soil coverage of the project farms, with presence of exposed soil.

It is important to highlight, however, that so far, the project has implemented eucalyptus plantations, which did not take place in all areas previewed, which will follow the schedule previewed at section 4.2.1. This monitoring includes only the areas where the project activity was already implemented.

For this reason, changes in carbon stock in shrubs and trees at the baseline are estimated as zero.

6.2.1 Carbon stock in shrubs

It is assumed that the carbon stock in shrub biomass is zero in the baseline scenario for the area monitored, because changes in above- and below-ground biomass carbon stock of non-arboreal vegetation on degraded soil in the baseline scenario is not plausible.

6.2.2 Changes in carbon stock in trees, litter, and dead wood in baseline

For the estimates of carbon stock in dead wood and litter, the AR-TOOL12 topics 6.2 and 7.2 were applied, respectively, named the "conservative default-factor based method for estimation of carbon stock". The method allows for estimating carbon stocks under such pools based on conservative default factors, as outlined in the following equations:

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

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

Where:

$C_{DW,i,t}$	Carbon stock in dead wood within the project boundary i at a given point of time in year t; t CO_2e
$C_{LI,i,t}$	Carbon stock in litterwithin the project boundary 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
DF_{LI}	Default factor for the relationship between carbon stock in litter and carbon stock in living trees; per cent

Through the guidelines of the AR-TOOL12, carbon stock under litter and dead wood pools were estimated by correlating them with the carbon stock in the tree biomass, applying the

estimated data for the stock in trees at baseline within the project boundaries (as described earlier, in item 4.1.1) and conservative default factors presented by the tool.

6.3 Project Emissions

The monitoring period of this report is from the start date (02/11/2017) to 21/02/2022, which is the date the last parcel from the inventory was measured.

The actual net GHG removals by pools 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 CO_2-e
$\Delta C_{P,t}$	Change in the carbon stocks in project, occurring in the selected carbon pools, in year t; t CO_2-e
$GHG_{E,t}$	Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year t, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e

6.3.1 Stratification

Stratification was defined according to section 5.3 of the "AR-ACM0003 A/R Consolidated Large Scale Methodology Afforestation and reforestation of lands except wetlands Version 02.0". The methodology states that if the distribution of biomass in the project area is not homogeneous, stratification should be performed to improve the accuracy of biomass estimation.

For actual net GHG removals, for the areas monitored under this monitoring event, the stratification was based on the project planting plan, considering the year of plantation and responsible for planting.

Table 17 - Stratum for plot sampling under this monitoring period

Stratum	*Total area*	*Responsible for planting*	*Year of planting*
Stratum 1	3,275.66	Funds	2017
Stratum 2	2,438.70	Funds	2018
Stratum 3	234.52	Suzano	2017
Stratum 4	714.07	Suzano	2018

Stratum 5	5,202.27	Suzano	2019
Stratum 6	256.65	Suzano	2020

6.3.2 Change in carbon stock in Project

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

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

Where:

$\Delta C_{P,t}$	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$\Delta C_{TREE\_PROJ,t}$	Change in carbon stock in tree biomass in project in year *t*, 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 CO_2-e
$\Delta C_{SHURB\_PROJ,t}$	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 CO_2-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 CO_2-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 CO_2-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 CO_2-e

It is considered that the eucalyptus plantations will be harvested every 7 years and reestablished by replanting the area. It is important to highlight that soil preparation at Suzano S.A is carried out based on the principles of minimum cultivation (restricted to the planting lines or pits),achieving a balance between soil preparation quality and maintenance of forest residues (litter and dead wood) on the soil ensuring the conservation of the structure and biomass below the soil (attachment 5).

