



**Verified Carbon
Standard**

EL ARRIERO AFFORESTATION ON DEGRADED GRASSLAND UNDER EXTENSIVE GRAZING PROJECT

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project comprises a total of 4,567 hectares (ha) of land previously under extensive grazing by beef cattle, on which afforestation to obtain high-value, long-lived timber products and sequester large amounts of carbon dioxide from the atmosphere was established.

The project began on April 30, 2009 and is currently on its 12th year. Forests are based on a 22–25-year rotation of Loblolly Pine (*Pinus taeda*) and Hybrid Pine (*P. caribea* x *elliotti*) plantations, managed with three pruning (1st at 2.3-3.3m, the 2nd at 4.44m and the 3rd at 5.6m) and two thinning operations, to obtain knot-free, high-diameter logs suitable for saw-milling. The proposed pruning was completed on the 9th year of the project (2018) and currently the first of the two thinning operations has been carried out according to the forest El Arriero management plan¹. Plantation was completed by the second year of the project and the forests will be replanted after clear-cut harvest. Practices are certified under the FSC standard². The baseline study determined that perpetuation of extensive grazing is the most likely use of the land. Additionality is demonstrated by the fact that the expected internal rate of return of the proposed project activity without considering carbon finance is lower than the benchmark internal rate of return for this type of investment in Uruguay. In addition, barrier analysis and common practice analysis showed that afforestation in the area of the proposed project activity is not likely to occur without carbon financing.

Planted forests removed carbon dioxide from the atmosphere and stored it in different carbon pools (living above-ground and below-ground biomass, soil, litter, and dead wood). In this third monitoring event the carbon stock in different pools is measured and compared to the previous monitoring event. The total carbon stock stored in the different pools amounts to 1,938,400 tCO₂e. Having in consideration the previous verification event, this third verification of the project will issue 681.488 tCO₂e. The long-term average is not yet reached, which has been recalculated at 2,186,749 tCO₂e.

1.2 Sectoral Scope and Project Type

The activity implemented by the project participant consists in the establishment of forests on land that had previously been grassland for hundreds of years, and therefore corresponds to the VCS scope 14: “Agriculture, Forestry and Other Land Use” as an Afforestation, Reforestation and Revegetation (ARR).³

The project is not a grouped project.

1.3 Project Proponent

Organization name	Forestal El Arriero SRL
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¹ Manejos_predios_Arriero

² See FSC certificate at: <http://info.fsc.org/details.php?id=a0240000005sSGJAA2&type=certificate&return=certificate.php>

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1.4 Other Entities Involved in the Project

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Role in the Project	Data processing, archiving and preparation of the VCS documents
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1.5 Project Start Date

The project started on April 30th, 2009, when the activities that lead to the generation of GHG emission removals (preparing land for planting) were first implemented. The project start date was also checked during validation.

1.6 Project Crediting Period

The crediting period for Forestal 'El Arriero' project ranges from April 30th, 2009, to April 30th, 2109, for a total of 100 years.

1.7 Project Location

The project is located in East Uruguay, in Cerro Largo and Treinta y Tres departments. It comprises several sites, which are classified in 4 regions based on geographic location. The areas are homogeneous in terms of soil types, climate, land use history and socio-economic conditions. The map in Figures 1 and 2 shows the exact location of the project, as well as the cadastral units owned by Forestal 'El Arriero SRL', and figures 3 to 6 shows the 4-region project area division mentioned above.

Project area was stratified to homogenize the population and achieve more accurate results in the variables measured. The preliminary stratification was done prior to the implementation of the measurements and was established in the Monitoring Plan of the Project Design. The strata were defined with three main variables: tree species, plantation date and region.

Nevertheless, the actual number of strata can always vary. Project strata can be constantly re-defined after plantation if disturbance events take place or in the case the carbon stock calculation results in a very low uncertainty value. In the first monitoring event the strata were maintained as defined in the Project Description. In the second monitoring event, the carbon stock was calculated with a very low uncertainty value (below 3%), demonstrating that the subdivision of strata based on such variables was excessive. However, just as previously, it was decided to maintain the strata for two main reasons: the number of plots to measure was not excessive and the project developer decided to be very conservative and maintain the error of estimation far from the maximum allowed.

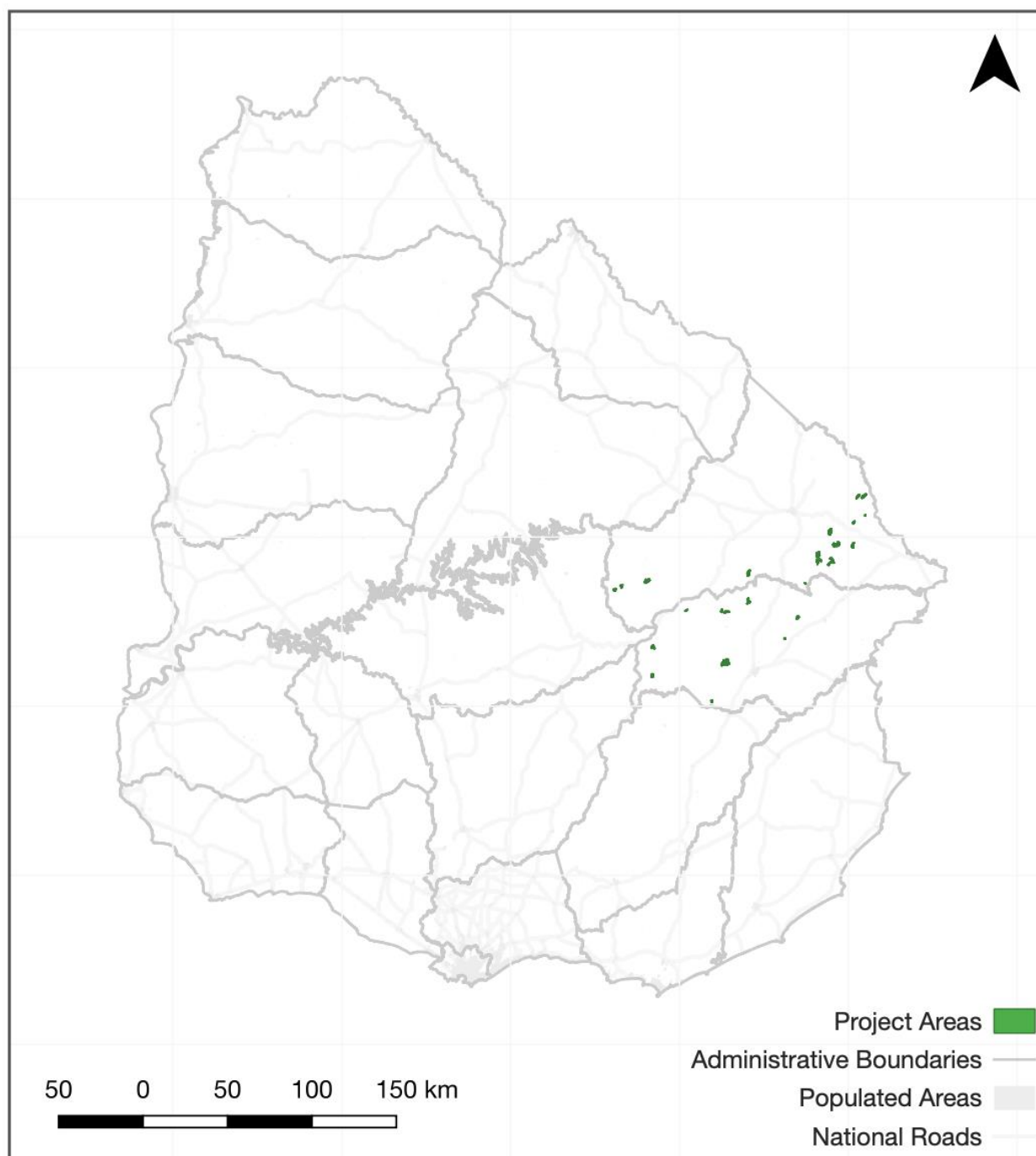


Figure 1. Map of Forestal 'El Arriero' SRL project boundaries.

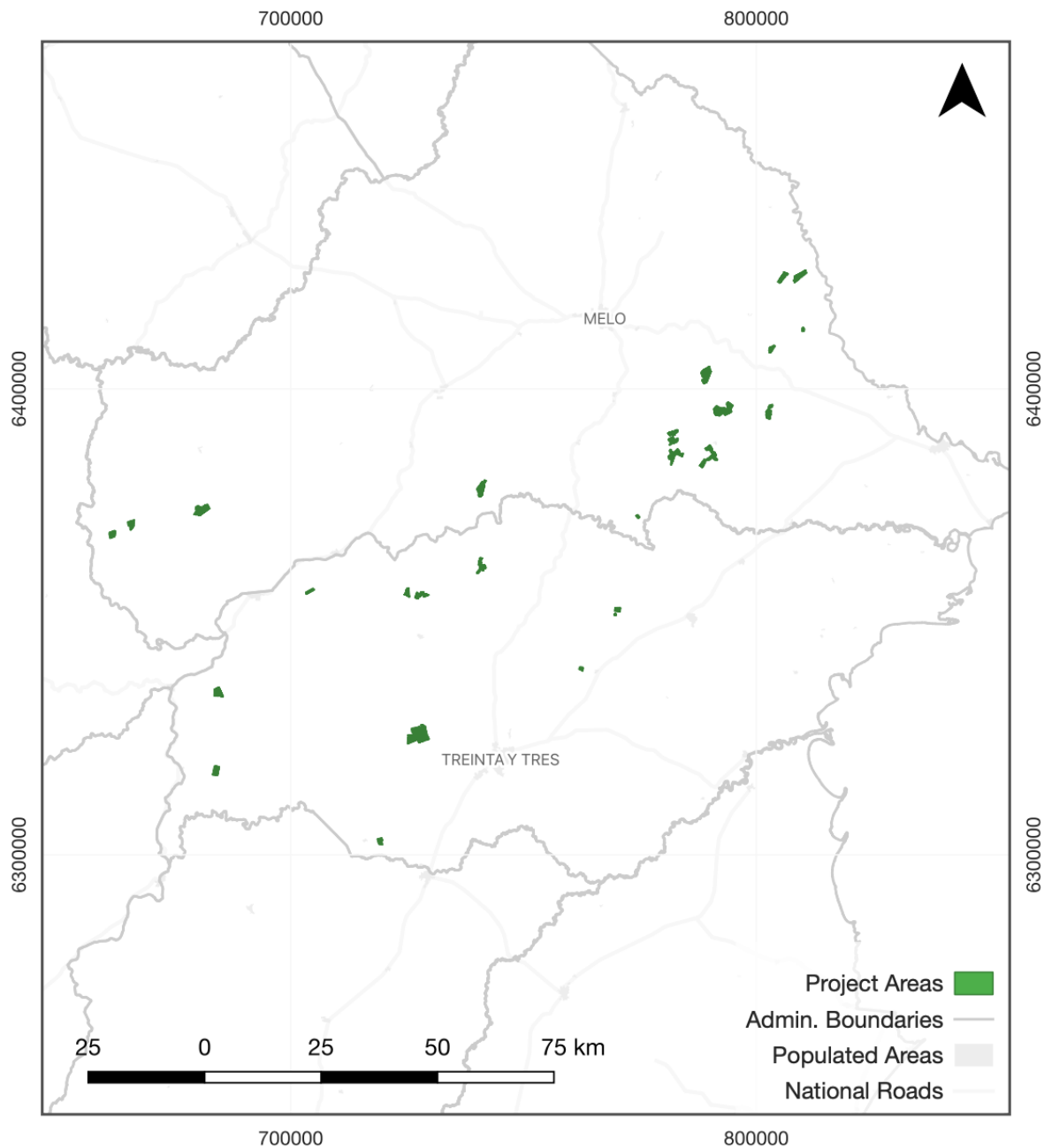


Figure 2. Map of Forestal 'El Arriero SRL' project boundaries. Plane coordinates in WGS 84 / UTM zone 21S (EPSG 32721).

