Serra do Sudeste Landscape Restoration and Reforestation Project

Document Prepared by The Green Branch

Project Title	Serra do Sudeste Landscape Restoration and Reforestation Project
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Contents

1 PROJECT DETAILS

1.1 Summary Description of the Project

The **Serra do Sudeste Landscape Restoration and Reforestation Project** ('Project') is a VCS AFOLU (Agriculture, Forestry and Other Lands Use) project (scope 14) and falls specifically under the ARR (Afforestation, Reforestation and Revegetation) category.

The project goal is the reforestation of degraded lands, which would continue to remain degraded, and would become increasingly more degraded, in absence of the project. The project aims to restore natural biodiverse forest and produce crops through agroforestry in other areas. This is done through Assisted Natural Regeneration (ANR). A secondary goal is to expand in the region. In this case, the first farm will serve as a hub to be able to scale to adjacent farms and acquire more land to add to the project.

The project is located in Brazil – Municipality of Bagé, in the state of Rio Grande do Sul. The total area of the project is 1.037 hectares and is privately owned by the Titton family ('Owner'). An estimated **470 ha** is suitable for reforestation.

The farm has been used extensively for cattle ranching and has an average livestock load of 600 cows. As a result, the land has been rid of its vegetation and the soil quality is gradually decreasing. The environmental damage and the decline of economic viability of the business as usual, has caused the owner to consider a sustainable strategy. The goal is to develop a project that:

A) Sequesters carbon in a measurable predictable and verifiable way;

B) Is ecologically, socially and economically sustainable;

C) Is financially viable and profitable;

D) Can be monitored in a standardized and verifiable way;

E) Is scalable and easy implemented in similar conditions.

The project is expected to generate GHG emissions reductions through reforestation of degraded grassland. Biomass growth in the project area is expected to sequester. Also, following out the strategy a total of **256.313 tonnes of CO_2** is to be sequestered by reforestation of native forest. This results in an average annual amount of **8.544 tonnes of CO_2**.

The crediting period lasts **30 years** and runs from **March 1, 2021 to February 28, 2051.**

1.2 Sectoral Scope and Project Type

The **Serra do Sudeste Landscape Restoration and Reforestation Project** ('Project') is a VCS AFOLU (Agriculture, Forestry and Other Lands Use) project (scope 14) and falls specifically under the ARR (Afforestation, Reforestation and Revegetation) category.

The project will use the methodology AR-AMS0007 of the CDM methodologies.

1.3 Project Eligibility

The project is eligible for scope 14, AFOLU, for the following reasons:

1. It falls under the scope of Afforestation, Reforestation and Revegetation (ARR), because the aim is to plant new trees and agroforestry crops, whereas this would not be the case if not for the project.
2. The project has an Agricultural Land Management (ALM) component. This means the farmer must learn how to take care of the forest and get accustomed with the new practices.
3. Improved Forest Management (IFM) is reached by the strategy which implies management methods for the owner.
4. Reduced Emissions from Deforestation and Degradation (REDD) also applies as the project is designed to restore the degraded land and protect the area as a whole, including the parts that thus far have been spared from deforestation.

When the strategy is implemented and followed up according to the agreement with the owner, all frameworks apply, and the project is eligible for scope 14.

1.4 Project Design

The project is designed to follow multiple activities as described in section 1.3 Project Eligibility. The strategy will account for proper land use and management of the land used for native forests, as well as the land used for agroforestry and the land we protect. The strategy prescribed by the project holds in consideration all and whole practices that are needed to reach the goals of the project.

1.5 Project Proponent

Organization name	The Green Branch B.V.
Contact person	Kasper Kupperman
Title	Managing partner
Address	Marconiplein 16, Rotterdam (Netherlands), 3029AK
Telephone	+31 6 13411853
Email	k.kupperman@thegreenbranch.nl

1.6 Other Entities Involved in the Project

Organization name	Fazenda do Salsa Agricultura e Pecuaria LTDA
Role in the project	Landowner
Contact person	Martin Titton
Title	Shareholder
Address	Avenida da Cavalhada 5720, Porto Alegre (Brazil)
Telephone	+55 51 8423-8450
Email	martinbtitton@gmail.com

Organization name	PassiFlora Network VOF
Role in the project	Consultant
Contact person	Thomas Heger
Title	Consultant
Address	Rijnveste 37, Wageningen (Netherlands)
Telephone	+31 6 45 96 16 46
Email	thomas-heger@outlook.com

1.7 Ownership

TGB has rightful ownership of the project because of the following criteria, following the requirements of *VCS Standard v4.0*, for which evidence shall be presented:

1) A right of use arising or granted under statute, regulation or decree by a competent authority.

2) Project ownership arising under law.

3) An enforceable and irrevocable agreement with the holder of the statutory, property or contractual right in the land, vegetation or conservational or management process that generates GHG emission reductions or removals which vests project ownership in the project proponent.

The land is rightfully owned by the Titton family and is registered at SICAR (Sistema Nacional de Cadastro Ambiental Rural) under the CAR registry number: RS-4301602-B605.C62A.5737.4207.A2FD.0B75.631B.DF68 D. The receipt of this fact has been added in *Appendix 3: Recibo Inscrição CAR Bagé.*

TGB is in the process of signing a contract with the landowner, giving TGB the rights to be the project proponent and implementer of the project. Also, this document proves TGB to be the party who will be the rightful owner of the carbon credits which are produced under the project activities. All certified carbon credits will be issued to the account of TGB and registered in their name. TGB will negotiate the rights of these issued VCUs to the final beneficiaries. Payments for these rights will follow the terms and conditions of this contract as set out in the *Attachment A: Collaboration Contract.*

This contract gives TGB the competency to access the project site at all times in relation to the project activities. Also, it grants TGB all data, research and imagery needed for proper inspection and monitoring.

The project will follow all relevant laws, regulations and decrees as set out in *1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks.*

1.8 Project Start Date

The start date of the project is the first day of the project interventions. The autumn sowing begins in March and ends in May. The optimal time to start is thus **1 March 2021**. This is the date that we begin with the preparations and implementation of Assisted Natural Regeneration. According to the implementation planning, this will be done by the end of March or the beginning of April. From this point forward, the sequestration of carbon in the vegetation and soil will start.

1.9 Project Crediting Period

The crediting period will run from **1 March 2021** up to **28 February 2051**, totalling 30 years. A schedule of the crediting period is added in *Appendix 2: Implementation Plan.*

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	x
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2021	8887,0
2022	8887,0
2023	8887,0
2024	8887,0
2025	8887,0
2026	8887,0

2027	8887,0
2028	8887,0
2029	8887,0
2030	8887,0
2031	8887,0
2032	8887,0
2033	8887,0
2034	8887,0
2035	8887,0
2036	8887,0
2037	8887,0
2038	8887,0
2039	8887,0
2040	8887,0
2041	7857,4
2042	7857,4
2043	7857,4
2044	7857,4
2045	7857,4

2046	7857,4
2047	7857,4
2048	7857,4
2049	7857,4
2050	7857,4
Total estimated ERs	**256313,0**
Total number of crediting years	**30**
Average annual ERs	**8.544**

1.11 Description of the Project Activity

Porto Alegre Landscape Restoration and Reforestation Project is a reforestation project aiming to provide a sustainable alternative to cattle ranching and soybean cultivation. The project activity involves the conversion of a degraded cattle ranch in the Southern Brazilian state of Rio Grande do Sul towards a regenerative farming system. A large area of farmland that was previously used to grow soy and keep cattle will be reforested. These reforestation activities are part of a larger effort to provide a sustainable alternative scenario to the Business-as-Usual (BaU), which includes implementing sustainable grazing practices and an olive agroforestry system.

This pilot project is a first step in the implementation of a landscape wide reforestation initiative which will greatly increase the sustainability of the target landscape, both in terms of ecological sustainability as well as social and economic sustainability. The project will provide alternative income sources for farmers and create job opportunities while restoring a valuable ecotone, the transition area between the Atlantic forest and the Pampa. A table with all stakeholders and their position is shown in *Section 2.2* (*Table 3*).

By diversifying farm income, the project plan contributes to the resilience of the farm system. An olive orchard will be implemented, resulting in a long-term land use and the associated reduction in soil erosion. The cattle herd will be reduced in size from 600 to ca. 60 cattle and it will be placed strategically in the valley area on the property. This will reduce soil erosion drastically by removing grazing pressures on the erosion-prone hilltops. The remaining area will be reforested.

On the map below (*Figure 1)*, the project plan is illustrated. The total area (1037 ha) consists of existing forest (green), shrubland (yellow) and degraded pasture. The degraded pasture will be divided into an olive orchard (blue) and cattle pasture (red), with the remainder being reforested (brown).

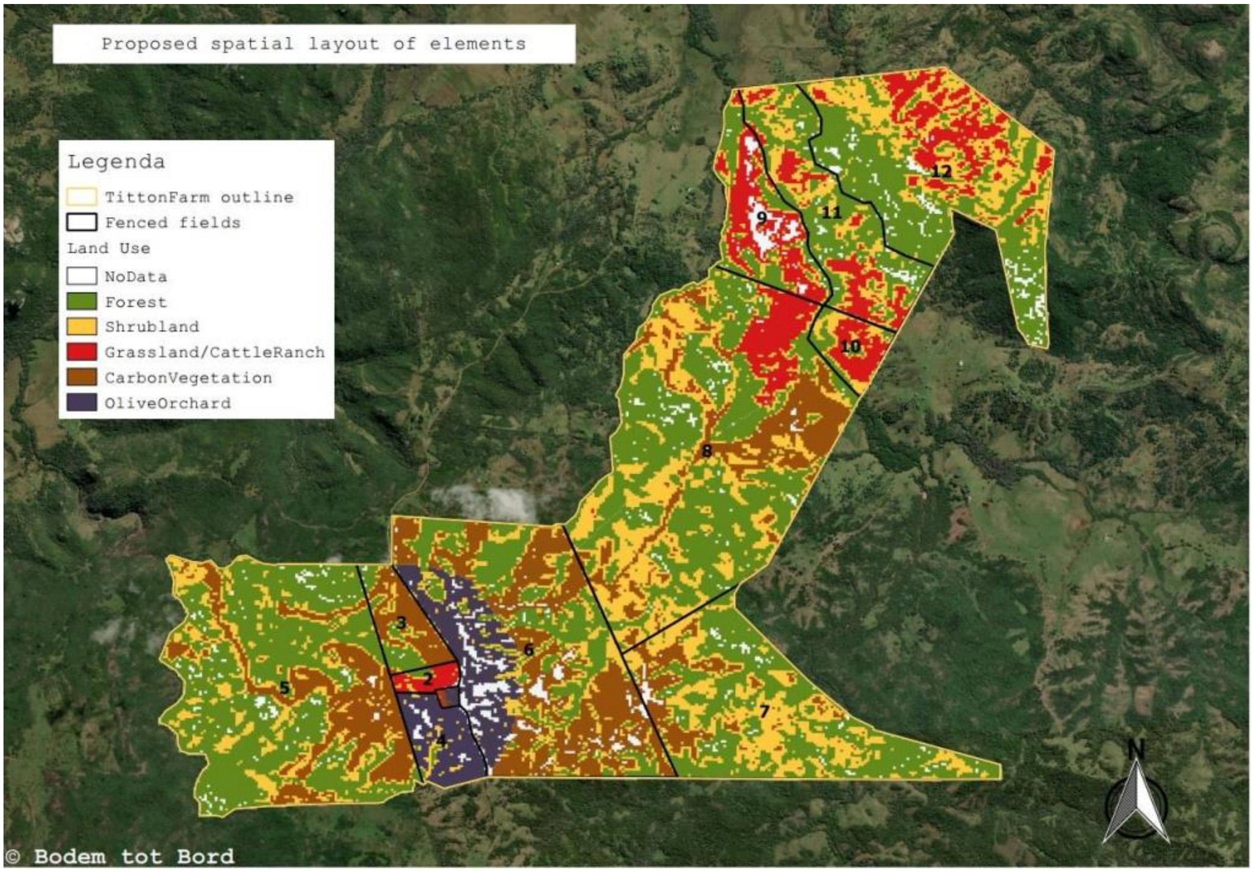

Figure 1: Proposed spatial layout of elements.

In table X, land use stratification of the baseline- and project scenario are presented. Based on Landsat 8 imagery of March 2020, the current vegetation was stratified in three strata: grassland, shrubland and forest (see section 1.14 for more information). Sample points that read ‘no data’ were divided pro rato over the other strata. For the project scenario, discussions with the landowner resulted in a new division of land uses, diversifying farm income and resulting in a more resilient farming system. 480 ha of current grass- and shrubland will be reforested. As explained further in section 1.13 and 3.4, shrubland is subject to periodic clearing in the baseline scenario.

Table 1: Project land use stratification.

Current stratification			**Project Stratification**	
Stratum	*Size (ha)*		*Stratum*	*Size (ha)*
Existing forest	470,3		Existing forest	470,3
Shrubland	262		Reforestation	480
Grassland	302,9		Cattle Ranch	65
			Olive Orchard	20
Total	1035,4		Total	1035,4

Assisted Natural Regeneration will be employed as a reforestation technique (Shono, 2007). This technique stimulates the natural regeneration of forests by 'kickstarting' the succession process. We will implement ANR through the widely spaced (3,3 x 3,3m) planting of pioneer trees (*Dodonaea viscosa)*. After 3 years, additional enrichment planting will take place (*Schinus molle and Araucaria angustifolia)* at an even wider spacing of 15,8 x 15,8m (*Table 1).* The aim of this widely spaced planting is to realize recruitment of native seedlings. Thus, this reforestation technique is not about individual trees, but about restoring the ecosystem that was once in place.

Table 2: : Key species for Assisted Natural Regeneration

Year	Species	Type	Max size (m)	Life span (y)	density (plants/ha)	Spacing
0	*Dodonaea viscosa*	Shrub/small tree	9,00	15	900	3,3 x 3,3
3	*Schinus molle*	Tree	15,00	50	40	15,8 x 15,8
3	*Araucaria angustifolia*	Large tree	30,00	400	40	15,8 x 15,8

ANR is an effective and efficient reforestation technique that can contribute to climate mitigation as well as biodiversity restoration (Evans 2015). The reforested areas will return to a highly biodiverse and ecologically complex state, sequestering carbon in the process. Numerous ecosystem functions will be greatly amended, as increasing soil health will result in better hydrology and lower soil erosion.

The highly deforested Serra do Sudeste, the mountainous area where the project site is located, is not located within the jurisdiction of any jurisdictional REDD+ program. Few incentives exist for landowners to maintain a decent forest cover on their land, resulting in eroded and degraded landscapes (*Figure 2*).


Figure 2: Denuded hilltops in the region.

Currently, forest cover at the project site is still at 43%, indicating a high potential for the forest to grow back naturally. This is unique in the area, where many fazendas (farms) have been deforested completely except for the most inaccessible places. This project will therefore be a starting point for reforesting the surrounding areas, in terms of demonstrating the viability of our approach as well as providing seeds.

See *Appendix 2: Implementation Plan* for an implementation schedule.

