# FORESTAL AZUL CARBON PROJECT

Document Prepared by UNIQUE forest investment GmbH

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| **Project Title** | "Afforestation and restoration of degraded forests in Eastern Paraguay" or Forestal Azul Carbon Project |
| **Version** | 1.2 |
| **Report ID** | |
| **Date of Issue** | 04-04-2024 |
| **Project ID** | 2469 |
| **Monitoring Period** | 01-January-2021 – 30-September-2022 |
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# 1 PROJECT DETAILS

## 1.1 Summary Description of the Implementation Status of the Project

The VCS grouped project "Afforestation and restoration of degraded forests in Eastern Paraguay" validated in 2023 the management of 1,300 ha of Eucalyptus plantations in the department of San Pedro, Paraguay. The current monitoring report includes only the areas validated. New instances are expected in future years.

In early 2023 the GIS team re-assessed the limits of planted areas using very high-resolution imagery. The revised limits influence mostly the area of compartments within a given management unit but resulted in only a minor change of the total net production area. The current project area is 1,300 ha. 7 ha were lost due map adjustment.

All silvicultural activities were implemented following the description in the PDD.

The GHG emission reduction generated from the plantations until 30-09-2022 for this monitoring report are 77,834 $tCO_2e$. The non-permanence risk rating is 12% (as determined in the AFOLU non-permanence risk report attached as a separate document). Therefore, the total number of buffer credits that need to be deposited into the AFOLU pooled buffer account is 9,340 $tCO_2e$. The number of GHG credits eligible to be issued as VCUs for the first project instances of this monitoring period is 68,493 $tCO_2e$.

| Audit Type | Period | Program | VVB Name | Number of years |
|---|---|---|---|---|
| Validation/Verification | 01-06-2018-31-12-2020 | VCS (AFOLU) | TüV Nord GmbH | 2.6 |
| Verification | 01-01-2021 – 30-09-2022 | VCS (AFOLU) | TüV Süd GmbH | 1.75 |
| Total | 01-06-2018– 30-09-2022 | | | 4.25 |

## 1.2 Sectoral Scope and Project Type

According to VCS Standard document version 4, chapter A1.1 (19.09.2019) the project activities fall under the eligible AFOLU project category of "Afforestation, Reforestation and Revegetation (ARR)". The proposed project is a grouped project.

## 1.3 Project Proponent

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|---|---|
| Organization name | Forestal Apepu S.A. |
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## 1.4 Other Entities Involved in the Project

Forestal Azul has a service provision contract with UNIQUE for the technical management of the plantations. The operational plantation management is conducted mainly by UNIQUE's Paraguayan subsidiary UNIQUE Wood Paraguay S.A. together with UNIQUE forest investment GmbH, with the technical assistance of UNIQUE land use GmbH.

| | |
|---|---|
| Organization name | UNIQUE Wood Paraguay |
| Role in the Project | Project development and implementation |
| Contact person | Rafael Ortiz |
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|---|---|
| Organization name | UNIQUE forest investment GmbH |
| Role in the Project | Project development support |

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|---|---|
| **Contact person** | Irene Calo Vidal |
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## 1.5 Project Start Date

Starting date of the ARR project activity: 01-06-2018.

## 1.6 Project Crediting Period

| | |
|---|---|
| Project start date: | 01-06-2018 |
| Project end date: | 31-05-2038 |
| Total number of crediting years: | 20 years |

## 1.7 Project Location

Forestal Azul is a large landholding (hereinafter referred to as Estancia or Finca) with an area of 2,309 ha (Estancia Rodeo Guazu). It is located in the eastern region of Paraguay, in the district of San Pedro, approximately 250 km north from the capital Asunción and 20 km south from Santa Rose del Aguaray. The property is easily accessible through the paved road Ruta 3, followed by a dirt road on the last 7.5 km. It is surrounded by other large landholdings mainly dedicated to cattle grazing, soy, maize, and forestry. In the north, the River Aguaray Guazú establishes itself as a natural border to the property.


**Figure 1: Geographical location of the Estancia Rodeo Guazú**

The FMU Forestal Azul currently encompasses a target net production area of around 1,805 ha, already including first instance plantations. For further expansion, other properties in the vicinity will be considered. Since these areas have not yet been identified, the outer project boundary is the entire Department of San Pedro. The plantations of the first project instances are located between 24°37'54.00S – 24°43'31.00S and 56°20'06.00W – 56°14'25.00W.

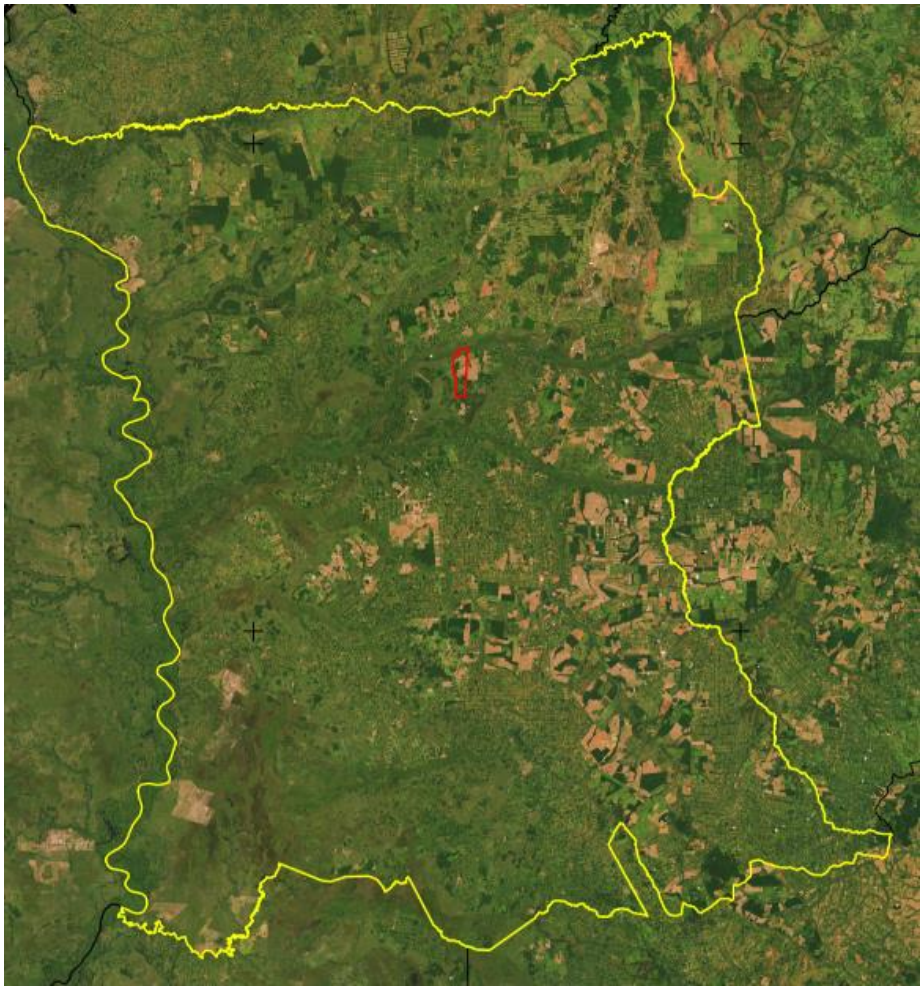


**Figure 2: Outer boundary of Forestal Azul Carbon Project (Department of San Pedro), inside Forestal Azul first instance.**

Project GIS maps are available as supporting documentation.

## 1.8 Title and Reference of Methodology

Approved CDM methodology: AR-ACM0003 "AR Large scale – Afforestation and reforestation of lands except wetlands", version 2

These CDM methodological tools will be used in accordance with the methodology:

- "Combined tool to identify the baseline scenario and demonstrate additionality", version 01
- "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, version 4.2
- "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities, version 3.1"
- "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity", version 4.0

- "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", version 01.1.0
- Tool "Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A/R CDM project activities", version 1.0.1

## 1.9 Participation under other GHG Programs

The project has not been registered or seeking registration under any other GHG program. It also has not been rejected by any other GHG program.

## 1.10 Other Forms of Credit and Supply Chain (Scope 3) Emissions

GHG removals generated by this project will not be used for compliance with binding limits to GHG emissions since such limits are not enforced in Paraguay. There are no emissions trading programs in place in the country. The grouped project is not being used to create other environmental credits.

Forestal Azul establishes forest plantations and sells the wood for further processing. The scope of the carbon certification only encompasses land use, meaning all emission reduction that occurs after harvesting is not captured by this certificate. In case in the future any methodology under any standard allows to account for harvested wood products affecting the value chain, the ownership and scope must be defined further downstream in the value chain.

To ensure full compliance with the standard unique has included a statement in its webpage, according to VCS Standard 4.4. section 3.23.8[1].

## 1.11 Sustainable Development Contributions

[1] https://www.unique-forestinvestment.de/

**Table 1: Sustainable Development Contributions**

| Row number | SDG Target | SDG Indicator | Net Impact on SDG Indicator | Current Project Contributions | Contributions Over Project Lifetime |
|---|---|---|---|---|---|
| 1) | 1.1 | 1.1.1 Proportion of population below the international poverty line | The project provides formal jobs in the rural areas of the San Pedro Department, a region affected by high levels of poverty (36 % of its population was poor in 2020) and high levels of informality (> 70 % of employment is informal). The project pays the minimum wage and observes all benefits.<br><br>Project activities provide, on average, 20-30 jobs per 1,000 ha, without considering industrialization, compared to baseline land uses of cattle (1-3 jobs per 1,000 ha) and agriculture (15-20 jobs per 1,000 ha). | The project provided on average 72 Full Time Equivalents since 2018 (59 FTE per 1,000 ha). In 2022, 78 FTE were engaged, and of these, 69 FTE come from rural areas in Eastern Paraguay. | The project is expected to maintain this level of job provision. Workers engaged in project activities later in the value chain are not factored in, meaning the impact is even greater. |

| Row number | SDG Target | SDG Indicator | Net Impact on SDG Indicator | Current Project Contributions | Contributions Over Project Lifetime |
|---|---|---|---|---|---|
| 2) | 15.1 | 15.1.1 Forest area as a proportion of total land area | The project establishes forest plantations on areas deforested decades ago and used for cattle (implanted pastures) or agriculture (mechanized soy production). | To date, 1,500 ha of plantations were established on ex agricultural and pasture land. In 2022, 145 ha of pasture land were planted and 1,350 ha of existing plantations managed and maintained.<br><br>In addition, 378 ha of degraded natural forests were enriched. | Overall, the project is expected to establish and maintain about 2,850 ha on areas deforested decades ago.<br><br>In addition, the project conducts restoration of degraded natural forest through intensive enrichment planting on 378 ha. On these areas, the project enriches the degraded forest with exotic species and manages natural regeneration.<br><br>Also, the project protects remnants of other natural forests directly and indirectly. Directly through the protection of 1,200 ha of natural forests on own land and indirectly by providing sustainably produced biomass from plantations reducing the pressure on natural forests. |

| Row number | SDG Target | SDG Indicator | Net Impact on SDG Indicator | Current Project Contributions | Contributions Over Project Lifetime |
|---|---|---|---|---|---|
| 3) | 9.2 | 9.2.1 Manufacturing value added as a proportion of GDP and per capita | Plantations are established for the production of quality timber. Large part of the timber will be processed in the country, contributing to the development of local industrialization in a country dominated by the primary sector (export of soy and beef). The forest sector has turned from net exporter to net importer in the 90s. | To date, the project has only produced biomass for energetic purposes (30,000 $m^3$) and not yet quality timber, as plantations are too young and only first thinning has been realized.<br>Note that biomass from first thinning replaces the widespread biomass from informal origin in the national market that contributes to natural forest degradation. | The project is expected to produce around 150-200 k $m^3$ p.a. of quality logs starting 2031. |
| 4) | 9.2 | 9.2.2 Manufacturing employment as a proportion of total employment | Due to the relatively large scale production of quality timber, processing capacity in the country will need to be scaled up for sawn timber or plywood. | At the moment, the impact on manufacturing employment is still low, as most wood is still used for biomass production. | From 2029 onwards, the project is expected to foster industrialization through the production of about 100 k $m^3$ of quality logs p.a. that will be used for plywood or sawn timber. |
| 5) | 13 | Tonnes of greenhouse gas emissions avoided or removed | Through tree planting, the project will conduct to net sequestration of carbon. | During the monitoring period, the project has sequestered 77,000 t $CO_2$. | The project is expected to reach at least 280,000 t$CO_2$. |

# 2 SAFEGUARDS

## 2.1 No Net Harm

Project activities are FSC® certified and conducted according to best practice. Procedures are in place to ensure safeguards are implemented as exhibited in the following Tables.