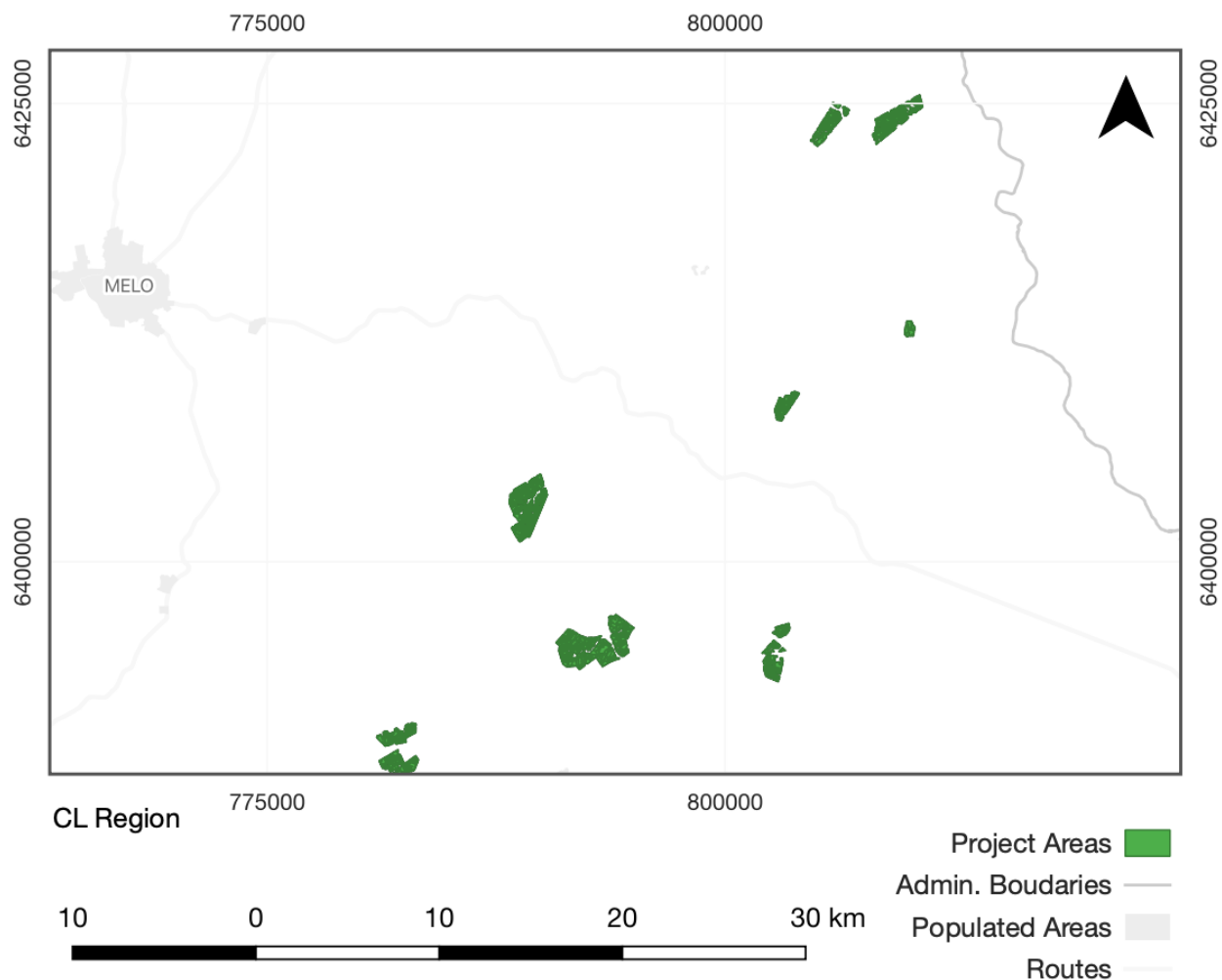


Figure 3. Location of properties belonging to Forestal 'El Arriero SRL' corresponding to the region CL (Cerro Largo). Plane coordinates in WGS 84 / UTM zone 21S (EPSG 32721).

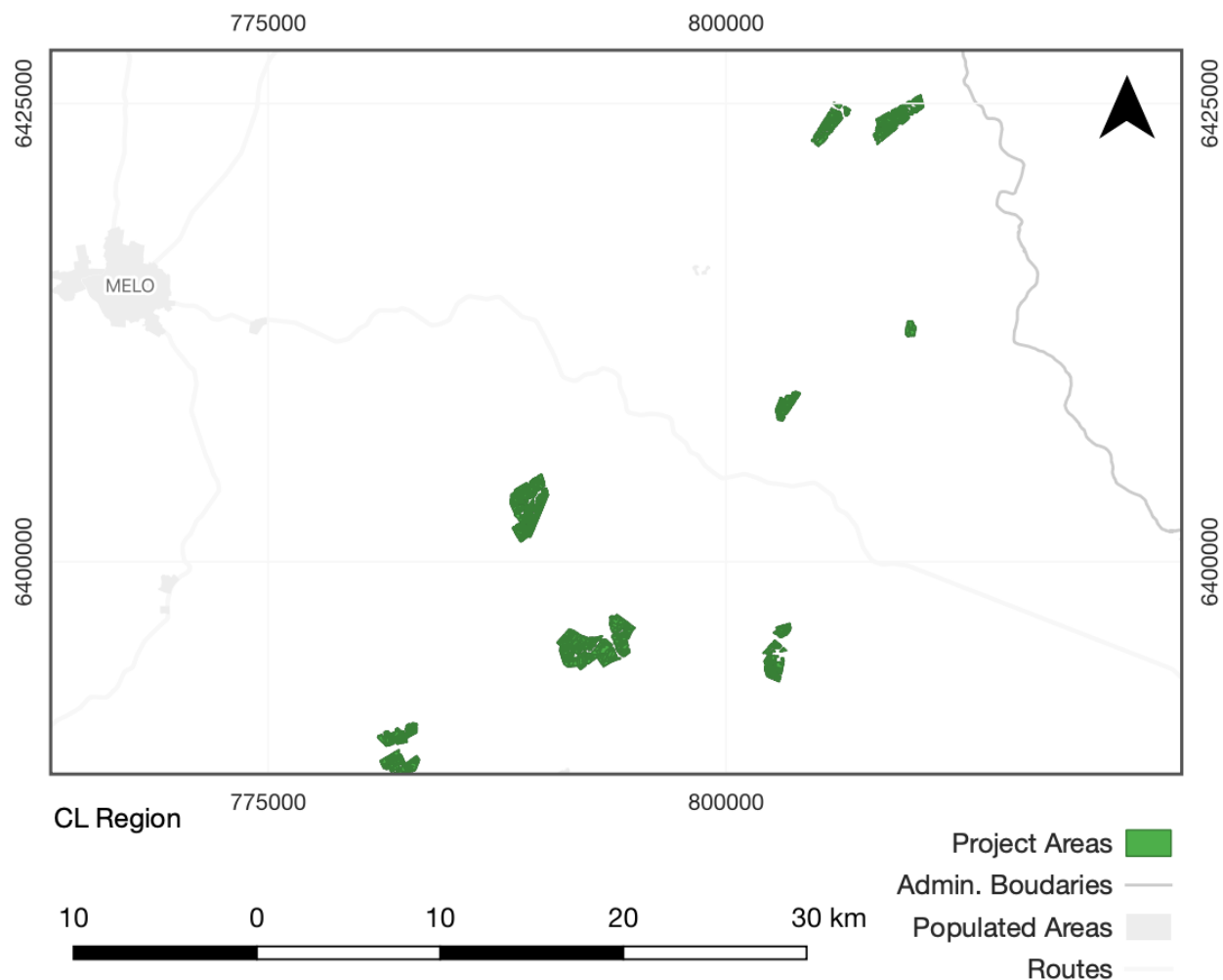


Figure 4. Location of properties belonging to Forestal 'El Arriero SRL' corresponding to the region CL-TT1 (Cerro Largo-Treinta y Tres). Plane coordinates in WGS 84 / UTM zone 21S (EPSG 32721).