1.12 Project Location

See *Attachment B: Titton Fazenda* for a .KML file on the boundaries and geolocation of the project. Also, the cadastral registration can be found in *Appendix 3: Recibo Inscrição CAR Bagé.*

The project site is situated in the Serra do Sudeste, a mountainous area in the south of Rio Grande do Sul, Brazil (*Figure 3).*

Figure 3: Location of Rio Grande do Sul and the project site. Adapted from maphill.com

From pollen records, we know that the vegetation here was originally forest, with similar trees and shrubs as the Atlantic Forest in the North of the state (Behling 2016). However, the presence of these species sharply declines around 200 years before present. This decline coincides with the colonization of the area by Portuguese settlers (Corrêa 2013). Presently, the Serra do Sudeste is highly deforested, with forest fragments remaining only in inaccessible places.

The Serra do Sudeste is in a transition area between the Atlantic forest and the Pampas (grasslands) to the South. As an ecotone, it is a valuable bridge between the two biomes, providing habitats for plants and animals from the Pampas and the Atlantic forest alike. As such, this area could play an important role in the conservation of biodiversity in Southern Brazil, if forest cover were to increase.

A spatial analysis of the project site was performed by combining and modifying open source datasets in Qgis, resulting in elevation maps, satellite imagery and vegetation maps. Open source data was taken from Landsat number 8 (*Figure 4)*. This satellite records blue, green, and red light in the visible spectrum as well as near-infrared, mid-infrared, and thermal-infrared light. Near infrared is the part of the spectrum that is reflected by healthy plants. Together with the visible colour green this indicates differences in vegetation, for example grass or trees. Combined with sample points taken across the farms fields these vegetation differences could be classified into grass, shrubland and forest.

The project site is located about five hours away by car from the state capital of Porto Alegre, and about one hour away from Bagé, the nearest city.

Further relevant information will be presented in the next section *1.13. Conditions Prior to Project Initiation*.

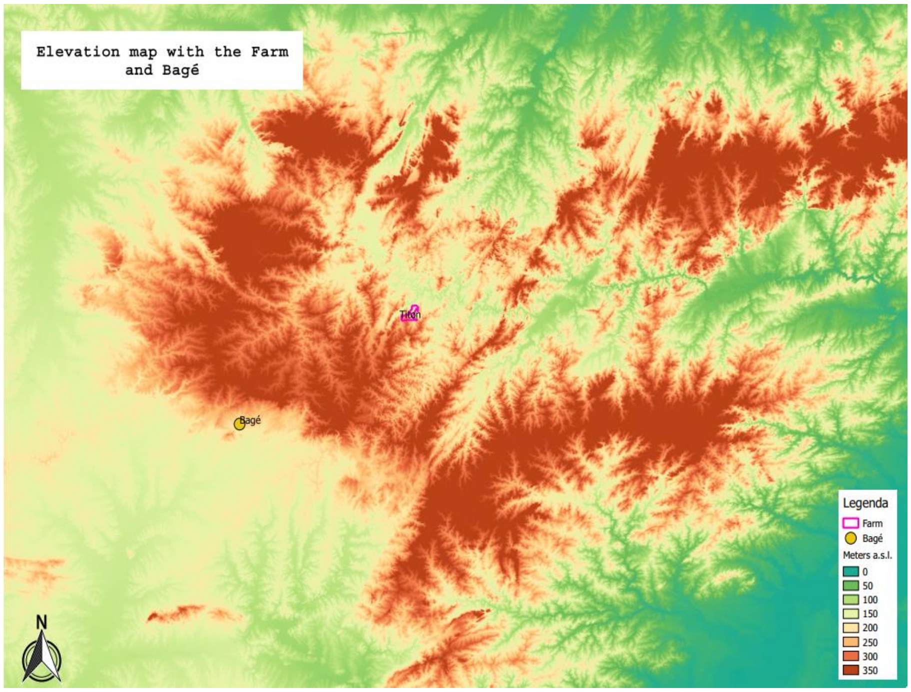

Figure 4: Digital elevation map of the Serra do Sudeste region in Rio Grande do Sul.

1.13 Conditions Prior to Project Initiation

Biogeographical context and history

Serra do Sudeste is in the transition area between two important biomes: the Mata Atlântica to the north, and the Pampas to the south. The Mata Atlântica, also known as the Atlantic Forest, is a large forest that stretches along the East coast of Brazil. The biome is a true biodiversity hotspot: it has a high species richness and many of these species are endemic (Fabio 2002). The Atlantic Forest stretches into the northern part of Rio Grande do Sul, covering the mountainous area north of Porto Alegre with its characteristic Araucaria forests (*Figure 6*). Despite its monumental importance for biodiversity conservation, carbon sequestration and other ecosystem services, the Atlantic Rainforest has lost over 70% of its native vegetation cover (Rezende 2018). The areas that remain are highly fragmented, isolating populations of plants and animals in small forest patches.

The Pampa biome to the south of the state contrast sharply with the forests of the North, as they are characterized by their natural grasslands, interspersed with some trees and shrubs. This biome stretches down through Uruguay to Argentina, forming vast natural grasslands.

The hills where the project is located, the Serra do Sudeste, are separated from the mountains in the north by the valley created by the Jacuí river and its tributaries (*Figure 5*). The forests in these hills are remarkably similar to the forests in the North of the state. For example, the characteristic Brazilian pine (Araucaria angustifolia) can still be found in some places, despite heavy overharvesting of its seeds and wood in the past (*Figure 6*). Through pollen analysis of soil cores, Behling et al. (2016) found that

Araucaria angustifolia and other Atlantic Forest species were present in this region 500 years ago, but sharply declined about 200 years ago (Behling 2016). This corresponds with the colonization by Portuguese settlers around 1821 A.D. (Corrêa 2013). These insights substantiate that the original vegetation of the project site is forest.

Figure 5: Elevation map of Rio Grande do Sul state, indicating the project location with a star. Adapted from Scheridon 2020.

Figure 6: Brazilian pine (Araucaria angustifolia) is a characteristic species of the Atlantic forest which also occurred in the project site up to 500 years ago.

Hydrology, pedology and climate

The area has a humid subtropical climate characterized by year-round rainfall and a significant temperature difference between winter (June - August, 14,2 °C on average) and summer (December - February, 21,6 °C on average) (climate-data.org) (*Figure 7*).

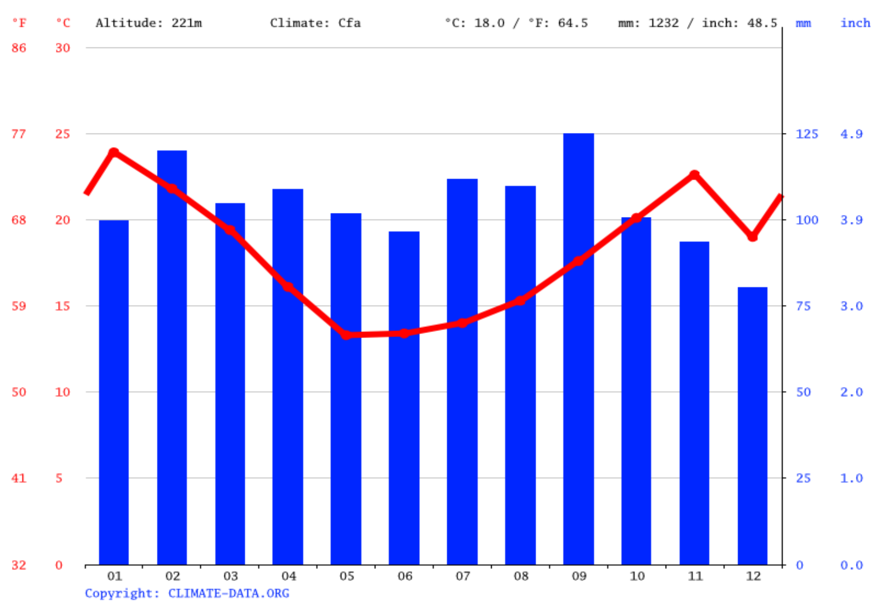

Figure 7: Temperature and rainfall distribution throughout the year (climate-data.org)

The project site ranges from 320 meters above sea level on the hilltop close to the farmhouse to 140 meters above sea level in the north-eastern valley. This results in an interesting gradient of soils and vegetation. The sandy soils up on the hills support mainly drought tolerant tree species (e.g. Celtis ehrenbergiana). The clay soils in the northern valley support a low-growing gallery forest which is inundated in winter. Here, we see species such as Pouteria salicifolia, which is adapted to having wet feet for a part of the year (*Figure 8*). The project site is part of the Jacuí river watershed.

Figure 8: Gallery forest of Pouteria salicifolia in the Northern valley of the project site.

Flora

Broad-leaved laurel forest fragments remain in several places in the project site. Epiphytic bromeliads, mosses and ferns indicate these highly biodiverse plant communities are old and well developed (*Figure 9*).

A vegetation assessment resulted in a database of 17 confirmed plant species, which were used to identify the most common succession pathway for the project site. This pathway can be observed in places on the farm where vegetation was cleared years ago. When left to develop, Dodonaea viscosa and Baccharis dracunculifolia are the first species to colonize the area. After a few years, Schinus lentiscifolius and Schinus molle start forming the undergrowth, and eventually outcompete the pioneers. We observed several unknown species of the Lauraceae family taking over, forming dense and tall forest. In the undergrowth of this forest, large trees such as Celtis ehrenbergiana and Scutia buxifolia can sprout. If a population of Araucaria angustifolia would still be reproducing, this large tree would eventually take over and form the climax vegetation.

Figure 9: epiphytic ferns indicating a well-developed ecosystem

Aside from the native species described above, several exotic species were found. Melia azedarach and an unidentified species of bamboo are worth mentioning here. The former is a fast-growing tree that can reach heights of over 40 meters under the right conditions (Useful Tropical Plants Database 2014), while the latter is a clumping bamboo that rapidly produces a lot of biomass. These plants were most likely planted many years ago by the people settling in the area because of their useful properties.

Fauna

During field work on the farm, many bird species were observed. As birds are important dispersers of seeds, they may be of relevance in the future. A list of bird species and their preferred food sources is provided below (*Table 2*). Furthermore, the area is said to be frequented by the invasive European wild boar (Sus scrofa).

Table 3: Bird species observed in the project site, their food sources and their conservation status.

Name	***Scientific name***	***Food***	***Conservation status (IUCN)***
American kestrel	*Falco sparverius*	*Small animals*	*Least concern*
Bare-faced ibis	*Phimosus infuscatus*	*Insects*	*Least concern*
Black vulture	*Coragyps atratus*	*Carcasses*	*Least concern*
Campo flicker	*Colaptes campestris*	*Insects*	*Least concern*
Cattle tirant	*Machetornis rixosa*	*Insects*	*Least concern*
Great kiskadee	*Pitangus sulphuratus*	*Insects*	*Least concern*
House sparrow	*Passer domesticus*	*Seeds, insects*	*Least concern*

Limpkin	*Aramus guarauna*	*Snails, molluscs, insects, small reptiles*	*Least concern*
Monk parakeet	*Myiopsitta monachus*	*Buds, young leaves, bark, berries, fresh seeds*	*Least concern*
Red-legged seriema	*Cariama cristata*	*Snakes*	*Least concern*
Roadside hawk	*Rupornis magnirostris*	*Small animals*	*Least concern*
Ruddy ground dove	*Columbina talpacoti*	*Seeds*	*Least concern*
Sayaca tanager	*Thraupis sayaca*	*Flowers, fruits, buds*	*Least concern*
Southern crested caracara	*Caracara plancus*	*Small animals*	*Least concern*
Southern lapwing	*Vanellus chilensis*	*Insects*	*Least concern*
Tropical kingbird	*Tyrannus melancholicus*	*Insects, fruits of Alchornea, Cymbopetalum mayanum and Bursera simaruba*	*Least concern*
Turkey vulture	*Cathartes aura*	*Carcasses*	*Least concern*

White monjita	*Xolmis irupero*	*Insects*	*Least concern*
Yellow-browed tyrant	*Satrapa icterophrys*	*Insects*	*Least concern*

Vegetation cover and land use prior to implementation of project activities

Based on Landsat 8 imagery of March 2020, the vegetation was stratified in three strata: grassland, shrubland and forest. Eight sample points were taken to verify and benchmark the stratification. Boundaries to the cattle fields were drawn on the map based on information from the landowner, resulting in *Figure 10*. For each field, the surface areas of grassland, shrubland and forest were calculated.

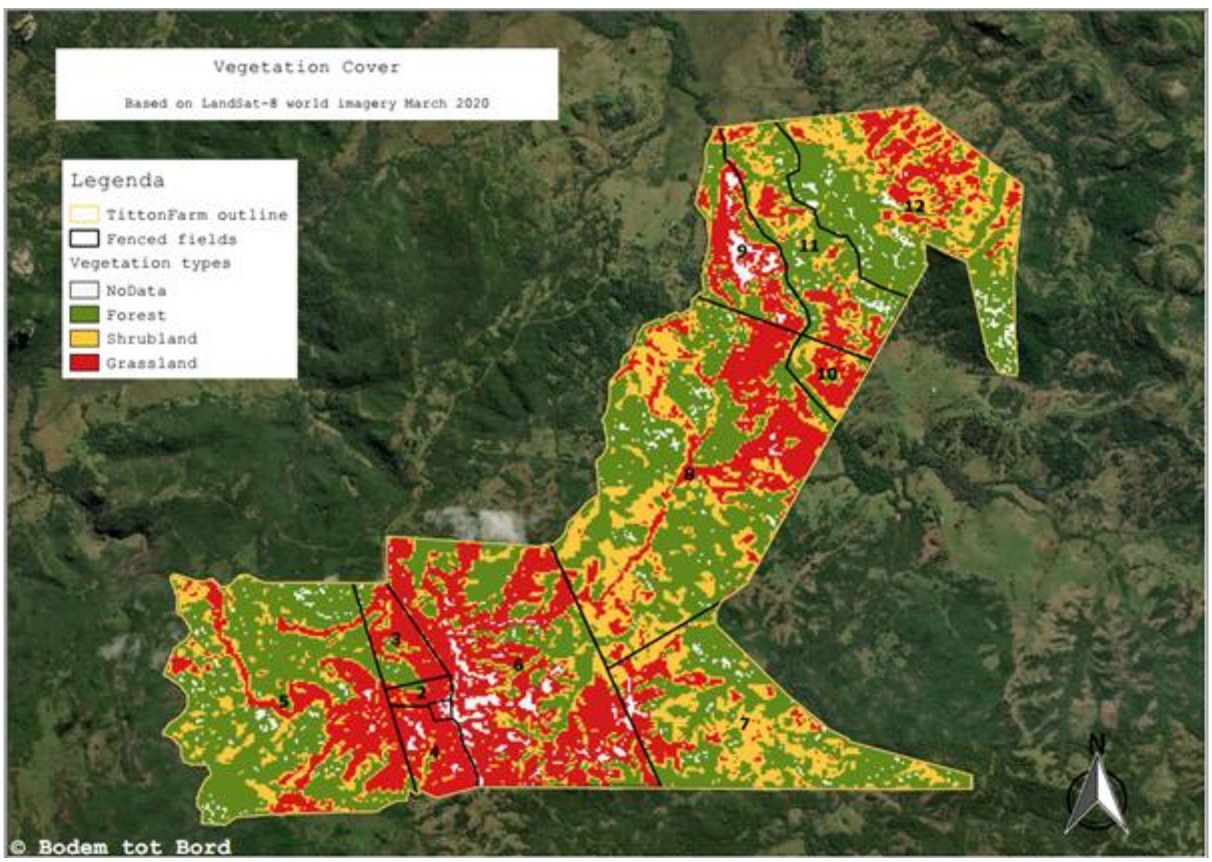

Figure 10: Current land use distribution in the project site

Large areas of the project site are recovering from past clearing. These areas are covered in shrubs and small trees, and account for 24,3% of the land cover. 28% of the farm is covered in grassland, part of which is degraded due to many years of soy production. Soil degradation is visible in the landscape in the form of gully erosion (*Figure 11)* and exposed soil. (*Figure 12*)

Figure 11: Gully erosion in the project area.