Table 2: Environmental impact and mitigation measures implemented

| Environmental impacts | Mitigation measures |
|---|---|
| **Habitat destruction and conversion though plantations**<br><br>Plantations could have negative impacts on local ecosystem and biodiversity if they are established on natural ecosystems. | ▪ Plantations are established on areas previously used for implanted pastures (beef production) or mechanized agriculture. Plantations are always established on heavily modified areas. Tree planting reduces erosion, contributes to an improved water household, sequesters carbon and in some cases, provides better condition for the connection of natural forests (natural corridors for biodiversity).<br><br>▪ Under no circumstances does forest conversion take place for the establishment of plantations. A historical land use assessment is conducted before planting.<br><br>▪ A condition for land purchase is the absence of non-resolvable liabilities that could prevent the issuance of an environmental license. The license is subject to the observation of the environmental law, including non-deforestation after 2004.<br><br>▪ A biodiversity monitoring system is developed and introduced on production sites to evaluate the impact on the project on biodiversity. |
| **Impacts of eucalypts on water availability**<br><br>Eucalypts are characterized by high water consumption. Such behavior may cause water scarcity in dry environments. | ▪ The project region, exhibits annual precipitation > 1,300 mm. Also, the region is natural forest area, highly fragmented and degraded, meaning the plantations may contribute in improving the water household (increased water retention in the soil compared to agriculture, etc.).<br><br>▪ Eucalypts are not planted in areas important for water recharge (in lowlands subject to flooding).<br><br>▪ Buffer zones of rivers and streams are protected. |
| **Invasive behavior of exotic species**<br><br>In some areas, eucalypts have been described as having an invasive | An invasive behavior of eucalypts has not been observed in the project to date. Following practices are applied to further diminish this risk:<br><br>▪ Exotic trees are planted only in demarcated areas. |

| Environmental impacts | Mitigation measures |
|---|---|
| behavior. However, this has not been observed in Paraguay until now. | ▪ Genetic eucalypt material planted mostly encompasses clones (not seeds), with limited capacity to produce seeds and spread.<br>▪ Plantations are combined with grazing systems where cattle controls any unwanted regeneration. |
| **Soil erosion**<br>FMUs are located on terrain that shows soft declinations. However, forestry activities may still potentially cause erosion, during the installation and use of roads and, particularly, during harvesting. | ▪ Roads are built respecting good practices to facilitate proper drainage and prevent erosion.<br>▪ In areas dedicated to plantations with fragile soils, contour lines, ridges or other measures are implemented to control surface runoff to counteract erosion.<br>▪ Thinning and harvesting are carried out in a controlled manner, with heavy machinery circulating only on the roads and tracks of the extraction of signs. |
| **Pesticides and inputs**<br>Plantations require the application of chemical inputs, such as calk for soil acidity, fertilizer, herbicides (glyphosate) and Fipronil for ant control. Such inputs, when used without care, can affect non-target organisms and affect human health negatively. | ▪ The plantations require input such as lime, fertilizer, and pesticides for ant and weed control (Glyphosate and Fipronil). These are common products in Paraguay, already used previous to the activity on these sites. The input use of the plantations is much lower when compared to agriculture, and roughly the same when compared to beef production.<br>▪ Inputs are quantified and applied only when needed, following specific dosage and recommendations of the producer.<br>▪ Pesticides and other chemical inputs are stored in deposits with impermeable floors, ventilation and fire-extinctors.<br>▪ The products are only received if they are in their original containers, are still valid, and accompanied by the security sheet.<br>▪ Packaging of potentially toxic waste is disposed according to national regulations and recycled by an accredited company.<br>▪ Workers are trained to apply inputs according to best practices and avoid affecting non target organisms. |
| **Fuels and oils**<br>The machinery used in the finca requires oils and fuels. If not well maintained, these may leak into the soil or waterways. | ▪ Machinery used is well maintained.<br>▪ Fuels and oils are organized, stored and labelled appropriately.<br>▪ Fuel and oil exchange are conducted on impermeable platforms. |

| Environmental impacts | Mitigation measures |
|---|---|
| **Illegal activities**<br><br>Hunting, fishing and the uncontrolled extraction of timber and plants may in the finca by company workers or external people may further contribute to the degradation of ecosystems. | ▪ Permanent presence of company staff in the FMU ensures the control of activities in the area.<br>▪ Hunting, fishing and uncontrolled logging of natural timber species is strictly forbidden.<br>▪ Appropriate signs are installed, and workers are continuously instructed about prohibited activities. |
| **Forest fires**<br><br>Eucalyptus plantations are susceptible to fire, which can have devastating environmental consequences | ▪ During the dry season, permanent vigilance is conducted.<br>▪ Staff are continuously trained in fire prevention and firefighting.<br>▪ Firebreaks are installed, the fuel on site is maintained low, particularly during the dry season.<br>▪ Appropriate fire prevention and firefighting tools are available at each site, as well as the protective equipment for firefighting.<br>▪ Cooperation with neighbors is in place in all units for vigilance and combat.<br><br>Up to now in the oldest plantations managed by Unique (9 years), forest fires have affected less than 0,6 % of the total plantation area. |

Table 3: Social impact and mitigation measures implemented

| Risk | Affected stakeholders | Mitigation measures |
|---|---|---|
| **Displacement/livelihoods /access to ecosystem services** | Local community members | ▪ The project is taking place on private properties.<br>▪ The legality of the titles is assessed, as well as the absence of disputes over land, including customary land.<br>▪ A social due diligence is carried out encompassing consultation with local communities before conducting plantations. In addition, a grievance mechanism is used to rule out or act upon disputes and/or conflicts. No conflicts about land use or access has been raised to date.<br>▪ Neighboring community members do not depend on the resources on production |

| Risk | Affected stakeholders | Mitigation measures |
|---|---|---|
| | | sites, meaning plantations do not restrict local people's access or use of resources of critical importance to their livelihoods, or negatively affect ecosystem services. Mostly, community members have small plots for cultivation and animal husbandry, or work in neighboring properties.<br>▪ The project provides employment to members of the local community.<br><br>The project does not cause displacement, eviction, or any form of limited access to critical resources to local community members. Plantations on all sites have been established on rightful private properties previously used for cattle or soy production. |
| **Risks of accidents / Health and safety**<br><br>Forestry is characterized by dangerous work, particularly when harvesting. Other jobs, such as the application of pesticides and chemical products, also bear risk for human health. | Field workers | ▪ Constant on-the-job trainings and trainings for specific dangerous work are implemented (e.g.: chainsaw operation).<br>▪ Procedures for the correct use, storage and application of pesticides and chemical products are put in place.<br>▪ Provision of security equipment adequate for the different types of work.<br>▪ Trainings in emergency preparedness, first aid and health and safety.<br>▪ Provision and monitoring of first aid kits.<br>▪ Installation of warning signs in dangerous places.<br>▪ Provision of appropriate food and accommodation for workers.<br>▪ Annual consultations with workers on job satisfaction.<br><br>While accidents have been recorded, the rate remains low (about 3 to 4 accidents a year; 2 in 2022), and to date, none of these have resulted in severe or long-term injury or death. |

| Risk | Affected stakeholders | Mitigation measures |
|---|---|---|
| Non-observation of minimum labor benefits (wage, social security, etc.).<br><br>In rural Paraguay, labor is usually informal. Therefore, benefits such as social security are not observed. | Sub-contracted workers | Monitoring of minimum working standards among contractors and sub-contracted personnel. Any deviation of minimum standards is corrected.<br><br>Semi-professional contractors with little experience in administration and staff management were required to work with a bookkeeper that assists them with formalities, such as social security. |
| **Dust and noise /accidents on the road**<br><br>Transport of wood products and inputs in and out of the FMU could increase traffic and increase dangers to the communities located on the access road. Workers circulating in motorbikes could also be at risk by increased traffic and dust. | All workers and neighboring community members | ▪ Speeding signs are introduced along internal roads.<br>▪ The use of helmets is required and monitored when using motorbikes.<br>▪ Instruct drivers in safe driving, particularly on the community access road.<br>▪ Grievance mechanism |
| **Reputational risks / political risks**<br><br>Eucalypts have been criticized by environmental groups in Paraguay, as well as large landholdings. | The company (Forestal San Pedro) | ▪ Engaging environmental and social actors in management decisions<br>▪ Implementing best practices<br>▪ Grievance mechanism<br>▪ FSC certification |

## 2.2 Local Stakeholder Consultation

In this Chapter following aspects are described:

- The procedures or methods used for engaging local stakeholders (e.g., dates of announcements or meetings, periods during which input was sought).

  *Please refer to sub-section A below*

- The procedures or methods used for documenting the outcomes of the local stakeholder communication.

*Input of stakeholders is taken into account during initial due diligence (due diligence reports and rural appraisals), through the social monitoring system (a procedure is in place) and third party-consultations. Please refer to sub-sections A and B below.*

- The mechanism for on-going communication with local stakeholders.

  *Mainly through the social liaison officers and the grievance mechanism. However, social events and trainings are also platforms to facilitate exchange. In addition, many fieldworkers come from local communities, through whom community-Company networks are strengthened.*

- How due account of all and any input received during ongoing communication has been taken. Include details on any updates to the project design or justify why updates are not appropriate.

  *Inputs received are documented trough the social due diligence reports and the grievance mechanism. During the monitoring period, the project was expanded significantly, and thereby, the stakeholder list was expanded to include a number of new neighbouring communities and new service providers to work on the expansion area. An additional Community Liaison Officer was introduced to the project for this expansion.*

For AFOLU projects, also demonstrate how the project has communicated the following with local stakeholders:

- The results of project implementation, including the results of monitoring.

  *Please refer to the public summary of the management plan (see sub-section C).*

- Any changes, where relevant, to risks, costs and benefits the project may bring to local stakeholders.