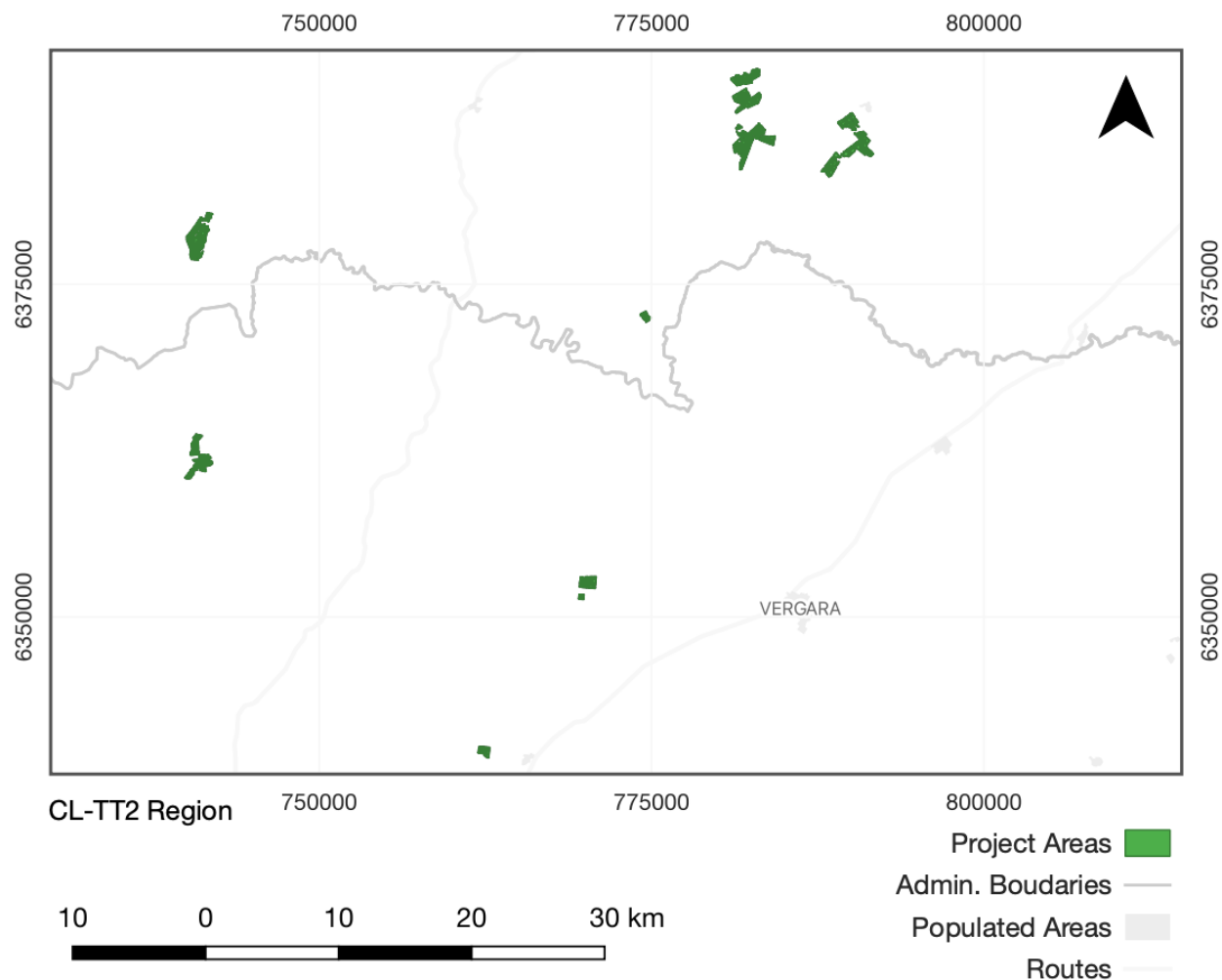


Figure 5. Location of properties belonging to Forestal 'El Arriero SRL' corresponding to the region CL-TT2. Plane coordinates in WGS 84 / UTM zone 21S (EPSG 32721).

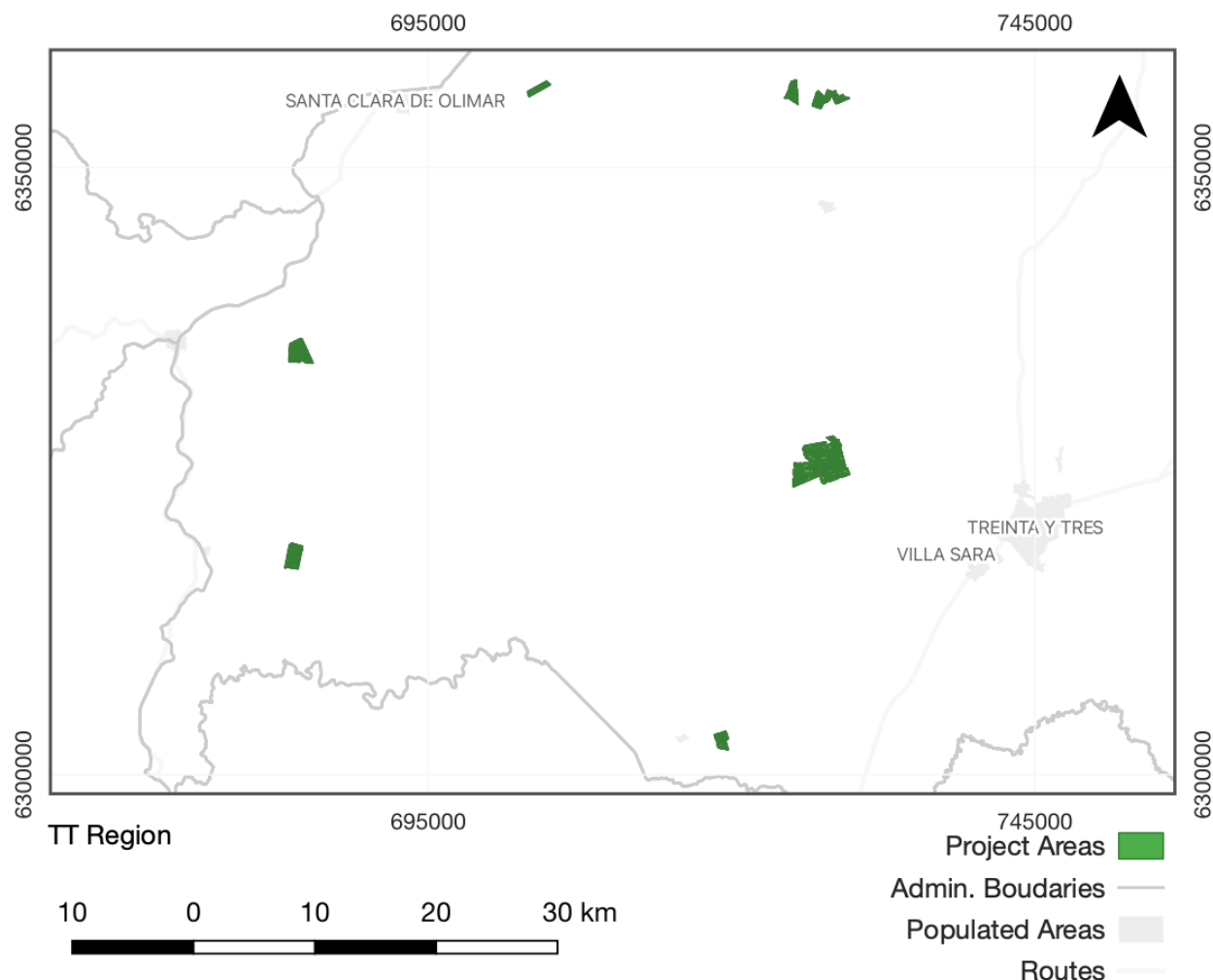


Figure 6. Location of properties belonging to Forestal 'El Arriero SRL' corresponding to the region TT (Treinta y Tres). Plane coordinates in WGS 84 / UTM zone 21S (EPSG 32721).

The geographic coordinates (in decimal degrees) corresponding to each farm of the El Arriero project are described below:

Table 1. Geographical coordinates of the El Arriero project establishments

Region	Farm	Latitude	Longitude
CL (Figure 3)	Los Martines	-32.2761	-53.7156
	El Sarandi	-32.2808	-53.7543
	El Terco	-32.37977	-53.7040
	Tres Panes	-32.41926	-53.77535
	Altiro	-32.5436	-53.7762
	El Germano	-32.5411	-53.8764
	El Pedregoso	-32.4716	-53.9211
	El Betty	-32.5312	-53.7728
	Cat	-32.8085	-55.2723

CL-TT1 (Figure 4)	Pochotito	-32.7880	-55.2297
	Sandobayu	-32.7582	-55.0680
	La Calera	-32.7059	-54.4302
	La Sierra	-32.9163	-54.5728
	San Fermin	-33.1841	-54.5605
CL-TT2 (Figure 5)	El Enloquecido	-32.619	-53.989
	Tres Cuartos	-32.631	-53.905
	Rita	-32.7505	-54.0699
	Caburga Lake	-32.934	-54.104
	Dionisio Diaz	-33.049	-54.189
	La Calera	-32.856	-54.425
	La Guadalupe	-32.6035	-53.9923
	Las Viboras	-32.6289	-53.9909
TT (Figure 6)	Eeepectacula	-33.110;	-55.025
	Pisoteado	-33.263;	-55.029
	Vamoarriba	-33.392;	-54.646
	Reloco	-32.913;	-54.816

All properties of 'El Arriero SA' are legally owned and are covered by deeds duly registered with the National Records, registered with the corresponding number for the Registration of Real Estate. There are no conflicts related to tenure or use rights over the land affected by the project or its products as demonstrated during validation.

Project boundaries have been identified using GPS and aerial photographs and have been laid on a geographic information system. No visible landmarks have been established on the field. Maps with exact project boundaries and its coordinates will be available for the verification team.

1.8 Title and Reference of Methodology

The consolidated CDM methodology AR-ACM0001 "Afforestation and reforestation of degraded land" (version 05.2.0, EB 65) was applied:

<http://cdm.unfccc.int/methodologies/DB/X4VOLW3Y7IJCH9WSBXC2Q0JKG9UZ>

The following methodological tools, to which the selected methodology refers to, were used:

- Version 01 of "Combined tool to identify the baseline scenario and demonstrate the additionality in A/R CDM project activities".
- Version 01 of "Tool for testing significance of GHG emissions in A/R CDM project activities".
- Version 04.0.0 of "Estimation of non-CO2 GHG emissions from burning of biomass attributable to a A/R CDM project activity"
- Version 01 of "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities".
- Version 02.0.0 of "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activity".

- Version 03.0.0 of “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activity”.
- Version 01 of “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity”.
- Version 01.1.0 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”.

Forestal 'El Arriero SA' Project Document was validated and ultimately registered under the VCS on the 18th of January 2013. At that moment the methodology “AR-ACM0001 Afforestation and Reforestation on degraded land” (V 5.2.0, EB 65) was still valid to be used in Afforestation and Reforestation CDM (or VCS) projects. According to the CDM, the request for registration of any project using the mentioned methodology could be submitted until the day in which 'El Arriero' was registered. After that date the methodology was substituted with the Combined Methodology: “AR-ACM0003: Afforestation and reforestation of lands except wetlands”. However, for the purpose of this project Monitoring Reports and subsequent monitoring reports, the methodology to be applied corresponds to AR-ACM0001.