Figure 12: Exposed soils in the project area.

Farming practices prior to project implementation

Current farming practices involve periodically clear-cutting vegetation and establishing pasture in new areas on the farm when old pastures are depleted. In doing so, the farmer rotates fallow land with grazing land. Furthermore, a large part of the farm was used for the cultivation of glyphosate resistant soybean between 2012 and 2017. This has resulted in a depletion of the soil seed stock, soil organic matter loss and soil compaction. Our reforestation strategy will significantly improve the sustainability of soil management at the farm by reducing grazing pressure and reducing soil erosion.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project is in compliance with the latest versions and updates of the *Forest Code (Código Florestal)* as formulated by Embrapa, and lawfully executed by the Brazilian Ministry of Agriculture.

As defined by Law No. 12.651/2012, Permanent Preservation Area is a protected area, covered or not covered with native vegetation, with the ecological function of conserving water resources, landscape, geological stability and biodiversity, facilitating the gene flow of fauna and flora, protecting the soil and ensuring the well-being of the human population.

With a view to the recompositing of some categories of APP in areas considered to be consolidated, Law 12.651/2012 establishes transitional rules, specifying the minimum dimensions to be reconstituted to ensure the provision of associated ecosystem services. When applying such rules, the size of the property in fiscal modules and the characteristics associated with the APPs are taken into account (for example: width of the watercourse; surface area of the water table).

The additions to this law that are considered are the rules of Decree No. 7.830, of October 17, 2012 and Decree No. 8.235, of May 5, 2014. These Decrees establish general rules complementary to the Environmental Regularization Programs of the States and the Federal District. The programs referred to in this Decree are restricted to the regulation of the Areas of Permanent Preservation, Legal Reserve and restricted use, which may be carried out through recovery, restoration, regeneration or compensation. The

Areas considered APP by the law, regardless of whether they are on public or private land, include:

- 30 meters on each side of water courses less than 10 m wide;
- 50 meters on each side of water courses between 10 and 50 m wide;
- 100 meters on each side of water courses between 50 and 200 m wide;
- 200 meters on each side of water courses between 200 and 600 m wide;
- 500 meters on each side of water courses greater than 600 m wide;
- Around ponds, lakes, water reservoirs, both natural and artificial;
- Around the springs and water eye, whatever its topographical situation;
- Slopes, sandbanks, stabilizing dunes of mangroves, mangroves, edges;
- Top of hills, hills, mountains and hills, areas in altitude exceeding 1,800 meters, whatever vegetation;
- Paths in the marginal range, in horizontal projection.

Not all above mentioned areas are relevant to the project.

1.15 Participation under Other GHG Programs

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

The project is not, nor has it been, seeking other registrations under any other GHG Programs.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG Programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project is not affiliated, nor has it any activities, binding to an emissions trading program or any other binding limits.

1.16.2 Other Forms of Environmental Credit

We are enlisting this project and future projects in the region (which will be pooled) to the pilot projects of LandScale and will do an assessment accordingly. LandScale helps to assess and verify claims about various SDGs at landscape level.

1.17 Additional Information Relevant to the Project

Leakage Management

Considering leakage, one of the most important factors in the implementation of this project is that it fits in the social and cultural values of the area. To prevent any leakage or displacement of harmful practices, the following leakage management and safeguards have been applied:

- The landowner is educated on the financial, social and economic benefits of landscape restoration, reforestation, regenerative farming, agroforestry and carbon farming. The landowner gets insights through the monitoring plan to track the development and measures of ecological values.

- Rather than eliminating the business as usual, we make a transition to farming where the previous activities (cattle farming) are still practiced in a more sustainable way. This prevents the farmer from displacing this to neighbouring areas where leakage emissions might occur.

- The landowner is also a ‘hub manager’. The goal of the hub manager is to include neighbours and farms in the area to the project. By serving as a flagship project and leading by example, they will convince others to participate in regenerative carbon farming making leakage very likely to occur. This manner of involvement will rather cause more negative emissions and carbon capture.

We have set a perimeter around the farm including at least all the direct neighbours. This area is being monitored by Global Forest Watch to detect tree coverage loss and give alerts for deforestation and forest fires.

If, against expectations, any leakage occurs, this will be identified and reported. We will then proceed to mediate if possible and work on a solution to mitigate these effects.

Commercially Sensitive Information

The Green Branch and landowner himself value transparency greatly, therefore no relevant information has been undisclosed. Only information that is not relevant for the project or the certification hereof has been excluded to ensure brevity and accuracy. This information contains:

- Personal insights, remarks and opinions about ecological, social and economic values;
- Economic details forthcoming from the farm system analysis;
- Findings that are not in any way additional to the research or do not have influence on project metrics and/or performance;
- Information used for evaluation of internal processes.

Sustainable Development

Sustainable development is of grave importance for Brazil on a national level. Brazil was the host of two of the biggest international conferences on sustainability ever: The United Nations Conference on Environment and Development (1992 Earth Summit) and the United Nations Conference on Sustainable Development (Rio+20). In the latter of these events the UN has released the document: "Transforming our World: the 2030 Agenda for Sustainable Development" (UN, 2015). Brazil has then pledged to make domestic advances in environmental, social and economic areas.

The project supports multiple Sustainable Development Goals. The relevant goals are:

- 2.4.) By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality;

- 13.1.) Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries;

- 13.3.) Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning;

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

- 15.2.) By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally;

- 15.3.) By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world;

- 15.5.) Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species;

- 15.9.) By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts;

- 15.10.) Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems;

- 15.11.) Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation

Further Information

There is no further information to disclose.

2 SAFEGUARDS

2.1 No Net Harm

The project is designed so that there will be no negative externalities. Environmental and social performance will be assessed using the LandScale framework. The project is designed to improve environmental services and socio-economic values. This is held in high regard in every phase of the project development from design, to implementation to monitoring. The holistic approach of the project must achieve better soil fertility, soil structure, water retainment and biodiversity. In the implementation phase there will be as little disturbance as possible and very limited use of machinery and heavy equipment. Also, we refrain from using toxins and chemical fertilizers as we believe in natural sources and solutions.

Through proper land and cattle management, negative impacts caused by day-to-day business are minimized. These include impacts such as trampling, overgrazing, malnourishment and manure.

The project design causes no negative socio-economic impacts to the local community, farmers or landowner. Appropriate measures have been taken to ensure that a). the farmers and landowner are fairly compensated, b). it fits in the social structure and adheres to local cultural values, and c). has no negative impact of any kind to its surroundings.

The job description for the farmers changes slightly due to the added and altered activities on the land. This causes not for a loss of labour, rather a diversification of labour. The farmers are being educated on their new tasks and can still pridefully practice what they have done for generations: herding cattle. This is an important cultural issue for the region. Through extensive and open conversation with the farmers, we can say with certainty that they do not perceive any negative socio-economic impacts, nor foresee any.

Through leakage management and proper monitoring, we ensure that all deviations from these expectations will be identified and reported. We will then proceed to mediate if possible and work on a solution to mitigate these effects.

2.2 Local Stakeholder Consultation

Local stakeholders were consulted on multiple occasions during the design phase of this project, and there is still ongoing contact via social media. Below, we describe how stakeholders were identified and consulted, and how they shaped the actual plan. A description of all relevant laws and regulations covering workers rights is given in *Section 2.5.*

Identification

During field work on location in February/March of 2020, we sought to develop a plan for the reforestation of the project area. Aiming to create a socially sustainable strategy, we identified local stakeholders via the internet, through "snowballing" via our local contacts, and by attending local stakeholder gatherings. Social media were used to get contacts with local farmers, for example through the Facebook group "Gauchos do Rio Grande do Sul". The resulting list of stakeholders included local NGOs, farmers cooperatives, landowners and environmental protection groups.

Co-creation

To make a viable plan that lands well with the local actors, we have planned sessions with the landowner and farmer to include their ideas. These insights have often been used in the project development phase.

We worked closely with Everton, the local farm manager, in developing the reforestation strategy. Everton accompanied us during several field visits to explain current farm processes and help identify local tree species. His input has been indispensable to the development of the current project plan and will remain indispensable throughout the development process. We will be working closely with both the farm manager as well as the landowner to ensure a smooth transition from the current farm system to a more sustainable one.

Consultation

Several in-depth interviews were conducted with stakeholders to identify their perceptions regarding land use, forest and our reforestation plans specifically. We generally received positive feedback on our plans, especially when we described how bringing back the forest could boost farmer incomes.

In March we attended a meeting with local farmers, landowners, families and environmentalists. This meeting was helpful to identify a cross-section of the inhabitants of the municipality. The interviews had no fixed construction or order. This was done deliberately to allow the free flow of the conversation to identify what the local community values and pains are. After listening, we proposed our methodologies and project goals to them to learn from their experience and see if they foresee obstacles with our plan. Lastly, we invited them to brainstorm with us on how to overcome these obstacles and make our plans fit in the local social structures.

Below, a list of stakeholders and their position is presented (*Table 3)*, followed by a series of interviews conducted with local inhabitants.

Table 4: List of stakeholders and their position.

Group	Stakeholder	Position
Initiator	Titton family	*Owners of the farm. Are interested in making money out of this project. To them, a project that provides them with more income than their current income is a successful project.*
Initiator	The Green Branch	*Initiators of the project. Aim at implementing a successful reforestation strategy and derive carbon credits from the project. Their goal is to carry out a reforestation project that benefits everyone and generates money through carbon farming.*
Organisations	Verra	*Determines the standard for reforestation and issuing carbon credits.*
Organisations	Non-governmental organizations (NGOs)	*Might be interested in the project and could choose to collaborate or help reach out to a broader public. A successful reforestation project with native forest could interest them in collaboration or inspire them to use our techniques in their own projects. Moreover, NGOs aiming at nature conservation will be happy to see nature restoration carried out sustainably. In short, NGOs are interested in a sustainable reforestation project that benefits both nature and people.*
Organisations	FEPAM	*Environmental organization in Rio Grande do Sul. Is probably interested, but its role is yet to be determined. TGB is now in the process of*

		determining their participation and trying to involve them into the stakeholders.
Organisations	Big agricultural parties	*These become more important when the project is expanded. Might prefer to see agricultural land used for other purposes than reforestation and are probably influential.*
Organisations	The Green Branch’s clients	*Are interested in investing in a project that enables them to compensate their carbon emissions sustainably.*
Organisations	Political parties	*Are not directly affected by the project but do make the rules we have to adhere to.*
Natural stakeholders	Nature/biodiversity	*If the project is carried out successfully, nature and biodiversity can expand. Nature’s interest is a project in which a maximum of native tree species are planted.*
Natural stakeholders	Rare tree species	*The project could benefit the abundance of rare tree species, like Araucarias. Rare tree species benefit, as they are part of biodiversity, from a lot of newly planted trees where rare tree species find a place to grow and expand.*
Local inhabitants	Everton	*Lives on the farm and values his work as* gaucho*. Reforestation on the Titton farm might change his daily work. It is in his interest to provide a project in which he can keep working on the farm without losing income.*

Local inhabitants	Diane	*Lives on the farm too. Does not interact with the cows on a daily basis, but might be affected by reforestation, for example by change in income. She is interested in a project that does not affect her daily life negatively, for example by lowering her income or negatively influencing her daily activities.*
Local inhabitants	Local farmers	*Are not influenced by the project directly but could help with upscaling if they're interested. Depending on the farmer, they might either be interested in a project that generates more income than their current income, or in continuing the traditional gaucho lifestyle without interference.*
Local inhabitants	Neighbours	*Are not directly influenced either but would probably be the first to reach out to if the project is successfully implemented at the Titton farm. As with local farmers, they could be interested in a project that generates more income than their current income.*

Stakeholder perceptions

To develop a socially sustainable strategy we contacted local stakeholders via telephone or Facebook. Respondents were asked about their occupation, if relevant their connection to the farming lifestyle, and what their day-to-day life looked like. Then, their opinion about the project was asked. Depending on the response, we went deeper into the subject and questions from respondents were answered. We would ask why they would be positive or negative, what would be necessary to make such a project work and if they think other people in the region would be interested too.

In total, ten interviews were performed. Participants were both men and women, aged 25 to 67 years old. Four live close to our farm, the other six live in another part of the state. Four of them were former farmers or stayed in close connection to the country life. As this sample consisted of only ten participants, the analysis resulted in an indication of the situation and shows the general response to our project. The interviews were semi-structured and allowed room for elaboration. The most important results are summarized below.

Question 1: “I’ve heard that every landowner is obliged to have 10 percent native forest on their lands. Do you know about this rule? Do you think it is a good rule?”

When talking to the participants, the first striking remark is that our participants acknowledge that forests are important for soil and local animals, and native forests in particular. Everyone knows about the rule of 10% native forests on farms and farmers were keen on talking about the native forests on their own land. They often knew exactly how much of their land was covered in native forests, which might indicate the value people add to native forests. “Here [on the farm], we live together in harmony with nature” was a common statement. This does, however, not mean that all forests are preserved: some respondents are okay with clearing land for cows if necessary, despite the fact they think forests are important.

Question 2: “Do you have a farm? If not, what is your connection to the farm life?”

There is a large perceived difference between a big-scale and small-scale farm. When people were asked if they had a *fazenda*, they often laughed and said that they did have some land, but they would not call it a *fazenda*. It is generally agreed upon that big-scale farmers are richer and have more means to gain money compared to small-scale farmers.

Question 3: “We are working with two farmers that have quite some degraded land. There are companies that want to pay money for the presence of native trees, because of their ability to capture carbon dioxide. The farmers we are working with are interested in growing native trees on their lands and earning money like this. What do you think about this idea?”

All participants responded positively when they were told about the project. Everyone agreed that more forests could be beneficial for the area and farmers, as there were many places where the soil had degraded or suffered under drought. The latter had been a problem ever since he started farming, according to a 60-year-old farmer. A first challenge would be earnings. Some participants stated that farmers would only be interested if they would earn enough by having forests on their lands; otherwise it would neither be appealing nor fair. Another challenge would be tradition, as two participants remarked the strong sense of tradition in this region. The region is known for cattle farming and some might be too attached to this way of living to give up on their cattle. On the contrary, some participants even brought up other inhabitants of the region that would be interested in reforestation projects.

Apart from these responses, we found that unemployment seems to be a problem in the region, according to our respondents. On the one hand, it’s hard to find a job as gaucho (cowboy), as there are not many positions available. On the other hand, especially young people would rather not work as a gaucho. Regrettably, they are drawn to the city for its appealing job opportunities.