  *The risks are analysed in the Table under Section 2.1. No additional risks have been identified, as the project expansion does not entail new operations and the expansion takes place in the same region. Through the public summary of the management plan, inception meetings and the grievance mechanism, neighbouring communities are informed about possible risks and impacts. In addition, project benefits, such as job opportunities and participation in social projects have been expanded to the new scope of the project.*

- Any changes, where relevant, to relevant laws and regulations covering workers' right in the host country.

  *The local labour law is followed at all times, and service providers are monitored in this regard. No relevant changes in the labour law happened during the monitoring period.*

- The process of VCS Program verification and the validation/verification body's site visit.

  *Audit processes are explained to local stakeholders (particularly contractors and workers).*

**A – Engagement with local communities and sub-contracted personnel**

The project area is surrounded by large private landholdings and communities (see Figures 3 and 4). During the monitoring period, Forestal Azul purchased a large landholding known as Santa Ana (Figure 4) that increased the Company's gross areas by 3,030 ha. Now, the Company owns roughly 5,300 ha. Accordingly, new neighbouring communities were included into the scope of the Company management.

Following communities have been listed by Forestal Azul as priority stakeholders, encompassing either directly neighboring communities or Communities affected by project activities:

- Paso Tuna: The community is located on the road entering Forestal Azul, meaning the entry road of the Community is shared with the Company. Therefore, Community members may be affected by heavy traffic for wood transport. Also, many of the workers in Forestal Azul come from this Community.
- Yvyra Petei: Community directly neighboring the newly acquired property Santa Ana.
- Piro'y: Community directly neighboring the newly acquired property Santa Ana.

The last two communities in this list have been added in 2022 through the expansion on the new property known as Santa Ana.

Community members have their own farms – usually between 5 and 30 ha. They either have their own property titles or an occupation certificate by the rural development authority – INDERT. They either work their lands or are employed by neighbouring large landholdings to work with cattle or agriculture. Work is mostly unsteady and informal.

Results of stakeholder engagement during the verification period

- In November 2022, 65 workers were interviewed regarding employee satisfaction (25 external, 40 direct employees). Job satisfaction is high. Evaluation scores applied are between 1and 5, 1 being "Unacceptable" and 5 "Very good". All scores are above 3, and most above 4.
- Three grievances were collected and could be resolved. All of the grievances were related to labour issues, mainly to the conditions provided by the service provider or to communication issues. The number of grievances is considered normal and should be interpreted within the context of the overall good work satisfaction.

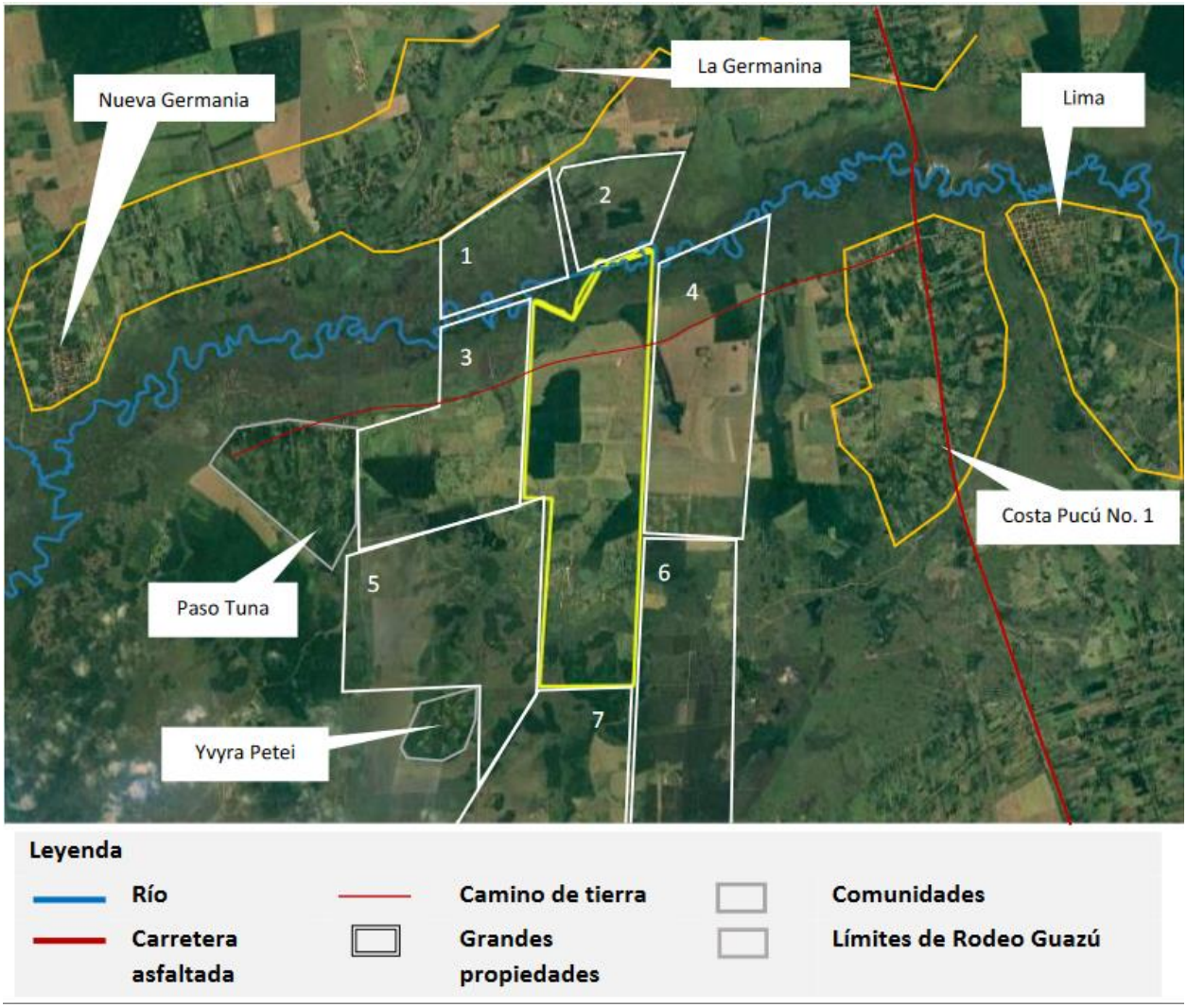



Figure 3 Communities and landholdings surrounding Rodeo Guazu, the first property acquired by Forestal Azul in 2018

*Source: Unique land use*

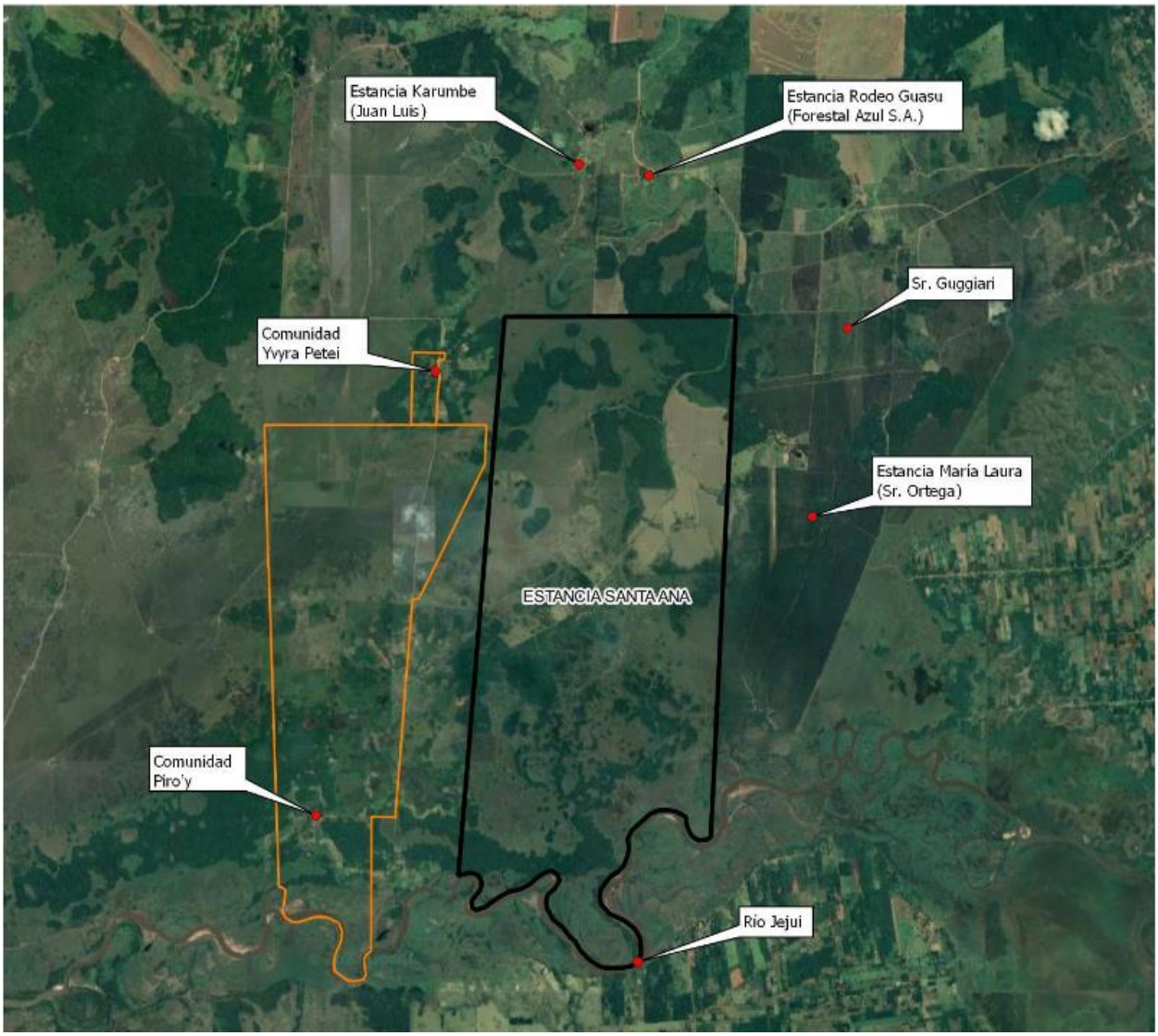



Figure 4 Communities and landholdings surrounding Santa Ana, the second property acquired by Forestal Azul in 2022

*Source: Unique land use*

The local stakeholder engagement strategy involves:

- Collection of basic baseline information of the community (location, number of families and main livelihood, land tenure and available infrastructure) and identification of key community representatives and local organizations.
- Inception meeting with the community to introduce the project and the team, its expected impacts, and the communication and grievance mechanism. During the monitoring period, in June/July 2022, introductory meetings were realized in the neighbouring Communities of the expansion area listed above.

- Introduction of a Community Liaison Officer (CLO) to introduce and manage a Communication and Grievance Mechanism. The CLO acts as the main contact person between local stakeholders and project managers. In case of grievances, these are recorded and follow up is conducted for each grievance received. In 2022, a new CLO was introduced into the team to manage communication, summing up to two full time CLOs working for the Company. In 2022, 3 grievances were recorded and provided follow-up until a solution was reached. All were related to labour relations and work-related issues.
- Introduction of the social monitoring system, which includes the monthly assessment of labour relations, to ensure sub-contracted personnel is employed according to the conditions of the national labour code, health and safety, and an annual or bi-annual assessment of job-satisfaction among sub-contracted personnel. In addition, any incidents -fire events, grievances, accidents – are recorded and managed. Results are available in the office and a summary is annually published through the public summary of the management plan.