1.9 Participation under other GHG Programs

“‘El Arriero’ afforestation on degraded grasslands under extensive grazing project” is not participating under any other GHG Program.

1.10 Other Forms of Credit

N/A

1.11 Sustainable Development Contributions

Sustainable Development Goal N° 8: Decent work and economic growth

The project has generated and will continue to generate decent employment through formal hiring in areas far from the cities. The project developer has created direct and indirect full-time positions for the local population. This implies a benefit for the local workforce since the project will train them for forestry projects, allowing them to apply for better jobs in Cambium as in other forestry companies.

In addition, Cambium stimulates the entrepreneurship of rural women which allows the regional economy to grow.

The project is promoting economic growth in the region due to the jobs it generates but also due to the investment made and the timber market it is generating.

Sustainable Development Goal N° 12: Ensure sustainable consumption and production patterns

The project strengthens the scientific, technological and innovation capacity of a developing country to move towards more sustainable production patterns. The project is FSC certified which shows that it is producing wood sustainably.

On the other hand, according to the report 'Forestry Sector in Uruguay' of Uruguay XXI, the prospects of the Uruguayan forestry sector for the coming years are presented. One of them mentions the expansion of wood construction in the country, which will imply construction of sustainable buildings that will reduce GHG emissions in the construction sector. On the other hand, he mentions the increase in the consumption of biomass fuels, which will reduce GHG emissions since less fossil fuels will be consumed.

Sustainable Development Goal N° 13: Climate Action

By the mere continuation of the activities of the "Forestal El Arriero" project, it contributes to the Sustainable Development Goal (SDG) number 13 "Take urgent measures to combat climate change and its impacts", through the removal of atmospheric CO₂ associated with the photosynthesis by growing forests and stored in different reservoirs (above and below ground biomass, dead wood, litter and soil organic carbon).

In addition, 'El Arriero' project, does not allow the burning of waste from the pruning of its trees, since this would generate emission from biomass burning and risk of biodiversity loss.

Even more, the area in which the project is implemented will preserve the native forest. The plantation of the project area will always maintain distance to the native forest and will never compete with it.

The project activity will generate – in the near future- biomass that will be taken to mills. In it, there will be timber processing that will generate a residue (dust, waste, etc.). In Uruguay, this material is used to generate renewable energy.

Sustainable Development Goal N° 15: Life on Land

The project also contributes to SDG number 15 "Protect, restore and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss" given that afforestation activities are carried out on degraded land (due to a history of overgrazing by livestock) and the wood is produced in a sustainable and FSC-certified way, reversing the degradation process.

On the other hand, management cares for and conserves native forests within the limits of the property, removing exotic species in the buffer zone so that the native forest can continue to grow and thus allow the growth of terrestrial ecosystems. In addition, the hunting of wild animals is prohibited since this would reduce biodiversity.

Table 2: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1	8	8.2.1. Annual growth rate of real GDP per employed person	Increase of GDP per employed person	Real GDP in Uruguay has increased in 2018-2019 and 2021 ³ . The GDP has decreased in the year of pandemic, but it should not be considered as it is a worldwide outlier in economy performance. As the number of direct and indirect employees in the forestry sector in Uruguay has been maintained ⁴ , there was an increase in real GDP of Uruguay per employed person.	As there are no previous reports regarding a specific SDG indicator, the contribution over the project lifetime is the same as the current project contributions. Notwithstanding, it is worth mentioning that the GDP of Uruguay has been forecasted to grow at a conservative annual rate of 2.7% in the following 5 years ⁵ .

³ <https://datos.bancomundial.org/indicador/NY.GDP.MKTP.KD.ZG?end=2021&locations=UY&start=2018>

⁴ “Empleo en el sector agropecuario: situación 2019 a partir de las Encuestas Continuas de Hogares e impactos preliminares del COVID-19”, Ministry of Agriculture, Livestock and Fisheries (<https://www.gub.uy/ministerio-ganaderia-agricultura-pesca/comunicacion/publicaciones/empleo-sector-agropecuario-2019/empleo-sector-agropecuario-2019>)

⁵ Page 36 in the Accountability presentation of the Ministry of Economy to the Uruguayan Parliament: <https://www.gub.uy/ministerio-economia-finanzas/sites/ministerio-economia-finanzas/files/documentos/publicaciones/RDC%202021%20Exposici%C3%B3n%20de%20motivos.pdf>

2	12	12.1.1. Number of countries with sustainable consumption and production (SCP) national action plans or SCP mainstreamed as a priority or a target into national policies	Increase of sustainable consumption	The main destination of the harvested products in 'El Arriero' project will be to supply local or international sawmills. The final product will be timber to be used for different purposes (e.g. for the construction of sustainable buildings), having as a result the avoidance of GHG emissions and storing large amounts of carbon in harvested wood products. Part of the thinnings from Forestal El Arriero were exported to China. A substantial amount of the timber used in China comes from non sustainable sources or natural forests. Arriero's exports replace in part these non sustainable sources In May 2022, the Ministry of Housing and Territorial Planning of Uruguay promoted the construction of social housing made of wood, since wood is a less expensive and environmentally friendly material⁶	As there are no previous reports regarding a specific SDG indicator, the contribution over the project lifetime is the same as the current project contributions. There is no individual metric, but an approximation should be % of wood imported by China coming from countries where the species is non native and thus a planted species. Notwithstanding, it is worth mentioning that the crediting period of 'El Arriero' is 100 years, with multiple harvesting events during this period. The project will be contributing to the production of wood (harvested wood products) that will be used in the construction of sustainable buildings.
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⁶ https://www.gub.uy/ministerio-vivienda-ordenamiento-territorial/sites/ministerio-vivienda-ordenamiento-territorial/files/documentos/publicaciones/MVOT.%20%282022%29.%20Hoja%20de%20Ruta%20para%20la%20Construcci%C3%B3n%20de%20Vivienda%20Social%20en%20Madera%20en%20Uruguay%20%281%29_compressed.pdf

3	13.0	Tonnes of greenhouse gas emissions avoided or removed	Increase of CO ₂ removals	By growth of the 4,567 ha of pine forest planted from 2009 to 2011, Project 'El Arriero' has sequestered through photosynthesis by the growing forests.681,488 tonnes of carbon from the atmosphere during this monitoring period.	As there are no previous reports regarding a specific SDG indicator, the contribution over the project lifetime is the same as the current project contributions. Notwithstanding, it is worth mentioning that it is estimated that over the project lifetime carbon removals will amount to 2,186,749 tonnes of CO ₂ .
4	15	15.2.1 Progress towards sustainable forest management and proportion of land that is degraded	Increase of area with sustainable forest management	El Arriero applies a sustainable management to 100% of the forest, this is why FSC certification has been achieved. It also contributes to the accumulation of above and below ground biomass as well as deadwood and litter, promoting the increase in storage of carbon in soils. During this verification period, it has been demonstrated that the soil organic carbon has increased in 50,565 tCO ₂ . Afforestation activities does also serve as to prevent the soil of being eroded from multiple climatic drivers (wind and rain).	As there are no previous reports regarding a specific SDG indicator, the contribution over the project lifetime is the same as the current project contributions. Notwithstanding, it is worth mentioning that during the project lifetime, the soil organic carbon will be increased, which will stop the degradation and desertification of soils.

5	15	15.8.1. Proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species	Increase in the prevention control of exotic species in the native forests present in the establishment	The Uruguayan Ministry of the Environment has created a Biodiversity and Ecosystem Services⁷ commission to care for and grow the country's biodiversity. Through this commission, exotic plant species that may affect native forests are presented. Through this list of species, Cambium monitors 100% of the native forests present on the property to care for and increase biodiversity. Additionally, 100% of El Arriero forest plantation is planted respecting the necessary distance to native forest present in the land owned by the project proponent, as required by law.	As there are no previous reports regarding a specific SDG indicator, the contribution over the project lifetime is the same as the current project contributions. Notwithstanding, it is worth mentioning that the care of the native forest of the property is located will allow the growth and promoting the biodiversity of the country.
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⁷ <https://www.gub.uy/ministerio-ambiente/biodiversidad-servicios-ecosistemicos>

2 SAFEGUARDS

2.1 No Net Harm

The afforestation of the 'El Arriero' project is carried out on grasslands that have been degraded due to extensive grazing by cattle and sheep. Cattle and sheep production has been installed in the region of the El Arriero project since the 17th century, causing the grasslands to be at a critical level of degradation due to grazing.

'El Arriero' project will allow the soils to recover from degradation since the afforestation makes the soil to increase in soil organic carbon.

In addition, this project in all its components and phases guarantees that there is not and will not be any damage to the environment or socioeconomic aspects. The project proponent has established measures against any type of negative environmental impact: 'El Arriero' has FSC certification, demonstrating that the project's afforestation is being managed to preserve biological diversity, benefiting the lives of populations and stakeholders.

Among other practices, El Arriero does not burn any material during site preparation neither during the forest management, a practice that is still in place in some parts of Uruguayan grassland areas. Hunting is not allowed in any of the El Arriero sites. And the project developer applies the removal of exotic species from buffer and conservation areas.

In terms of the benefits that the project bring to society in general: higher work standards and safety gears, employment in remote areas, engagement with local Schools with environmental education, COVID support program and entrepreneur program with women.

El Arriero project has been registered in National Forest Directorate even before planted. The project is very well known by this agency from the Ministry of Livestock, Agriculture and Fisheries which mandates the presentation of the details of the project: where it is being implemented, species planted, management, which are the soils being used and much etcetera's. Not only the Ministry of Livestock but also the Ministry of Environment must also be notified and both Ministries needs to give their approval in order to start any activity on the field. Both approvals have been obtained since a long time, meaning that the project complies with all the environmental and social regulations.

In this way, it is shown that 'El Arriero' does not generate a risk for the environment where it is present.

2.2 Local Stakeholder Consultation

Cambium Forestal Uruguay, has a "SOCIAL MANAGEMENT PLAN" in which is describe the relationship of the company with the stakeholders near the project activity.

The people in charge of maintaining a good relationship with the stakeholders are the Supervisor and the Area Manager of El Arriero. Both are primarily responsible for communications and relations with neighbours, community representatives and institutions.

It is part of the role of the Head of Area and the Supervisor to have good relations with the community. This is achieved in part with good "day-to-day" communication with stakeholders. Also, all the meetings, interviews or any other approaches made, must be record, especially with the Development Commissions, schools, relevant actors of a community or direct neighbours.