Conclusion

We conclude that the proposed project could benefit local stakeholders, namely through providing employment opportunities and access to capital for sustainable agricultural development. Sensitivity is required towards the traditional gaucho culture in the area, which is deeply rooted in cattle farming. The project will provide opportunities for implementing cattle ranching practices which are sustainable and do not degrade pastureland.

Ongoing contact in the future

This project is the start of a greater effort in the region, where hopefully a multitude of farmers will collaborate to restore the wider landscape. To facilitate this, we will be creating a local cooperative of carbon farmers. This association of landowners with all sizes of land will be instrumental in the development of a regional effort to gain forest cover in the Serra do Sudeste while preserving the traditional gaucho culture.

All meetings, consultations with local stakeholders or requested conversations are being documented and TGB will take minutes. A summary of these events are always shared with the stakeholders and is open for comments. When there are points of action these will be followed and development will be shared with the relevant agents. All documentation is kept for the full lifetime of the project.

Concerning the process of the certification, all relevant stakeholders will be notified when there are certain events:

- PDD open for public comments
- Comments received and how they have been processed
- Validation and verification
- VVB audit
- Initial issuance

Everyone involved will be able to see the results of the monitoring and leakage management plan. This will be done on a yearly basis to ensure transparency to all stakeholders.

The farmers cooperative will also be used as an information channel, to help participating farmers communicate with us and each other. To realize this, we will be organizing more stakeholder gatherings in March/April 2021, when our team will return to Brazil to implement the plan.

2.3 Environmental Impact

The project is designed to have a no negative, but rather maximum environmental impact. To be sure that we do not overlook any possible environmental impact and that we have estimated the impact correctly, we make use of an environmental impact assessment. This assessment will be done through our monitoring and leakage plan. Also, we will use the guidelines of the LandScale programme to make assessments about the Sustainable Development Goals, whether positive or negative.

2.4 Public Comments

This section is not yet applicable for this version, since it is the draft under development. The public comments will be processed according to the rules and regulations as set forth in *VCS Standard v4.0.:*

1) All projects are subject to a 30-day public comment period. The date on which the project is listed on the project pipeline marks the beginning of the project's 30-day public comment period.
2) Projects shall remain on the project pipeline for the entirety of their 30-day public comment period.
3) Any comments shall be submitted to Verra at secretariat@verra.org and respondents shall provide their name, organization, country and email address. At the end of the public comment period, Verra provides all and any comments received to the project proponent.
4) The project proponent shall take due account of any and all comments received during the consultation, which means it will need to either update the project design or demonstrate the insignificance or irrelevance of the comment. It shall demonstrate to the validation/verification body what action it has taken.

2.5 AFOLU-Specific Safeguards

The identification of local stakeholders and the results are described in section *2.2. Local Stakeholder Consultation.* This section discusses the risks due to the project implementation phase.

Regarding the implementation of this project, no stakeholder risks have been identified other than the safety of the labour force during the preparation of the land, sowing and planting. Especially in respect to the current outbreak of COVID-19. We will discuss both separately.

To ensure all local rules and regulations are followed with respect to the labour force, we refer to the Consolidation of Labour Laws (Consolidação das Leis do Trabalho, CLT). CLT was amended in 2017 through Law N. 13467 in 2017. The workers are all experienced and sourced from the region. The landowner has experience with the labour force. All contracts are fixed term contracts.

With respect to COVID, we take precarious measures to ensure their health and safety. Also, we will provide equipment to stop the spread of the virus. Fundamentally, we adhere to the most recent legislation, Law No. 13,979. However, this law does not offer any provisions for protective measures at work. Nonetheless we will prepare a COVID safety plan together with the local stakeholders and labour force. Amongst others, there will be general rules and a code of conduct for:

- Personal hygiene: TGB will offer clean water and antibacterial soap for everyone on site during the implementation. TGB will also offer gloves and masks for those who prefer to wear these.

- Social distancing: We will be working outside whenever possible, while remaining socially distant with at least 1.5 meters in between persons. When we must be indoors, this norm will be upheld, and the room will be well ventilated.

- Sickness: Workers shall declare everyday that they are healthy and have not been around sick people. This document is signed before work starts to ensure no sick people will work on site.

- Agreements: To improve safety we shall inquire the local stakeholders and labour force if there are any extra regulations that they deem important to mitigate these risks

The procedures for ongoing communication are described in section *2.2. Local Stakeholder Consultation.*

The grievance redress procedure will be set up as stated in the rules and requirements of the VCS standard v4.0:

1) The project proponent shall attempt to amicably resolve all grievances and provide a written response to the grievances in a manner that is culturally appropriate.

2) Any grievances that are not resolved by amicable negotiations shall be referred to mediation by a neutral third party.

3) Any grievances that are not resolved through mediation shall be referred either to a) arbitration, to the extent allowed by the laws of the relevant jurisdiction or b) competent courts in the relevant jurisdiction, without prejudice to a party’s ability to submit the grievance to a competent supranational adjudicatory body, if any.

If grievances of the landowner occur that could jeopardize the project performance or continuity and have reached the third state, will be settled according to the contract in *Attachment A: Collaboration Contract.*

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The **Serra do Sudeste Landscape Restoration and Reforestation Project** (‘Project’) is a VCS AFOLU (Agriculture, Forestry and Other Lands Use) project (scope 14) and falls specifically under the ARR (Afforestation, Reforestation and Revegetation) category. The project goal is the reforestation of degraded lands, which would continue to remain degraded, and would become increasingly more degraded, in absence of the project. The project aims to restore natural biodiverse forest and produce incremental crops through agroforestry.

The title of the applied methodology is the AR-AMS007, as disclosed under the United Nations Convention on Climate Change CDM (Clean Development Mechanism) methodologies: A/R Small-scale Methodology: “Afforestation and reforestation project activities implemented on lands other than wetlands - Version 03.1”

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

(a) Clean development mechanism project standard;

(b) A/R methodological tools:

(i) “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”;

(ii) “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”;

(iii) “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”;

(iv) “Estimation of non-CO_2 greenhouse gas (GHG) emissions resulting from burning of biomass attributable to an A/R CDM project activity”;

(v) “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity”.

Furthermore, we will use the “*VT0001 Tool for measuring aboveground live forest biomass using remote sensing (Verra version 3.0)*” as an addition to our monitoring plan.

3.2 Applicability of Methodology

Table 5: Applicability conditions for methodology and tools.

Condition	Justification
AR-AMS007	
The land subject to the project activity does not fall in wetland category;	The project site consists of agricultural land and regenerating shrubland and does not cover any wetlands. The area is located in the Serra do Sudeste, a mountainous area in the south of the state of Rio Grande do Sul, Brazil at an elevation between 140 and 320 meters above sea level.
Soil disturbance attributable to the project activity does not cover more than 10 percent of area in each of the following types of land, when these lands are included within the project boundary: (i) Land containing organic soils; (ii) Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 2 and 3 to the AR-AMS007 methodology.	(i) As demonstrated through soil sampling, the soils in the project area have a SOM percentage of between 1-3% and thus cannot be considered organic soils under the definition contained in Annex A of the IPCC report "Good Practice Guidance for Land Use, Land-Use Change and Forestry". (ii) The largest part of the grassland to be reforested can be considered highly degraded, as shown in section 1.13. Some areas appear to be in a decent state, especially those in the valley in the North-East of the farm. These areas will not be reforested.
Clean Development Mechanism project standard	
The project will comply with the conditions put forth in the CDM project standard, as these are reflected in the methodology and tools.	
AR-TOOL 14: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities	
No internal applicability conditions	
AR-TOOL 12: Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities	
No internal applicability conditions	

AR-TOOL 16 Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities	
The areas of land to which this tool is applied: (i) Do not fall in the wetland category; (ii) Do not contain organic soils as defined in the "Annex A: glossary" of the IPCC GPG LULUCF 2003; (iii) Are not subject to any of the land management practices and application of inputs as listed in the Tables 1 and 2;	Demonstrated above (AR-AMS007).
The A/R CDM project activity meets the following conditions: (i) Litter remains on site and is not removed in the A/R CDM project activity; (ii) Soil disturbance attributable to the A/R project activity, if any, is: -In accordance with appropriate soil conservation practices, e.g. follows the land contours -Limited to soil disturbance for site preparation before planting and such disturbance is not repeated in less than twenty years.	Over the project duration, litter will remain on site and will not be removed. Soil disturbance during project implementation will be minimal, comprising only enrichment planting in year 3. 80 trees will be planted in planting pits measuring 40 by 40 cm. Soil disturbance can therefore be calculated as follows: ((0,4 * 0,4) *80)/10.000*100 = 0,128% of the total surface area.
AR-TOOL: Estimation of non-CO_2 greenhouse gas (GHG) emissions resulting from burning of biomass attributable to an A/R CDM project activity.	
The Tool is applicable to all occurrences of fire within the project boundary Non-CO_2 GHG emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum	Any instance of fire larger than the minimum threshold of 22,9 ha as reported by the host party will be reported and accounted for, if it covers an area greater than 5% of the project area. This is further described in the monitoring plan.

threshold area reported by the Host party for the purpose of defining a forest, provided that the accumulated area affected by such fires in a given year is ≥ 5% of the project area.	
AR-TOOL 15: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity	
This tool is not applicable if the displacement of agricultural activities is expected to cause, directly or indirectly, any drainage of wetlands or peat lands.	The project does not displace any farming activities and therefore will not cause, directly or indirectly, any drainage of wetlands or peatlands.
VT0001 Tool for measuring aboveground live forest biomass using remote sensing (Verra version 3.0)	
AFOLU activities the same or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project shall not lead to violation of any applicable law even if the law is not enforced;	This condition is met as any planned project activity is entirely legal in the host country. All aspects comply with local, regional and national legislature.
The use of this tool to determine additionality requires the baseline methodology to provide a stepwise approach justifying the determination of the most plausible baseline scenario. Project proponent(s) proposing new baseline methodologies shall ensure consistency between the determination of a baseline scenario and the determination of additionality of a project activity.	We will apply this methodology as an addition to our monitoring plan and will not apply it to determine additionality.

3.3 Project Boundary

Source		Gas	Included?	Justification/Explanation
Base line	Above Ground Biomass	CO_2	Yes	Accounted as indicated by AR-AMS007
	Below Ground Biomass			
		CO_2	Yes	Accounted as indicated by AR-AMS007
	Dead wood and litter	CO_2	Yes	
	Soil organic carbon	CO_2	No	Not included in baseline calculations, as indicated by AR-AMS007
Project	Above Ground Biomass	CO_2	Yes	Accounted as indicated by AR-AMS007
	Below Ground Biomass			
		CO_2	Yes	Accounted as indicated by AR-AMS007
	Dead wood and litter	CO_2	Yes	Accounted as indicated by AR-AMS007
	Soil organic carbon	CO_2	Yes	Accounted as indicated by AR-AMS007

Project map

The maps below were presented previously but will be added here for illustration of the physical locations of management activities in the project site (*Figure 13)*.

Current situation and project situation

This map shows the project site and current stratification of land cover types. Currently, the red areas are degraded grassland, the yellow areas are recovering shrubland, and the green areas are existing forests. In the baseline scenario, the yellow areas will be cleared in the near future (next 1 -3 years) to replace degraded pastures. Project activities will be implemented in the red area's, while the yellow areas will be left to recover. On the map below, project- and non-project activities are illustrated (*Figure 13)*.

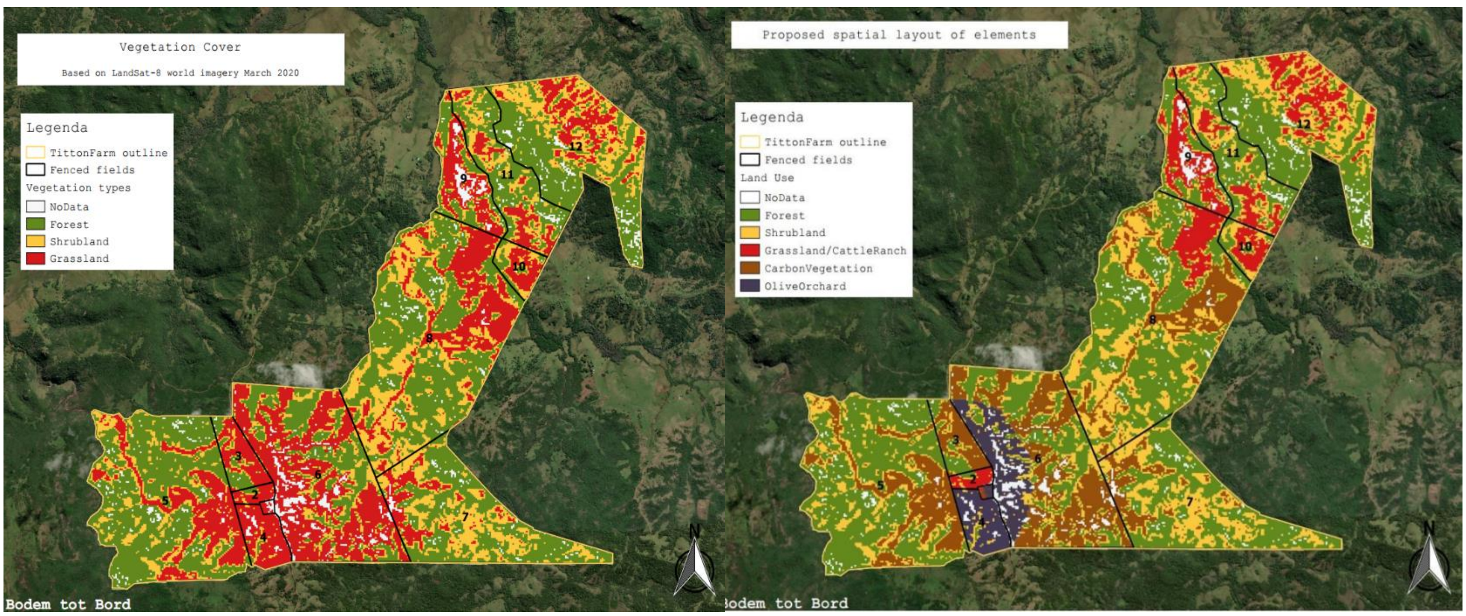

Figure 13: Non-project and project activities.

Implementation

In the degraded grassland area three new land uses will be implemented. The brown area is of interest regarding project activities: it is the area actively being reforested. In the blue area, an olive orchard will be planted, while the red area will serve as pasture for the remaining cattle. No leakage belts are present.