**B – Third-party stakeholder consultations**

Stakeholder consultation is conducted:

- initially before planting on a new site, during social due diligence, local people and neighbours are interviewed to evaluate risks and safeguards. The social due diligence report on the expansion site Santa Ana showed there is no superposition or land conflict between plantation sites and local community land. In addition, a communication channel has been established between project managers and community representatives.
- every year by independent FSC auditors during annual audits. The scale and scope of these consultations varies. Usually, it includes interviews with sub-contracted workers, contractors, and community members of those FMUs audited. In 2022, the latest FSC audit, these have not resulted in critical or negative comments by project stakeholders.
- in addition, internally, the Company annually conducts job satisfaction interviews to sub-contracted field staff. Overall, job satisfaction remains high.

**C – Public disclosure**

A public summary of the management plan and monitoring results is disclosed for the public on an annual basis. The annual public summary for 2021-2022 can be retrieved here: https://www.unique-wood.com/wp-content/uploads/2022/07/2021-2022-Forestal-Azul_Resumen-del-Plan-de-Manejo-4.pdf

## 2.3 AFOLU-Specific Safeguards

For AFOLU projects, provide details on the following:

- Activities implemented to mitigate risks local stakeholders due to project implementation.

*See Table of social risks under Section 2.1. The social monitoring system includes health and safety aspects, compliance to the labour law by service providers, grievances, accidents, meetings, and progress in the implementation of social projects.*

- Any updates, where relevant, to the property and land use rights of the local stakeholders and a demonstration that the project has not negatively impacted such rights without first obtaining the free, prior and informed consent of the affected parties, and provided just and fair compensation if done so.

  *The due diligence conducted on the new site shows that plantations have been established on private property which is undisputed by other stakeholders. The indigenous community located next to the project area is the rightful owner of its land. The due diligence reports are available in the office.*

- The processes used to communicate and consult with local stakeholders during the monitoring period, including any information about any conflicts that arose between the project proponent and local stakeholders and whether any such conflicts were resolved via the established grievance redress procedure.

  *No conflicts have been reported during the monitoring period.*

# 3 IMPLEMENTATION STATUS

## 3.1 Implementation Status of the Project Activity

Since the last verification period, the established areas did not suffer any variation and the silvicultural activities continued as planned. In early 2023 the GIS team re-assessed the limits of planted areas using very high-resolution imagery. The revised limits influence mostly the area of compartments within a given management unit but resulted in only a minor change of the total net production area. Map adjustment reduced 7 ha since the limits were not clear at the beginning of the plantation.

| Tree density | Total area | Plantation establishment (ha) | | |
|---|---|---|---|---|
| | | 2018 | 2019 | 2020 |
| **1000 trees/ha** | 626.5 | 186.0 | 353.0 | 87.5 |
| **800 trees/ha** | 108.0 | - | - | 108.0 |
| **714 trees/ha** | 411.0 | 159.0 | 252.0 | - |
| **500 trees/ha** | 50.5 | - | 41.0 | 9.5 |
| **476 trees/ha** | 104.0 | - | - | 104.0 |
| | **1,300** | ***345*** | ***646*** | ***309*** |

Silvicultural activities continued as planned and described in the chapter 1.11 Description of the project activity in the Joint PDD. Forestal Azul maintained its FSC certification (FSC-C141437) in 2022.

## 3.2 Deviations

### 2.1.1 Methodology Deviations

No deviations from the methodologies and tools used during this project were undertaken.

### 2.1.2 Project Description Deviations

The area validated suffered minor changes during this process of verification. The company purchased high quality imagery to evaluate the areas and the inventory conducted in 2022 confirmed the new delineation. The evaluation consisted in the adjustments of the limits of the compartment areas. Overall, the adjustment resulted in a net loss of 7 ha. These correspond to plantations established in 2020 and were discounted from the total project area. Even though these areas have been established and therefore included in the PD, this area was never verified and therefore no loss event has occurred. The total area established and included in this MR is 1,300 ha, with the distribution presented in Section 3.1

## 3.3 Grouped Projects

Currently the project does not present any new areas. The 1,300 ha were part of the PDD, although only the plantations older than one year were verified in the 1st monitoring report. The following monitoring report includes data for the complete area. It is expected to include new areas in the next verification report.

# 4 DATA AND PARAMETERS

## 4.1 Data and Parameters Available at Validation

| Data / Parameter | MAI |
|---|---|
| Data unit | $m^3/ha/yr$ |
| Description | Mean Annual Increment |
| Source of data | Estimated growth tables |
| Value applied | 35 |

| | |
|---|---|
| **Justification of choice of data or description of measurement methods and procedures applied** | The value applied is a conservative average of all plantations. Growth estimations are based on inventory data, locally available information on growth performance and the eucalyptus growth simulator of EMBRAPA. |
| **Purpose of Data** | Determination of Ex-Ante volume growth of the plantations |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | Conversion factor from C to $CO_2$ |
| **Data unit** | $tCO_2/tC$ |
| **Description** | Carbon coefficient times the fraction oxidized times the ratio of the molecular weight of carbon dioxide to carbon |
| **Source of data** | Default as per IPCC |
| **Value applied** | 44/12 |
| **Justification of choice of data or description of measurement methods and procedures applied** | 44/12 is the molecular weight ratio to convert tonnes of carbon to tonnes of $CO_2$ as used per IPCC default value |
| **Purpose of Data** | Conversion factor from C to $CO_2$ |
| **Comments** | Conversion factor from C to $CO_2$ |

| | |
|---|---|
| **Data / Parameter** | $CF_{TREE}$ |
| **Data unit** | t C(t.d.m.)$^{-1}$ |
| **Description** | Carbon fraction of tree biomass |
| **Source of data** | Default value |
| **Value applied** | 0.47 |
| **Justification of choice of data or description of measurement methods and procedures applied** | According to the applied tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" IPCC default value of 0.47 is used |
| **Purpose of Data** | Determination of baseline emissions/removals and project emission/ removals |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $R_{TREE\_BSL}$ |
| **Data unit** | dimensionless |
| **Description** | Root : Shoot ratio of trees |
| **Source of data** | Default value |
| **Value applied** | 0.25 |
| **Justification of choice of data or description of measurement methods and procedures applied** | According to the applied tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" IPCC default value of 0.25 is used |
| **Purpose of Data** | Determination of baseline emission/removals |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $b_{Forest}$ |
| **Data unit** | t d.m. $ha^{-1}$ |
| **Description** | Total Aboveground biomass of trees in the country, where the AR CDM project activity is located |
| **Source of data** | Value for tropical moist deciduous forest in Paraguay, de Sy et al. (2015) |
| **Value applied** | 80 |
| **Justification of choice of data or description of measurement methods and procedures applied** | Scientific study |
| **Purpose of Data** | Calculation of baseline emission removals |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $\Delta C_{DW\_BSL}$ |
| **Data unit** | percent |
| **Description** | Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass |
| **Source of data** | Default factor |
| **Value applied** | 1% |
| **Justification of choice of data or description of measurement methods and procedures applied** | According to the applied tool " Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities ", the project mean annual precipitation is 1300 mm/yr. |

| | |
|---|---|
| Purpose of Data | Calculation of baseline emission removals |
| Comments | - |

| | |
|---|---|
| Data / Parameter | $\Delta C_{LI\_BSL}$ |
| Data unit | percent |
| Description | Conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass |
| Source of data | Default factor |
| Value applied | 1% |
| Justification of choice of data or description of measurement methods and procedures applied | According to the applied tool " Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities ", the project mean annual precipitation is 1,300 mm/yr. |
| Purpose of Data | Calculation of baseline emission removals |
| Comments | - |

| | |
|---|---|
| Data / Parameter | BEF |
| Data unit | dimensionless |
| Description | Biomass expansion factor, expressing the additional biomass of a tree when only stem volume is known. |
| Source of data | Default factor |
| Value applied | 1.15 |
| Justification of choice of data or description of measurement methods and procedures applied | According to IPCC Good Practice Guidance for LULUCF – Table 3A.1.10, Broadleaf Temperate forest since no sub-tropical values are available, lower confidence interval |
| Purpose of Data | Calculation of project emission removals |
| Comments | - |

| | |
|---|---|
| Data / Parameter | $R_{TREE}$, project |
| Data unit | dimensionless |
| Description | Mean of Root : Shoot ratios published for Eucalyptus globulus and E. camaldulensis |
| Source of data | Average |
| Value applied | 0.37 |

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied | According to Barton and Montagu (2006) & Fabiao et al. (1995) |
| Purpose of Data | Calculation of ex-ante and ex-post project emission removals |
| Comments | - |

| | |
|---|---|
| Data / Parameter | Wood density |
| Data unit | t/m³ |
| Description | Weight to volume relation of Eucalyptus grandis and E. urophylla |
| Source of data | Zanne et al. (2009) |
| Value applied | 0,54 |
| Justification of choice of data or description of measurement methods and procedures applied | According to Zanne et al. (2009) a mean of all available wood densities of E. grandis and E. urophylla was calculated. |
| Purpose of Data | Calculation of project emission removals |
| Comments | - |

| | |
|---|---|
| Data / Parameter | $SOC_{REF,i}$ |
| Data unit | t C $ha^{-1}$ |
| Description | Reference SOC stock corresponding to the reference condition in native lands |
| Source of data | IPCC Default value, See CDM Tool 'tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' |
| Value applied | 47 |
| Justification of choice of data or description of measurement methods and procedures applied | According to the applied tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" a default value of 47 for tropical moist climate regions and soils with low activity clay (LAC). |
| Purpose of Data | Calculation of project emission removals |
| 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** | IPCC Default value, See CDM Tool 'tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' |
| **Value applied** | Agriculture: 0.48 |
| **Justification of choice of data or description of measurement methods and procedures applied** | Pasture/Grassland: 1.0 |
| **Purpose of Data** | Table 4 of the applied tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" gives 0.48 as a relative stock change factor for long term cultivation in a tropical moist region and 1.0 for grasslands. |
| **Comments** | Calculation of project emission removals |

| | |
|---|---|
| **Data / Parameter** | $f_{MG,i}$ |
| **Data unit** | dimensionless |
| **Description** | 9 |
| **Source of data** | IPCC Default value, See CDM Tool 'tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' |
| **Value applied** | Full tillage/Agriculture: 1 |
| **Justification of choice of data or description of measurement methods and procedures applied** | Moderately degraded/Pasture: 0.97 |
| **Purpose of Data** | Table 4 of the applied tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" gives a default value of 1 for full tillage in agriculture and Table 6 0.97 for tropical moderately degraded grasslands |
| **Comments** | Calculation of project emission removals |

| | |
|---|---|
| **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** | IPCC Default value, See CDM Tool 'tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' |
| **Value applied** | Medium/cropland: 1 |
| **Justification of choice of data or description of measurement methods and procedures applied** | Medium/grasslands: 1 |
| **Purpose of Data** | According the Table 5 of the applied tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" an input factor of 1 is used when medium manure input is applied, while table 6 shows an input factor of 1 for medium manure inputs in grasslands. |
| **Comments** | Calculation of project emission removals |