In these meetings, it is important to inquire about:

- Eventual impacts generated by the operations carried out within the equity managed by the company.
- Eventual requirements that the community may have. These requirements may include requests for water, grazing, firewood extraction, beekeeping, training in various subjects, visits to forestry operations, etc.

For Cambium it is important to handle and respond to all complaints correctly and within reasonable timeframes. An unanswered complaint or claim can become a major problem in the future.

The responsibility of keeping the records of complaints or claims, and the letters when appropriate, falls on the respective Head of Area.

Information that the company delivers to the neighbour and institutions in its area of influence can be informative material (brochures, etc.), or orders from Cambium to third parties. By way of example, the following can be mentioned:

- Presentation of the area chief or supervisor to the community or neighbour when new fields are acquired to be managed.
- Delivery of Summary Management Plan, brochures, other types of graphic materials
- Requests from the company to the neighbour to solve a problem that is causing the company
- Other

In addition, El Arriero has a FSC certification. For the certification of FSC, the FSC carried out a consultation with stakeholders related to the project, evaluating their conformity. Through this consultation, it is confirmed that the project complies with the FSC principles such as the environment, legal, social, or economic requirements.

The FSC consults local and national governmental and non-governmental organizations (NGOs) involved in forest management, as well as individuals and members of communities directly affected by forest management.

It is important to mention that for the monitoring report of the 'El Arriero' project, no comments or complaints were received from the stakeholders during the consultation period.

2.3 AFOLU-Specific Safeguards

As it has been stated before, Forestal 'El Arriero' project has FSC certification⁸ and therefore is committed and has proven to have no negative impacts on the local stakeholders or the environment.

Cambium, the company in charge of the 'El Arriero' project, has created a 'Social Management Plan' which details the actions that the company will take to reduce the impact of the project in the area of influence. The objectives of the plan are:

- Evaluate the social impact of project operations and establish preventive or mitigating measures to reduce the impact
- Establish a communication channel with stakeholders
- Identify those responsible for the resolution of the possible negative impacts of the projects

⁸ <https://info.fsc.org/details.php?id=a0240000005sSGJAA2&type=certificate#result>

- Define roles within the company structure
- Establish procedures to deal with community demands

For this reason, Cambium defines that in order to achieve greater efficiency of the 'Social Management Plan', there must first be a continuous and permanent contact of the Supervisor and Head of the Project Area with the stakeholders. In addition, they must identify the main negative social impacts that the different project activities may present in order to mitigate or prevent them.

In this way, Cambium has identified the possible activities of the project that can generate a negative social impact on the stakeholders.

These activities are:

- pesticide application
- waste burning
- harvest or commercial thinning
- round wood transport
- works on public roads

These activities generate an impact on the stakeholders since they generate concern about the contamination in the nearby water courses, damage to the bees, intoxication of the workers who apply pesticides, damage to the properties of the neighbours due to the burning and even inconvenience due to the nuisance smoke. Due to these concerns on the part of stakeholders, Cambium decides to address these impacts through an assessment and take action. The evaluation consists of:

1. Identify and evaluate with the stakeholders (such as: the president of the promotion commission, teachers, those in charge of the polyclinics, neighbours, others) the impacts of these activities
2. Then it is analysed what preventive or mitigating measures can be implemented
3. The Area Manager is informed of the measures taken
4. Lastly, regular contact is maintained with stakeholders to assess the effectiveness of the measures.

It is important for Cambium that stakeholders participate in the identification and evaluation of impacts and their corresponding measures to mitigate the impact, since this allows the stakeholder to have the opportunity to contribute or resolve their doubts and that the measures taken to mitigate the impact are agreed between all parties.

Once an agreement is reached to mitigate the impacts of the aforementioned activities, the Project Supervisor must inform the stakeholders of the activity to be carried out with its corresponding scope and ways of working of the activity to be developed. Then you should explain the preventive measures that will be carried out for this activity. Lastly, the Area Chief must communicate the concerns and actions agreed upon with the community.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

Forestal 'El Arriero SRL' first areas were planted in 2009 and the last ones in 2011. The project has recently completed its 12th year. The forests had already had one thinning operation in the third year. Forest planted in year 2009 had already had two pruning operations, the first one at 3m height and the second at 4.80 m height. Practically all forest plantations realized in 2010 had already had two pruning, the second at 4,80m height, the area that is not pruned at 4,80 m height had already been pruned at 3m. Forests planted in year 2011 had already had one pruning at 3m height.

As has been stated in the project description (PD), the methodology identifies activity displacement as the only potential source of leakage (conversion from grazing land to forestry). As it was demonstrated during validation, the project implementation does not and did not cause any displacement of activities. The only activity in the project area prior to the start date is extensive grazing by beef cattle, which continues to occur after project start. This can be audited by the verification team during remote verification and validation.

The information related to the non-permanence risks of the project is presented in a separate document called "Non-Permanence Risk Report".

3.2 Deviations

3.2.1 Methodology Deviations

There are no methodology deviations

3.2.2 Project Description Deviations

In this latest monitoring report, the long-term average (LTA) was updated based on the latest inventory and a national online growth simulation tool (SAG)⁹ for *Pinus taeda*. New growth was projected through this tool for each forest age and then averaged to obtain a single value for each year of growth. Although the estimated final volume remained the same, the LTA was updated to 2,186,749 tCO₂e, due to improvements in the shape of the growth curve.

However, since the validation of the project there have been different deviations from the 'El Arriero' project that were mentioned in previous monitoring reports.

In the monitoring report carried out in 2013, it is mentioned that the project had a deviation with respect to the original area of the project, going from 5,377 ha to 4,987 ha. This area difference is explained due to the improvement of the geographic information system that detects area changes that were not identified with the previous technology. With the geographic information systems, minor errors were identified in the shapefiles of the forest plantations that led to the reduction of the project area. It is worth mentioning that this is not a reduction in the limits of the project but a reduction in the plantation area.

On the other hand, in the second verification of the 'El Arriero' project, the project had a deviation with respect to the forest area, going from 4,987 ha to 4,567 ha. This was due to the fact that the 'Obdulio'

⁹ More information on the tool:

Cecilia Rachid Casnati, Andrés Hirigoyen. 2015. «SAG taeda»: Sistema de Apoyo a la Gestión de plantaciones de Pinus taeda. INIA. Serie Técnica N° 224.

Access to tool:

<http://www.iniaforestaluy.com/sag/ingreso.aspx>

field/stratum was not approved by DINAMA, so the plantation area that would be destined for the 'El Arriero' project had to be discounted. It is worth mentioning that this does not imply that the limit of the project was reduced, but rather that there was a reduction in the area destined for forest plantations.

3.3 Grouped Projects

Forestal 'El Arriero SRL' afforestation on degraded grasslands under extensive grazing is a single GHG Project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	A_i
Data unit	ha
Description	Area of stratum i
Source of data	Monitoring of strata and stand boundaries is done using a Geographical Information System (GIS) which allows for integrating data from different sources (including GPS coordinates and Remote Sensing data)
Value applied	Variable depending on stratum
Justification of choice of data or description of measurement methods and procedures applied	A description of the measurement methods is available upon request in Cambium Forestal.
Purpose of Data	Determination of baseline scenario, calculation of baseline emissions and Calculation of project emissions

Comments	GPS is the most important tool used for measuring geographical variables or parameters: project boundaries and predefined stratum boundaries, forest area, area of disturbances (fires, droughts, harvesting, etc.). All information collected is immediately integrated to the GIS. Each plot coordinates are charged on the GPS before the field visit in order to reach the exact location of each sample plot. The operator selected on the GPS the following steps: “Destiny > Waypoints”. The waypoint of interest is selected by pressing “Go”. Exact procedures to locate plots on field are described in the Terms of Reference described in chapter 3.3 Monitoring Plan.
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Data / Parameter	$BEF_{2,j}$
Data unit	Dimensionless
Description	Biomass expansion factor for conversion of stem biomass to above-ground biomass for tree species or group of species j
Source of data	IPCC default values (e.g., Table 3 A.1.10 of IPCC GPG-LULUCF 2003)
Value applied	From 1.15 to 3.4, depending on the tree age
Justification of choice of data or description of measurement methods and procedures applied	The values applied are the unique source of information for such variable. No local or national values exist.
Purpose of Data	Estimation of aboveground biomass carbon content
Comments	N/A

Data / Parameter	CF_j
Data unit	t C t ⁻¹ d.m.
Description	Carbon fraction of tree biomass for species or group of species j
Source of data	The IPCC default value of 0.5 t C t ⁻¹ d.m.
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	The values applied are the unique source of information for such variable. No local or national values exist.
Purpose of Data	Determination of baseline scenario, calculation of baseline emissions and Calculation of project emissions
Comments	N/A

Data / Parameter	D_j
Data unit	t d.m. m ⁻³
Description	Basic wood density for species or group of species j
Source of data	IPCC 2003. Table 3 A.1.9-1 Basic wood densities of stem wood
Value applied	0.44
Justification of choice of data or description of	The value is from a reliable source of information and coherent with national values

measurement methods and procedures applied	
Purpose of Data	Determination of baseline scenario, calculation of baseline emissions and Calculation of project emissions
Comments	N/A

Data / Parameter	R_j
Data unit	Dimensionless
Description	Root-shoot ratio for species or group of species j
Source of data	Tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs"
Value applied	Ranges from 0.2 to 0.4 as a result of the equation suggested in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs" (see section 5.2). The values depend on the aboveground biomass as input (specific values are presented in the ex-post carbon estimations), therefore as the trees grow and accumulate biomass the parameter is updated with the equation.
Justification of choice of data or description of measurement methods and procedures applied	The values applied are the unique source of information for such variable. No local or national values exist.
Purpose of Data	Determination of baseline scenario, calculation of both baseline and project emissions

Comments	The equation used to obtain R is in chapter 4.2 of this Monitoring Report
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Data / Parameter	$V_{TREE_{j,p,i}}$
Data unit	m ³
Description	Stem volume of trees of species or group of species j in plot p in stratum i
Source of data	Local Growth Models
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Value used to determine the project ex – ante carbon sequestration
Comments	In case of ex-ante calculation, growth was estimated based on average growth according to specific site conditions presented in the project site. Local growth models were used for ex-ante estimation to describe the yield curve and determine the Long-Term Average of available carbon credits. Local growth models will not be used for ex-post estimation which were based on field measurements: tree's DBH and height

Data / Parameter	SOC_{REF}
Data unit	t C ha ⁻¹

Description	Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation, normally forest by climate region and soil type applicable to stratum i of the areas of land under High Activity Clay soils (HAC)
Source of data	Table 3 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities.
Value applied	88
Justification of choice of data or description of measurement methods and procedures applied	There are no local, regional, or national values for that variable.
Purpose of Data	Used to estimate the carbon sequestration in soils (Determination of baseline scenario, calculation of baseline emissions and Calculation of project emissions)
Comments	N/A