Due to the company's procedures of keeping the stumps and lowering them at the time of the soil preparation operation, the below-ground biomass is not compromised when the above-ground biomass is harvested, or during replanting. Thus, the maintenance of forest residues after harvest improves the physical-chemical attributes of the soil, incorporation of organic matter, besides increasing the cycling and efficiency of nutrient use[94]. In areas that receive fertilization and irrigation, as in the Project areas, it is possible to notice an increase in the carbon stored in the soil, attributed to the higher production of fine roots[95]. As long as the Eucalyptus stand is renewed and the above ground biomass grows again, the below ground biomass will be maintained in the area in relation to harvesting and replanting operations, and the same applies to the stock of litter and dead wood, which contributes to the maintenance of organic carbon. Due to the application of the methodology AR-ACM0003, this stock behavior cannot be clearly visualized, and are devalued for the eucalyptus activity. This consideration is conservative.

The Native reforestation activity will not include harvesting events or improved forest management techniques whatsoever. Hence, the Long Term Average GHG benefit will not be applied for this stratum, considered it will not be disturbed throughout the project lifetime. Also, carbon stock in soil organic carbon will be applied only for this stratum.

Estimation for Change in carbon stock in tree and shrub biomass

For ex-post assessment of carbon stock in tree biomass at a given moment, the guidelines on AR-ACM0003 and AR-TOOL14, “Estimating carbon stock in trees at a point of time”.

The assessment of above and below ground in tree biomass per hectare at a point in time (per year), considering the referenced parameters, was calculated based on the IPCC Equation 3.2.5 [96]:

$$G_{Total} = G_w * (1 + R)$$

Where:

G_{total} average annual biomass increment above and belowground, tonnes d.m. ha-1 yr-1

[94] ALVARENGA, Ramon Costa et al. Sistema integração lavoura-pecuária-floresta: condicionamento do solo e intensificação da produção de lavouras. 2010.

[95] GATTO, Alcides et al. Estoques de carbono no solo e na biomassa em plantações de eucalipto. Revista Brasileira de Ciência do Solo, v. 34, p. 1069-1079, 2010.

[96] IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Chapter 3, Section 3.2. Available at: <https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Chp3/Chp3_2_Forest_Land.pdf>. Last Access: 18th March 2022.

G_w average annual aboveground biomass increment, tonnes d.m. ha-1 yr-1

R root-to-shoot ratio, dimensionless

$$G_w = I_v * d * BEF$$

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

d Basic wood density, tdm/m^3 merchantable volume

BEF Biomass expansion Factor for conversion of merchantable volume to aboveground tree biomass, dimensionless

In order to determine the ΔCtree, the equations 12, 13 and 14 of the ARR-TOOL14 were applied:

$$C_{tree} = \frac{44}{12} * \ CF_{tree} * B_{tree}$$

$$B_{tree} = A * b_{tree}$$

$$b_{tree} = \sum_{i=1}^{M} w_i * b_{tree,i}$$

Where:

CF_{tree} Carbon fraction of tree biomass; t C (t d.m.)-1

A Project area

B_{tree} Tree biomass within the biomass estimation strata; t d.m.

b_{tree} Tree biomass per hectare within the biomass estimation strata; t d.m. ha-1

wi Ratio of the area of stratum i to the sum of areas of tree biomass estimation strata (i.e.), dimensionless

The b_{tree} parameter on the abovementioned equation is equivalent to the G_{total} variable previously mentioned multiplied by the forest age.

The BEF parameter is estimated through a linear correlation of default values from IPCC[97], based on the age of the trees:

$$BEF = -0{,}033928571 * age + 0{,}432857143$$

The R parameter is also estimated through a linear correlation of default values from IPCC[86], based on the age of the trees:

$$R = -0{,}020714286 * age + 0{,}367142857$$

For monitoring the carbon stock at the project are under this monitoring period, the values below obtained from the monitoring event for the Iv and from Suzano database for density are applied:

Table 18 – Parameter values applied for calculating Project emission removals

Stratum	Iv (m³/ha/year)	D (tdm/m³)	CF (tC/tdm)
Stratum 1	36.45	0.46	0.47
Stratum 2	36.78	0.44	0.47
Stratum 3	30.74	0.47	0.47
Stratum 4	33.93	0.44	0.47
Stratum 5	32.89	0.43	0.47
Stratum 6	35.54	0.43	0.47

As required by the tool, the uncertainty of the calculation was assessed through the equation below.

$$u_c = \frac{t_{VAL} \times \sqrt{\sum_{i=1}^{M} w_i^2 \times \frac{s_i^2}{n_i}}}{b_{TREE}}$$

Where:

u_c Uncertainty in C_{TREE}

t_{VAL} Two-sided Student's t-value for a confidence level of 90 per cent and degrees of freedom equal to n – M, where n is total number of sample plots within the tree biomass estimation strata and M is the total number of tree biomass estimation strata

[97] IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Available at: <https://www.ipcc.ch/publication/good-practice-guidance-for-land-use-land-use-change-and-forestry/>. Last Access: 18th March 2022

s_i^2 Variance of tree biomass per hectare across all sample plots in stratum i; (t d.m. ha^{-1})^2

n_i Number of sample plots in stratum i.

$b_{TREE,i}$ Mean tree biomass per hectare in stratum i; t d.m. ha^{-1}

Stratum	Number of plots (N)	Area of sample plot (Ap,i)	Mean VTCC (m³/ha)	Wi	Si²
Stratum 1	103	41,200.00	158.90	7%	1,016.09
Stratum 2	89	35,809.70	152.50	4%	1,166.78
Stratum 3	24	9,600.00	119.02	0%	1,342.82
Stratum 4	75	30,000.00	125.02	0%	1,366.07
Stratum 5	502	200,800.00	45.50	18%	216.25
Stratum 6	27	10,800.00	48.77	0%	79.60
TOTAL	**820**	**328,209.70**	**103.55**		**3,446.57**

Considered a tval of 1.645, the uncertainty assessed for C_{TREE} was equal to 0.66%, under the 10% threshold. Hence, no discounts over the CTREE should be applied due to uncertainty.

Estimation for Change in carbon stock in litter and dead wood

For the assessment of carbon stock in dead wood and litter for the project area monitored under this monitoring report, the AR-TOOL12 topics 6.2 and 7.2 were applied, respectively, named the "conservative default-factor based method for estimation of carbon stock". This approach requires dead wood and litter not to be removed from the project area. Therefore, it is important to highlight that neither the carbon stocks will be removed from the project area, both for eucalyptus and native plantations, as identified at Suzano's operational procedures. On eucalyptus plantations, dead wood and litter may be slightly moved aside when they are located at planting lines, and stumps may be cut in half or deepened at the soil, but not removed, in line with the methods requirements.

The method allows for estimating carbon stocks under such pools based on conservative default factors, as outlined in the following equations:

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

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

Where:

$C_{DW,i,t}$ Carbon stock in dead wood within the project boundary i at a given point of time in year t; t CO_2e

$C_{LI,i,t}$ Carbon stock in litter within the project boundary 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

DF_{LI} Default factor for the relationship between carbon stock in litter and carbon stock in living trees; per cent

Through the guidelines of the AR-TOOL12, carbon stock under litter and dead wood pools were estimated by correlating them with the carbon stock in the tree biomass, applying the estimated data for the stock in trees within the project boundaries. For the dead wood and litter estimation, the conservative default factor identified by the tool was applied.

Estimation for Change in carbon stock in soil organic carbon

This stock was not considered under this monitoring report, considered only eucalyptus plantations took place on the project area, so far, for which no stock in soil organic carbon will be considered, ss mentioned under sections 3.2 and 3.3. Therefore, it is estimated as zero.

6.3.3 Increase in non-CO2 GHG emissions

The AR-ACM0003 defines that GHG emissions resulting from herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary, and transportation attributable to the project activity shall be considered insignificant and therefore accounted as zero.