## 4.2 Data and Parameters Monitored

| | |
|---|---|
| **Data / Parameter** | FF |
| **Data unit** | - |
| **Description** | Form Factor for volume |
| **Source of data** | Empiric measurement |
| **Description of measurement methods and procedures to be applied** | Diameter and height were measured in 2023 of20 trees in different stem lengths to determine the tree volume and the form factor. The result was 0.42 and 0.4 is applied to be conservative |
| **Frequency of monitoring/recording** | In 2023, 20 trees were measured and statistically analyzed to ensure the requirements of the AR tool 18. |
| **Value monitored** | 0.4 |
| **Monitoring equipment** | Diameter tape |
| **QA/QC procedures to be applied** | The team was trained for the activity and the results were proofed by the technical expert. |

| | |
|---|---|
| **Purpose of the data** | Calculation of volume |
| **Calculation method** | Excel |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $A_i$ |
| **Data unit** | Ha |
| **Description** | Area of tree biomass stratum i |
| **Source of data** | GIS or/and GPS |
| **Description of measurement methods and procedures to be applied** | Areas in project area will be tracked in the field using the GPS. Each plot which will be subject to planting is tracked – a standard procedure of the baseline and monitoring inventory |
| **Frequency of monitoring/recording** | Before the start of the project (planting) and adjusted thereafter every y since yearly with satellite imaginery |
| **Value monitored** | See project database or section 3.1 in the current MR. The total area included in the current verification is 1,300 ha. |
| **Monitoring equipment** | GPS (Garmin), GPS Smartphones, QGIS software |
| **QA/QC procedures to be applied** | Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible; all field team members are trained in GPS/GIS application |
| **Purpose of the data** | Calculation of project emissions |
| **Calculation method** | GIS tool |
| **Comments** | - |

| Stratum | Area (ha) |
|---|---|
| 2018_714 | 159 |
| 2018_1000 | 186 |
| 2019_500 | 41 |
| 2019_714 | 252 |
| 2019_1000 | 353 |
| 2020_476 | 104 |
| 2020_500 | 9,5 |
| 2020_800 | 108 |
| 2020_1000 | 87,5 |

| | |
|---|---|
| **Data / Parameter** | $w_i$ |
| **Data unit** | Dimensionless |
| **Description** | Relative weight of the area of stratum I, the area of the stratum i divided by the project area. |
| **Source of data** | Calculated |
| **Description of measurement methods and procedures to be applied** | N/A |
| **Frequency of monitoring/recording** | Calculated for each monitoring event, at least every five years |
| **Value monitored** | For this monitoring period, the estimated values are: |

| Stratum (Year_tree density) | $W_i$ |
|---|---|
| 2018_714 | 0.12 |
| 2018_1000 | 0.14 |
| 2019_500 | 0.03 |
| 2019_714 | 0.19 |
| 2019_1000 | 0.27 |
| 2020_476 | 0.08 |
| 2020_500 | 0.01 |
| 2020_800 | 0.08 |
| 2020_1000 | 0.07 |

| | |
|---|---|
| **Monitoring equipment** | N/A |
| **QA/QC procedures to be applied** | N/A |
| **Purpose of the data** | Calculation of project emissions/removals |
| **Calculation method** | Area of the stratum i divided by the project area |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $S_i$ |
| **Data unit** | t d.m. (or t d.m. $ha^{-1}$) |
| **Description** | Estimated standard deviation of biomass stock in stratum i |
| **Source of data** | Project based monitoring system |
| **Description of measurement methods and procedures to be applied** | N/A |

| | |
|---|---|
| **Frequency of monitoring/recording** | si is calculated for each monitoring event, at least every five years |
| **Value monitored** | For this monitoring period, the estimated values are:<br>Stratum (Year_tree density) / $S_i$<br>2018_714 / 21.22<br>2018_1000 / 25.79<br>2019_500 / 12.01<br>2019_714 / 20.65<br>2019_1000 / 21.30<br>2020_476 / 20.31<br>2020_500 / 17.54<br>2020_800 / 8.95<br>2020_1000 / 12.99 |
| **Monitoring equipment** | N/A |
| **QA/QC procedures to be applied** | N/A |
| **Purpose of the data** | Calculation of uncertainty of project emissions/removals |
| **Calculation method** | Excel or tool available to calculate standard deviation |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | $n_i$ |
| **Data unit** | Dimensionless |
| **Description** | Number of sample plots in stratum i |
| **Source of data** | Calculated |
| **Description of measurement methods and procedures to be applied** | N/A |
| **Frequency of monitoring/recording** | ni is calculated for each monitoring event, at least every five years |
| **Value monitored** | Stratum (Year_tree density) / $n_i$<br>2018_714 / 25<br>2018_1000 / 26<br>2019_500 / 12<br>2019_714 / 38<br>2019_1000 / 42<br>2020_476 / 17<br>2020_500 / 3 |

| | |
|---|---|
| | 2020_800 \| 12<br>2020_1000 \| 13 |
| Monitoring equipment | N/A |
| QA/QC procedures to be applied | N/A |
| Purpose of the data | Calculation of project emissions/removals |
| Calculation method | The calculation method is described in the Chapter 4.3 |
| Comments | - |

| | |
|---|---|
| Data / Parameter | $A_{p,i}$ |
| Data unit | Ha |
| Description | Size of a sample plot in stratum i |
| Source of data | Field measurement |
| Description of measurement methods and procedures to be applied | After calculating the No of sample plots required to achieve the desired precision level (90/10) a stratified random selection is carried out. |
| Frequency of monitoring/recording | Yearly |
| Value monitored | 200 and 280m² |
| Monitoring equipment | N/A |
| QA/QC procedures to be applied | Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible; all field team members are trained in GPS/GIS application |
| Purpose of the data | Calculation of project emission removals |
| Calculation method | It is calculated based on the area needed to include 20 trees in the Permanent Sample Plot, varying strictly by tree planting density. In cases were the psp did not have 8 trees alive, the area was extended to include 40 trees. The calculation method is described in the chapter 4.3. |
| Comments | - |

| | |
|---|---|
| Data / Parameter | DBH |
| Data unit | cm |
| Description | The diameter at breast height (1.3 m from the ground) |

| | |
|---|---|
| **Source of data** | Field measurements in sample plots. |
| **Description of measurement methods and procedures to be applied** | The circumference or DBH of the tree at 1.3 m will be measured in the field for each tree presented in the Permanent Sample Plot. |
| **Frequency of monitoring/recording** | Every year after the first year of plantation |
| **Value monitored** | n.a. (see Excel base carbon accounting sheet) |
| **Monitoring equipment** | Diameter tapes |
| **QA/QC procedures to be applied** | Training of inventory team is fundamental to ensure the quality of the data. Analysis to avoid typos or mistakes comparing with past years are conducted after the measurements and re-measurements might be required. |
| **Purpose of the data** | Estimation of ex-post project emissions/removals |
| **Calculation method** | N/A |
| **Comments** | - |

| | |
|---|---|
| **Data / Parameter** | H |
| **Data unit** | m |
| **Description** | Height of tree planted |
| **Source of data** | Field measurements in sample plots. For ex ante estimations, H values are derived from growth tables used in the project |
| **Description of measurement methods and procedures to be applied** | Height of the tree is measured using a vertex IV |
| **Frequency of monitoring/recording** | Every year after the first year of plantation |
| **Value monitored** | N/A (see Excel base carbon accounting sheet) |
| **Monitoring equipment** | Vertex IV |
| **QA/QC procedures to be applied** | To ensure that measurements have been taken correctly, it is important to calibrate the Vertex IV at least once every day, even twice when the temperatures are very high. |
| **Purpose of the data** | Estimation of ex-post project emissions/removals |
| **Calculation method** | - |
| **Comments** | Calculation of project emission removals |

| | |
|---|---|
| **Data / Parameter** | T |
| **Data unit** | Year |
| **Description** | Time period elapsed between two successive estimations of carbon stock in a carbon pool |
| **Source of data** | Recorded time |
| **Description of measurement methods and procedures to be applied** | N/A |
| **Frequency of monitoring/recording** | N/A |
| **Value monitored** | N/A |
| **Monitoring equipment** | N/A |
| **QA/QC procedures to be applied** | N/A |
| **Purpose of the data** | Calculation of project emission removals |
| **Calculation method** | N/A |
| **Comments** | If the two successive estimations of carbon stock in a carbon pool are carried out at different points of time in year t2 and t1, (e.g. in the month of April in year t1 and in the month of December in year t2), then a fractional value will be assigned to T |

## 4.3 Monitoring Plan

**Monitoring system structure**

Forestal Azul has a technical team that manages and monitors the plantations. The monitoring system uses standard procedures in order to obtain verifiable and reliable information on the growth of the plantations, thus allowing the accounting of the sequestered carbon.

The complete monitoring system of the project includes different aspects. On the one hand, a monitoring system is used to record operations, inputs used and associated costs, using Excel tools for different analyses. In addition, yearly inventories are conducted to assess the development of the plantations. A GIS project is also continuously updated with reliable information of location, project boundaries, plots, infrastructures, etc.

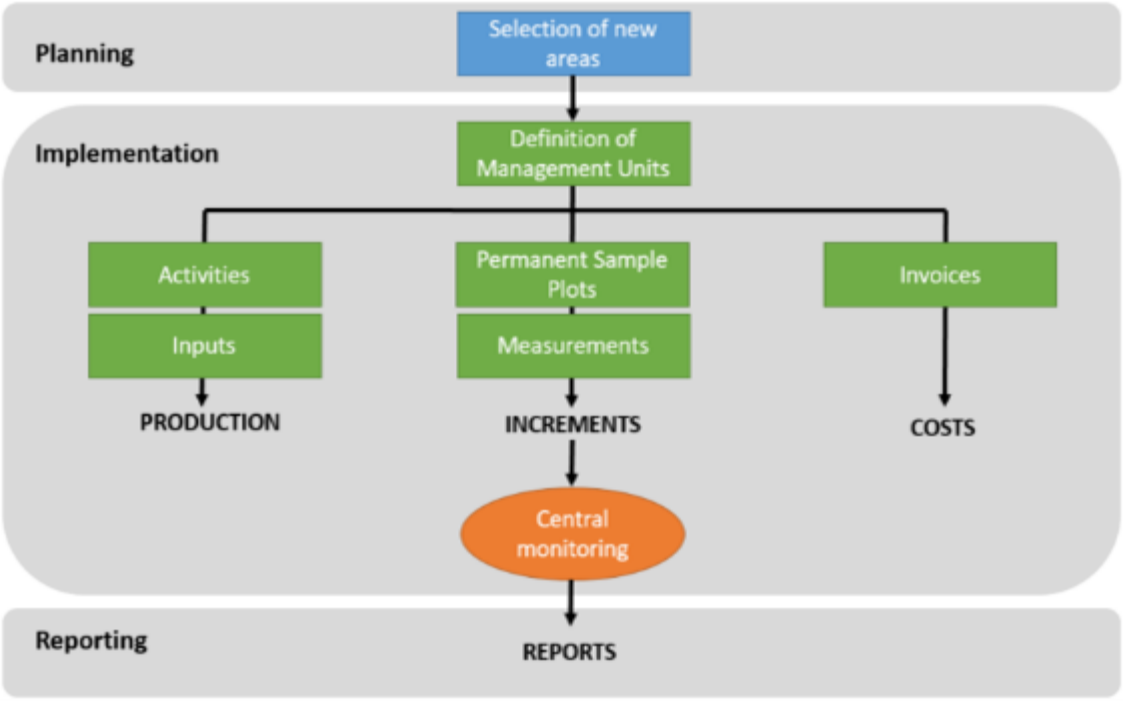



**Figure 5. Overview of the production monitoring system of the project**

Forest growth monitoring is based on field measurements once a year, starting after plantations turn 1-year of age. During inventories, the development of planted trees is evaluated, including aspects such as forest health and the quality of pruning. The objective of the measurements is to be able to monitor the growth of the trees and the progression of the value of the assets.