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; dimensionless
Source of data	Tables 6 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities.
Value applied	1

Justification of choice of data or description of measurement methods and procedures applied	There are no local, regional, or national values for that variable.
Purpose of Data	Used to estimate the carbon sequestration in soils (Determination of baseline scenario, calculation of baseline emissions and Calculation of project emissions)
Comments	N/A

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, dimensionless
Source of data	Table 6 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities.
Value applied	0.95
Justification of choice of data or description of measurement methods and procedures applied	There are no local, regional, or national values for that variable.
Purpose of Data	Used to estimate the carbon sequestration in soils (Determination of baseline scenario, calculation of baseline emissions and Calculation of project emissions)
Comments	N/A

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	Tables 6 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities.
Value applied	0.7
Justification of choice of data or description of measurement methods and procedures applied	There are no local, regional, or national values for that variable.
Purpose of Data	Used to estimate the carbon sequestration in soils (Determination of baseline scenario, calculation of baseline emissions and Calculation of project emissions)
Comments	N/A

Data / Parameter	Dead Wood
Data unit	t C ha ⁻¹
Description	Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass
Source of data	Tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”

Value applied	8% of carbon stock in trees biomass
Justification of choice of data or description of measurement methods and procedures applied	There are no local, regional, or national values for such pool in this type of forest
Purpose of Data	Determination of baseline scenario, calculation of baseline emissions and Calculation of project emissions
Comments	N/A

Data / Parameter	Litter
Data unit	t C ha ⁻¹
Description	Conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass
Source of data	Tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”
Value applied	4% of carbon stock in trees biomass
Justification of choice of data or description of measurement methods and procedures applied	There are no local, regional, or national values for such pool in this type of forest
Purpose of Data	Determination of baseline scenario, calculation of baseline emissions and Calculation of project emissions
Comments	N/A

4.2 Data and Parameters Monitored

Data / Parameter	A_i
Data unit	ha
Description	Area of stratum i
Source of data	Monitoring of strata and stand boundaries was done using a Geographical Information System (GIS)
Description of measurement methods and procedures to be applied	Strata areas were measured based on cartography documents, related with GIS.
Frequency of monitoring/recording	Every time the project boundaries are modified, when disturbance events take place, the project participants shall re-build the stratum and add the area of the project under disturbance in the GIS.
Value monitored	4,567
Monitoring equipment	Garmin GPS, model eTrex Legend.
QA/QC procedures to be applied	N/A
Purpose of the data	Determination of baseline scenario, calculation of baseline emissions and Calculation of project emissions
Calculation method	N/A
Comments	As stated in the PD, Cambium Forestal SRL is the manager of Forestal 'El Arriero SRL' and continuously monitors the area of the forest plantations

Data / Parameter	<i>DBH</i>
Data unit	cm
Description	Diameter at Breast Height of tree
Source of data	Field measurements
Description of measurement methods and procedures to be applied	DBH is measured at 1.3 m above ground, over the bark. In case of stem deformation at this level, measurement was done over the deformation once the stem took its normal shape, with the purpose of being conservative. DBH was measured in all trees within the plots.
Frequency of monitoring/recording	Every tree within sample plots
Value monitored	3,707 values in 14 strata in 124 plots
Monitoring equipment	A diametric tape for measuring DBH. 

QA/QC procedures to be applied	A quality control procedure consisted in staff member periodical training. The staff members were trained to make DBH measurements without errors: using firstly a measuring tape (to determine exactly where 1,3 meters height is located in their own bodies). Afterwards, they measured DBH in front of experts and member's staff to achieve procedure consistency. Instruments were checked and tested before starting the verification process. Items checked: Correct visualization of numbers in the measuring tape. Lack of mechanical problems. The measuring tape length is not a problem since it is impossible that it stretches. Bark that was not stuck to the stem was removed before measuring. 10% of the plots were measured by a second party
Purpose of the data	Calculation of project removals
Calculation method	N/A
Comments	The trees are considered inside the plot if more than 50% of DBH is inside the plot. Exact procedure to measure this variable is described in the ToR for the quotation of consulting firms to perform the field measurements.

Data / Parameter	<i>H</i>
Data unit	m
Description	Height of trees within sample plot

Source of data	Field measurement
Description of measurement methods and procedures to be applied	Every tree inside the plot is measured in height The measurement was done according to the following procedure: Identification of the individual tree to measure. At the same level (independently that the measuring equipment corrects the value according to the slope). The expert always tried to be situated at a certain distance to the tree equivalent to the height of the tree.
Frequency of monitoring/recording	Every tree inside the plot
Value monitored	3,707 values in 14 strata in 124 plots
Monitoring equipment	Clinometer. See the following figure of the type of clinometer used during the monitoring events to measure tree heights. This image represents an electronic clinometer of Haglof, Sweden. 
QA/QC procedures to be applied	When referring to this electronic device, it is recommended to check the correct visualization of the display. The clinometer was always kept in safe places in order to avoid display rupture. The equipment batteries were always in full charge and back up batteries were always available in case of emergency. Control measurements were made using all involved equipment (human error should be minimized at minimum with well training and cross-checked control measurement activities). 10% of the sampling plots were measured by another party.

Purpose of the data	Calculation of project removals
Calculation method	N/A
Comments	N/A

Data / Parameter	Ap_i
Data unit	m ²
Description	Area of sampling plot
Source of data	Field measurement
Description of measurement methods and procedures to be applied	The centre of the plot was marked with the assistance of a GPS. One staff member stayed at the centre of the plot taking notes of the diameters and heights measured while the other expert of the team walked inside the plot measuring them. Both experts were always connected with a measuring tape, and every tree measured was previously checked to determine if the distance to the centre was minor to 12.62 m (radius of a circular plot of 500m ²).
Frequency of monitoring/recording	Every plot measured in El Arriero, 124 in total
Value monitored	500m ²
Monitoring equipment	Measuring tape
QA/QC procedures to be applied	In order to avoid over and under-estimations, every tree was considered inside the plot when the mark of 12.62 m overpassed the 50% of the diameter of every tree.

Purpose of the data	Calculation of project removals
Calculation method	$500m^2 = r^2 * (12.62) * \pi$
Comments	Sample plots are permanent and circular. The plots were laid down in a shapefile, positioned systematically with a random start. The location of the plots within the forest plantation was done with a GPS. The area of each plot is not a variable but a fixed value but must be measured by its radius in order to determine the variable "number of trees within the plot".

4.3 Monitoring Plan

The aim of the Monitoring Plan is to record and monitor the necessary parameters to ensure that the project followed the corresponding methodology in the validated and registered PD and that the inputs to the carbon calculations are both accurate and up to date.

Monitoring was done according to the consolidated methodology AR-ACM 0001 "Afforestation and reforestation of degraded lands" (version 05.2.0, EB 65). The PD was registered mentioning the version 5.1.1 of the referred methodology, but the applicable version is the one stated above. Analysis of its applicability conditions have been developed in section 2.2 of the PD.

Monitoring stage comprised gathering information, performing calculations, and making estimations of GHG removals. In this monitoring event, it is ensured that commonly established principles of forest inventory and management were put into practice with the elaboration of a Monitoring Plan. Strictly speaking the document is called "Terms of Reference" (used in an open tender to receive monitoring services quotations) but it is used as a Monitoring Plan. This Monitoring Plan is a document prepared by Climit with the purpose of specifying the procedures and standardization for the measurement of each variable. This document is in Spanish. A summary of it was redacted to prepare the Terms of Reference of a tender. El Arriero presented the terms of reference to "Bosque Servicios Forestales" which is permanently working for Cambium Forestal. They were hired to perform the service.

All data gathered as part of the monitoring plan was archived electronically and will be kept at least for two years after the end of the crediting period.

According to the methodology applied, monitoring covered carbon stock changes for living above-ground. Below ground biomass was estimated indirectly based on above-ground biomass measurements and litter and dead wood were finally estimated as a percentage of carbon stock in tree biomass.

Monitoring event took place between November 11th, 2021, and December 17th, 2021. The third party involved in this stage was "Bosque Servicios Forestales," a Uruguayan consultancy and services company, specialized in forest inventories.

Bosque Servicios Forestales' staff was compound by 4 people during the monitoring events. They worked divided in two groups: 4.

With the purpose of controlling and checking the measurement equipment and measuring team capabilities, an independent monitoring group was requested to measure 10% of the plots.

Sampling design and stratification

Project boundaries were defined at the beginning of project activity and the same geographic boundary will be maintained, according to VCS AFOLU requirements. However, the project area will be permanently monitored along the crediting period, since new strata may be created after potential disturbances effects (pests, droughts, fire). There have been updates to the project area which have been disclosed in this document and described in more detail in previous monitoring reports.

Geographic coordinates are established, recorded, and archived. A Geographic Information System was implemented for the validation and is updated for verification. All the geographical information will be available for the verification team.

With the purpose of developing the monitoring plan, Forestal 'El Arriero SRL' was classified into 14 strata. Stratification was done considering region; age class (plantation date); and species planted (*Pinus taeda* and Hybrid pine *P. caribea x elliotti*). The project boundaries suffered no disturbances and the strata remained unaltered even when insignificant intra-stratum variability was detected in some strata, meaning that the number of strata was found to be higher than needed. The first verification resulted in a measurement error of less than 3% and new estimations indicated that the number of plots could be reduced to less than 60 (instead of 124). El Arriero decided to maintain the number of strata and plots to ensure the error of estimation was minimal, even if it was much lower than required.

Permanent sampling plots are selected since these are considered more efficient for estimating changes in carbon stocks by filtering out any variance due to plot effect. The plots allocation is registered in a GIS and can always be located. The plots were established at the field with a stick painted in blue at the centre of the plot, every tree at the beginning or end of every row is also painted in blue (with its number in the plot). These marks are proved to be seen after four or five years.

The location of the plots followed the guidance given by the corresponding methodological tool, as well as IPCC Good Practice Guidance for LULUCF (2002), chapter 4.3. The points for the permanent sampling plots were generated at random within the planted areas in the Geographic Information System. The map with the location of the sampling plots was loaded on the GPS receptors used by forest inventory crews, so that they can reach the plots accurately. An example of the software output for two contiguous strata is shown in *Figure 7*.