The AR-TOOL08 for estimating emissions from burning biomass indicates the following equation:

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

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-CO_2 GHGs resulting from use of fire in site preparation in year t;t CO_2-e
$GHG_{FMF,t}$	Emission of non-CO_2 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 CO_2-e
$GHG_{FF,t}$	Emission of non-CO_2 GHGs resulting from fire in year t; t CO_2-e

No burning activity was implemented by the project proponent in any of the project areas monitored, although this practice is usually widely implemented under the baseline scenario for deforestation and pasture regrowth stimulation.

Hence, fire was not used by the project proponent for site preparation, nor was biomass burned within the project boundary. Moreover, fire was not used to clear the land of harvest residue prior to replanting of the land for the eucalyptus plantations or other forest management at both project area activities, although harvest events are foreseen for the project activity to be implemented.

In case of forest fires that surpasses a threshold of 5% of the project area, the AR-TOOL08 must be applied, and all the required procedures for loss events will be dully applied. It is important to highlight that no fire events were seen at the project areas monitored so far.

Under such conditions, $GHG_{SPF,t}, GHG_{FMF,t}$ and $GHG_{FF,t}$, are accounted as zero. Therefore, project emissions, $GHG_{E,t}$ are also accounted as zero.

6.4 Leakage

The estimation of the increase in GHG emissions resulting from the displacement of pre-project agricultural activities within the boundaries of a forestry or reforestation (A/R) project is governed by the instrument "Estimation of the increase in GHG emissions attributable to the displacement of pre-project agricultural activities in the CDM/R project activity"; t CO2-e. considering the determination of the following parameter:

$$LK_t = LK_{AGRIC,t}$$

Where:

LK_t = Leakage emission due to the displacement of agricultural activities in year t

$LK_{AGRIC,t}$ = Leakage emission resulting from displacement of agricultural activities in year t; t CO2e

For the lands within the project boundary from which pre-project agricultural activities are to be moved outside the project boundary are delineated and their area is to be estimated. The leakage emission resulting from the displacement of the activities should be estimated considering equation 1 of the aforementioned tool:

$$LK_{AGRIC,t} = \frac{44}{12} * (\Delta C_{BIOMASS,t} + \Delta SOC_{LUC,t})$$

Where:

$LK_{AGRIC,t}$ = Leakage emissions resulting from displacement of agricultural activities in year t; t CO2e

$\Delta C_{BIOMASS,t}$ = Decrease in carbon stock in the carbon pools of the land receiving the activity displaced in year t; t d.m.

$\Delta SOC_{LUC,t}$ = Change in soil organic carbon (SOC) stock due to land-use change in the land receiving the displaced activity in year t; tC ha^{-1}

Considered the project area monitored under this monitoring report, it can be said that:

The project activity does not expect any displacement of the agricultural activities present within the project boundary before its start, so leakage emissions are considered negligible and therefore considered zero.

Since land acquisition, previous owners are required to remove any animals present on area, and the areas are expected to remain unoccupied until the project implementation start, which can take more than a year to take place. However, according to MapBiomas[89], an initiative of the Greenhouse Gas Emissions Estimation System (SEEG) from the Climate Observatory's produced by a collaborative network of co-creators made up of NGOs, universities and technology companies organized by biomes and cross-cutting themes, the land occupied with pasture activities in the cities where the project is located have been slowly reducing since 2005. Between 2005 and 2021, the land covered by pasture reduced almost 22% and between 2017 and 2021, the first monitoring period of the ARR Horizonte Carbon Project, pasture areas decreased by 5%[89]. So, it is likely that the animals that were removed from project area were relocated to existing pastures, that is, no forest areas were opened for grazing because of the implementation of the project. Moreover, the number of

cattle decreased by 12[90] since 2017 in the cities where the project is located, suggesting that the total number of animals on the receiving pastures (displaced and existing) has not exceeded the capacity of the pastures, which corroborates low probability of leakage.