Inventories were conducted during the last few months of each year. In 2022, the period of data collection was earlier than usual, July until October, instead of November until December as in previous years. The analysis of the inventory data feeds into the decision-making for the upcoming year. This allows to report reliably to investors and to plan silvicultural interventions, leading to adaptive management. The data is used to choose the genetic material to be planted in new sites according to their behaviour and adjust the schedules of pruning and harvesting.

**Geographical delimitation of project boundaries**

The area of the project has been delimited using satellite imagery. The plantations are divided into compartments, the smallest monitoring unit with an average surface of around 30-40 ha. Each compartment is tracked and recorded as polygon and sent to the GIS department. The GPS track in the first approach, and later, the overall plantation boundaries, are continuously re-assessed and updated with GIS and satellite imagery.

**Stratification and update of effective areas**

Stratification was primarily conducted based solely on soil analysis conducted before planting. The classification refers to differences expected in the Mean Annual Increment (MAI) and is therefore a sensitive step for overall growth calculation. However, soil analysis does not always cover all the eventualities in the terrain (eg. Depth). This first classification is re-evaluated on a yearly basis based on the growth differences of the same species. When significant differences are identified, the classification might be readapted.

Each compartment shares a common stratum (same age, species and ideally soil quality and growth). This is the smallest unit used for all silvicultural measures.

**Sampling design, plot selection and location**

For the monitoring of plantation growth and the estimation of future yields, annual forest inventories are conducted in Permanent Sample Plots (PSPs) installed randomly in all production sites. The data obtained is fundamental to assess survival rates, forest health, to calibrate growth and yield tables, and finally, to predict the mean annual increment (MAI) and the sequestered carbon of the plantations.

As a general rule, the PSPs consist of 20 planted trees (regardless of whether they survived or not) and are established randomly.

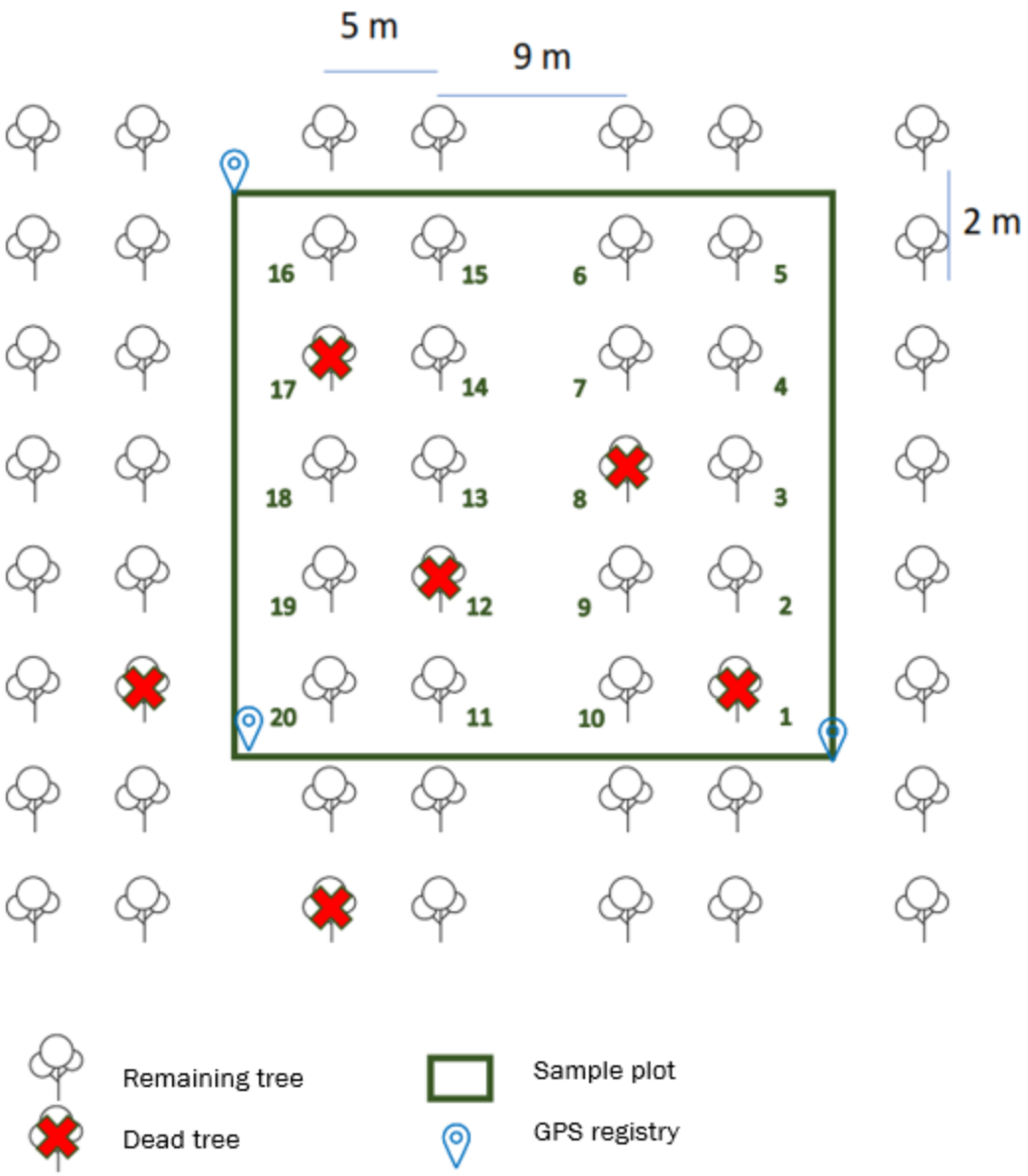



**Figure 6. Standard inventory plot – 20 trees**

In older areas, were second thinning was already conducted, the number of remaining trees in each plot was too small to conduct statistical analysis. Therefore, in 2022, whenever the trees in the plot were less than 8, the size of the plot was duplicated, meaning 40 equivalent trees were measured.

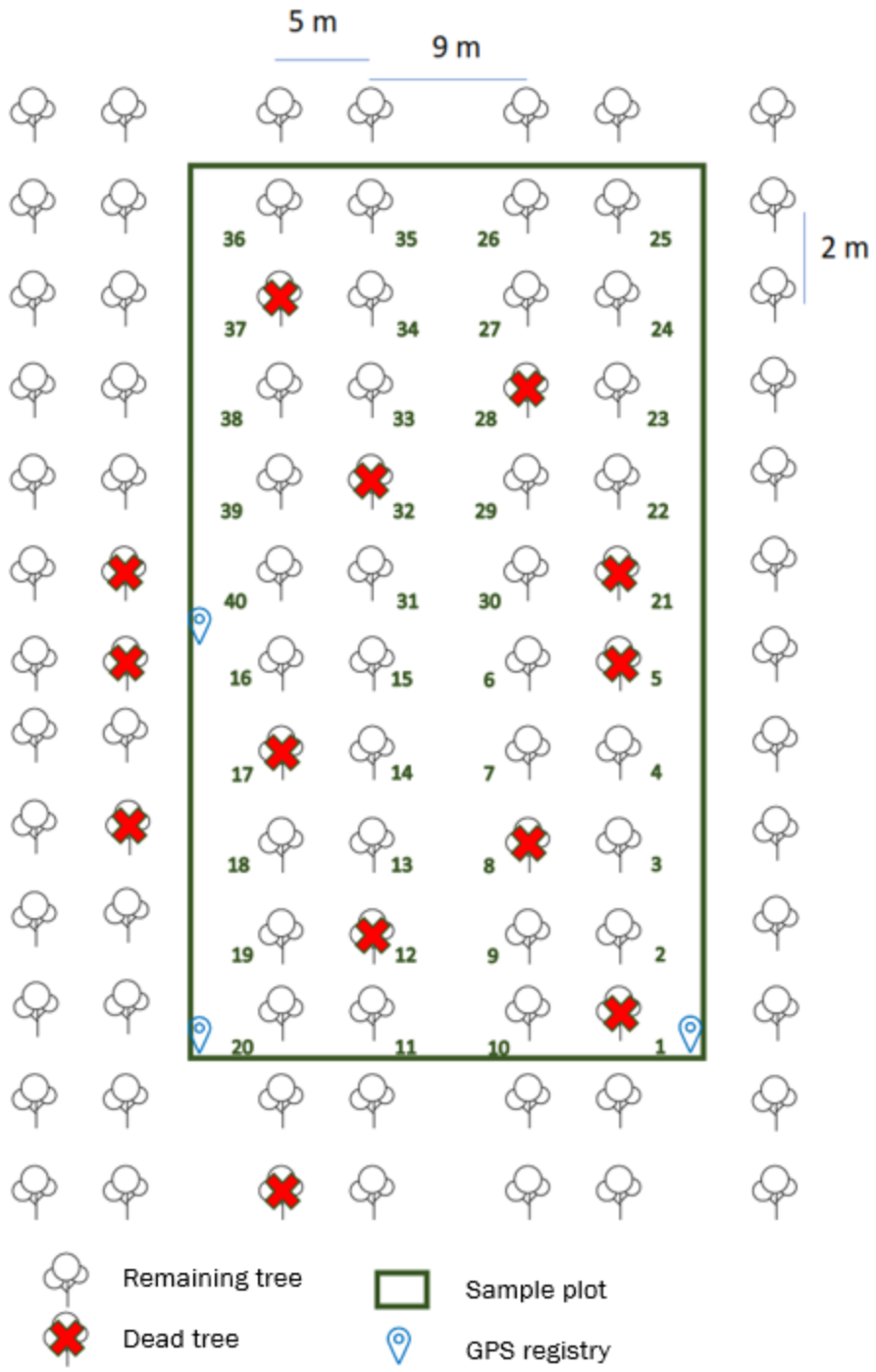



**Figure 7. Extended inventory plot – 40 trees**

According to internal procedures, the minimum density is 1 PSP every 10 ha, corresponding to a minimum sampling size of 0.2 % in terms of area. However, to date, the real average is 1 PSP every 6 ha, corresponding to 0.3% of the planted area.

Table 21. PSP size depending on planting density

**Table 4. PSP size depending on planting density**

| Spacing | Plot size ($m^2$) – 20 trees | Plot size ($m^2$) – 40 trees |
|---|---|---|
| 9 x 2.5 | 250 | 500 |
| 5 X 2 | 200 | 400 |
| 8 x 3 | 480 | 960 |

Trees in PSPs are numbered as shown in Figure 25 and their coordinates are recorded. Measurements are performed every year. The first measurement takes place at least one year after planting.

**Data Collection**

Following data is measured: Vitality of the tree, tree height, diameter at breast height (DBH), manifestation of diseases or damages, quality of silvicultural treatments applied, and additional observations if any. Data collection is conducted using an application developed by UNIQUE.

The company has SOPs for the measurement of PSPs and data collection, the document is available as complementary documentation.