3.4 Baseline Scenario

As stated in section 5.2 of the methodology, the baseline scenario is the continuation of pre-project land use, i.e. periodically clearing bushland/forest to create grazing- or cropland. Cultivated land under this land use scenario has been well documented to result in several problems, as soil fertility and SOM content declines steadily over consecutive years of cultivation. To counter this measure, the farmer periodically clears areas that had been left to recover. For a more elaborate description of pre-project land use, see section 1.13

The baseline scenario entails the removal of all biomass from a given area, either by burning/clearing or through decline in SOM over consecutive years of cultivation. Any GHG removals accomplished in each area will therefore be emitted again under the present land use strategy. As a result, we can calculate the baseline as follows:

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t} \qquad \text{Equation (1)}$$

Where:

$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks in year *t*; t CO_2-e
$\Delta C_{TREE\_BSL,t}$	=	Change in carbon stock in baseline tree biomass within the project boundary in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{SHRUB\_BSL,t}$	=	Change in carbon stock in baseline shrub biomass within the project boundary, in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{DW\_BSL,t}$	=	Change in carbon stock in baseline dead-wood biomass within the project boundary, in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e
$\Delta C_{LI\_BSL,t}$	=	Change in carbon stock in baseline litter biomass within the project boundary, in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

Below, the expected change in these carbon pools is discussed.

There will be no change in tree- and shrub biomass in the baseline scenario. Although shrubs and trees rapidly colonize fallow areas after cultivation, they are periodically cleared to create space for new grass-/cropland. The cleared biomass is burnt, and any carbon contained is re-emitted. Therefore, the change in carbon stocks in both tree and shrub biomass in the baseline will be accounted as 0.

The same reasoning applies to both the dead wood- and litter pools. As the baseline scenario entails slash and burn agriculture, any carbon sequestered through regeneration of fallow lands will be re-emitted when said land is cleared for cropping/grazing. Any left-over carbon, such as SOM (which is not accounted for in the baseline), will also be emitted through consecutive years of unsustainable agriculture, returning the soil to an infertile, erosion prone, almost inorganic state.

As such, we can say that:

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t} = 0$$

3.5 Additionality

As requested by section 5.2 of the AR-AMS007 methodology, additionality will be demonstrated through a barrier analysis. This barrier analysis is based on *Appendix 1* of the methodology.

Barrier analysis

a) Investment barriers, other than economic/financial barriers, inter alia:

(i) Debt funding not available for this type of project activity.

Brazil thrives on agriculture. However, long term investments are hard to come by. Traditional investors prefer annual crops and cattle over perennial crops. The market, and the currency, is very volatile. This causes investors to prefer short term investments with high returns. This phenomenon is also fed by a) the investment trap for farmers and b) demand pressure from other countries (Da Silva, 2000).

a) Farmers are often not capable of saving money to invest themselves and need income annually to have a livelihood. Although they would rather make more money in the long-term, they have no other choice than continue bad practice to be able to have an income today.

b) Rising demand from foreign countries for e.g. wood and soy is putting pressure on mass production, deforestation and unsustainable practices (Henders, 2015).

Also, carbon is relatively unknown as a commodity and risks are not yet mapped sufficiently. Altogether, this makes it next to impossible to find investment for these kinds of projects.

The Green Branch has arranged all financing activities and compensation for the farmer to make this project possible.

(d) Barriers relating to local tradition, inter alia:

(i) Traditional knowledge or lack thereof, of laws and customs, market conditions, practices.

As described previously, Serra do Sudeste has a real 'Gaucho' way of life (Oliven, 2006). Most of the land has been in the family for over a hundred years. Farmers receive their education from their fathers who have gotten it from tradition. They take great pride in the Pampas where their cattle grazes. Due to this one-sided point of view, they cause considerable harm to their land and the ecosystem. Through extensive cattle ranching, their land degrades rapidly, and this makes it hard for the animals as well.

Without this project intervention, these practices will most likely have gone on until the damage is irreversible. Through the implementation and education, these farmers can make the transition to nature-inclusive agriculture.

(e) Barriers due to prevailing practice, inter alia:

(i) The project activity is the "first of its kind". No project activity of this type is currently operational in the host country or region.

There have been no reported AFOLU projects in the region. We could not find evidence of any projects in Serra do Sudeste through a) internet research, b) stakeholder consultation, c) local authorities, or d) local community.

In addition, we found that the concept of these projects: to reforest and restore the land, was fairly unknown among the local community.

The conception of an AFOLU project in this area would be very unlikely.

3.6 Methodology Deviations

In this project we don't deviate from the methodology. However, we have added a remote sensing monitoring and measuring plan which will be compliant with *VT0001 Tool for measuring aboveground live forest biomass using remote sensing (Verra version 3.0).* This will allow us to train an algorithm for measuring biomass and carbon stock.

This addition does not relate to any other part of the methodology then the procedures for monitoring and measuring. Nor will it negatively impact the conservativeness of the quantification of GHG emissions. The measurements from the monitoring plan will be used for certification. This data is additional.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As described in section 5.2 of the methodology, “the baseline scenario of a small-scale A/R CDM project activity implemented under this methodology is continuation of pre-project land use.” The current land use scenario consists of a cycle of fallow, clearing, cropping and grassland, followed by a new fallow. As further elaborated upon in *Section 3.4*, this land use scenario might accumulate incremental amounts of carbon within one cycle, but then loses this all once land is cleared.

Therefore, baseline emissions/removals can be described as follows:

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t} = 0$$

4.2 Project Emissions

In this section, we will first set forth the quantification of project emissions/reductions each year, i.e. the change in carbon stocks per year.

In accordance with the selected methodology, actual net GHG removals by sinks in year will be represented as follows:

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t} \quad \text{Equation (2)}$$

Where:

$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$GHG_{E,t}$	=	Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year *t*, as calculated in the tool “Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity”; t CO_2-e

Actual net GHG removals by sinks in year t therefore consists of the change in carbon stocks in the project scenario over year t, minus non-CO_2 GHG emissions as a result of the project activity. We will focus on the latter first.

Increase in non-CO2 GHG emissions within the project boundary

This parameter is determined through A*R-TOOL: Estimation of non-CO_2 greenhouse gas (GHG) emissions resulting from burning of biomass attributable to an A/R CDM project activity. Within this application, version 04.0.0* was applied.

The project activities do not include any burning of biomass for site preparation. Indeed, the project activities will result in the cease of burning activities which are common in the baseline scenario. As a result, this parameter can be confidently and conservatively estimated at 0, i.e.:

$$GHG_{E,t} = 0$$

Natural or accidental occurrences of fire within the project boundary will be monitored and reported as described within the monitoring plan.

Change in the carbon stocks in project in year t

In accordance with the methodology (section 5.5), this parameter can be described with the following equation:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t} \qquad \text{Equation (3)}$$

Where:

$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$\Delta C_{TREE\_PROJ,t}$	=	Change in carbon stock in tree biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{SHRUB\_PROJ,t}$	=	Change in carbon stock in shrub biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{DW\_PROJ,t}$	=	Change in carbon stock in dead-wood biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e
$\Delta C_{LI\_PROJ,t}$	=	Change in carbon stock in litter biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e
$\Delta SOC_{AL,t}$	=	Change in carbon stock in SOC in project, in year *t*, as estimated in the tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"; t CO_2-e

The change in total carbon stocks are estimated as a sum of the change in individual carbon stocks, which are quantified through their respective tools. We will discuss these carbon stocks and their rate of change individually. In all cases, we are considering an ex-ante estimation.

Change in carbon stock in tree and shrub biomass

In accordance with the selected methodology and the applicable tools, change in carbon stocks in trees and shrubs was determined ex-ante through estimation by modelling of tree growth and stand development (Tool section 8.2). The following formula, adapted from formula 10 in the tool, was used:

$$\Delta C_{TREE} = \frac{44}{12} \times CF_{TREE} \times \Delta b_{FOREST} \times (1 + R_{TREE}) \times A$$

Where:

ΔC_{TREE} = Mean annual change in carbon stock in trees; t CO_2e yr^{-1}

CF_{TREE} = Carbon fraction of tree biomass; t C $(t.d.m.)^{-1}$.
A default value of 0.47 t C $(t.d.m.)^{-1}$ is used unless transparent and verifiable information can be provided to justify a different value.

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

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

A = Area; ha

For the mean annual increment, a modelled estimate was obtained from an independent consultancy party, namely PassiFlora Network VOF. The estimated above ground biomass productivity based on literature review. These values were compared to table A3.1.5 of the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003). The estimations obtained are presented in the table below (*Table 5)*.

Table 6: Estimates of mean annual increment of above ground biomass.

Party	Estimated	Sources/justification
PassiFlora Network	7,45 t.d.m./ha/y	Vivieira 2008, Silver 2000, “Biomass productivity in naturally recovering tropical forests and allometric equations for the Atlantic forest of Southern Brazil."
IPCC	7 t.d.m./ha/y (y1-20) 2 t.d.m./ha/y (y20-30)	IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003), Value for sub-tropical climate with a short dry season.

The value obtained by PassiFlora is close to the IPCC's estimation, but significantly better grounded in local conditions. The value was based on two studies: One describes allometric biomass accumulation in the Atlantic Forest close to the project site. The other paper describes how biomass accumulation is likely to continue after 20 years:

"... biomass may eventually reach a maximum sequestration potential and no longer reduce the amount of CO 2 in the atmosphere. The time period this requires is not well known, but it has been speculated that such a limit is reached in the first 50–100 years following forest establishment." -Silver 2000

Therefore, we argue it is reasonable to go with the PassiFlora estimate of this parameter.

For the root-shoot ratio as well as the carbon fraction, we will apply the conservative default values of 0,25 and 0,47 respectively. The project area is 480 ha. Combining these values, we come to the following calculation:

$$\Delta C_{TREE} = \frac{44}{12} \times CF_{TREE} \times \Delta b_{FOREST} \times (1 + R_{TREE}) \times A$$

$$= \frac{44}{12} \times 0.47 \times 7{,}45 \times (1+0.25) \times 458$$

$$= 7{,}355.48 \text{ tCOe / y}$$

Change in carbon stock in dead wood

This parameter is defined using *AR Tool 12: "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities".* All applicability conditions are met, and the parameters are defined as follows:

Table 7: Parameters as defined by ARtool12.

Parameter	SI Unit	Description
$C_{DW,t}$	t CO_2e	Carbon stock in dead wood within the project boundary at a given point of time in year *t*
$\Delta C_{DW,t}$	t CO_2e	Change in carbon stock in dead wood within the project boundary in year *t*
$C_{LI,t}$	t CO_2e	Carbon stock in litter within the project boundary at a given point of time in year *t*
$\Delta C_{LI,t}$	t CO_2e	Change in carbon stock in litter within the project boundary in year *t*

For this project, there will be no measurements for dead wood or litter. Instead, the conservative default-factor based method for estimation of carbon stock in dead wood and litter is used. The corresponding equations are as follows:

$$C_{DW,i,t} = C_{TREE,i,t} \times DF_{DW}$$ Equation (9)

Where:

$C_{DW,i,t}$	=	Carbon stock in dead wood in stratum *i* at a given point of time in year *t*; t CO_2e
$C_{TREE,i,t}$	=	Carbon stock in trees biomass in stratum *i* at a point of time in year *t*, as calculated in the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”; t CO_2e
DF_{DW}	=	Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass; per cent
i	=	*1, 2, 3, …* biomass estimation strata within the project boundary
t	=	*1, 2, 3, …* years elapsed since the start of the A/R CDM project activity

$$C_{LI,i,t} = C_{TREE,i,t} \times DF_{LI}$$ Equation (15)

Where:

$C_{LI,i,t}$	=	Carbon stock in litter in stratum *i* at a given point of time in year *t*; t CO_2e
$C_{TREE,i,t}$	=	Carbon stock in trees biomass in stratum *i* at a point of time in year *t*, as calculated in tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”; t CO_2e
DF_{LI}	=	Conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass; percent
i	=	*1, 2, 3, …* biomass estimation strata within the project boundary
t	=	*1, 2, 3, …* years elapsed since the start of the A/R CDM project activity

The function is derived from the total carbon stock in trees. Therefore, DF_{DW} and DF_{LI} must be determined by the tool. The percentage is derived from the tables in section 8 from the tool. The project site has a tropical moist climate (1232 mm rain per year) and is below 2000 meters in altitude. This leads to the values:

$$DF_{DW} = 1\%$$

$$DF_{LI} = 1\%$$

Change in Soil Organic Carbon stock

This parameter is defined using *Tool AR0016: "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"*. All applicability conditions are met, and the parameter is defined as follows:

Parameter	Unit	Description
$\Delta SOC_{AL,t}$	t CO_2-e	Change in SOC stock in areas of land meeting the above applicability conditions, in year *t*

To be able to calculate the change of SOC, first the initial SOC is calculated. This is being done with the tables 3-6 of the tool and with the following equation:

$$SOC_{INITIAL,i} = SOC_{REF,i} * f_{LU,i} * f_{MG,i} * f_{IN,i} \quad \textbf{(1)}$$

where:

$SOC_{INITIAL,i}$	SOC stock at the beginning of the A/R CDM project activity in stratum *i* of the areas of land; t C ha^{-1}
$SOC_{REF,i}$	Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation – normally forest) by climate region and soil type applicable to stratum *i* of the areas of land; t C ha^{-1}
$f_{LU,i}$	Relative stock change factor for baseline land-use in stratum *i* of the areas of land; dimensionless
$f_{MG,i}$	Relative stock change factor for baseline management regime in stratum *i* of the areas of land; dimensionless

$f_{IN,i}$	Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum *i* of the areas of land; dimensionless
i	*1, 2, 3, …* strata of areas of land; dimensionless

The reference SOC stock is determined by table 3 of the tool. Following the IPCC Climate Zones, the project is located in a Moist Tropical Area. All relevant areas have sandy soils containing >70% sand and <8% clay. According to the table, this indicates that there is 39 tC/ha in the topsoil.

$$SOC_{REF} = 39 \text{ tC/ha}$$

Using Table 6 of the methodology, we have determined f_{LU}, f_{MG} and f_{IN} for grassland. The relevant area is degraded and there are no inputs on the land

$$f_{LU} = 1{,}00$$

$$f_{MG} = 0{,}70$$

$$f_{IN} = 1{,}00$$

When we fill in all the parameters, we get the following equation:

$$SOC_{INITIAL} = 39 * 1{,}0 * 0{,}70 * 1{,}0 = 27{,}3 \text{ tC/ha}$$

There will be no soil disturbance attributable to project interventions. Therefore, we can assume:

$$SOC_{LOSS,i} = 0 \qquad \textbf{(3)}$$

where:

$SOC_{LOSS,i}$	Loss of SOC caused by soil disturbance attributable the A/R CDM project activity, in stratum *i* of the areas of land; t C ha^{-1}
0.1	The approximate proportion of SOC lost within the first five years from the year of site preparation
i	*1, 2, 3, …* strata of areas of land; dimensionless

Now we can determine the rate of change in SOC stock until steady state occurs after 20 years.

$$dSOC_{t,i} = 0 \quad \text{for } t < t_{PREP,i} \tag{4}$$

$$dSOC_{t,i} = -\frac{SOC_{LOSS,i}}{1\ year} \quad \text{for } t = t_{PREP,i} \tag{5}$$

$$dSOC_{t,i} = \frac{SOC_{REF,i} - (SOC_{INITIAL,i} - SOC_{LOSS,i})}{20\ years} \quad \text{for } t_{PREP,i} < t \leq t_{PREP,i} + 20 \tag{6}$$

where:

$dSOC_{t,i}$	The rate of change in SOC stock in stratum *i* of the areas of land, in year *t*; t C ha^{-1} yr^{-1}
$t_{PREP,i}$	The year in which first soil disturbance takes place in stratum *i* of the areas of land
$SOC_{LOSS,i}$	Loss of SOC caused by soil disturbance attributable the A/R CDM project activity, in stratum *i* of the areas of land; t C ha^{-1}
$SOC_{REF,i}$	Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation – normally forest) by climate region and soil type applicable to stratum *i* of the areas of land; t C ha^{-1}
$SOC_{INITIAL,i}$	SOC stock at the beginning of the A/R CDM project activity in stratum *i* of the areas of land; t C ha^{-1}
i	*1, 2, 3,* … strata of areas of land; dimensionless
t	*1, 2, 3,* … years elapsed since the start of the A/R CDM project activity

The values are calculated as:

$$dSOC = 0 \text{ tC/ha for } t < t_{prep}$$

$$dSOC = -\frac{0}{1} = 0 \text{ tC/ha for } t = t_{prep}$$

$$dSOC = \frac{39 - (27{,}3 - 0)}{20} = 0{,}585 \text{ tC/ha for } t_{prep} < t < t_{prep+20}$$

4.3 Leakage

The calculations for leakage are determined through *Tool AR0015: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity.* This tool provides procedures to determine the following parameter:

Parameter	SI Unit	Description
$LK_{AGRIC,t}$	t CO_2e	Leakage emission due to the displacement of agricultural activities in year *t*

However insignificant and hence accounted as zero. The project applies to this regulation because the tool also states that leakage emission attributable to the displacement of grazing activities under certain conditions are considered of the following conditions:

(a) Animals are displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land;

And:

(b) Animals are displaced to forested lands, and no clearance of trees, or decrease in crown cover of trees and shrubs, occurs due to the displaced animals;

In the early stage of the project, the cattle will be reduced and moved to the grazing land in the valley in a manner that does not exceed the appropriate stocking rate. When the forest has reached an age where it is possible for the cows to graze in forest without hurting the vegetation or the soil, we will research a farm model based on silvopastoralism.