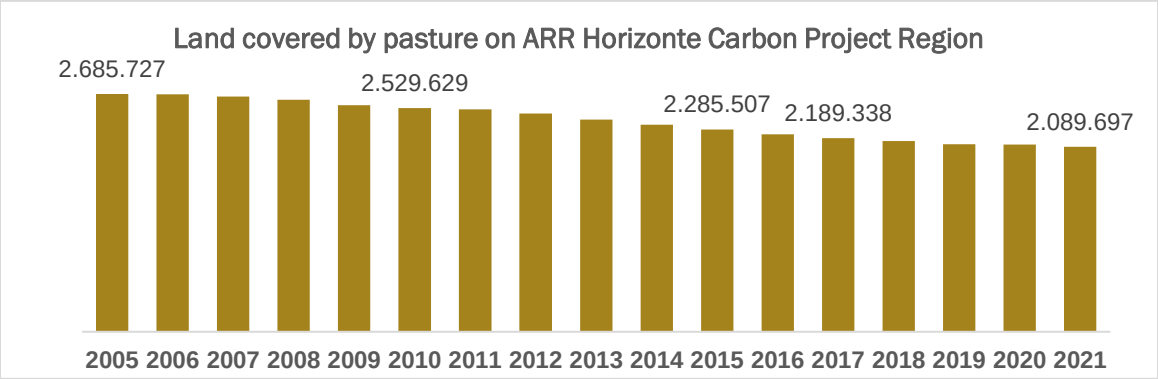

Figure 77: Land covered by pasture in the region of ARR Horizonte Carbon Project[89]

In addition, it is known that the Cerrado biome is the second most impacted biome by deforestation in the country, with 33,5% of the deforested areas [60] . This can be noted by assessing images from the cities where the project is located, where most of the land can be easily identified as grasslands. Nevertheless, almost all forest areas near the project area belong to the project proponent.

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It is also important to highlight that social activities to be implemented due to the project will bring another income for the local communities, so that they can raise independence from cattle ranching activities.

Therefore, Leakage emissions are considered insignificant and, therefore, accounted as zero under this monitoring event.

6.5 Net GHG Emission Reductions and Removals

According to the equation 5 of the methodology AR-ACM0003 v2.0, the net anthropogenic GHG removal by sink is:

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

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 = GHG emissions due to leakage, in year t; t CO2-e

Nevertheless, the non-permanence risk assessment conduced for this project determined that a percentage of 10% of the Net GHG emission reductions should be allocated at the Buffer pool, as indicated under the table below.

Additionally, according to the standard requirements, for those projects where harvesting practices are considered in the project area, the loss of carbon due to harvesting shall be include in the quantification of the project emissions. Because the eucalyptus planting considers an increase in project area during the first seven years of implementation and a harvesting period every seven years, the long-term average (LTA) GHG benefit was reassessed, considering the areas monitored so far, as follows:

$$LTA = \frac{\sum_{t=0}^{n} PE - BE_t}{n}$$

Where:

LTA = The long-term average GHG Benefit.

$\mathrm{PE_t}$ = The total to-date GHG emission reductions and removals generated in the project scenario (tCO2e). Project scenario emission reductions and removals shall also consider project emissions of CO_2, N_2O, CH_4, and leakage.

$\mathrm{BE_t}$ = The total to-date GHG emission reductions and removals projected for the baseline scenario (tCO_2e).

t = Year.

n = Total number of years in the established time period

The LTA (without risk buffer discount) is calculated considering 35 years.

The LTA estimated for the monitored area is 2,253,106 tCO_2e and according to the standard requirements the LTA indicates the total credits available to be issued.