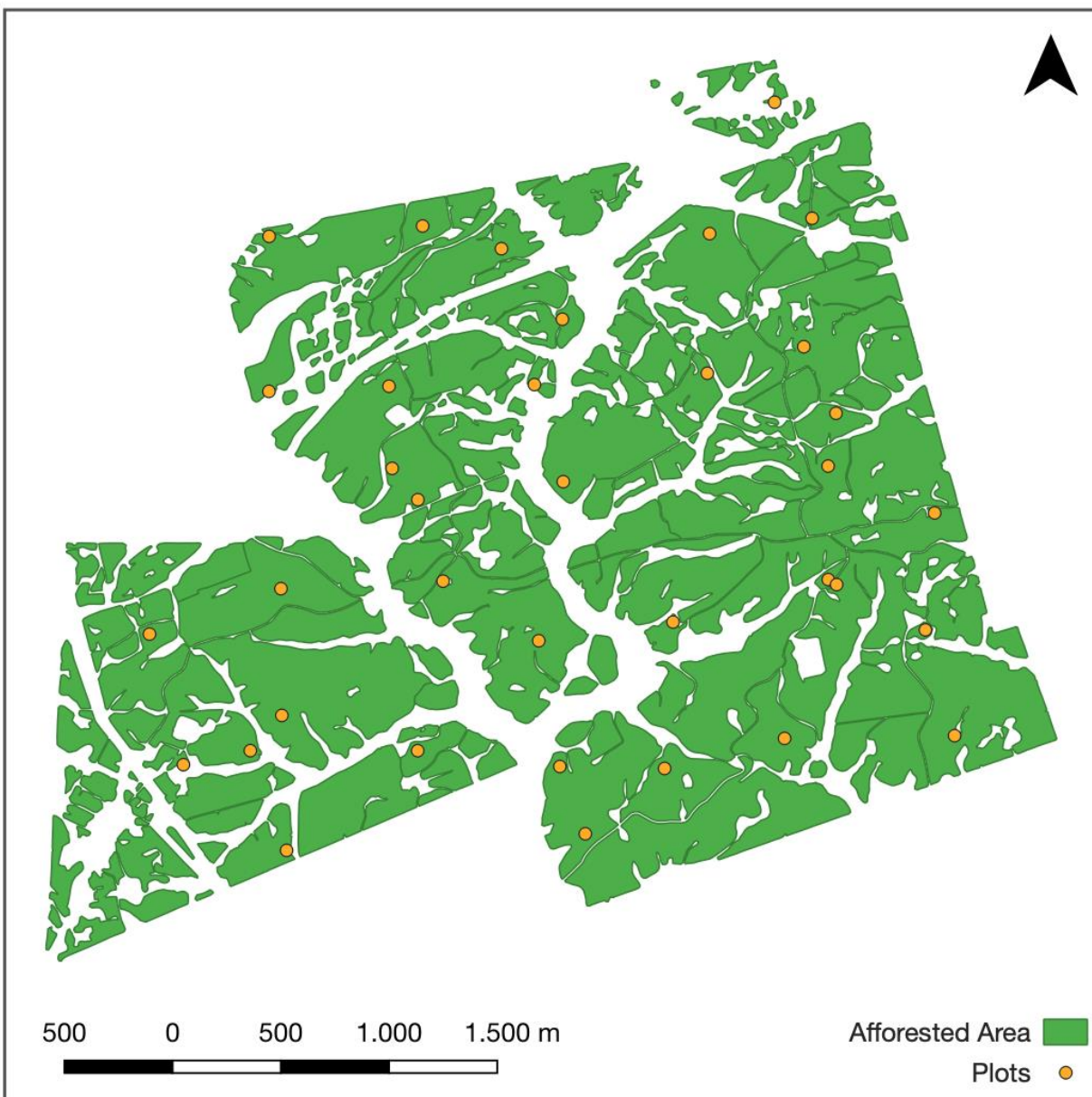


Figure 7. Example of location of permanent sampling plots.

Above ground carbon pool was measured following the methodology procedures and IPCC Good Practice Guidance for LULUCF (2003) established in the PD and Monitoring Plan. Carbon stocks in above ground biomass of trees are estimated by applying the BEF method, which calculates the biomass of trees of each species per unit area in each stratum at a given point of time, based on the following three dimensions: diameter at breast height (DBH), basal area and height, obtained from field measurements. By applying the BEF method, volume equations are used to convert tree dimensions to stem volume of trees based on DBH and height measurement in each plot. Stem volume of trees is then converted to above-ground and below-ground tree biomass using basic wood density (D) and root-to-shoot ratio (R). Default carbon fraction (CF) value was used to estimate the carbon stock.

Prior to the start of the inventory, all equipment used during field work was checked and calibrated.

Managing data quality

A Quality Control System will be implemented for routinely checking for data consistency, correctness, and completeness; for identifying and correcting errors and omissions; and for properly documenting and archiving data and documentation related with the monitoring activities. Quality Assurance measures will be implemented, to verify that data quality objectives are met, and in general, to support the effectiveness of the QC system.

QA/QC plan includes various activities aiming at achieving accuracy and precision of data, and transparency of procedures, such as:

- development of Monitoring Plan for field measurements, clearly defining all staff responsibilities and raising awareness about the importance of each task for producing reliable results.
- proper training of field measuring teams as the training all staff's members received prior to the field data collection.
- periodical check and maintenance of measuring instruments; all mechanical, optical, and electronic instruments were periodically checked by qualified personnel. In addition, consistency on field data will be permanently monitored, to detect any malfunctioning. The equipment was calibrated periodically. The calipers, diameter and meter tapes were weekly contrasted with a master tape.
- collection of information directly in electronic format to avoid errors when passing information from paper to computers.
- fully document and archive field and processed data, as well as all procedures used; to ensure data preservation, all relevant data, data analyses, static factors, photos, images, GIS output and other data shall be stored in electronic and paper format. The information is kept in servers which are weekly backed up in an external drive.
- establish procedures for eliminating inconsistent or erroneous field data; perform random checks of field measurements in order to detect measurement errors or systematic biases; some of such measures were: 1) during field work 10% of measurements were carried out by an independent party; 2) establish procedures to ensure representativeness of PSPs (i.e., if a plot was located in a non-representative area, the plot was relocated some few meters until finding a representative area); the allocation of samples in the field will be systematic with random start, so, the differences between population and sample mean and variance tend to be neutralized; identification of plots in the field are coded and recognizable only to the monitoring team

Operational and management structure

The monitoring was coordinated by the property manager and implemented by a qualified contractor. One staff member of Forestal 'El Arriero SRL' was identified as the focal point.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Since the baseline scenario that has been selected corresponds with the continuation of an activity that has been taking place without changes for more than 20 years, it is assumed, in agreement with IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry (2003), that the net GHG removals by sinks in the baseline equals zero.

5.2 Project Emissions

Forestal 'El Arriero SRL' project activity does not have GHG emissions. However, this chapter refers to the removals of GHG performed by this project activity.

Net anthropogenic GHG removals by sinks is estimated as the actual net GHG removals by sinks minus the baseline net GHG removals, minus leakage. The following general formula described in the methodology is used to calculate the net anthropogenic GHG removals by sinks of an A/R project activity, in t CO₂-e:

$$C_{AR-CDM} = \Delta C_{ACTUAL} - \Delta C_{BSL} - LK$$

Where:

C_{AR-CDM} Net anthropogenic GHG removals by sinks; t CO₂-e.

ΔC_{ACTUAL} Actual net GHG removals by sinks; t CO₂-e.

ΔC_{BSL} Baseline net GHG removals by sinks; t CO₂-e.

LK Total GHG emissions due to leakage; t CO₂-e.

The actual net greenhouse gas removals by sinks were estimated using the following equation described in the methodology:

$$\Delta C_{ACTUAL} = \Delta C_P - GHG_E$$

Where:

ΔC_{ACTUAL} Actual net greenhouse gas removals by sinks; t CO₂-e.

ΔC_P Sum of the changes in above-ground and below-ground tree biomass, dead wood, litter, and soil organic carbon stocks in the project scenario; t CO₂-e.

GHG_E Increase in GHG emissions because of the implementation of the proposed A/R CDM project activity within the project boundary; t CO₂-e.

The following formula described in the methodology is used in order to estimate GHG emission:

$$GHG_E = \sum_{t=1}^{t^*} GHG_{E,t}$$

Where:

GHG_E	Increase in GHG emissions as a result of the implementation of the proposed A/R CDM project activity within the project boundary; t CO ₂ -e.
$GHG_{E,t}$	Increase in non-CO ₂ emissions due to biomass burning of existing vegetation as part of site preparation in year t; t CO ₂ -e.
t	1,2,3, t* years elapsed since the start of the A/R CDM project activity.

The tool for “Estimation of non-CO₂ GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity” has been considered. The use of fire for site preparation and/or to clear the land of harvest residue prior to replanting is specifically excluded from the project management and therefore project emissions are estimated as zero.

Carbon stock changes

ΔC_P is the sum of the changes in above-ground and below-ground tree biomass, dead wood, litter, and soil organic carbon stocks in the project scenario. In the ex-ante estimation, all pools were accounted for. Following is presented the equation for the estimation of ΔC_P . Calculations are described below.

$$\Delta C_P = \Delta C_{TREE} + \Delta C_{LI} + \Delta C_{SOC}$$

Where:

ΔC_P	Change in carbon stock in all selected carbon pools in the project scenario, t CO ₂ -e.
ΔC_{TREE}	Change in carbon stock in tree biomass in project, 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.
ΔC_{DW}	Change in carbon stock in dead wood biomass in project, 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.
ΔC_{LI}	Change in carbon stock in litter biomass in project, 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.
ΔC_{SOC}	Change in carbon stock in SOC in project, 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.

Biomass carbon pools

Above and below ground biomass have been estimated according to the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activity.” Carbon estimations in trees are based on field measurements of monitored parameters, chapter 3.2 of the Monitoring Report. Estimations are archived as part of the project verification and will be available for the verification team.

The aboveground biomass corresponds to tree biomass, no shrubs are considered for estimation. The method used for estimating change in carbon stock in trees is the “stock change method”. Change in

carbon stock in trees in two successive points in time is calculated as the difference between the two estimated stocks. As this is the first monitoring report the carbon values in every pool is the result, the starting point of the crediting period is zero carbon.