This will cause no net harm, positive emissions or decrease in carbon stock within or outside the project boundaries. Therefore, leakage due to displacement of pre-project agricultural activities will be accounted for as zero throughout the project lifetime.

4.4 Net GHG Emission Reductions and Removals

All relevant calculations and sources are described in *Chapter 4, section 1-3.* Additional elaboration can be found in *Attachment C: Carbon Calculations.*

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2021	0	8887,0	0	8887,0
2022	0	8887,0	0	8887,0
2023	0	8887,0	0	8887,0
2024	0	8887,0	0	8887,0
2025	0	8887,0	0	8887,0
2026	0	8887,0	0	8887,0
2027	0	8887,0	0	8887,0
2028	0	8887,0	0	8887,0
2029	0	8887,0	0	8887,0
2030	0	8887,0	0	8887,0
2031	0	8887,0	0	8887,0
2032	0	8887,0	0	8887,0
2033	0	8887,0	0	8887,0
2034	0	8887,0	0	8887,0
2035	0	8887,0	0	8887,0
2036	0	8887,0	0	8887,0
2037	0	8887,0	0	8887,0
2038	0	8887,0	0	8887,0
2039	0	8887,0	0	8887,0
2040	0	8887,0	0	8887,0
2041	0	7857,4	0	7857,4
2042	0	7857,4	0	7857,4

2043	0	7857,4	0	7857,4
2044	0	7857,4	0	7857,4
2045	0	7857,4	0	7857,4
2046	0	7857,4	0	7857,4
2047	0	7857,4	0	7857,4
2048	0	7857,4	0	7857,4
2049	0	7857,4	0	7857,4
2050	0	7857,4	0	7857,4
Total	0	256313,0	0	256313,0

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	A_{tot}
Data unit	ha
Description	The total project area.
Source of data	Data is collected by using satellite imagery and ground truthing.
Value applied	480
Justification of choice of data or description of measurement methods and procedures applied	The data comes forth from the monitoring plan executed by Open Forests.
Purpose of Data	Determination of baseline scenario (AFOLU projects only)
Comments	N/A

Data / Parameter	dSOC
Data unit	tC/ha/y
Description	The rate of SOC change within the project boundary under baseline conditions
Source of data	AR-AM0016
Value applied	0.585
Justification of choice of data or description of measurement methods and procedures applied	Value of the calculation model “Tool for estimation of changes in soil organic carbon stocks due to the implementation of A/R CDM project activities”.
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	CF_{tree}
Data unit	tC/t.d.m.
Description	Carbon fraction of tree biomass
Source of data	AR-AM0014
Value applied	0,47 The default values are used unless transparent and verifiable information can be provided to justify a different value.
Justification of choice of data or description of measurement methods and procedures applied	Default value of the tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities.
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	Δb_{forest}
Data unit	t.d.m./ha/y
Description	Estimates of mean annual increment of above ground biomass.
Source of data	PassiFlora Network
Value applied	7,5
Justification of choice of data or description of measurement methods and procedures applied	Vivieira 2008, Silver 2000, “Biomass productivity in naturally recovering tropical forests and allometric equations for the Atlantic forest of Southern Brazil."
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	R_{tree}, R_{shrub}
Data unit	Dimensionless
Description	The root-shoot ratio used to determine the proportion of belowground biomass in relation to the aboveground biomass.
Source of data	AR-AM0014
Value applied	R_{tree} = 0,25 R_{shrub} = 0,40 The default values are used unless transparent and verifiable information can be provided to justify a different value.
Justification of choice of data or description of measurement methods and procedures applied	Default value of the tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities.
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	b_{forest}
Data unit	t.d.m./ha
Description	Default above ground biomass in forest of the region
Source of data	Table 3A.1.4 of IPCC GPG-LULUCF 2003
Value applied	209 t.d.m./ha Values from Table 3A.1.4 of IPCC GPG-LULUCF 2003 are used unless transparent and verifiable information can be provided to justify different values.
Justification of choice of data or description of measurement methods and procedures applied	Default value of the tools: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities." (AR-AM0014)
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	BDR_{sf}
Data unit	Dimensionless
Description	Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0 (i.e. 100 per cent) and the default above-ground biomass content per hectare in forest in the region/country where the A/R CDM project activity is located.
Source of data	AR-AM0014
Value applied	A default value of 0.10 should be used unless transparent and verifiable information can be provided to justify a different value.
Justification of choice of data or description of measurement methods and procedures applied	Default value of the tools: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities." (AR-AM0014)
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	CO_2 fraction
Data unit	tCO_2/tC
Description	Equivalent of CO2 to the amount C
Source of data	AR-AMS0007
Value applied	44/12
Justification of choice of data or description of measurement methods and procedures applied	Default value of the tools: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities." (AR-AM0014) and "Default value of the "Tool for estimation of changes in soil organic carbon stocks due to the implementation of A/R CDM project activities" (AR-AM0016).
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	t-value
Data unit	Dimensionless
Description	Two-sided student t distribution with infinite degrees of freedom
Source of data	AR-AMS0007
Value applied	1,645 (consistent with a two-sided student t confidence interval of 90%)
Justification of choice of data or description of measurement methods and procedures applied	Default value of the tools: "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities." (AR-AM0014) and "Default value of the "Tool for estimation of changes in soil organic carbon stocks due to the implementation of A/R CDM project activities" (AR-AM0016).
Purpose of Data	Calculation of baseline emissions
Comments	N/A

In addition to the abovementioned, all data and parameters available at validation mentioned in the tool "*Tool for measuring aboveground live forest biomass using remote sensing*" apply.

5.2 Data and Parameters Monitored

Data / Parameter	A_i; $A_{plot,i}$
Data unit	ha
Description	Area of stratum i; area of sample plot in stratum i
Source of data	Satellite imagery and ground truthing
Description of measurement methods and procedures to be applied	Areas are measured with satellite imagery and by the technical team of The Green Branch, following the monitoring plan described in section 5.3.
Frequency of monitoring/recording	Annually before verification event
Value applied	N/A

Monitoring equipment	Landsat imagery and Hansen data from Global Forest Watch
QA/QC procedures to be applied	QA/QC in accordance with chapter 8 "Quality Assurance and Quality Control" of the "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories".
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	All data will be internally documented and archived for good practice purposes.

Data / Parameter	w_i
Data unit	Dimensionless
Description	Relative weight of the sample plot *i* to the stratum area
Source of data	Calculation
Description of measurement methods and procedures to be applied	The plot sizes are measured by the operational team of The Green Branch. The stratum polygons are measured with remote sensing.
Frequency of monitoring/recording	Before verification event.
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions
Calculation method	$w_i = A_{plot} / A_i$

Comments	All data will be internally documented and archived for good practice purposes.

Data / Parameter	$N_{i,j}$
Data unit	Tree/ha
Description	Number of trees of species j in the stratum i
Source of data	Field measurement
Description of measurement methods and procedures to be applied	Measurements are performed by the technical team of The Green Branch, following the monitoring plan described in section 5.3.
Frequency of monitoring/recording	Annually before verification event
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	QA/QC in accordance with chapter 8 "Quality Assurance and Quality Control" of the "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories".
Purpose of data	Calculation of project emissions
Calculation method	Counting
Comments	All data will be internally documented and archived for good practice purposes.

Data / Parameter	$CC_{tree,i}$, $CC_{shrub,i}$
Data unit	Dimensionless
Description	Crown cover of trees or shrubs in stratum i
Source of data	Field measurement and satellite imagery

Description of measurement methods and procedures to be applied	Ocular estimation of crown cover will be carried out by the technical team of The Green Branch, following the monitoring plan described in section 5.3.
Frequency of monitoring/recording	At baseline and before every verification event
Value applied	Crown cover will be 0 at the baseline measurement
Monitoring equipment	Described in the monitoring plan in section 5.3.
QA/QC procedures to be applied	QA/QC in accordance with chapter 8 “Quality Assurance and Quality Control” of the “IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories”.
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Calculation method	N/A
Comments	All data will be internally documented and archived for good practice purposes.

Data / Parameter	$H_{treei,j}$
Data unit	Meters
Description	Height of tree of species j in stratum i
Source of data	Field measurements
Description of measurement methods and procedures to be applied	Measurements are performed using the line transect method by the operational team of The Green Branch, following the monitoring plan described in section 5.3.
Frequency of monitoring/recording	Annually before verification event
Value applied	N/A
Monitoring equipment	Clinometer
QA/QC procedures to be applied	QA/QC in accordance with chapter 8 “Quality Assurance and Quality Control” of the “IPCC Good Practice Guidance and

	Uncertainty Management in National Greenhouse Gas Inventories”.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	All data will be internally documented and archived for good practice purposes.

Data / Parameter	$d_{treei,j}$
Data unit	Meters
Description	Diameter at breast height of tree of species j in stratum i.
Source of data	Field measurements
Description of measurement methods and procedures to be applied	Breast height is determined at 1,30m. Measurements are performed by the operational team of The Green Branch, following the monitoring plan described in section 5.3.
Frequency of monitoring/recording	Annually before verification event
Value applied	N/A
Monitoring equipment	Diameter tape
QA/QC procedures to be applied	QA/QC in accordance with chapter 8 “Quality Assurance and Quality Control” of the “IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories”.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	All data will be internally documented and archived for good practice purposes.

Data / Parameter	b_i
Data unit	t/ha
Description	Biomass above and below ground in stratum i.
Source of data	Calculation based on ground truthing measurements and satellite imagery.
Description of measurement methods and procedures to be applied	Values before calculation are derived from other data and parameters.
Frequency of monitoring/recording	Annually before verification event.
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	QA/QC in accordance with chapter 8 “Quality Assurance and Quality Control” of the “IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories”.
Purpose of data	Calculation of project emissions
Calculation method	Allometric equations are used to determine the aboveground biomass from the data and parameters found in the plot sample. The root-shoot ratio is then used to determine belowground biomass.
Comments	All data will be internally documented and archived for good practice purposes.

Data / Parameter	s_i
Data unit	t d.m./ha
Description	Estimated standard deviation of biomass stock per unit area in *i*
Source of data	Calculation
Description of measurement methods	The estimation of the standard deviation will follow from the data gathered.

and procedures to be applied	
Frequency of monitoring/recording	Before verification event.
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions
Calculation method	Statistic programmes can be used to calculate the variance.
Comments	All data will be internally documented and archived for good practice purposes.

5.3 Monitoring Plan

The methods for measuring, recording, storing, aggregating, collating and reporting data and parameters.

The methods for calculating biomass consist of multiple unit measurements that follow allometric calculations and calculations as set forth in *Tool AR-AM0014: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities.* In this methodology, multiple ways of determining biomass are allowed.

Carbon stock in trees at a point of time is estimated by using one of the following methods or a combination thereof:

a) Estimation by measurement of sample plots;
b) Estimation by modelling of tree growth and stand development;
c) Estimation by proportionate crown cover;
d) Updating the previous stock by independent measurement of change.

This monitoring plan will use option a) estimation by measurement of sample plots.

Under this method, carbon stock in trees is estimated based on measurements of sample plots. Sample plots are installed in one or more strata. Two sampling designs are available:

a) Stratified random sampling;
b) Double sampling.

This monitoring plan will use option a) Stratified random sampling. In addition, we will make use of remote sensing and GIS. For this, we will use *VT0005: Tool for measuring aboveground live forest biomass using remote sensing.*

The process of the monitoring activities are:

Step 1: Determining sample plots.

Following the guidelines as set by Open Forest and the *Tool VT-0015*, 20 polygons are determined for each land-use stratification Forest, Shrubland and Grassland/Bare Soil. In each of the polygons there will be a sample plot. For polygons containing Grassland/Bare Soil, the biomass is determined to be zero.

Further explanation about sample plots and stratification can be found in *Section 5.3.6.*

Step 2: Measuring biomass in trees.

To calculate biomass, the operational team must perform monitoring activities on several units. These are described in *Section 5.2. Data and Parameters Monitored.* The field team will need to measure the following data manually:

a) A_i: The area of the sample plot *i* in ha;
b) $N_{i,j}$: The number of trees of species *j* in plot *i* in trees/ha;
c) $H_{treei,j}$: The height of a tree of species *j* in plot *i* in meters;
d) $d_{treei,j}$: The breast-height diameter of tree of species *j* in plot *i* in meters

The area is measured with a grid of tape to set out the required area and to determine which trees fall inside or outside the plot boundaries. The Project Manager will then make an inventory on which species are found in the sample plot and in what quantity they appear.

Of every tree, the height is measured with a clinometer and its diameter is measured with diameter tape. Both measurements will be registered for the specific tree.

The project manager is now able to determine plot biomass and hereafter area biomass with the calculations from the methodology.

Step 3: Measuring biomass in shrubs.

Carbon stock in shrubs at a point of time is estimated based on shrub crown cover. The area within the project boundary is stratified by shrub crown cover. Those areas where the shrub crown cover is less than 5 per cent are treated as a single stratum and the shrub biomass in this stratum is estimated as zero.

Calculations will be done according to *Tool AR-AM0014*. To be able to do so, the field team must measure the following data manually:

a) A_i: The area of the sample plot *i* in ha;
b) CC_{shrub}: crown cover of shrubs in percentage of plot area *i*.
c) CC_{tree}: crown cover of trees in percentage of plot area *i*.