**Data analysis**

The analysis of the inventory data is done with the simple average of the trees in the plot and interpolation to area occupied by the trees measured. These values are then averaged at the compartment level. To calculate the total volume per compartment and property, values are multiplied by the reported area of the compartment. In this way, following parameters are calculated at compartment level:

- Minimum, average and maximum DAP
- Minimum, average and maximum height
- Density of living trees *
- Active stand density *
- Basal area *
- Volume *

- Average affection by pests (wasp, fungus) and cattle damage

*These values are calculated per hectare and require the area of the plot for interpolation. The area of the plot depends on the planting density and were presented in .

Calibration of growth and yield tables

Production tables used to estimate growth and yield are based on inventory data, locally available information on growth performance and the eucalyptus growth simulator of EMBRAPA (Brazilian Agricultural Research Corporation; Empresa Brasileira de Pesquisa Agropecuária). Tables used are separated by silvicultural system and the expected MAI. In Paraguay, there are no production tables available based on long standing scientific research, and therefore, tables may be subject to variations while they are calibrated. A MAI variation of 5-10 % from one year to the other is considered acceptable and within the normal ranges of biological production. Within time, the reliability of these production tables is expected to increase.

Currently, for the quality timber production there are 4 basic growth tables to reflect the differences in silvicultural regime, and to separate standard quality sites from marginal sites. The growth tables for standard quality sites foresee thinnings at the age of 2, 6 and 9, and the final cut in year 12 for both silvicultural regimes. In some cases when planting density is lower than 500, rotation applied is only 10 years and only 1 thinning in age 5 is planned. Whenever the site conditions are below standard and the plantations are underperforming, growth tables for marginal sites were applied, where the final cut is estimated at year 15. According to the measured plantation development, standard quality and marginal sites are subdivided into site classes (MAI classes) in function of the development of tree height over plantation age.

**Procedures for internal auditing and QA/QC**

Monitoring requires provisions for quality assurance (QA) and quality control (QC) to be implemented via a QA/QC plan. The main parts of this QA/QC are:

- Collecting reliable field measurements
- Verifying methods used to collect field data
- Procedures to ensure reliable field measurements
- Data maintenance and archiving

Collecting reliable field measurement data

Collecting reliable field measurement data is an important step in the quality assurance plan. Those responsible for the measurement work are properly trained in all aspects of the field data collection as well as the different instruments to use during the activity. The local forest manager responsible is well trained to use the instruments and conduct the inventories. The FMU manager conducts yearly on-the-job trainings with the workers supporting the activity, ensuring new workers are properly trained.

**Verifying methods used to collect field data**

The data collection app is calibrated annually and verified by the monitoring responsible. Also, its correct use is described by the SOPs, and updated whenever necessary by the monitoring responsible.

**Verifying data entry and analysis techniques**

Analysis is conducted by the forest manager of the FMU, results are discussed and corrected, if needed, with input from the local forest managers, and then verified by and discussed with an experienced supervisor. Final data is also underlying the analysis of the Biological Asset Value, which is under great scrutiny by investors. Annually, growth and monitoring results are reported on specifically.

**Procedures to ensure reliable field measurements**

Before conducting the analysis of the data, quality control of the obtained data is conducted by the monitoring responsible. Unexpected results or high deviations between trees in the PSPs are evaluated, and PSPs are re-measured when necessary. Also, a comparison with previous years is conducted to ensure consistency of the data throughout the project lifetime.

To ensure correct and reliable data regarding carbon sequestration, every verification year a re-measurement of 5% of all plots is conducted 1 to 4 months after the first measurement has been completed.

**Data maintenance and archiving**

Because of the relatively long-term nature of project activities, data archiving (maintenance and storage) are an important component of the work. All data are automatically updated in a cloud facilitated by the project manager (UNIQUE), to

which the technical staff of the project and monitoring team has access too. Occasionally, access is given to third-parties, such as auditors.

Copies of all raw data, reports of analysis and supporting spreadsheets will be stored in a dedicated long-term electronic archive for at least 2 years following the end of the last crediting period.

# 5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

## 5.1 Baseline Emissions

Baseline emissions for this monitoring period (m2) was calculated based in the methodology AR-ACM0003. "Afforestation and reforestation of lands except wetlands" (Version 02.0) baseline net GHG removals by sinks are calculated using Equation 1 of the methodology. It is expected that soil carbon stocks will not show a permanent net increase:

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

Where:

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sink 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

$\Delta C_{SHRUB\_BSL,t}$ = Change in carbon stock in baseline shrub biomass within the project boundary, in year t

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

$\Delta C_{LI\_BSL,t}$ = Change in carbon stock in baseline litter biomass within the project boundary, in year t

The baseline for the areas part of this monitoring report was already calculated as part of the Project description in 2022. In the PDD is described the method use for the assessment. In order to calculate correctly the LTA in the ex-post calculations of the current monitoring report, all calculations were done based on the stratification of year and plantation density. Plantations established in 2018 and 2019 were

already accounted in the first verification, the second verification includes the baseline analysis of the areas planted in 2020.

**Table 5. Distribution of areas in the project (1st verification and 2nd verification)**

| Stratum (Year_Density) | Total project area (ha) | Areas part of 1st verification | New areas of 2nd verification |
|---|---|---|---|
| 2018_714 | 159 | 161 | -2 |
| 2018_1000 | 186 | 185 | 2 |
| 2019_500 | 41 | 41 | 0 |
| 2019_714 | 252 | 252 | 0 |
| 2019_1000 | 353 | 354 | -1 |
| 2020_476 | 104 | | 104 |
| 2020_500 | 10 | | 10 |
| 2020_800 | 108 | | 108 |
| 2020_1000 | 88 | | 88 |
| Total | 1,300 | 993 | 308 |

The table below displays the baseline carbon stocks for the pre-existing trees which are subject to this monitoring period.

**Table 6. Baseline biomass for this monitoring period**

| Stratum (Year_Density) | Project year | Annual planted area (ha) | $C_{TREE_{BSL}}$ and $C_{SHRUBS_{BSL}}$ and (t $CO_2e$) | $C_{DW,i,t}$ and $C_{LI,i,t}$ trees (t $CO_2e$) | Total Baseline emission (t $CO_2e$) |
|---|---|---|---|---|---|
| 2018_714 | 1 | 159 | - | - | - |
| 2018_1000 | 1 | 186 | - | - | - |
| 2019_500 | 2 | 41 | - | - | - |
| 2019_714 | 2 | 252 | - | - | - |
| 2019_1000 | 2 | 353 | - | - | - |
| 2020_476 | 3 | 104 | 646 | 7 | 653 |
| 2020_500 | 3 | 10 | 61 | 1 | 62 |
| 2020_800 | 3 | 108 | - | 0 | 0 |
| 2020_1000 | 3 | 88 | - | 0 | 0 |
| Total | - | 1,300 | 707 | 8 | 715 |

## 5.2 Project Emissions

The actual net GHG removals by sinks have been calculated using equation 2 of the methodology (AR-ACM0003: Afforestation and reforestation of lands except wetlands. Version 02.0) as described below.

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

Where:

| | |
|---|---|
| $\Delta C_{ACTUAL,t}$ | = Annual actual net greenhouse gas removals by sinks at time t; t $CO_2$-e $yr^{-1}$ |
| $\Delta C_{P,t}$ | = Change in carbon stocks in project, occurring in the selected carbon pools, at time t; t CO2-e $yr^{-1}$ |
| $GHG_{E,t}$ | = Increase of 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, t $CO_2$-e |

Change in the carbon stocks in project have been calculated using equation 3 of the methodology, however shrub biomass is not considered in this project:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SOC\_PROJ,t}$$

Where:

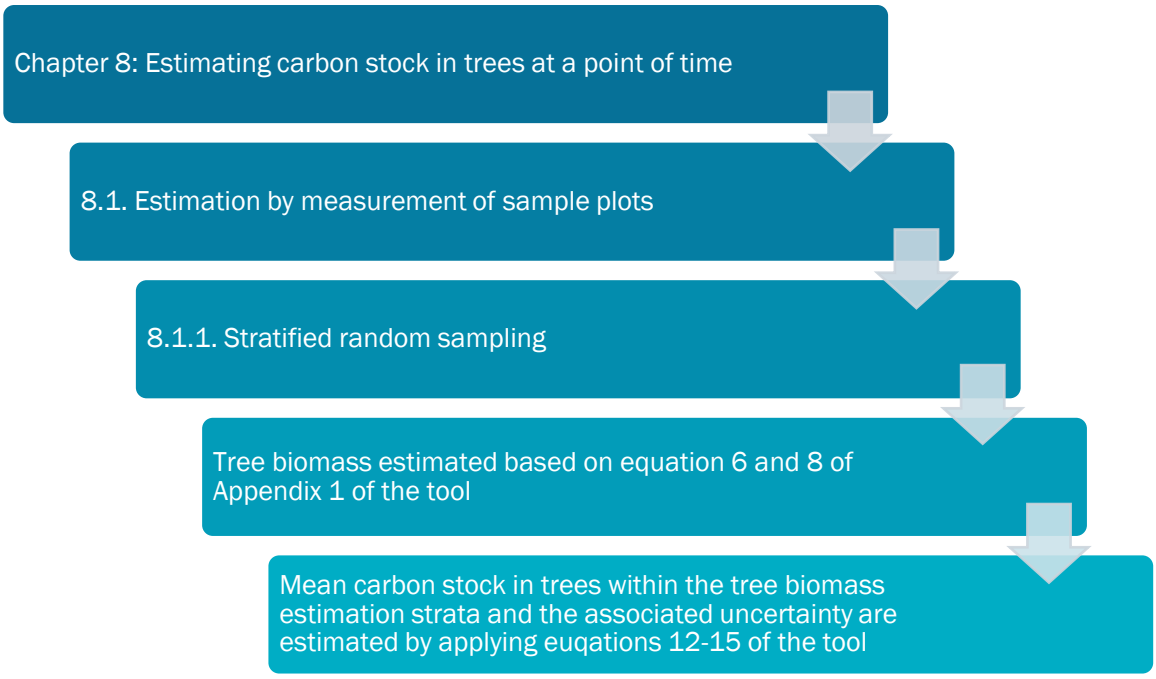
| | |
|---|---|
| $\Delta C_{P,t}$ | = Change in carbon stocks in project, occurring in the selected carbon pools, at time t; t $CO_2$-e $yr^{-1}$ |
| $\Delta C_{TREE\_PROJ,t}$ | = Change in carbon stock in tree biomass in project in year t, as estimated in AR-TOOL14; t $CO_2$-e $yr^{-1}$ |
| $\Delta C_{SOC\_PROJ,t}$ | = Change in carbon stock in the soil organic carbon (SOC) pool within the project boundary, as estimated in AR-AM0014, in year t; t $CO_2$-e $yr^{-1}$ |

### Estimation of carbon stock changes in trees and shrubs

Carbon stock changes of trees and shrubs are estimated applying the AR-Tool 'A/R Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities' (Version 04.1).

Estimation of carbon stock change in trees

The following sections and equations of the tool are applied:




The following equations of the methodology have been applied:

$$C_{TREE,t} = \frac{44}{12} * CF_{TREE} * B_{TREE,t}$$

$B_{TREE,t} = b_{TREE,t} * A$

$$b_{TREE,t} = \sum_{i=1}^{M} w_i \times b_{TREE,t,i}$$

Where:

| | |
|---|---|
| $C_{TREE,t}$ | = Carbon stock in tree biomass within the project boundary at a point in time in year t; t $CO_2$-e. |
| $CF_{TREE}$ | = Carbon fraction of tree biomass; t C (t d.m.)$^{-1}$. |

$B_{TREE,\,t}$ = Total tree biomass within the project boundary at a given point in time in year t; t d.m.