As in ex-ante estimations, the following equations were used in order to estimate above and below ground biomass ex-post measurements:

$$B_{TREE_{j,p,t,i}} = V_{TREE_{j,p,t,i}} * D_j * BEF_{2,j} * (1 + R_j)$$

Where:

$B_{TREE_{j,p,t,i}}$ Biomass of trees of species j in sample plot p of stratum i in late 2021

$V_{TREE_{j,p,t,i}}$ Stem volume of tree species using field measurements of tree parameters (DBH and height), default values (tree shape factor) and complemented with worksheets data processing (interpolation of not-measured heights); m³.

The applied equation for volume estimation is no other formula than the cylinder volume equation corrected by a taper value (TSF):

$$V_{TREE} = Basal\ area * Height * TSF$$

Where:

$$Basal\ area = \frac{\pi * DBH^2}{4}$$

DBH: Diameter at Breast Height

TSF: Tree Shape Factor

According to the methodology, for ex post estimation, the volume equation used must be demonstrated to be appropriate for the purpose of estimation of tree biomass by applying the tool “Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A/R CDM project activities”. The appropriateness of the equations is demonstrated through the satisfaction of the following condition, in the sense that the formula is very generic and applicable in any case:

The equation has been used in the commercial forestry sector in Uruguay for 10 years or more.

During the first and second verification event, PP decided to use other TSF values. These new values correspond to real TSF values obtained by tree age, by Cambium. A document containing explanations about the procedures followed in order to obtain these values is attached to this sheet.

The tree shape factor values used in El Arriero carbon stock calculations figure in table 3.

Table 3. Tree Shape Factor (TSF) values for pines by DBH developed by PRAIF based on a site study (Sorrentino, 1993)¹⁰.

DBH (cm)	TSF
<20	0.50
<25	0.47
<30	0.46
<35	0.46

D_j : Basic wood density of tree species j. The species j corresponds to the only species used in this project: Pinus sp., with a basic density of 0,44 t.d.m./m³. This parameter was established as “available at validation” in the Project Design, thus it was not measured or monitored. The value was obtained and corresponds to default value for Pinus pinaster in IPCC LULUCF Good Practice Guidance (2003), Table 3A.1.9-1

(http://www.ipccnggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Chp3/Anx_3A_1_Data_Tables.pdf).

As also established in the validation report, the applied value is also mid-range in values for loblolly pine wood density published by Oregon State.

BEF_{2j} : Biomass expansion factor for conversion of stem biomass to above-ground tree biomass, for tree species j (Pinus sp.); dimensionless. The BEF_2 is to be used in connection to grow stock biomass data and not with increment data, as described in chapter 3.2 of the GPG for LULUCF (2003)). The value was also available at validation and not monitored, it ranged from 3.4 (for young forest) to 1.34 (9 years old forests) and the exact values applied for different plantation dates are reported in the final worksheet for carbon stock calculation. These values were calculated using a model (Sanquetta et al. 2011)¹¹ based on the age of the trees; the equation is as follows:

$$BEF = 3.287 * AGE^{-.3684}$$

R_j : Root-shoot ratio for tree species j; dimensionless. The values applied were taken from the suggested equation from the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs":

$$R = \frac{e^{-1.085+0.9256 \cdot \ln(A)}}{A}$$

¹⁰ Capítulo VI - Alternativas regionales para la producción forestal integral: Cuadro 6.7. Factores de Forma de las Especies de Eucalyptus y Pinus
<http://www.oas.org/dsd/publications/Unit/oea20s/ch08.htm>

¹¹ Sanquetta et al.: Biomass expansion factor and root- to-shoot ratio for Pinus in Brazil. Carbon Balance and Management 2011 6:6. doi:10.1186/1750-0680-6-6

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3196695/pdf/1750-0680-6-6.pdf>

Where A is aboveground biomass content (t.d.m/ha). The aboveground biomass was calculated per year of plantation and different values were obtained. See table 4 with the results of the estimation.

Table 4. Aboveground biomass and R values estimated by year of plantation.

Year of plantation	Aboveground biomass (t.dm/ha)	R estimated based on the aboveground biomass measurement (dimensionless)	R used for ex-ante estimations in and approved in validation
2009	187.3	0.230	0.254
2010	197.4	0.232	0.248
2011	167.2	0.235	0.251

Finally, the carbon stock in tree biomass within the project boundary is estimated as follows:

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

Where

C_{TREE} Carbon stock in tree biomass within the project boundary; t CO2-e.

B_{TREE} Biomass of trees within the project boundaries.

CF_{TREE} Carbon fraction of tree biomass; 0.5 t C td.m-3.

Soil organic carbon

Estimates of soil organic carbon (SOC) stocks were done in accordance with the “Tool for the estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activity”. As suggested by the tool, it is assumed that the implementation of the project activity firstly decreases the SOC content of the lands from pre-project level, due to the site preparation.

Afterwards, the SOC increases to the level that is equal to the steady-state SOC content under native vegetation. The increase in SOC content in the project scenario takes place at a constant rate over a period of 20 years from the year of planting. The project meets the applicability conditions of this tool - as demonstrated in validation- since the areas of land to which the tool is applied do not fall into wetland category, do not contain organic soils and are not subject to any of the land management practices and application of inputs listed in the tool.

Litter remains on site and is not removed, and soil disturbance is in accordance with appropriate conservation practices, limited to site preparation and not repeated within 20 years.

Table 5. Parameters used for estimation of Soil Organic Carbon (SOC)

Parameter	Symbol	Value	Source (SOC estimation tool, V01.1.0)
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Reference SOC (tC/ha)	$SOC_{REF,i}$	88	Table 3. HAC soils, warm temperate, High Activity Clay soils
Reference SOC (tC/ha)	$SOC_{REF,i}$	63	Table 3. HAC soils, warm temperate, Low Activity Clay soils
Land use factor	$f_{LU,i}$	1	Table 6. All permanent grassland
Management factor	$f_{MG,i}$	0.70	Table 6. Severely degraded grassland. Lands are identified as degraded lands using the “Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities”
Input factor	$f_{IN,i}$	1	Table 6. Grassland without input of fertilizer

The correspondent carbon sequestration calculation is presented to the verification team in the total carbon stock estimation worksheet.

Litter and Dead Wood

Estimations were done in accordance with the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities” using a default and conservative value of 8% and 4% of carbon stock in tree biomass for dead wood and litter respectively.

5.3 Leakage

Application of the tool “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity” led to the conclusion that this source of leakage (conversion from grazing land to forestry) is negligible.

Through the application of the “Guidelines on conditions under which increase in GHG emissions related to displacement of pre-project grazing activities in A/R CDM project activity is insignificant”, which is one of the applicability conditions of the tool, the resulting conclusion was that the project will not cause any displacement of the activity occurring before project implementation. The project meets the stated conditions (b) and (d) as follows:

(b) The total area displaced corresponds to the total area of the project 4,567 ha, meaning that the grazing area displaced is 100% and more than 50 ha, then the value “ $n - a$ ” (where “ n ” is the area in hectares expected to be displaced and “ a ” is 5% of the total project area or 50 ha) is 4,567 – (0.05*4,567) = 4,338.7. This area, used for grazing cattle, can be identified as degraded.

(i) The grazing cattle displaced by Arriero's project were relocated to neighbouring areas. It was already demonstrated that the project areas are degraded or degrading due to overgrazing, and because the grazing animals were moved to neighbouring zones, the same conditions apply to the soil.

(ii) Moreover, the animals were displaced only for 2 to 3 years and have returned to the same site. The silvicultural management practice does not permit the animals to be grazing at the while the trees are small to avoid any physical damages. During the period of displacement, the grasslands to where the cattle go had the necessary carrying capacity, as seen in table 10 of the PD document. After 2 or 3 years the trees become big enough for the animals to be reintroduced, and now the project is at a stage in which there is no displacement whatsoever.

(d) The total number of animals expected to be displaced is more than 40 LSU, and the total number of animals expected to be displaced were displaced to the already mentioned areas (i and ii) or the remaining option (v): slaughterhouses. This is a common practice in the beef production systems in Uruguay.

Given all this, we believe the application of the tool “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity” is not necessary. The application of the “Guidelines on conditions under which increase in GHG emissions related to displacement of pre-project grazing activities in A/R CDM project activity is insignificant”, which was superseded by the previously mentioned tool, resulted in the conclusion that the project will not cause any displacement of the activity occurring before project implementation.

- It is worth noting that the afforested areas represent only about 45-50% of the total area owned by the project participant (lowlands, biological corridors, roads, rocky areas, settlements, among others, complete the rest of the land use). Also, Uruguayan grazing activity is completely compatible and even associated with forestry, for instance, during site preparation a high stocking rate of cattle, more than what is usual, is introduced within the project area during the prior months to help reduce the amount of above ground biomass to minimize the use of herbicide
- After the trees are big enough (about two years after planting) cattle are reintroduced and managed in a silvopastoral system with trees (both activities complement each other: the trees are managed for high-value sawlogs and, at the same time, provide shade and shelter for livestock and forage, reducing stress and increasing forage production). The impact of cattle displacement is reduced to two years over thirty-year rotation.
- Another important point to consider is that the total area under project activity is not afforested in the same year; plantation happened from 2009 to 2011.
- The impact of this staggered plantation plan substantially reduces the eventual grazing displacement each year.



Figure 8. Silvopastoral system in Uruguay

Cattle existing before the project commenced either stayed within project boundaries or in an area controlled by project participant or be sold to the market (calves and surplus heifers are normally sold in the market for fattening on other grazing areas, while cows, heifers and a reduced number of bulls are sold to slaughterhouses). It is El Arriero's policy that landowners can continue with their activities for a certain period after the purchase of the land, so that they have time to reduce the population of their cattle. In some cases, they may even stay in the land.

Furthermore, according to data gathered from governmental Livestock Controller Division (DICOSE) there has been a smooth increase in the beef cattle number of heads at a national level. On the other hand, according to data taken from National Forest Directorate (DGF) forest plantations have also been increasing for the same period. In addition, native forest has been also increasing in terms of area in the last 43 years at the National level. According to National Forest Inventory (2010) and to the forest maps based on aerial photographs of 1967 native forests have increased 21% in terms of area. The fact that total forest area and number of livestock have been increasing is evidence that project activity does not result in displacement of the previous productive system.

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO ₂ ee)	Project emissions or removals (tCO ₂ ee)	Leakage emissions (tCO ₂ ee)	Net GHG emission reductions or removals (tCO ₂ ee)	Buffer pool allocation	VCUs eligible for issuance
2018	0	170,372	0	170,372	17,037	153,335
2019	0	170,372	0	170,372	17,037	153,335
2020	0	170,372	0	170,372	17,037	153,335
2021	0	170,372	0	170,372	17,037	153,335
Total	0	681,488	0	681,488	68,149	613,339