The area is measured with a grid of tape to set out the required area and to determine which shrubs fall inside or outside the plot boundaries. CC_{tree} needs only to be done at the beginning of the project. CC_{shrub} must be measured before every verification event. The measurement of crown cover will be done with the line transect method.

Step 4: Calculations of carbon stock.

The data is checked by the Project Manager and appropriate calculations are done to determine the carbon stock in the plot area, stratum area and finally the total area. All calculations will be done according to the methodologies. These calculations will be done again in the internal audit.

Step 5: Data management.

The recording, storing, aggregating and collating of the data happens via the TGB Dashboard. The Project Manager will have its own login code to put in the data from the monitoring. All data is stored here without ever being deleted. This data is available to the Project Chief who does the internal auditing. Hereafter, the Project Chief uses this information for Open Forests as well as the final monitoring report for the VVB and Verra.

The organizational structure, responsibilities and competencies

The **Serra do Sudeste Landscape Restoration and Reforestation Project** has a multi-stakeholder proposition wherein different groups of people carry different tasks. Here we make a differentiation between the organizational layer and the operational layer. The organizational layer is responsible for all coordination, procedures and the certification in general. The operational layer is responsible for all the field work, ground truthing and daily maintenance.

The Green Branch will be responsible for the overall coordination and communication between all parties. They have appointed all actors their responsibilities and guidelines for how to properly fulfil these. These are written down in an internal guide for maintenance, monitoring and reporting referred to as the TGB Monitoring Manual.

All actors and their activities are shown in *Figure 14: Organizational structure of monitoring activities.* Below the figure there is a short explanation of every actor.

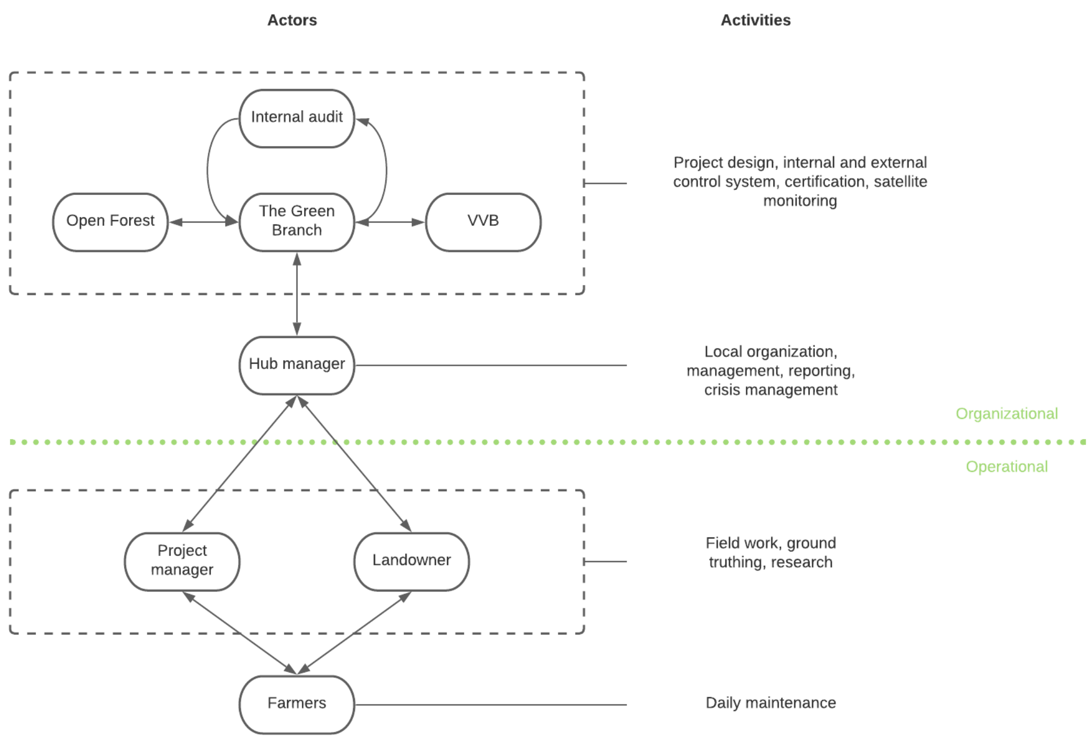

Figure 14: Organizational structure of monitoring activities.

The responsibilities of each actor bottom-up:

- Farmers: They take care of the day-to-day activities on the farm and the forests. They have been educated on the project and are in possession of a TGB Monitoring Manual. They do not bear responsibility for the monitoring but are asked to report on any sickness, droughts and overall fitness of the forest.

- Landowner: Oversees the project and follows the arrangements that are stated in the contract with The Green Branch (Service Provider):

  A) the provision of access to the Site at all times for the Service Provider and its affiliates (upon prior written notice of 3 (three) days);

B) *on the best-efforts basis, cooperation in executing the Business Proposal throughout the Project's lifetime;*

C) *on the best-efforts basis, the provision of accurate data and cooperation in deploying the Monitoring Plan;*

D) *the obligation to not deviate from the Project outlines without prior written consent from the Service Provider;*

E) *on the best-efforts basis, the provision of information to the Service Provider on all and any developments on and surrounding the Landowner's farm;*

- Project Manager: The Project Manager is in service of The Green Branch and has extensive knowledge and experience in agronomy and forestry in the area. They deliver input for co-creating projects in the area and are specifically trained for the monitoring and reporting. Because they have scientific knowledge and academic capabilities, so they can be trusted to deliver high quality monitoring data. They also report on other ecological values and SDGs. The project manager is also in charge of research and experiments in the field.

- Hub Manager: The Hub Manager is in service of The Green Branch and is responsible for the local management and coordination of a multitude of projects in the area. He oversees all arrangements with the landowners and Project Manager and is the direct line with The Green Branch head office. He is the head of the local team and can act quick when necessary.

- The Green Branch: TGB is the project proponent and its headquarters is situated in the Netherlands. They are responsible for the project design and implementation, legal activities, financing activities, certification, the Monitoring Manual and the final monitoring report.

- Internal Audit: The internal audit to cross-check for mistakes and omittances is done by the Project Chief, who is mainly situated in the Netherlands. This Internal Audit will follow the procedures explained in *Section 5.3.4.: Procedures for internal auditing and QA/QC.* The Internal Audit will also communicate any non-conformances with the validated monitoring plan and report on policies and accountability.

- Open Forests: From their website: *"Our focus lays on developing integrated information management systems for forestry, agroforestry and conservation projects. We support organizations to acquire satellite-, drone-, and field data and assist with remote sensing and data analysis tasks, provide web-based forest information management software, and run a project presentation and communication platform. "*

Open Forests has developed a monitoring plan to determine biomass and carbon stock. They follow the criteria as set out in the tool *VT0015: "Tool for measuring aboveground live forest biomass using remote sensing".* They use the data delivered from the Project Manager on site to calibrate the remote sensing algorithm.

- VVB: The Validation and Verification Body will be the intermediate between Verra and The Green Branch. They will check the monitoring report on its completeness and accuracy to receive certification.

As an addition to check for wildfires, deforestation alerts and trends in the surrounding area, we make use of Global Forest Watch. This allows us to approach 'real time' monitoring. This addition does not have any merit, it is only used to check for red flags so we can act quick if needed.

The policies for oversight and accountability of monitoring activities.

The policies for oversight and accountability are stated as follows:

A) Everyone who is responsible for a). measuring, b). recording, c). storing, d). aggregating, e). collating and f). reporting of the data and parameters has third-level education or has followed specific training by someone from the project staff.

B) Data and parameters are being checked at different stages, namely:

  a) by the Project Manager during and after measurements;
  b) by the Hub Manager before they are submitted into the dashboard;
  c) by the Project Chief during the internal auditing and QA/QC;
  d) by Open Forests when they process it in the remote sensing algorithm.

C) The Monitoring Manual will be given to all actors as well as training on how to perform the monitoring activities. Every crediting period there will be a refresh training.

D) The Green Branch, as project proponent, will be ultimately responsible for every monitoring report or handling non-conformances.

In the *Figure 15* below, the data pathway is shown from measurement to reporting.

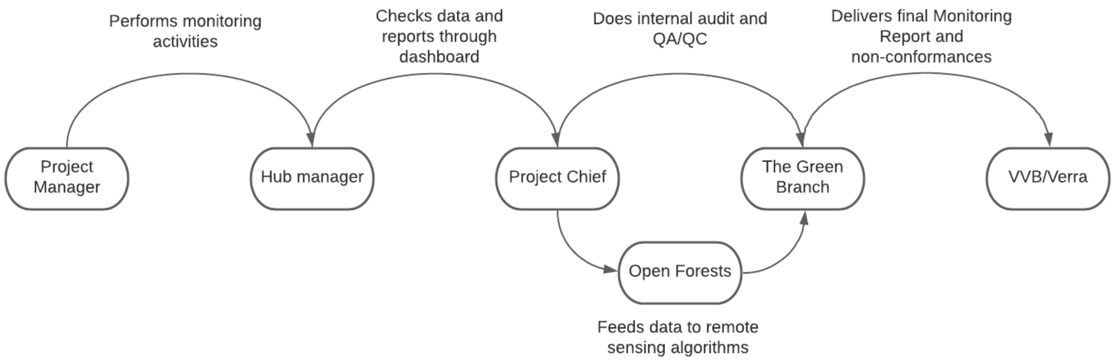

Figure 15: Data pathway of monitoring activities.

In addition, The Green Branch will develop an Adaptive Management Plan as the project evolves. This document will use the PDD and TGB Monitoring Manual as foundation. The goal is to systematically develop new insights and make a resilient guide for future governance. The goals of the Adaptive Management Plan will be:

a) Make a conceptualization of the system with real input;
b) Set quantifiable restoration goals and manage expectations;
c) The preferred processes of decision-making;
d) Clearly defined feedback mechanisms to learn from development and improve management.

The procedures for internal auditing and QA/QC.

The project shall use the QA/QC principles from chapter 8 *"Quality Assurance and Quality Control"* of the *"IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories".*

Also, TGB has embedded the following safeguards:

a) TGB Monitoring Manual;
b) internal Auditing;
c) extra monitoring with Open Forests providing satellite imagery and GIS;
d) training of staff;
e) education of farmers and landowners.

The Internal Audit shall be performed by the Project Chief of TGB, who has oversight of all projects and guarantees its accountability. The Internal Audit consists of:

a) verification of the data;
b) review of all monitoring reports;
c) approving and delivering the final monitoring report;
d) a review of all documents;
e) cross checking all calculations;
f) checking is all policies and procedures have been followed correctly.

The procedures for handling non-conformances with the validated monitoring plan.

Non-conformances can be checked in the operational and organizational layer. In the operational layer, it should be detected by the Project Manager when performing the monitoring procedures. In the organizational layer, it should be detected by TGB's internal audit. When these non-conformances are found, the Project Chief and the Project Manager will research the origin of the errors. When this has been identified, they will jointly determine next steps and propose a solution. This could either be:

A) The non-conformance is a measurement error: The measurements will be done again with the TGB Monitoring Manual until they are done correctly and provide accurate measurements.

B) The non-conformance is a calculation error: The Project Manager and the Project Chief will redo the calculations necessary until all non-conformances are omitted.

C) The non-conformance is a procedural error: When the validated monitoring plan is unable to be executed for any reason, may it be force majeure or an operational/organizational fault, this will be communicated with the VVB and Verra. If necessary, TGB shall prepare a revisited monitoring plan and submit a request for a deviation.

Any sampling approaches used, including target precision levels, sample sizes, sample site locations, stratification, frequency of measurement and QA/QC procedures.

For each ground truth location, the field team picks a random point that represents the stand. According to *VT0001 for measuring aboveground live forest biomass using remote sensing*, the plot should be a minimum of 50m x 50m if rectangular, or a 30m radius if circular. Furthermore, 5 sample plots from each land cover class should be labelled as validation plots, while the remaining 15 should be labelled calibration plots.

OpenForests will provide The Green Branch with any further parameters and guidelines (e.g. minimum, maximum and distribution of polygon sizes, location of polygons) to guide the ground-truthing technicians on the ground. A depersonalised proposal is shown in *Appendix 4: Proposal Open Forests.*

These measurements and QA/QC procedures will be done every year before the verification ever.

APPENDIX

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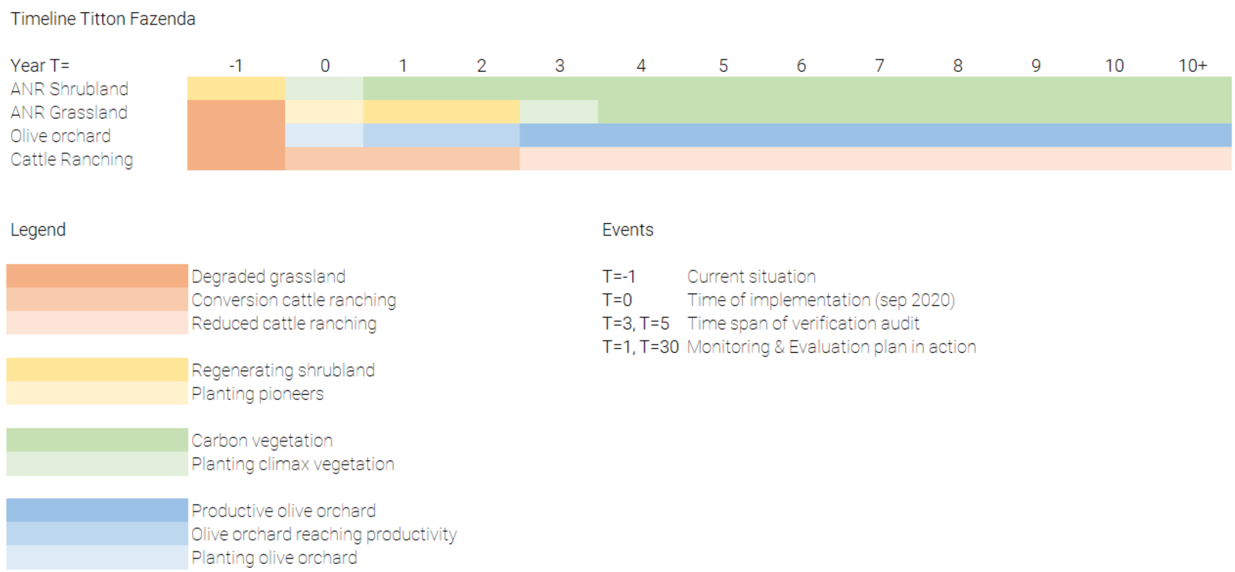
Appendix 2: Implementation Plan

The project interventions will take place over the first three years according to the schedule below. T=0 determines the starting date of the project.