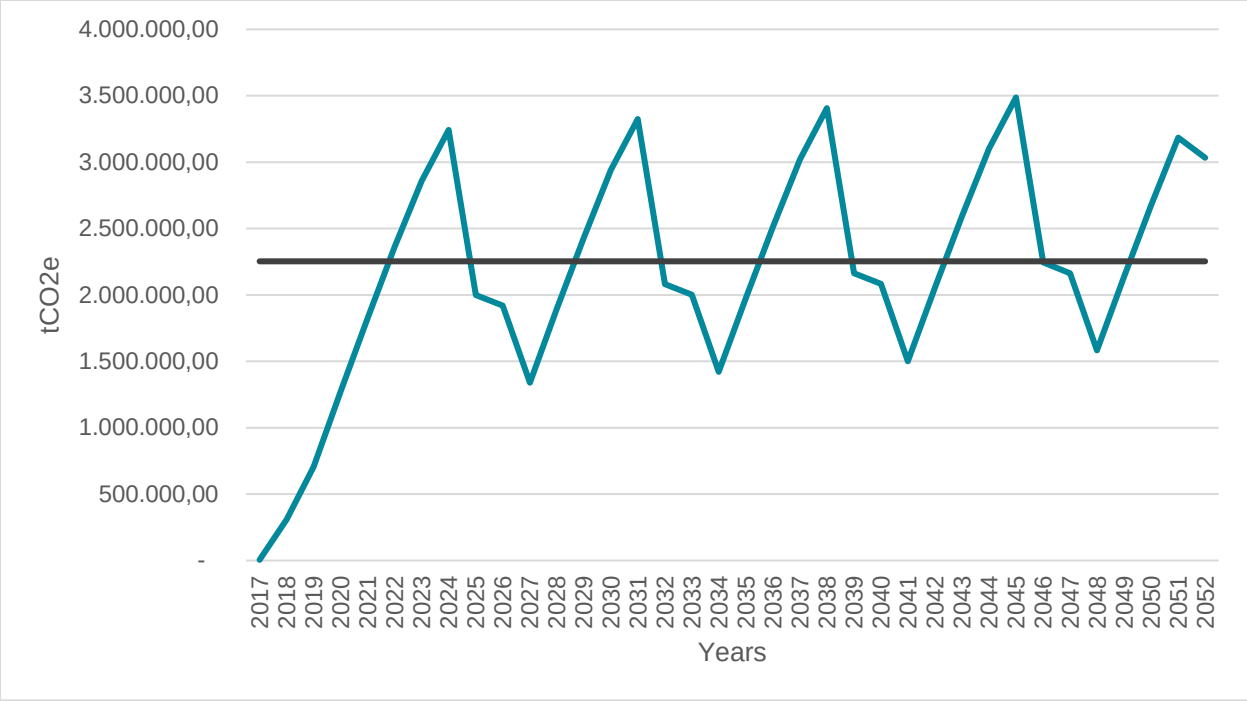

Figure 78 Illustration of the expected total GHG benefit of the project's long-term average

The following table shows the Net GHG emission removals, buffer allocation and VCUs eligible for issuance, which did not reach the LTA estimated for the project yet.

Table 19 Net GHG emission removals

Period	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)	Buffer pool allocation	VCUs eligible for Issuance
02/11/2017 to 31/12/2017	12,627.08	17,811.91		5,184.83	519.00	4,665.00
01/01/2018 to 31/12/2018	13,439.48	323,629.29		310,189.81	30,501.00	274,503.00
01/01/2019 to 31/12/2019	13,439.48	719,131.30		705,691.82	39,551.00	355,951.00

01/01/2020 to 31/12/2020	18,372.81	1,295,055.32		1,276,682.51	57,100.00	513,890.00
01/01/2021 to 31/12/2021	25,500.54	1,851,816.59		1,826,316.05	54,964.00	494,669.00
01/01/2022 to 21/02/2022	25,500.54	1,926,411.87		1,900,911.33	7,460.00	67,135.00
Total	25,500.54	1,926,411.87		1,900,911.33	190,095.00	1,710,813.00