$b_{TREE,\,t}$ = Mean tree biomass per hectare within the project boundary at a given point in time in year t; t d.m. $ha^{-1}$

$A$ = Project area; ha

$w_i$ = Ratio of the area of stratum i to the sum of areas of tree biomass estimation strata (Ai/A), dimensionless

$b_{TREE\,,t,i}$ = Mean tree biomass per hectare in stratum i at a given point in time in year t; t d.m. $ha^{-1}$

### Determination of tree biomass $b_{TREE,\,t,j}$

Tree biomass estimation follows the guidance for measurement of variable plots given in Appendix 1 of the Tool, equations 6 and 8.

The following table summarizes the values applied for equation 8 (of Appendix 1 of the Tool):

**Table 7. Values applied to calculate tree biomass**

| Equation value | Description | Value applied | Source |
|---|---|---|---|
| $v_{TREE,j}$ ($BA_{p,i}$) | vTREE = DBH*height*form factor<br>Stem volume per hectare of trees of species j in sample plot p of stratum i estimated by using the basal area of the plot as entry data into a volume table or volume equation; m3 ha-1. The form factor applied is 0.4. | See Excel inventory data 2019 | Published and project volume tables. |
| $D_j$ | Density (over-bark) of tree species j; t d.m. m-3 | 0.54 | Zanne et al (2009)2 |
| $BEF_{2,j}$ | Biomass expansion factor for conversion of tree stem biomass to above-ground | 1.15 | IPCC value, Table 3A.1.10, Broadleaf Temp |

[2] https://datadryad.org/stash/dataset/doi:10.5061/dryad.234

| | | | |
|---|---|---|---|
| | tree biomass, for tree species j; dimensionless | | |
| $R_j$ | Root-shoot ratio for tree species j; dimensionless | 0.37 | Barton and Montagu (2006)3 & Fabiao et al. (1995)4 |

The calculation of the tree biomass was done in Excel. The file '2022 FASA Carbon Inventory M2' is available as supporting documentation.

**Table 8. Summary calculation $B_{TREE}$ and $C_{TREE}$**

| Stratum | Area (ha) | wi | bTREE,t t d.m. ha-1 | BTREE,t t d.m. | CTREE,t t $CO_2$-e |
|---|---|---|---|---|---|
| 2018_714 | 159 | 0.12 | 44.85 | 58,307 | 100,483 |
| 2018_1000 | 186 | 0.14 | | | |
| 2019_500 | 41 | 0.03 | | | |
| 2019_714 | 252 | 0.19 | | | |
| 2019_1000 | 353 | 0.27 | | | |
| 2020_476 | 104 | 0.08 | | | |
| 2020_500 | 9,5 | 0.01 | | | |
| 2020_800 | 108 | 0.08 | | | |
| 2020_1000 | 87,5 | 0.07 | | | |
| **TOTAL** | **1,300** | **1.00** | | | |

**The carbon calculations shows that the values of the project are still far from reaching the LTA. The table below shows the comparison between the LTA ex-ante and the project for the different strata:**

[3] Fabião, A., Madeira, M., Steen, E., Kätterer, T., Ribeiro, C., & Araújo, C. (1995). Develop-ment of root biomass in an Eucalyptus globulus plantation under different water and nutri-ent regimes. Plant and Soil, 168(1), 215-223.

[4] Barton, C. V., & Montagu, K. D. (2006). Effect of spacing and water availability on root: shoot ratio in Eucalyptus camaldulensis. Forest Ecology and Management, 221(1-3), 52-62.

**Table 9. Comparison of bTREE and current LTA with Ex-Ante LTA**

| Stratum | Average of bTREE,i | Average bTREE, i t CO2e | LTA Ex Ante | Δ LTA, t CO2e to reach LTA |
|---|---|---|---|---|
| 2018_714 | 45,39 | 78,2 | 190,2 | 112,0 |
| 2018_1000 | 47,24 | 81,4 | 213,0 | 131,6 |
| 2019_500 | 35,18 | 60,6 | 180,5 | 119,8 |
| 2019_714 | 41,84 | 72,1 | 190,2 | 118,1 |
| 2019_1000 | 46,30 | 79,8 | 213,0 | 133,2 |
| 2020_476 | 48,72 | 84,0 | 180,5 | 96,5 |
| 2020_500 | 32,63 | 56,2 | 180,5 | 124,2 |
| 2020_800 | 37,59 | 64,8 | 190,2 | 125,4 |
| 2020_1000 | 51,82 | 89,3 | 213,0 | 123,7 |

**Calculation of uncertainty following the guidance of Appendix 2 of the A/R Methodological Tool**

**Table 10. Calculation of uncertainty**

| Stratum | $s_i$ t.d.m. $ha^{-1}$ | $n_i$ | $u_c$ % | $u_c$ mean (t $CO_2$-e) | $u_c$ Discount (t $CO_2$-e) |
|---|---|---|---|---|---|
| 2018_714 | 25.8 | 26 | 5.6% | 5,602 | 0 |
| 2018_1000 | 12.0 | 12 | | | |
| 2019_500 | 20.6 | 38 | | | |
| 2019_714 | 21.3 | 42 | | | |
| 2019_1000 | 20.3 | 17 | | | |
| 2020_476 | 17.5 | 3 | | | |
| 2020_500 | 9.0 | 12 | | | |
| 2020_800 | 13.0 | 13 | | | |
| 2020_1000 | 20.3 | 188 | | | |
| TOTAL | 20.3 | 188 | | | |

Based on the Tool no discount of $C_{TREE}$ is necessary as $u_c < 10\%$

**Estimation of changes in soil organic carbon stocks**

For ex-post estimation of the SOC changes under the project scenario for this monitoring period, the default method of the A/R Methodological tool 'Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities' (Version 01.1.0) is applied. The application and justification of the tool is outlined in section 4.2.

The rate of change in SOC stock in the project scenario until the steady state in SOC content is reached (assumed in 20 years from the time of the initial site preparation) is calculated as 0.61 tC/ ha/ yr which represents the weighted average value over all baseline strata.

For this monitoring period, for each new planting area included in a certain year, only eight months are assumed for that planting year with the dSOC value.

**Table 11. Calculation of SOC change for this monitoring period**

| Year | SOC area (ha) | Cumulative SOC area (ha) | Total ΔSOC strata 1-4 (t CO2-e) |
|---|---|---|---|
| 2018 | 345 | 345 | 73 |
| 2019 | 646 | 991 | 135 |
| 2020 | 309 | 1,300 | 525 |
| 2021 | - | 1,300 | 3,337 |
| 2022 | - | 1,300 | 2,503 |
| **Total** | | | **6,572** |

**Change in carbon stocks of trees**

According to the tool AR-TOOL14 A/R Methodological tool 'Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities' (Version 04.1) at the first verification $C_{TREE}$, t2 is set equal to the carbon stock in the first verification. Based on this, the following table shows the change in carbon stock during the period between two points of time t1 (pre-existing baseline tree biomass

for 2020 plantations and last monitoring period for the already monitored 2018 and 2019 plantations) and t2. The Excel sheet '2022 FASA Carbon Inventory M2' details the full calculation of emission reductions for this monitoring period and is available upon request.

**Table 12. Change in carbon stocks during the period between two points of time t1 (pre-existing tree and shrub biomass) and t2.**

| Stratum (year_density) | Area strata 52ncluding in year t (ha) | $C_{TREE,t1} = C_{TREE\_BSL,t1}$ (M1 31-12-2020) | $C_{TREE,t1} = C_{TREE\_BSL,t1}$ (plantation date) | $C_{TREE\_PROJ\_DISCOUNT;\ t2}$ | $C_{DW\_PROJ;t2}$ | $\Delta C_{TREE+DW\_PROJ;\ (t2-t1)}$ |
|---|---|---|---|---|---|---|
| 2018_714 | 159 | 6211 | | 12,290 | | 6,079 |
| 2018_1000 | 186 | 10648 | | 14,377 | | 3,729 |
| 2019_500 | 41 | 10648 | | 3,169 | | - 7,479 |
| 2019_714 | 252 | 9000 | | 19,478 | | 10,478 |
| 2019_1000 | 353 | 3070 | | 27,285 | | 24,215 |
| 2020_476 | 104 | - | 653 | 8,039 | | 7,385 |
| 2020_500 | 10 | - | 62 | 734 | | 673 |
| 2020_800 | 108 | - | 0 | 8,348 | | 8,348 |
| 2020_1000 | 88 | - | 0 | 6,763 | | 6,763 |
| **TOTAL** | 1,300 | 39.577 | 715 | 100,483 | | 60,191 |

**Actual net greenhouse gas removals by sinks**

**Table 13. Actual net greenhouse gas removals by sinks for the different years of the monitoring period**

| Year | Project implementation (cum. Months) | Cumulative tree net GHG removals by sinks, in year t; (t $CO_2$-e) | Actual tree net GHG removals by sinks, in year t; (t $CO_2$-e) | Actual SOC net GHG removals by sinks, in year t; (t $CO_2$-e) | Actual total net GHG removals by sinks, in year t; (t $CO_2$-e) |
|---|---|---|---|---|---|
| 2021 | 12 | 41.129 | 41.129 | 4.070 | 45.199 |
| 2022 | 21 | 71.976 | 30.847 | 2.503 | 33.349 |
| **Total** | 21 | 71.976 | 71.976 | 6.572 | 78.549 |

## 5.3 Leakage

Leakage is in compliance with Section 6 of the A/R Tool as no displacement of cattle took place for planting.

**Table 14. GHG emissions due to leakage, in year t**

| Year | Leakage (t CO2-e) |
|---|---|
| 2021 | 0 |
| 2022 | 0 |
| **Total** | **0** |

## 5.4 Net GHG Emission Reductions and Removals

**Table 15. Net GHG Emission Reductions and Removals**

| Year | 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 |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 01-Jan-2021 to 31-Dec-2021 | 715 | 45.199 | - | 44.484 | 5.338 | 39.146 |
| 01-Jan-2022 to 30-Sep-2022 | - | 33.349 | - | 33.349 | 4.002 | 29.347 |
| **Total** | 715 | 78.549 | - | 77.834 | 9.340 | 68.494 |

The total GHG emission reductions for the 2nd monitoring period 01-January-2021 to 30-September-2022 are 77,834 $tCO_2e$. The non-permanence risk rating is 12% (as determined in the AFOLU non-permanence risk report attached as a separate document). Therefore the total number of buffer credits that need to be deposited into the AFOLU pooled buffer account is 9,340 $tCO_2e$. The number of GHG credits eligible to be issued as VCUs for the first project instances of this monitoring period is 68,494 tCO2e.

Cumulative emission reductions claimed during first verification and to be claimed in this second verification are compared to ex-ante estimations in the Table below:

| Ex-ante emissions reductions /removals | Achieved emissions reductions /removals | Percent difference | Justification for the difference |
|---|---|---|---|
| **116,391** | 108,767 | 9% | Loss of 7 ha due to adjustments of areas and some minor variations on growth. |