Appendix 3: Proof of SICAR registration

RECIBO DE INSCRIÇÃO DO IMÓVEL RURAL NO CAR

Registro no CAR: RS-4301602-B605.C62A.5737.4207.A2FD.0B75.631B.DF68	Data de Cadastro: 22/05/2018 16:53:09

RECIBO DE INSCRIÇÃO DO IMÓVEL RURAL NO CAR

Nome do Imóvel Rural: Fazenda do Salso		
Município: Bagé		UF: Rio Grande do Sul
Coordenadas Geográficas do Centroide do Imóvel Rural:	Latitude: 31°00'45,86" S	Longitude: 53°34'16,13" O
Área Total (ha) do Imóvel Rural: 1.077,7833		Módulos Fiscais: 38,4923
Código do Protocolo: RS-4301602-8D21.F4C3.AE96.E079.D728.5265.A452.218C		

INFORMAÇÕES GERAIS

1. Este documento garante o cumprimento do disposto nos § 2º do art. 14 e § 3º do art. 29 da Lei nº 12.651, de 2012, e se constitui em instrumento suficiente para atender ao disposto no art. 78-A da referida lei;
2. O presente documento representa a confirmação de que foi realizada a declaração do imóvel rural no Cadastro Ambiental Rural-CAR e que está sujeito à validação pelo órgão competente;
3. As informações prestadas no CAR são de caráter declaratório;
4. Os documentos, especialmente os de caráter pessoal ou dominial, são de responsabilidade do proprietário ou possuidor rural declarante, que ficarão sujeitos às penas previstas no art. 299, do Código Penal (Decreto-Lei nº 2.848, de 7 de setembro de 1940) e no art. 69-A da Lei nº 9.605, de 12 de fevereiro de 1998;
5. O demonstrativo da situação das informações declaradas no CAR, relativas às áreas de Preservação Permanente, de uso restrito e de Reserva Legal poderá ser acompanhado no sítio eletrônico www.car.gov.br;
6. Esta inscrição do Imóvel Rural no CAR poderá ser suspensa ou cancelada, a qualquer tempo, em função do não atendimento de notificações de pendência ou inconsistências detectadas pelo órgão competente nos prazos concedidos ou por motivo de irregularidades constatadas;
7. Este documento não substitui qualquer licença ou autorização ambiental para exploração florestal ou supressão de vegetação, como também nãodispensa as autorizações necessárias ao exercício da atividade econômica no imóvel rural;
8. A inscrição do Imóvel Rural no CAR não será considerada título para fins de reconhecimento de direito de propriedade ou posse; e
9. O declarante assume plena responsabilidade ambiental sobre o Imóvel Rural declarado em seu nome, sem prejuízo de responsabilização por danos ambientais em área contígua, posteriormente comprovada como de sua propriedade ou posse.

CAR - Cadastro Ambiental Rural

Página 1/3

RECIBO DE INSCRIÇÃO DO IMÓVEL RURAL NO CAR

Registro no CAR: RS-4301602-B605.C62A.5737.4207.A2FD.0B75.631B.DF68	Data de Cadastro: 22/05/2018 16:53:09

INFORMAÇÕES ADICIONAIS

Foi detectada uma diferença entre a área do imóvel rural declarada conforme documentação comprobatória de propriedade/posse/concessão [1074.412 hectares] e a área do imóvel rural identificada em representação gráfica [1.077,7833 hectares].

REPRESENTAÇÃO GRÁFICA

IDENTIFICAÇÃO DO PROPRIETÁRIO/POSSUIDOR

CNPJ: 87.656.153/0001-70	Nome: Fazenda do Salso Agricultura e Pecuária LTDA

ÁREAS DECLARADAS (em hectares)

CAR - Cadastro Ambiental Rural

Página 2/3

RECIBO DE INSCRIÇÃO DO IMÓVEL RURAL NO CAR

Registro no CAR: RS-4301602-B605.C62A.5737.4207.A2FD.0B75.631B.DF68	Data de Cadastro: 22/05/2018 16:53:09

Imóvel		**Imóvel**	
Área Total do Imóvel	1.077,7833	Área Consolidada	538,3220
Área de Servidão Administrativa	1,6410	Remanescente de Vegetação Nativa	537,3844
Área Líquida do Imóvel	1.076,1543	**Reserva Legal**	
APP / Uso Restrito		Área de Reserva Legal	0,0000
Área de Preservação Permanente	35,3888		
Área de Uso Restrito	0,0000		

MATRÍCULAS DAS PROPRIEDADES DO IMÓVEL

Número da Matrícula	Data do Documento	Livro	Folha	Município do Cartório
34.776	11/11/1993	2	1	Bagé/RS
18.269	27/12/1983	2	1	Bagé/RS

CAR - Cadastro Ambiental Rural

Página 3/3

Appendix 4: Proposal Open Forests

Proposal for Mapping Biomass in Porto Alegre, Brazil

From:

OpenForests UG (haftungsbeschränkt)
Moerser Straße 171
47803 Krefeld
Germany

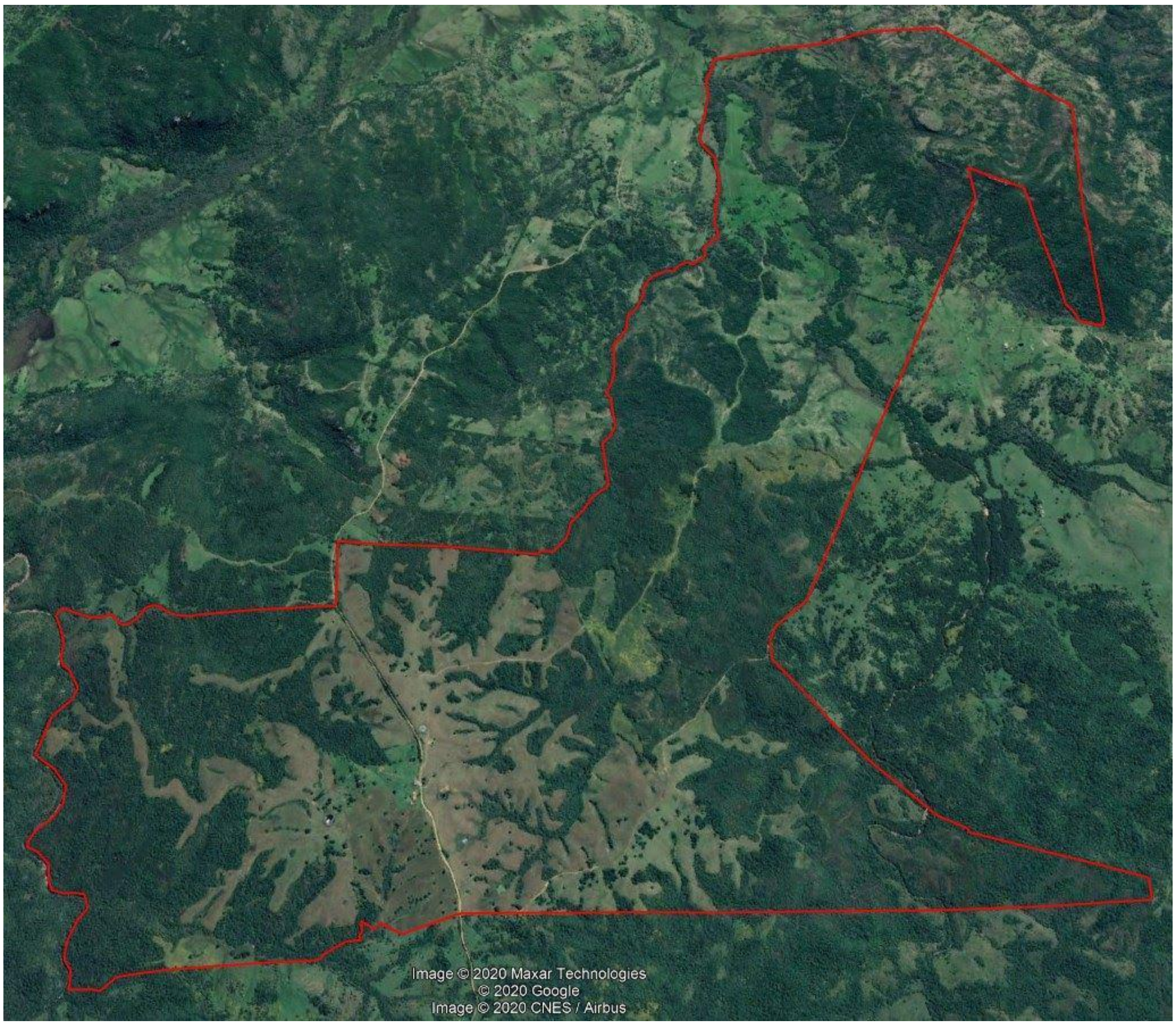
For:

The Green Branch B.V.
Marconistraat 16
3029 AK Rotterdam
Netherlands

Version 01.10.2020

Goal

The main goal of this project is to estimate the change in biomass over time of the Titton 1 cattle ranch in Rio Grande do Sul, Brazil (1.041 hectares) using a remote sensing neural network model that is calibrated and validated using *in-situ* measurement plots. The project aims to retrieve historical data regarding deforestation of the last 15 years of the area of interest (AOI), a baseline of current conditions, and monitoring every 3 months for 30 years into the future.



Area of interest: Titton 1 cattle ranch in Rio Grande do Sul

A **land cover map**will be produced to be able to divide the AOI into classes that include at least: forest, shrubland, grassland/cattle ranch, water, and bare soil. More classes may be added and the classes may be further subdivided into multiple strata if sufficient biophysical variance exists. The classes are needed to improve the accuracy of predicted biomass because the AOI is heterogeneous in nature. Furthermore, the classifications of certain areas may change over time as grasslands change into shrublands and shrublands change into forests, or any other significant change occurs.

After the land cover map is made, a **quantitative analysis** will be carried out to estimate biomass (t/ha) for every land cover class and the total AOI.
The historical analysis will provide necessary data for the Verified Carbon Standard regarding the last 15 years and the current land cover map will provide the necessary baseline for future monitoring. This will allow an analysis of past deforestation, or forest growth, and a constant monitoring of planned reforestation activities.

The land cover map and the quantitative analysis will require ground truth *(in-situ)*input from the client. Although existing neural network algorithms are commonly used to detect and differentiate land cover classes, ground truth data ensures a higher predictive accuracy .

It is highly recommended to include as many ground truth plots in order to optimize the algorithm training and make the best possible predictions. We suggest starting with 20 plots per land cover class with the possibility of increasing that number depending on the accuracy of the predictive model. More ground truth plots should yield a higher predictive accuracy.

Further, the current proposal is divided into two parts. The first part is dedicated to the creation of the **land cover map**. The second part will focus on **quantitative analysis** of the biomass estimations.

Package 1: 15 year History of Forest Loss and Current Land Cover Classification

Tasks

1. Produce a land cover map for a point in time in 2005 (possibly 2004 for cloud-free image) with Landsat imagery. Sentinel-2 data does not go back far enough for this analysis which is why we propose to use Landsat. From 2005-2019 we will produce a map or maps with Hansen data from Global Forest Watch to track and quantify forest loss.
2. Create composites for the last 12 months (2019-2020) of Sentinel-2 data over the AOI. (The possibility exists to use Sentinel-1 data depending on cloud cover and other factors).
3. Conduct a supervised classification of the AOI using Random Forest algorithm to determine land cover classes and distribution. Check for accuracy. Provide a map to The Green Branch to use as a guide for ground truth data collection.
4. Calibrate the Random Forest algorithm using ground-truth data from sample plots provided by The Green Branch. Check for accuracy.
5. Produce a land cover map using the trained Random Forest algorithm for the most recent Sentinel-2 data (or Sentinel-1).

Deliverables

- 1 shapefile with supervised Random Forest algorithm land cover classification from 2005 (or 2004).
- 1, or multiple, maps showing deforestation from 2005-2020 using Hansen data.
- 1 shapefile with supervised land cover classification of 2020 using the Random Forest algorithm. (To be provided before ground truth data mission)
- 1 shapefile with supervised land cover classification of 2020 using the Random Forest algorithm calibrated with ground truth data from The Green Branch.

Package 2: Quantitative Analysis

Tasks

1. Estimate the biomass for all AOI and all land cover classes found in the new land cover classification map.

2. Aggregate values by class and provide specific class-level data.

3. Conduct quarterly refresh of land cover classification using the trained algorithm and update biomass calculations accordingly.

Deliverables

- A CSV table with total estimated biomass in AOI and total estimated biomass per land cover class for the 2005 classification, the 2020 classification, and future classifications.
- 1 shapefile with land cover classification “refresh” and corresponding changes in biomass levels, provided quarterly.

Reducing or Adding Land Cover Classes

The effort for the training of the algorithm would only be reduced slightly by excluding certain classes. However, The Green Branch’s field mission would be shorter, because fewer ground truth points are needed. That said, each class should have relatively homogeneous biophysical properties so that biomass can be predicted accurately. For this reason, sub-classes may have to be made if there are significant species differences between different areas of shrubland, for example.

Expected Results/Risk

The main risk for a project like this is low predictive accuracy of the algorithm developed. The quality of the results depends on many factors: geographic region, quality, and quantity of ground truth data. For this reason, we propose to start with Package 1, and if an acceptable accuracy is produced with the predictive model, then we proceed to Package 2.

The minimum result to be considered valuable is an accuracy level of 75% on land cover class for Package 1. As the value of the results for The Green Branch's purposes cannot simply be expressed by the coefficient of determination R^2, The Green Branch decides whether the results for Package 2 are valuable or not.

Ground Truth provided by The Green Branch

Within the scope of this proposal, The Green Branch is responsible to **provide ground truth data**.
We propose the following practical approach:

As traveling from area to area takes up significantly more time than the actual data entry, we propose to collect qualitative data (land cover classes) and quantitative data (biomass) at the same time.

We recommend a random distribution of sample plots within each land cover class. If some of the randomized plot locations are deemed non representative of the land cover class, then the field team should have the liberty to reassign plots where needed. This allows optimizing the field outing regarding the geographical distribution of land cover classes, overnight accommodation, road accessibility, and weather conditions. This flexible approach results in a larger amount of ground control points per day.

The field team should collect the following ground truth data:

Class	ground truth polygons	sample plots (methodology chosen by The Green Branch)	distribution
Forest	20	At least 20(1 in each polygon)	Full range of Age/Volume (about 5 classes with 3 sample plots in each class). Range depending on the variety found in the field..
Shrubland	20	At least 20(1 in each polygon)	
Grassland	20	Only GPS coordinates taken	
Bare Soil	20	Only GPS coordinates taken	

For each land cover class there should be a wide spectrum of biomass (from young stands with low biomass to older stands with a higher biomass). The geographical distribution should be as widespread (all regions of the AOI) as possible with reasonable effort.

For each ground truth location, the field team captures data in a digital form.

This includes:

- Land cover class
- 1 polygon representing a homogenous stand
- 1 sample plot with biomass measurements
- GPS coordinates

Sample Plots

For each ground truth location, the field team picks a random point that represents the stand. According to the Verified Carbon Standard (VCS)*tool for measuring aboveground live forest biomass using remote sensing*, the plot should be a minimum of 50m x 50m if rectangular, or a 30m radius if circular. Furthermore, 5 sample plots from each land cover class should be labelled as validation plots, while the remaining 15 should be labelled calibration plots.

The exact method of measuring biomass will depend on the land cover class and on The Green Branch's capacities. OpenForests can provide more information and guidance on specific biomass monitoring methods if requested.

OpenForests will provide The Green Branch with any further parameters and guidelines (e.g. minimum, maximum and distribution of polygon sizes, location of polygons) to guide the ground-truthing technicians on the ground.